Factors Affecting Farmer' Autonomy and Sustainability of Smallholder Coffee Farming using SEM Lisrel

Sudarko, Sumardjo, Anna Fatchiya, Prabowo Tjitropranoto

Abstract: *Coffee is an important commodity in international trade. However, coffee farming in Indonesia is mostly managed by smallholder farmers who still apply traditional technology. This study was aimed to: (1) analyze the level of institutional role, agribusiness capacity, autonomy of farmer, and sustainability of smallholder coffee farming; (2) analyze factors affecting autonomy of farmers and sustainability of smallholder coffee farming. This research was carried out in Bondowoso and Malang Regency, East Java, Indonesia through the approach of survey conducted on 376 coffee farmers of all smallholder farmings of Robusta and Arabica coffee. Samples were collected by multistage random sampling done in the two regencies. Survey method was used in this study. Data were collected during July-October 2019 using the method of questionnaire, interview, and observation. Data were analyzed by descriptive and inferential method through SEM Lisrel. Result of the study showed that institutional support was categorized as low, while agribusiness capacity, autonomy of farmers, sustainability were included in moderate category. Factors found to affect the level of farmer' autonomyof farmers were the support of institutional role and agribusiness capacity of farmers. Factors directly affected the sustainability of smallholder coffee farming was autonomy of farmers, whereas the role of institution and agribusiness capacity of farmers were found to indirectly affect sustainability. To strengthen autonomy of coffee farmers towards the sustainability of smallholder coffee farming, agribusiness capacity building and strengthening is necessary. Therefore, all stakeholders (government, private institution, and community) will immediately design such program that involves the synergy of multi-institutions related to smallholder coffee farmers.*

Keywords: *agribusiness capacity, farmer' autonomy, role ofinstitution, sustainability of smallholder coffee farming.*

I. INTRODUCTION

Today, coffee is commercial product in more than 50 countries in the world [1], yet sustainability of world coffee farming tends to decrease due to several reasons, such as illegal logging, pest and disease, and massive soil erosion.

Sudarko*, Department of Agricultural Extension, Faculty of Agriculture, Jember University, Jember, Indonesia.

Sumardjo*, Department of Communication Science and Community Development, Faculty of Human Ecology, IPB University**,** Bogor, Indonesia**.**

Anna Fatchiya, Department of Communication Science and Community Development, Faculty of Human Ecology, IPB University**,** Bogor, Indonesia**.**

Prabowo Tjitropranoto, Department of Communication Science and Community Development, Faculty of Human Ecology, IPB University**,** Bogor, Indonesia.

Indonesia ranks fourth as coffee producer in the world, resulting in job opportunity for 1,79 millions of family head despite the low value of average national coffee productivity of 0,74 ton/ha/year (No 7 ASEAN) [2]. Coffee farming in Indonesia is mostly run traditionally by smallholder farmers with characteristic of low business scale, less use of technology, and low income [3]. Smallholder coffee farmer is extremely weak in facing global competition and free trade. Thus, strengthening the agribusiness capacity and farmer' autonomyfrom up-stream to down-stream is such a strategic effort to support the sustainability of smallholder coffee farming. Farmer institution has a strategic point to drive economy and agribusiness in rural area. Local institution is divided into three main parts that is a continuum, namely: (1) public sector institution (government); (2) private sector institution and (3) participatory institution (community) [4]. Economic and social institution of coffee farmer is still considered low yet highly determines market competitiveness [5]. The low level of farmer institution has impact on low interdependence (self-reliance) of farmer in agribusiness [6]. Farmers do not fulfil the functions of coffee agribusiness system which causes low production and poor quality and leads to difficulty in marketing [7]. Business capacity of farmer who has established partnership with company is also low, particularly concerning the capacity of managerial, entrepreneurship, and problem solving [8].

Farmer competitiveness in this global era could be strengthened by increasing agribusiness capacity of farmer. Farmer welfare has a potential to achieve through the increasing agribusiness capacity towards sustainable farmer farmer' autonomy[9]. As a commodity, productivity of coffee which is mostly cultivated by smallholder farmer can be increased by strengthening farmer self-reliance. Higher level of farmer' autonomyof community will result in increasing work satisfaction which has an impact on productivity increase [10]. Study result of [11] showed that farmer' autonomyis important to identify, navigate, and solve problems.

Sustainability of coffee farming has been a global issue. Alternative strategy in coffee development includes the strategy to expand market, develop the aspect of biotechnology, and strengthen international cooperation network [12]. Study result concerning effort to increase agribusiness development in environmental dimension requires more attention since it is still included in the low category.

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The urgency of coffee business sustainability is responded by coffee farmers by implementing Good Agriculture Practice (GAP) to obtain certificates of sustainable agriculture standard such as *Fairtrade, 4C, UTZ,* and *Organic* to achieve better life (in the aspect of social, economy, environment, and health). Coffee products with certificate of sustainability tend to have higher quality, price, and demand besides becoming the issue of global trade ([13], [14]). The demand for exported coffee that follows requirement of international trade system and certification for coffee product is likely to increase. There is only 16 percent of coffee traded in the world that has obtained the sustainability certificate and lower percentage of 6% is obtained by specialty coffee. All of those systems basically focus on the aspect of traceability and sustainability that will not degrade the environment (environmentally*)*, provide economic benefit (economically) and is accepted by the society (socially feasible) [15]. Important concept of coffee business sustainability is also emphasized by world experts who mentioned that agroforestry coffee certification program could improve nature and environment, both in the area of coffee farming and area surrounding the coffee farming [16].

Program of agricultural extension, that is appropriate to farmer needs in effort to increase the quality and competitiveness of coffee, becomes a strategic action step towards interdependence and welfare. It is inline with the study result [13] that coffee farmers who apply sustainable agricultural system will obtain a global guarantee and increasing of income up to 75 percent, fitting the objective of farming development. Furthermore, sustainable agriculture may increase the quality and value added of coffee in its primary, secondary, and tertiary farmer-based processing, resulting in empowered and self-reliant farmers performing coffee agribusiness towards sustainable agricultural system [17] and [18]. Sustainability of farming farmer in facing the impact of climate change was found to be high related to the aspect of social relationship and agribusiness, yet it was low on the aspect of environmental guarantee [19].

However, information and study on the model of role synergy and multi-institutional support, agribusiness capacity, and farmer' autonomyof farmers towards the sustainability of smallholder coffee farming that apply the analysis of Structural Equation Model (SEM) Lisrel is still limited. This study was aimed to: (1) identify the level of multi-institutional support, agribusiness capacity, farmer' autonomyof farmer, and sustainability of smallholder coffee farming; (2) analyze factors affecting farmer' autonomy and sustainability of smallholder coffee farming.

II. METHODS

This study applied the survey method completed by qualitative data and conducted in July-October 2019. Research location was the center development area of smallholder coffee farming in East Java, namely Malang and Bondowoso Regency. The location was selected by considering the high topography of Bondowoso Regency as the representative of Arabica Coffee and moderate topography of Malang Regency as the representative of Robusta coffee. All coffee farmers participated in farmer group in coffee production center located in Malang and Bondowoso Regency were selected as research population. Total population of the two area reached 6.470 farmers, consisted of 917 farmers from Bondowoso and 5.553 farmers from Malang Regency [2]. Number of sample or respondent of 376 coffee farmers was determined based on Slovin formula with margin of error of five percent. Respondents were consisted of 76 coffee farmers from smallholder coffee center in Bondowoso and 300 coffee farmers from smallholder coffee center in Malang. Sample of respondent was calculated using the technique of Multistage cluster random sampling [20]. This study used both quantitative and qualitative data obtained through observation and interview.

Variable of agribusiness capacity is the ability of coffee farmers in performing agribusiness function, including the technical skill and management skill, from up-stream to down-stream (production facility, cultivation, harvesting, post-harvest handling, primary processing, secondary and tertiary processing, and marketing [21] and [22]. Variable of institutional support indicates local institution related to coffee farmer community, both the government (agricultural agency, educational and research institution, and financing), private institution (agroindustry, company, exporter) and community institution (farmer group, cooperative, farmer group association) [23]. Variable of farmer farmer' autonomyis the ability of farmer to manage resources according to the needs, produce efficient and effective product, and establish cooperation with other party to develop and increase the life quality of farmers [24] and [25]. Variable of sustainability reflects coffee farming towards the balance of economy, social, ecological environment, and human health ([26], [15] and [27]). Research instrument has been tested to coffee farmers with similar characteristics to respondents in July 2019, i.e. 30 members of Sidomulyo 1 farmer group in Sidomulyo Village of Silo Subdistrict in Jember Regency of East Java, Indonesia.This study used construct and content validity with analysis of product moment correlation developed by Karl Pearson. Coefficient value of product moment correlation for all variables included variable of institutional support (X1) of (0,36-0,87), variable of agribusiness capacity (X2) of (0,32-0,62), variable of farmer' autonomy (Y1) of (0,32-0,97), and variable of sustainability (Y2) of (0,42-0,83) resulted in coefficient of correlation ≥0,3, hence instruments points were considered valid. This research also applied reliability test of Cronbach Alfa. Result of reliability test with Cronbach Alfa variable resulted in value of (X1:0,70) (X2:0,62), (Y1:0,88), and (Y2:0,87). Based on the reliability value, it was justified that research instrument was reliable and eligible for data collection process. Data analysis for the first objective, namely to identify and analyze the level of institutional support of multi-institutions, agribusiness capacity, farmer' autonomyof farmer, and sustainability of smallholder coffee farming was done descriptively using MS.Excel and *Statistical Product and Service Solution* (SPSS) PASW. Moreover, data analysis for the second objective, namely to analyze factors affecting farmer' autonomyand sustainability of smallholder coffee farming was conducted using the analysis of Structural Equation Model *(*SEM*)* [28] with Lisrel 8.70.

III. RESULTS AND DISCUSSION

1. The Level of Multi-institutional Role, Agribusiness Capacity, Farmer' autonomy and Sustainability of Smallholder Coffee Farming.

Based on Table 1, the role of multi-institutions of coffee farmer was categorized as low. The role of government institution was moderate, while the role of private and community institutions were included in low category. Government institution in this study was represented by the Agency of Agriculture or Farming, government financing, Center for research and development, and public higher-education institution. Of all government institutions, the Agency of Agriculture or Farming was found to have the biggest role in the development of smallholder coffee farmer, followed by research centers for coffee. This finding was in line with the study [29] which indicated that smallholder farmer empowerment program should involve all formal institutions to facilitate decision making and financing.

Private institution in this study included coffee processing unit/coffee agroindustry, cooperative, private banking, and coffee exporting company. The biggest role in smallholder coffee farmer empowerment was found in cooperative and coffee exporting company. The role of private institution is necessary to be improved in order to support smallholder coffee farmer to be able to survive in market competition. It is important for business competence and business own by smallholder farmer to survive and move forward in facing the challenge of competition [30].

Table 1 also shows that community institution such as farmer group association (*gapoktan*), farmer group, non-governmental organization, and forest village community institution (LMDH). It was found that farmer group association had the biggest role, followed by farmer group. This situation confirmed the result of study that informal leader in community institution played an important role in rural empowerment program [31].

Agribusiness capacity of smallholder coffee farmer was categorized as moderate (Table 1). The aspect of production facility preparation, farming management, and post-harvest handling was included in moderate category, while the aspect of primary processing (dried coffee bean), secondary processing (roasted coffee), and tertiary processing (ground coffee/ready-to-drink products) belonged to low category. The aspect of agribusiness capacity that obtained high category was capability in coffee harvesting process, post-harvest handling, and marketing of coffee bean.

Production facility discussed in this study included soil preparation and tillage and coffee seed purchasing. However, the addition of organic fertilizer in planting hole before planting and grafting of coffee plant for the superior seed category are two most difficult activities to be fulfilled by farmers. Furthermore, in term of the aspect of cultivation, farmers faced difficulty in planting shade trees for coffee plants in accordance with the soil contour.

Regarding the aspect of coffee harvesting, it was difficult for farmers to secure the harvested coffee cherry in farming area because they are often stolen. In harvesting activity, farmers faced had difficulty in sorting the coffee fruits according to the standard. In primary processing (from fresh coffee fruit to dry coffee beans), farmers found difficulty to apply wet processing system due to complex stages and unavailability of water required to wash the coffee fruit fragments from pulper machine. In secondary processing, farmers had problem in coffee roasting since modern roasting machine is expensive. For tertiary processing, farmers had difficulty in sorting ground coffee products according to market quality grade. In addition, in term of marketing aspect of coffee farming products, farmers have difficulty to design promotional activities, either through mass media or social media. Therefore, coffee farmers need to establish equal cooperation in a mutual cooperative forum as a social collective trading model [9].

Table- 1: Average score of the role of multi-institutions, agribusiness capacity, farmer' autonomy, and sustainability of smallholder coffee farming

Factors	Average Score	Category
The Role of Institution	**16,96**	**Low**
▪ Government	20,83	Low
▪ Private	12,03	Low
▪ Community	18,04	Low
Agribusiness Capacity	**55,05**	**Moderate**
▪ Production facility	65,49	Moderate
▪ Cultivation	65,72	Moderate
▪ Harvesting	72,07	High
▪ Post-harvest handling	66,73	High
▪ Primary processing	30,36	Low
▪ Secondary and tertiary processing	14,55	Low
▪ Marketing	70,43	High
Farmer' autonomy	**55,31**	**Moderate**
▪ Selectivness (filter systems)	52,81	Moderate
▪ Competitiveness (*competitive & comparative*)	59,31	Moderate
▪ Collaborativeness (*Interdependence*)	53,82	Moderate
Sustainability of smallholder coffee farming	**57,64**	**Moderate**
▪ Environment	56,34	Moderate
▪ Economy	54,81	Moderate
▪ Social	59,02	Moderate
▪ Health	60,40	Moderate

Category: Low (≤34,33), Moderate (34,34 - 66,67), High (>66,67)

As seen in Table 1, autonomy of coffee farmers in performing their farming business was also included in the moderate category. The aspect of filter systems, competitiveness, and collaborativeness also belonged to the moderate category. The aspect of selectiveness consisted of the ability of coffee farmer to provide and select optimal production facility, to search for appropriate information of innovation and technology fast, to actively discuss with many coffee experts in order to find inspiration and validate information, also to monitor the price development of coffee farming input and output from various sources. The most difficult for coffee farmers to obtain is finding appropriate information of technology and innovation fast. Therefore, support from extension agents is required so that coffee farmers could learn to use communication technology and social media since the power of information technology led to effectiveness in learning and working [32].

Aspect of competitiveness in this study indicated the ability of coffee farmers to meet the quality of coffee product, to sell the product at a good price, to penetrate national and international market, to meet the family needs from selling agricultural products, and to increase the production scale. In this aspect of competitiveness, coffee farmers were found to face major difficulty to penetrate and meet the demand of international market that requires high quality product. Alternative solution to apply is increasing government funding for extension activities based on innovation and research, thus farmers will be well trained and assisted [33].

In the aspect of collaborativeness that included the ability of farmers to establish wider farming networks with related stakeholders such as the agency of agriculture/farming, the agency of forestry, center for coffee research and development, private institution, partnership contract, agent of farming tool, marketing agent, and coffee producers. However, the most difficult thing to achieve was establishing networks with centers of research and development which further created impact on the lack of innovation information and weak farmer business capacity. This condition was supported by the result finding [34] showing that weak autonomyof farmers was caused by weak competence and capacity of farming farmers.
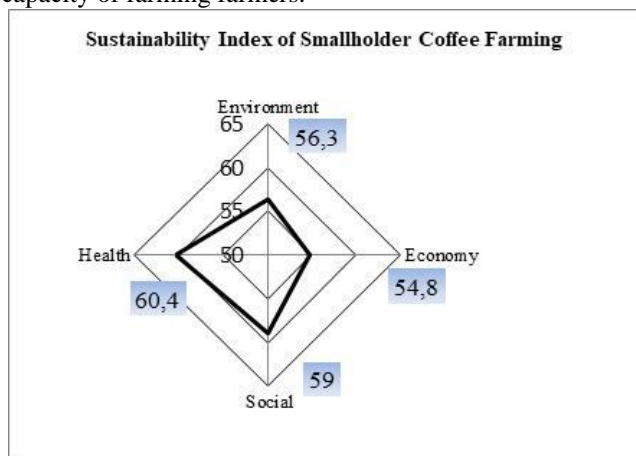
Figure 1: Sustainability Index of Smallholder Coffee Farming

Based on Table 1 and Figure 1, sustainability of smallholder coffee farming was categorized as moderate. The aspect of environment, economy, social, and health also belonged to the moderate category. Aspect of environmental sustainability measured in this study consisted of the perception of coffee farmers on soil fertility, erosion, availability of water source, pest and disease attack, population of shade trees, and increasing number of organic coffee plants. According to coffee farmer, the worst environmental aspects were soil erosion that frequently occurred due to floods and pest and disease attack. Result of study confirmed that illegal logging in coffee farming area resulted in lower economic welfare [35].

Concerning the aspect of economic sustainability that involved farmers; ease of fulfilling production facility, increasing productivity, increase in quality and price, national and international certification, and easy access to enter coffee market. Increase in productivity and quality were the two most difficult economic sustainability aspect to achieve by farmers. According to [36], modernization

insisted smallholder farmers on seeking new experience and being adaptive to meet the needs of farming business.

Aspect of social sustainability in this study included the harmonious condition among the members of farmer group, active participation of all members in mutual activities, synergistic cooperation, and crowded festivals or traditional events related to coffee. However, the last aspect, namely coffee festival or traditional event was found to obtain the lowest value of sustainability since each location held its own event, thus participation was still limited.

The aspect of health sustainability in the context of this study was measured based on coffee farmers' perception concerning the poisoning case in farmers and their family as they were exposed to chemical materials from chemical fertilizer, insecticide, herbicide, and other toxic chemical materials. Basically, all aspects were rarely done, but coffee farmers still found the case of herbicide exposure since some farmers used herbicide to clean weeds or grasses. This outcome was inline as reported by [37] the sustainability standard for coffee continues to develop and starts to be applied in global market, thus smallholder coffee farmers, particularly in developing country, have the potential to support and gain benefit from this situation.

2. Factors Affecting Autonomy of Farmers and Sustainability of Smallholder Coffee Farming.

Figure 1 shows the model of a *good fit* SEM analysis according to the standard of *Fit Statistics* [38]. Structural equation of SEM model is as follows:

- Y1 = 0.51*X1 + 0.42*X2……………R² = 0.61
- Y2 = 0.86*Y3…………………………R² = 0.74
- Y2= 0.44*X1 + 0.36*X2……………..R² = 0.45

  Description:
  Y1 = Autonomy level of coffee farmer
  Y2 = Sustainability of smallholder coffee farming
  X1 = The role of multi-institutions
  X2 = Agribusiness capacity of coffee farmer

Institutional role and agribusiness capacity of farmer directly affected aspect of smallholder coffee farmer which led to direct effect on the sustainability of smallholder coffee farming. The role of multi-institutions and agribusiness capacity of farmer indirectly affected the sustainability of smallholder coffee farming through the variable of self-reliance. This outcome confirmed the study [34] that farmer autonomywas affected by factors of farmer capacity and competence, the role of extension, and availability of technological innovation. Moreover, farmer autonomysignificantly affected the productivity level of coffee farming.

Based on the SEM model in Figure 2, it was found that government institution played the most strongest role that affected farmer' autonomy and sustainability. The finding was expected since government institution has various programs of empowerment and assistance provided for the community of smallholder coffee farmer, supported by competence social workers and extension agents. This implicates to conclusion that smallholder coffee farmer urgently requires the role of government institution to obtain the access of extension and assistance besides the capital aid fund.

The synergy between institution or coffee farming input supply agent and government financial institution such as price subsidy for fertilizer, tools, and processing machine. Moreover, government institution should also assist smallholder coffee farmer in opening the access of marketing at national level and export as well, thus the price of coffee product from farmer is economically feasible.
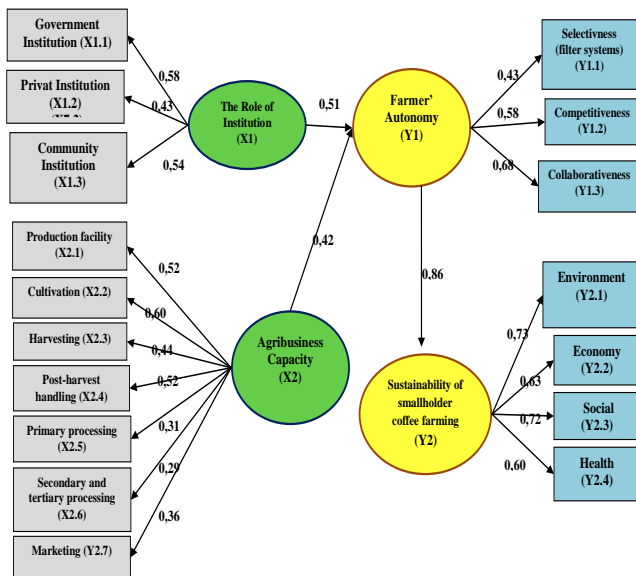
Chi-Square =270.01, df =115, P-value =0.00000, RMSEA=0.060
Figure 2: Result of SEM on Factors Affecting Farmer' autonomy and Sustainability of Smallholder Coffee Farming.

In term of agribusiness capacity variable, aspect that strongly affected farmer' autonomy and sustainability was fund to be coffee farming management. This situation was due to the fact that smallholder coffee farmers are starting to know and comprehend coffee cultivation management based on Good Agriculture Practice (GAP). However, the aspect of secondary and tertiary processing had the smallest contribution due to low percentage of smallholder coffee farmers (10-20%) who are able to process coffee bean into secondary and tertiary product, eg. roasted coffee bean and ground coffee, to be sold to consumer. Farmer knowledge about GAP and GMP (Good Manufacture Practice) should be improved by motivating them to be self-reliant [39].

In variable of farmer' autonomy, the strongest aspect found was collaborativeness of smallholder coffee farmer in establishing partnership and being egalitarian or confident in collaborating with stakeholders. However, the aspect of selectiveness (ability to obtain information) contributed the lowest value to affect sustainability since most smallholder coffee farmers highly depended on *leader opinion* (respected figure in village, formal and informal leader, and extension agents or other social workers) in obtaining rapid and appropriate information and innovation. This situation is supported by the statement [40] that farmer farmer' autonomycould be increased through farmer and extension capacity building, such as *farmer to farmer* model. According to [11] farmer' autonomyis such a space of awareness and responsibility of farmer to apply more sustainable farming. Dissemination of innovation was found to be greatly affected by the characteristic and type of

information obtained by farmers [41].

Table-2: Decomposition Between Exogenous and Endogenous Variables of SEM Model

Exogenous → Endogenous Variables	Coefficient of direct effect	Coefficient of indirect effect (self-reliance)	t-value	Category (t-table:5%, ≥1,96)
The role of institution → Self-reliance	0,51	-	4,89	Significant
Agribusiness capacity → Self-reliance	0,42	-	4,49	Significant
Farmer' autonomy→ Sustainability	0,86	-	6,80	Significant
The role of institution → Sustainability	-	0,43	5,66	Significant
Agribusiness capacity → Sustainability	-	0,36	5,07	Significant

Based on Figure 1, it is also shown that aspect of social sustainability is the most dominant variable of all sustainability aspect variables. This finding was due to the reason that coffee farming business has existed and developed over generations since the era of colonialism or in other word, coffee is *the way of life*, particularly coffee smallholder coffee farming in the mountain region of Semeru, Argopuro, and Ijen-Raung that has been protected by Geographical Indication (GI). This result confirmed the finding [18] that social institution is the most dominant aspect in sustainability index of smallholder coffee farming.

IV. CONCLUSION

The role of institution in the development of smallholder coffee farming was not yet optimal due to weak support from institution including the government institution, private institution, and community institution. The level of agribusiness capacity, farmer' autonomyof coffee farmer, and sustainability of smallholder coffee farming were included in the category of starting to increase (moderate). Factors affected the sustainability of smallholder coffee farming included the factor of farmer' autonomy (directly) and the role of multi-institutions and agribusiness capacity of farmer (indirectly). Factors found to affect autonomy of coffee farmer were the support of institutional role (government, private, and community) and agribusiness capacity of coffee farmer. Therefore, smallholder coffee farmers need empowerment assistance from all related institutions (Multi-stakeholder coordination) to increase and strengthen agribusiness capacity started from up-stream to down-stream. The strengthening program could be realized over the implementation of technological innovation and industrialization through the program of development and extension based on the needs of environmental and social wisdom.

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AUTHOR PROFILE

Sudarko S.P. M.Si. Department of Agricultural Extension, Faculty of Agriculture, Jember University, **Publications**: Strengthening farmer groups through the optimization of environmental and social synergy in farmer groups, **Research work:** Community development and agricultural extension

Prof. Sumardjo, Department of Communication Science and Community Development, Faculty of Human Ecology, IPB University, **Publications**: Role of agricultural counselling centre in the development of black rice program in Central Java, Indonesia, Reformatting agricultural extension institution: finding from the study of functional interactions among related components to agricultural extension in West Sumatra, **Research work**: Development communication, conflict resolution.

Dr. Anna Fatchiya, Publications, The strategies to improve the sustainability of fish processing business through extension services and fish processing innovation, Strategy for improving women's leadership capacity in Baran Village, Central Java, Impact of nutritional education on service quality in the integrated service posts (posyandu), Capacity building of ready-to-serve fish processor in micro-enterprises for business continuity, Factors affecting dynamics of fish processing group, Improving the empowerment of breeders with base of local problem potency through Student Service Learning, Strategy to develop traditional fishery business in implementing the principle of sustainable business, **Research work:** Extension development.

Dr. Prabowo Tjitopranoto, Department of Communication Science and Community Development, Faculty of Human Ecology, IPB University, **Publications**: Factors affecting the capacity of freelance extension agents and its impacts on farmers, **Research work**: Extension education, adoption, innovation, and diffusion, rural communication