Accelerating the adoption of sustainable coffee-cattle integrated farming system

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Abstract. The agricultural system in the watershed is mostly based on monoculture system. Where it has not been connected between farms that produce biomass, biomass processing industries, waste management, water utilization, energy generation, and soil conservation. This condition raises problems, for instance: (1) low productivity and quality of product, (2) un-used waste, and (3) dependence on external inputs. The coffee-livestock integration system is an approach that builds explicitly between biomass-producing agriculture, biomass processing industries, waste management, water use, energy generation, and soil nutrient conservation so that an integrated farming system (IFS) is sustainable. Even combines the crop farming system with livestock synergistically, that form an effective, efficient, and environmentally system, the level of its adoption is still low. The purpose of this study is to analyse the factors influenced adoption of the coffee-cattle integration system (CCIS) and formulate recommendations for its acceleration by using SWOT analysis. Result showed that the determinants of CCIS adoption are: farmer preference, financial resources, agro ecosystem, market incentivates, as well risk and uncertainty. Acceleration of adoption at the farm level can be done through (1) assistance in implementation; and (2) provision of agricultural facilities and infrastructure as well as agricultural machinery equipment.

Keywords: adoption, coffee-cattle, integration system, sustainable

1. Introduction

The basin’s rivers have an important role to the social and economic development of the region. The water resources of the basin’s rivers are essential for urban and industrial development including export industry, agricultural production, rural water supplies, electricity generation, and fisheries. Conversely, the incompatibility of agricultural land management has caused environmental problems. Lack of application of soil and water conservation technology, land degradation resulting in erosion, lack of vegetation cover that is protected, and the lack of awareness of farmers towards environmental conservation are factors that cause a decrease in environmental quality. In the farmer’s perception, land degradation is occurring mainly through changes in land productivity, which in turn affects their income [1].

In the case of agricultural development in the Citarum basin’s rivers, inadequate management of agricultural land has caused environmental problems, especially in agricultural cultivation in the upstream area of the Citarum watershed. Bandung Regency topography is a mountainous region where most of the farmers do horticultural farming in forest areas managed by Perhutani. State forest area in
Bandung Regency around 37,728 ha, managed by Perhutani and the Balai Konservasi Sumberdaya Alam.

In the context of the declaration of the Citarum Harum by the President of the Republic of Indonesia in early 2018, greening activities were carried out around the Citarum River Watershed, located in Kertasari Subdistrict, Bandung Regency. Reforestation is carried out by planting coffee plants that aim to repair and restore tens of thousands of hectares of ecosystems around the upper reaches of the Citarum River Basin which are damaged by inappropriate farming business systems. The Sistem Pengelolaan Hutan Bersama Masyarakat (PHBM) was also launched, specifically the utilization of Perhutani land by the community based on the prevailing MoU, one of which was the development of coffee commodities as a conservation effort. This is in line with Peraturan Presiden no. 15/2018 concerning the Acceleration of Pollution and Damage Control in the Citarum River Basin.

Economically, coffee plays an important role in the national economy. Coffee is a main export commodity as a foreign exchange besides oil and gas, and the domestic coffee market is still quite large. In 2017 the area of smallholder plantations was 1.205 million hectares with a production of 636.7 thousand tons. Total coffee exports in 2010-2019 tend to fluctuate. If in 2010 the total export volume reached 433.6 thousand tons with a total value of US $ 814.3 million, increasing to 467.8 thousand tons in 2017 with a total value of US$ 1187.16 million.

National coffee plantations are dominated by smallholder plantations, which is 96%. In the farming system level, the agricultural system is still based on monoculture system. Where it has not been connected between farms that produce biomass, biomass processing industries, waste management, water utilization, energy generation, and soil nutrient conservation. This condition raises problems, for instance: (1) low productivity and quality of product, (2) un-used waste, and (3) dependence on external inputs. The coffee-livestock integration system, as a model of Integrated Farming System (IFS), is an approach that builds explicitly between biomass-producing agriculture, biomass processing industries, waste management, water use, energy generation, and soil nutrient conservation so that an integrated farming system is sustainable. IFS provide opportunities for maintaining and extending biodiversity [2].

On the other hand, even combines the crop farming system with livestock synergistically, that form an effective, efficient, and environmentally system, the level of its adoption is still low. The purpose of this study was to analyze the factors that influence the adoption of the coffee-cattle integration system (CCIS) and formulate recommendations for its acceleration.

2. Materials and method

2.1. Research location and time

The study was conducted in the District of Kertasari, Bandung Regency in May 2019. Site selection is a river basin area and based on the existence of a coffee development program and the development of coffee Agro Techno Science Park (Taman Teknologi Pertanian/TTP).

2.2. Data types and sources, and its collecting method

The data collected consists of primary and secondary data. Primary data obtained through interviews and field observations. Interviews were conducted to 10 farmer groups in Kertasari District, namely Lembaga Masyarakat Desa Hutan (LMDH) Bumi Sangkuriang, Kelompok Tani (KT) Mutiara Tani, KT Puncak Lestari, KT Mekar Tani, KT Mekar Sari, KT Mekartani, KT Taruna Mandiri, KT Saluyu, and KT Alam Lestari. Field observations completed by inspecting coffee plantations and cattle pens. Secondary data were obtained from government institutions namely Statistik Perkebunan Kopi, Kabupaten Bandung dalam Angka, dan Kecamatan Kertasari dalam Angka.

2.3. Data analysis method

Data analysis used SWOT Analysis, a strategic planning framework used in evaluation of an organization, a plan, a project, or a business activity. SWOT Analysis is a significant tool for situation analysis that helps to identify organizational and environmental factors. SWOT Analysis has two
dimensions: Internal and external. Internal dimension includes organizational factors, also strengths and weaknesses, external dimension includes environmental factors, also opportunities and threats [3].

SWOT Analysis is typically drawn out in a four-quadrant box that allows for a summary that is organized according to the four section titles. In SWOT Analysis, strong and weak aspects of an organization are identified by examining the elements in its environment while environmental opportunities and threats are determined by examining the elements outside its environment. Most SWOT assessments focus on the current timeframe. It is a major drawback from the strategic point of view, thus there is extended SWOT providing a forward time frame for SWOT analysis [4]. SWOT analysis technique was used to indicate the current constraints and future possibilities of the Integrated farming system. In this study, the following phases were used are: (1) designing external and internal factors matrix, (2) analysing SWOT matrix, and (3) priorities identified strategies.

3. Result and discussion

3.1. The concept of integrated farming system

The combination of crop and livestock enterprises, that known by IFS, is practiced by numerous farmers throughout the globe. IFS is an interrelated complex matrix of soil, water, plant, animal and environment and their interaction with each other enable the system more viable and profitable over the arable farming system [5]. The concept of IFS is expected to advance the agricultural sector by utilizing the potential of local resources. The concept of integration of livestock in farming either plantations, food or horticulture is to place and cultivate a number of livestock, without reducing plant activity and productivity. The existence of livestock must be able to increase crop productivity as well as livestock production.

The system of integrating livestock with perennial crops must be comprehensive, taking all system components into consideration. An integrated farming system consists of a range of resource-saving practices that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment [6]. Integrated farming systems offer optimizing resource utilization rather than maximization of individual elements in the system [2].

The benefits of implementing livestock crop integration can be viewed from the: (a) agronomy, with the maintenance of productive capacity of the land, (b) economy, through product diversification obtained higher and quality results with less costs, (c) ecological, creating erosion control, and (4) socially, creating jobs in rural areas so as to suppress urbanization. In the integration system, plants and livestock interact to create synergy [6]. The integrated system represents a winning combination that reduces erosion; increases crop yields, soil biological activity and nutrient recycling; intensifies land use, improving profits; reduce poverty; and strengthen environmental sustainability.

The integration of coffee or livestock is a plantation system that is integrated with the livestock system through a cycle. Coffee fruit bunch is an abundant waste, because the amount reaches 45-50% of the weight of coffee harvested. From the coffee plant shade, the leaves can be used as forage for goats. Waste generated from coffee farming in the form of coffee fruit bunch and leaves form the coffee plant shade, can be utilized as animal feed, through the process of counting and flouring. Besides being a new source of income through the sale of goats, goats also produce milk during the lactation period. On the other hand, goat manure which is managed through the collection and separation of solid waste and liquid waste, can be used as fertilizer for coffee plants. Coffee livestock integration can also reduce the costs of controlling weeds and at the same time utilize renewable biological resources in the form of forage weeds that are generally abundant in coffee plantations. Optimal integration is expected to cause: increased coffee crop productivity, increased livestock productivity, reduced fertilizer costs, reduced livestock costs, increased soil fertility, and increased prevention erosion.
3.2. The coffee development at research sites

Bandung Regency has a tropical climate which is influenced by the monsoon climate with an average rainfall of 1,500 mm to 4,000 mm per year. Air temperature ranges from 12°C to 24°C with humidity between 78% in the rainy season and 70% in the dry season. The average rainfall reaches 1,500-4,000 mm per year or if the area of land is calculated, the volume of water that falls in the Regency of Bandung can reach 2,643-7.05 billion cubic meters. The huge potential of the water if not managed properly can cause a lot of inundation in various regions.

Hydrological potential in the form of abundant water resources, both underground and surface water. Surface water consists of 4 natural lakes, 3 artificial lakes and 172 rivers and tributaries. Utilization of surface water sources in general to meet agricultural, industrial, and other social needs. Utilization of deep ground water (60-200 m) is used for industrial, non-industrial, and a small part for households.

Existing land use in Bandung Regency consists of protected areas, agricultural cultivation areas, non-agricultural areas, and other areas. Land use in protected areas includes shrubs, lakes/reservoirs, forests, swamps, bushes, and rivers. Land use in agricultural cultivation areas include mixed gardens, plantations, rice fields, and oilseeds.

Land and climate conditions in the Bandung Highland and Soenda Mountain regions are very suitable for Arabica coffee plants. From this region produced good quality Arabica Coffee with excellent flavor and is known as Java Arabica Coffee Preanger. It is managed by 84 farmer groups/Forest Village Community Institutions, and its products are exported to various foreign countries at premium prices [7].

In 2014 The Geographical Indications (GIs) certificate was issued by IPR for Arabica Coffee from Priangan, West Java, under the name Kopi Arabika Java Preanger (KAJP). Based on IG the spread of KAJP is divided into two regions namely Bandung Highland and Soenda Mountain KAJP. Bandung Highland KAJP variants cover the regions of Garut Regency (Mount Cikuray and Mount Papandayan), Bandung (Mt Malabar, Mt Caringin/Tilu, and Mt Patuha), West Bandung (Mt Halu) and Cianjur (Mt Beser), while the distribution area of Soenda Mountain KAJP covering the districts of West Bandung, Purwakarta, Subang and Sumedang (Mt Burangrang, Mt Tangkuban Parahu and Mt Manglayang). Areas of potential area for KAJP cultivation in the Bandung Highland and Soenda Mountain areas are 266,680 ha and 28,860.99 ha, or a total area of 295,540.99 ha [8].

The area of coffee in Bandung Regency in 2018 is 10,724 ha. Every year, the average coffee field grows around 1,000 ha, as the coffee market continues to increase. Bandung Regency is able to produce coffee in the form of cherry fruit around 28,143 tons and processed coffee around 7,035 tons. The farmer groups involved are 206 groups of around 6,000 farmers. Arabica coffee harvest takes place during May-August. In one harvest season, farmer can produce 1500-2000 kg / ha of coffee cherry. Potential production that can be obtained is 3000 kg of fresh coffee. Arabica coffee fruit that is harvested is processed by wet processing, the harvested coffee fruit is sorted in advance to sort between perfectly ripe coffee and unripe coffee fruit, then dried until Arabica coffee is dried grain with a shrinkage of 65% so that every 100 kg coffee fruit (logs), produces about 35 kg of dried arabica grain. The price of coffee as cherry is Rp. 9,000/kg and as processed coffee is Rp. 75,000-150,000/kg.

The Ministry of Agriculture through the Indonesian Agency for Agricultural Research and Development (IAARD) has built 31 Agro Techno Science Park (Taman Teknologi Pertanian/TTP) spread across several districts in Indonesia. One of them, TTP Kopi in Cibeureum Village, Kertasari District, Bandung Regency. Bandung Coffee TTP supporting facilities submitted to the Bandung Regency Government include supporting facilities, wet coffee processing building, final coffee processing building, fermentation building, and drying floor. Other assets handed over in the form of nurseries and nurseries, semi-modern nurseries, coffee processing equipment and superior Arabica coffee seedlings. In addition, it will also be handed over in stages to a 100-hall hall building, TTP Kopi gate, guard post and water source management.
3.3. The mapping of coffee-cattle integration system implementation

Kertasari Subdistrict has an area of 15,112 Ha, with an altitude of 1,700 m asl, temperatures of 180°C to 250°C. Kertasari Sub-District is bordered by: North Side with Pacet Sub-District, East Side with Garut Regency, West Side with Pangalengan District and South Side with Garut Regency. Plantation land area of 4,988.49 Ha. The livelihoods of the residents of Kertasari Subdistrict, the majority are engaged in agriculture and labor of the Plantation as many as 16,330 people (57%) (Profil Kecamatan Kertasari 2018).

Ten farmer groups in Kertasari District were established in the period 2000-2018. The number of members is 10-25 members where as many as 6 farmer groups all members have coffee plant, the other 4 farmer groups mostly have. The average area of land owned is 0.4-3 ha with an average ownership area of 0.5 ha. The age of the coffee plant is divided into 2 groups, namely the farmer group that has long been engaged in coffee farming, and the farmer group that has just developed coffee commodities in line with the local government program and the Ministry of Agriculture with the establishment of the Agricultural Technology Park. The form of farming carried out is monoculture with the number of 2,000 stems per hectare, and polyculture with vegetable plants with a number of trees of 1,000-1,500 stems.

The development of coffee commodities is expected to improve and restore the condition of the ecosystem around the upstream of the Citarum River Basin which is damaged due to inappropriate farming business systems. In line with the program launched, several farmer groups that have just started developing coffee include: KT Mutiara Tani, KT Lembang Sari, KT Mukti Jaya and KT Taruna Mandiri.

At this time the development of the TTP has been carried out as a form of collaboration between the Ministry of Agriculture and the Regional Government. This TTP, which was built on land owned by the regional government (pemda), is to welcome the development of a technology-based agricultural economy. In harmony with the Citarum Harum Program, TTP will preserve nature while at the same time improve the welfare of farming communities through Science and Technology. The development of coffee-based farming still requires other efforts in the framework of the Acceleration of Pollution and Damage Control in the Citarum River Basin.

The objectives of the TSTP development carried out by the Ministry of Agriculture and Agriculture Ministry are: (a) improving the application and transfer of technology resulting from agricultural research and development, both from Indonesia Agency for Agricultural Research and Development (IAARD) or from others research institutions, the private sector and universities to the public, (b) building an integrated model of agriculture that integrates business components in an agribusiness system or value chains, both vertically and between subsystems, (c) improving the quality of human resources of farmers including young farmers, business people, and the community so that they are skilled in applying agrotechnology in agribusiness development.

Coffee plants need organic fertilizer produced by livestock, while livestock need feed that can be made from coffee waste. Coffee production will produce coffee skin waste, the amount of which depends on how it is harvested. When red-picked (ripe), 45% of the total weight will be produced consisting of 10% inner-skin and 35% outer-skin. When picked green will produce 21.5% of waste is a mixture of inner-skin and outer-skin. Furthermore, manure/waste produced can be used to produce biogas by installing biogas installations. The results of biogas processing in the form of liquid and solid waste are then used as fertilizer in the planting of coffee plant seeds [9].

From 10 farmer groups, there are 5 farmer groups where the members already have livestock. Integrated Farming System Mapping showed that the level of integration is not optimal. There are three principles that can describe the level of integration, namely: cycle conditions, rational, and a combination of economic and environmental feasibility [6]. The farming system is essentially cyclic (organic resources-livestock-land-crops). Therefore, management decisions related to one component may affect the others. Using crop residues is more rationally an important route out of poverty. For resource-poor farmers, the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production. Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.
The pattern of farm diversification in the coffee plantation area has actually been carried out by farmers, for example coffee farming with annual crops (coconut), food (corn), horticultural crops (bananas), livestock (goats and cows). However, plantation business activities and livestock business have not been carried out in an integrated manner. Coffee waste production is physically quite large, reaching 70% of the weight of wet fruit and has not been utilized optimally. In general, coffee waste is only buried in the ground to become compost. In some areas, coffee fruit bunch is left and becomes a source of spread of pests and plant diseases.

It has not been connected between farms that produce biomass, biomass processing industries, waste management, water utilization, energy generation, and soil nutrient conservation. This condition raises problems: (a) low productivity and quality of product, (b) un-used waste, and (c) dependence on external inputs. The CCIS is an approach that is expected to build explicitly between biomass-producing agriculture, biomass processing industries, waste management, water use, energy generation, and soil nutrient conservation so that an integrated farming system is sustainable.

3.4. The performance of Coffee-Cattle Integration System adoption
IFS are often assumed to include both crop and livestock enterprises, called mixed crop-livestock farming or integrated crop-livestock systems [10]. The key factors in integrated farming systems are the inter-dependence among enterprises within the system, synergetic transfer of resources among enterprises and the flexibility in the system to be sustainable in the long run [11]. In the CCIS there are 2 systems, namely the coffee cultivation system and the sheep livestock system. The adoption performance of the integration system can be seen from: how technology adoption in the coffee cultivation subsystem and sheep subsystem, and how each subsystem interacts.

Mapping conducted on CCIS is shown in Table 1. From the side of coffee plants, analysis was carried out on aspects of seed, cultivating technique, harvesting and processing. From the aspect of sheep livestock, an analysis is carried out on aspects of ownership, experience, cage, and waste.

| Subsystem | Aspect     | Condition                                                                 |
|-----------|------------|---------------------------------------------------------------------------|
| Crops: Coffee | Seed       | The seeds used are random seeds. Farmers get seeds from farmers or breeders. The varieties used are mostly local varieties |
|           | Cultivating technique | Cultivation is not in accordance with SOP so that it affects productivity and causes land degradation |
|           |            | The cropping pattern applied varies. Polyculture planting patterns are applied by growing coffee and horticultural commodities. In proportion, the area of horticultural crops is still dominant, causing land degradation |
|           |            | The use of fertilizers and balanced control has not been done. Fertilizers used are chemical fertilizers and chemical pesticides, so they are less environmentally friendly |
|           | Harvesting | Harvesting has not yet applied red quotes so that it affects the quality and price |
|           | Processing | Coffee processing waste in the form of fruit skin has not been utilized as feed or fertilizer Quality standardization has not been implemented well Packaging and labeling have not highlighted the superiority of the product as IG coffee |
| Livestock: Sheep | Ownership | A small number of farmers own sheep, but in very small numbers. |
|           | Experience | Farmers do not have adequate knowledge and experience in the sheep business. |
|           | Cage       | For farmers who already have cattle pens, the design and management of the pens have not yet followed the requirements for the application of IFS The location of the cage is far from the coffee plantation |
|           | Waste      | Livestock manure has not been used as organic fertilizer and energy source |
| CCIS      | Integration | Coffee and livestock management are still separate so that the utilization of waste from estate for livestock has not yet been developed and vice versa |
In terms of the IFS, coffee and livestock management are still separate so that the utilization of waste from estate for livestock has not yet been developed and vice versa. Based on the Cyclic principle, it is known that The farming system is not essentially cyclic. This is indicated by the fact limitation on: (1) the use of fertilizer from animal manure, (2) the use of coffee processing waste as feed, (3) biogas as an energy source. Based on the rational principle, it is known that there is no use in crop residues as an important route out of poverty. This is indicated by the ineffectiveness of: (1) management of crop waste and (2) optimization of land use. Based on Ecologically sustainable it has not run optimally. Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

Adoption decisions for farming practices must fit into a broader farm decision-making context that incorporates economic, environmental, and social. The low adoption of IFS is influenced by several factors. The determinants of adoption are: farmer preferences, resource endowment, market incentives, biophysical factors, as well risks and uncertainties [12]. Integrated farming system models will vary widely in each agro-climatic zones with very high location specific natural resource availability like rainfall, and other climatic factors, soil types, and market demand [13]. The determinants adoption of CCIS in Kertasari are: farmer preference, financial resources, agro ecosystem, market incentives, as well risk and uncertainty.

Farmers prefer to grow vegetables because of the economics reason. The integrated farming system changes the farmer's business activities to become wider, namely coffee and livestock. Coffee planting creates uncertainty because of the grass period in the first 3 years, in addition to post-harvest activities. On the other hand, farmers do not have the capital and experience to do livestock business.

Most farmers only have limited assets. The land used for farming is even limited to borrow and use land owned by other parties. Farm profits are not always reinvested in agricultural activities. Therefore, to implement CCIS, capital support is needed from other parties. Biophysical conditions such as soil quality, steepness of farmland, and plot size influence the physical production process. Since these conditions directly impact production costs and returns, they are implicitly economic determinants of adoption.

Agroecosystems support IFS activities. The use of animal manure is also a strategic step to overcome the decrease in land quality due to intensive use of chemical fertilizers and pesticides in vegetable farming. Technology has been available in the form of superior varieties, farming techniques, and processing that allows the creation of premium products. In addition, the growing specialty coffee market has resulted in increased prices that encourage farmers to develop coffee farming.

Risk and uncertainty relates to the market and institutional environment under which decisions are made. The price of coffee and livestock is relatively more stable compared to the price of horticultural commodities which is more volatile. CCIS will reduce production and marketing risks through business diversification and further processing of the products produced.

3.5. Strategies to accelerate the coffee-cattle integration system adoption

The integrated crop-livestock technology production has specific characteristics in all the three points covered by this research: strategy, competences and management, and those aspects differ in each integration pathway. The strategy choice process of technology adoption differed in each case, nevertheless the economic perspective value as a crucial factor for this technology adoption but with some specific differences [14].

The implementation of IFS will be greatly influenced by the current internal and external environmental conditions. Various efforts are needed to take advantage of opportunities and overcome existing threats, in line with efforts to utilize the strengths that are owned and overcome the weaknesses that exist in the current agricultural system. This effort is a strategy that will encourage the application of IFS which is compiled as a combination of using strengths to take advantage of opportunities, overcome weaknesses to take advantage of opportunities, use strengths to overcome threats, and eliminate weaknesses to overcome threats (Table 2).
Table 2. SWOT matrix of IFS adoption

| Internal Factors | Opportunities (O)                                                                 | Threats (T)                                                                 |
|------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------|
|                  | 1. Citarum Harum Policy                                                           | 1. Climate change                                                          |
|                  | 2. MoU Perhutani                                                                 | 2. Alternative commodities                                                 |
|                  | 3. Coffee TTP                                                                     | (horticulture)                                                             |
|                  | 4. Coffee GIs                                                                    |                                                                            |
|                  | 5. Local government coffee                                                        |                                                                            |
|                  | Development Program                                                              |                                                                            |
|                  | 6. The increasing trend of coffee consumption                                    |                                                                            |
| Strengths (S)    | 1. Revitalizing farmer groups to support the Citarum Harum Policy, the implementation of the Perhutani MoU, and the Coffee TTP | 1. Utilizing technology to implement coffee and livestock farming in the context of climate change mitigation and adaptation |
|                  | 2. Utilizing the technology of cultivation, coffee processing and livestock farming to increase productivity and develop superior coffee products, while supporting the protection of coffee GIs | 2. Utilizing IFS technology to increase the added value and competitiveness of coffee products |
| Weaknesses (W)   | 1. Expanding access to capital to implement IFS                                   | 1. Increase farmers' awareness through demonstration plots in the context of climate change mitigation and adaptation |
|                  | 2. Providing and optimizing of use IFS technology in farmers group level           | 2. Expanding access to capital and technology to implement IFS so as to increase the competitiveness of coffee-based businesses |
|                  | 3. Increase the intensity of counseling to accelerate the adoption of IFS         |                                                                            |
|                  | 4. Reinforce the MoU related to the period of land use                             |                                                                            |
|                  | W-O Strategies                                                                    | W-T Strategies                                                              |
|                  | W-T Strategies                                                                    |                                                                            |

Opportunities for implementing IFS can be seen from the various policies, programs and support currently available. The low adoption of IFS is caused by various weaknesses that exist in the current crop and livestock subsystems. The Citarum Harum Policy, MoU designed by Perhutani, and the Local Government Coffee Development Program will encourage the land conservation movement, one of which can be done through coffee cultivation supported by livestock business. The development of the Coffee TTP encourages the acceleration of diffusion of technologies related to coffee cultivation. From
the consumer side, the GIs of coffee has been obtained will be a very strategic promotional tool. In addition, lifestyle changes have created an increase in coffee consumption.

The threats that exist from the external environment are in the form of climate change that requires the adoption of a sustainable agricultural system, as well as the economic advantages of farming other commodities. Both of these challenges need to be anticipated so that IFS can be implemented properly.

The development of IFS is supported by various strengths owned by the agricultural system that has been running so far. These strengths consist of: Organized of Farmer groups, Availability of coffee cultivation and processing technology, Availability of livestock farming technology, Livestock business experience, and availability of coffee processing units. This power will drive the acceleration of the application of IFS.

The development of IFS will be influenced by a number of weaknesses that exist in the current agricultural system. Some weaknesses are related to farmers' resources and knowledge, such as capital scarcity for implementing IFS, limited experience in livestock management, low concerning in Sustainable agriculture for environmental aspects, insecurity in land ownership status as well limited extension in coffee and livestock commodities (focusing on food crops and horticulture).

IFS beyond the farm level often requires new networks, as current networks often include either specialized arable or specialized livestock farmers, particularly if regional specialization exists. Strategies should thus incorporate links with existing networks and institutional arrangements in designing crop-livestock integration beyond the farm level [15]. Generally, acceleration of adoption at the farm level can be done through (1) assistance in implementation; and (2) provision of agricultural facilities and infrastructure as well as agricultural machinery equipment. The S-O strategies is arranged to: (1) revitalizing farmer groups to support the Citarum Harum Policy, the implementation of the Perhutani MoU, and the Coffee TTP, and (2) utilizing the technology of cultivation, coffee processing and livestock farming to increase productivity and develop superior coffee products, while supporting the protection of coffee GIs.

The W-O strategies consist of: (1) expanding access to capital to implement IFS, (2) providing and optimizing of use IFS technology in farmers group level, (3) increase the intensity of counseling to accelerate the adoption of IFS, and (4) reinforce the MoU related to the period of land use. S-T strategies consist of: (1) utilizing technology to implement coffee and livestock farming in the context of climate change mitigation and adaptation, and (2) utilizing IFS technology to increase the added value and competitiveness of coffee products. Another strategy is a strategy that is built based on existing weaknesses and threats. The W-T strategies consist of: (1) increase farmers' awareness through demonstration plots in the context of climate change mitigation and adaptation, and (2) expanding access to capital and technology to implement IFS so as to increase the competitiveness of coffee-based businesses.

4. Conclusion
The implementation of Coffee-Cattle Integration System (CCIS) in Kertasari Subdistrict, Bandung Regency is still limited. The coffee and livestock are still manage separately; the utilization of waste from estate for livestock has not yet been developed and vice versa. The determinants of CCIS adoption are related to: farmer preference, financial resources, agro ecosystem, market incentives, as well risk and uncertainty. Acceleration of adoption at the farm level can be done through assistance in implementation and provision of agricultural facilities and infrastructure as well as agricultural machinery equipments.

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