Building agribusiness model of LEISA to achieve sustainable agriculture in Surian Subdistrict of Sumedang Regency West Java Indonesia

E Djuwendah, T Priyatna, K Kusno, Y Deliana and E Wulandari
Agribusiness Study Program, Faculty of Agriculture, Universitas Padjadjaran, Indonesia

E-mail: endah_djuwendah@yahoo.com

Abstract. Building agribusiness model of LEISA is needed as a prototype of sustainable regional and economic development (SRRED) in the watersheds (DAS) of West Java Province. Agribusiness model of LEISA is a sustainable agribusiness system applying low external input. The system was developed in the framework of optimizing local-based productive resources including soil, water, vegetation, microclimate, renewable energy, appropriate technology, social capital, environment and human resources by combining various subsystems including integrated production subsystems of crops, livestock and fish to provide a maximum synergy effect, post-harvest subsystem and processing of results, marketing subsystems and supporting subsystems. In this study, the ecological boundary of Cipunegara sub-watershed ecosystem, administrative boundaries are Surian Subdistricts in Sumedang. The purpose of this study are to identify the potency of natural resources and local agricultural technologies that could support the LEISA model in Surian and to identify the potency of internal and external inputs in the LEISA model. The research used qualitative descriptive method and technical action research. Data were obtained through interviews, documentation, and observation. The results showed that natural resources in the form of agricultural land, water resources, livestock resources, and human labor are sufficient to support agribusiness model of LEISA. LEISA agribusiness model that has been applied in the research location is the integration of beef cattle, agroforestry, and agrosilvopasture. By building LEISA model, agribusiness can optimize the utilization of locally based productive resources, reduce dependence on external resources, and support sustainable food security.

1. Introduction
Building LEISA agribusiness model is needed as a prototype of sustainable rural and regional economic development (SRRED) on watersheds (DAS) in West Java Province. Therefore, this agribusiness system is developed in the agribusiness development region that pays attention to ecological, social and functional boundaries.

Sustainable agricultural development is essentially producing food and conserving agricultural resource base. The term used to describe the terminology refers to ecological agriculture. One of the sustainable agricultural systems is Low External Input Sustainable Agriculture (LEISA), which emphasizes the efficient use of internal production factors to create sustainable agriculture. The five principles of sustainable agriculture are ecological stability, economic sustainability, just, humane, and flexible [1]. LEISA system combines the components of plants, animals, soil, water, climate, and humans in the production system in order to complement each other and have a sense of ecologically...
and economically proper integrated agricultural system [2].

Ecologically, Surian Subdistrict is located in sub-watershed of Cikandung, Cipunagara, which is one of rural areas that have great potential of natural resources for the development of LEISA system based on agriculture, livestock, and forestry. However, the development of Surian Subdistrict is slow, as can be seen in the lower economic growth rate compared to the economic growth rate of Sumedang Regency, and in the poor road infrastructure. This indicates that the synergy among the subsectors of agriculture, industry, and services is still weak. Therefore, the agricultural sector needs to be encouraged to be the regional economic base in the Surian Subdistrict.

The potential of agricultural resources existing in this region has not been fully utilized in supporting sustainable agriculture. This is evident from the fact that many farmers still rely on chemical fertilizers and drugs in the practice of plant cultivation, and that animal manure has not been optimally used as fertilizer or biogas in agricultural activities [3].

This study aimed to identify the potential agricultural resources in Surian Subdistrict of Sumedang Regency to support the sustainable agriculture of LEISA model, and to obtain a study of the potential of internal and external inputs in the agribusiness model of LEISA.

2. Methods
This research used qualitative method using case study technique. Case study is defined as a research strategy in which researchers carefully investigate a program, event, activity, process, or group of individuals [4]. The ecological boundary of the research location was Cikandung sub-watershed ecosystem, and is administratively located in the Surian Subdistrict of Sumedang Regency of West Java. The data used consisted of primary and secondary data. Primary data were obtained through interview with informants, participatory observation, and documentation. Secondary data were obtained through literature review of some research results. The object of the research was the various integrated farming of LEISA model.

3. Research and Discussion
3.1. The Potential of Surian Subdistrict in the Agricultural Development of LEISA System
Low external input and sustainable agriculture (LEISA) is agriculture that optimizes the utilization of natural resources (land, water, plants, animals, and humans) available somewhere that is economically proper, ecologically sound, and socially adapted to the local culture in that location [1].

Table 1 shows that the condition of agricultural resources of Surian Subdistrict has potency to support sustainable agriculture applying LEISA system. Most of the land in Surian Subdistrict is the land utilized by the community for the plantation of some crops such as Albasia, coffee, pepper, and banana. The sources of livelihood of the inhabitants are agriculture and livestock. The availability of local inputs for the development of the LEISA system in the Surian Subdistrict encompasses considerable agricultural land using rotary cropping pattern of rice–rice–non rice/palawija (soybean or corn), wetland irrigation, livestock manure, availability of crop residues, use of organic fertilizers, and integrated pest control.

In farming, farmers in Surian Subdistrict joined 5 combined farmer groups (gapoktan), namely Ranggamukti Jayasari, Giri Mukti, Suriatiadi, and Tunas Harapan. Cultivated commodities in the wetland and heterogeneous gardens were wetland paddy (6,324 quintals), soybean (1,791 quintals), tree yam (140 quintals), corn (357.43 quintals), sweet potato (120 quintals), fruits, and various timbers. The livestock farming included beef cattle (1,209 heads), goats (1,773 heads), sheep (1,766 heads), chicken (28,600 heads), and duck (1,805 heads). In addition, in the field of fisheries, types of fish that were mostly cultivated were carp (16,544 kg) and parrotfish (15,540 kg) [5]. Some agroindustry activities that were growing in Surian Subdistrict included tofu and tempeh business, and cassava chips and banana chips industries.
Table 1. The Potential of Agricultural Resources of Surian Subdistrict in 2016

| Agricultural Resource                        | Information                                      |
|----------------------------------------------|--------------------------------------------------|
| Land resource (Ha)                           |                                                  |
| - Wetland                                    | 951.07                                           |
| - Dry land                                   | 455.45                                           |
| - Forest                                     | 3,114.65                                         |
| - Height                                     | 170-500 m ASL                                    |
| Agro climate condition:                      |                                                  |
| Rainfall                                     | 2075 mm per year                                 |
| Rainy days                                   | 172                                              |
| Humidity                                     | 25                                               |
| Average temperature                          | 23-27 °C                                         |
| Water availability                           | 9-12 months coming from Cikandung River,         |
| Water resource                               | Cipunagara Watershed of Sumedang Regency         |
| Wetland cultivation techniques               | Ip-200, jajaran legowo 2 : 1 intercropping       |
| Irrigation                                   | Half-technical self-help                          |
| Agricultural and plantation commodities:     |                                                  |
| paddy, soybean, corn, sweet potato, peanut,   |                                                  |
| banana, and coffee                           |                                                  |
| Agroindustry type:                           |                                                  |
| Manufacture of tofu, tempeh, banana and      |                                                  |
| cassava chips                                |                                                  |
|                                            | Agricultural Waste                               |
|                                            | Straw, husk leaves of corn, cassava leaves, sweet|
|                                            | potato leaves, banana leaves, coffee skins       |
|                                            | Agroindustry waste                               |
|                                            | Soy skins, banana skins, cassava skins, tofu dregs,|
|                                            | and onggok of tofu                               |

Local inputs were in the form of animal waste that can be used as manure to cultivate rice crops. Animal waste was obtained from beef cattle groups found in almost all villages in the Surian Subdistrict. Based on the information of interviews conducted to breeders in the Ranggajaya cattle breeder group located in the village of Ranggasari, the animal waste produced about 4 kilograms per cow and 2 kg per sheep or goat. Thus, livestock manure produced in the Surian Subdistrict per day was predicted to reach 4.8 tons of cow dung and 7.08 tons of goat and sheep dung. Similarly, the urine of goat, cow, and sheep can be used as liquid organic fertilizer and local microorganism (MOL) to help fertilize the soil. However, only about 40 percent of the livestock manure potential was utilized as organic fertilizer. Other local inputs in the form of agricultural and agroindustrial waste can be used as the raw material for composting, or for animal feed.

According to farmers, the harvest or paddy straw residue reached 4 tons per hectare. Surian Subdistrict had a harvest area of wetland paddy of 1,840 hectares, thus the potential of paddy straw that can be processed into animal feed or returned to the soil as organic fertilizer was 7,360 tons.

Livestock maintenance is one component in farming that will integrate with other commodities cultivated by farmers. Thus, if small-scale farming oriented to the family business, then the development program is based on an integrated agricultural system. Several potential integrated agricultural technologies to support sustainable agriculture system in Surian Subdistrict included intercropping, agroforestry, and integration of laying duck maintenance with paddy rice.

3.1.1. Multi Cropping Pattern in the Wetland Ecosystem and Intercropping Pattern in the Dry Land Ecosystem

The commodities cultivated in the wetland of Surian Subdistrict were rice, corn, soybeans, cassava, green beans, and vegetables. Wetland was generally planted twice with rice and once with palawija as the alternative crops (rice–rice–non rice/palawija), both of which were planted in monoculture. Meanwhile, dry land like moor was planted with vegetable crops. There were also farmers who implemented intercropping pattern with paddy-fish integrative farming (mina padi) pattern, that is, (1) fish as the interval between rice planting seasons, which is usually done while
waiting for rice seedlings to be ready to plant, which is between 20 and 30 days; and (2) the maintenance of fish with paddy by using jajar legowo paddy planting system.

3.1.2. Jajar Legowo Planting System Jajar Legowo planting system is the way of planting wetland paddy with the pattern of several rows of plants interspersed with empty rows. Crop that should be planted in the empty rows are moved to be as insertion plants in the rows. Previously, jajar legowo planting was commonly applied to areas with many pests and disease attacks. On each empty row between every legowo unit, a shallow ditch can be made. The trenches can serve to collect the golden snail, reduce iron-poisoning level in paddy plants, or work for the maintenance of small fish [6]. The implementation of this system can reduce, even stop, the population of plant hopper pests in the wetland without the use of synthetic pesticides, so the results from time to time will remain, and the results do not contain residues of synthetic pesticides. Another advantage, this model can improve soil fertility because the fish manure and food waste serve as fertilizer.

According to information from agricultural extension officers, only about 30 percent of farmers in Surian Subdistrict applied this legowo-farming pattern. This is because the large majority of farmers were still farming with conventional system.

3.1.3. Agroforestry Agroforestry is a farming system that combines forest trees with agricultural crops, livestock, and/or fish on the same land to form a pattern of cultivation with the aim to optimize the social, economic, and ecological benefits [7].

Pepper and cardamom are plantation crops that are excellent for the community in Surian through the intercropping cultivation pattern with banana plants, animal feed, moluccan albizia (Falcataria moluccana Miq.) and magnolia blumei (Magnoliatia glauca Bl). By looking at the pattern of utilization of plantation land in Surian Subdistrict, it can be said that this region has developed agrosilvopasture. Agrosilvopasture is a combination of forest plants or woods and grasses of forage in order that the conservation is guaranteed and the demand for forage is sufficient without damaging the environment and the weight of the beef livestock and reducing feed conversion.

3.1.4. Integration of laying duck maintenance with paddy rice In order to utilize agricultural waste and plant pest control in Surian Sub-district, there are many farmers who apply the maintenance business of laying duck with traditionally maintained rice paddy. The form of management is grazing on the move. In this system of integration, duck farms feed on the remnants of rice that are lost or left behind during harvest, the grass growing in paddy fields, insects, snails, stone crabs, small frogs and so on [8]. Meanwhile, rice paddy will benefit from the reduction of pest attacks such as weeds, insects and others because it has been eaten by the duck livestock. In addition, organic fertilizer is obtained in the form of manure from ducks while grazing.

Integration of ducks and paddy fields provides benefits in terms of egg production and better rice production, supported by the reciprocal benefit (interaction) of integrated cohesive integration between ducks and rice [9]. The results of the previous [10] in North Sumatra showed that ducklings integrated with irrigated rice paddy fields could control the golden snail pest and the implications of duck and rice egg production increased significantly.

3.2. Obstacles of the Potential of Agriculture in Surian Subdistrict In order to develop the potential of Surian Subdistrict, there were still several obstacles, including that the available human resources had not been able to be developed well yet both in terms of knowledge and skills in the processing of manure into compost, liquid fertilizer or biogas, in the technologies for processing straw or animal feed, and in jajar legowo farming pattern technology and paddy-fish integrative farming. Some had already been accustomed to use outside input because they found it more practical as it does not require much labour. There are limitations of the field extension workers (PPL), where not all villages have PPL, as well as poor infrastructure and transportation, and lack of water ponds to store water during the water crisis in dry seasons.
3.3. Development of Agribusiness Model LEISA

Agribusiness model of LEISA is one of Green Business Model, which is a business model that does not cause externalities to the environment physically, socially, or economically. Agribusiness Model of LEISA is an agribusiness system that applies sustainable agribusiness model with low external input. The system is developed in order to optimize the utilization of locally-based productive resources, including land, water, vegetation, microclimate, renewable energy, appropriate technology, social capital, environment, and human resources (including youth and women), by combining various subsystems that include:

(a) integrated and sustainable production subsystem of crops, livestock, and fish, so that they complement each other and provide maximum synergistic effect;
(b) processing subsystem of yields and post-harvest;
(c) marketing subsystem; and
(d) supporting subsystem.

Sustainable agricultural system must be built on the foundation of renewable resource that comes from the farm and the surrounding environment. The classification of internal and external resources will be helpful in understanding and developing agribusiness with LEISA model. Inputs as productive resources used differently in each agribusiness subsystem are divided into 2 (two) kinds: internal inputs and external inputs. In developing the agribusiness model of LEISA, the inputs or productive resources used are based on the internal inputs by minimizing external inputs.

Table 2. Internal and External Inputs in LEISA Agribusiness Model

| A. Food Production Subsystem                  | B. Subsystem of Post-Harvest and Crop Processing |
|----------------------------------------------|-----------------------------------------------|
| Agro-polis as a unit of integrated farming area based on watershed ecosystem | Locally based raw materials and other materials |
| The sun as the renewable source of energy in the process of photosynthesis of plants | The raw materials processed using renewable energy from local resources |
| Water: coming from rain or local irrigation networks | Labor coming from the local area |
| Nutrition (nitrogen from air fixation) coming from soil and recycled organic matter | Capital focusing on the utilization of social capital |
| Performing weed control and pest diseases in biological, cultural, and mechanical way Seed: produced from self/local farming | Production management initiated by the farmers and local communities |
| Agricultural machinery: assembled and managed by the farmers and local communities Labor: coming from the family and/or those around the farming | |
| Capital focusing on the utilization of social capital | Raw materials and other materials purchased from outside the area |
| Production management initiated by the farmers and local communities | Raw materials are processed using non-renewable energy |
| Management: from input traders, field extension workers, and so on | Labor coming from outside the area |
### C. Crop Marketing Subsystem

| Tools and machinery produced and developed by the local residents | Tools and machinery purchased from the other outside the area |
|---|---|
| Waste recycled | Waste not recycled |

- Residents and local government are proactive in making agro-eco-system potential for agrotourism.
- Government and private sectors are proactive in making the local agro-ecosystem zone potential for the development of tourism.
- Food and non-food distribution agencies are initiated by farmers and/or partner institutions, such as farmer groups, food barns, village-owned enterprises (*BUMDes*), and cooperatives.
- Distribution agencies of food and non-food agricultural products are not initiated by farmers and/or partner institutions that favor farmers.
- Village markets, local retails, and retails in the outside area market local food and non-food production.
- Rural markets and retails market non-local food and non-food products.
- The marketing management of the crops is arranged by local farmers and entrepreneurs.
- The management of marketing the crops is initiated by outsiders.

### D. Supporting Subsystem

| Information and communication system is based on local specific agribusiness. | Agribusiness information and communication system is general. |
|---|---|
| Agribusiness research and development is conducted by local people and local government. | Agribusiness research and development is organized by government, private parties, and external capital owners. |

- Micro-Economic Institution includes Joint Business Groups, Cooperatives, Barns, and Village-Owned Enterprises.
- Financial institution: Bank
- The effort to improve ecosystem services is initiated by local communities and local government.
- Effort to improve ecosystem services is initiated by external parties.

Source: [11]

In the production subsystem, LEISA’s method refers to the efforts of (1) optimizing the utilization of existing local resources by combining various components of farming systems, i.e. crops, livestock, fish, soil, water, climate, and humans in order to complement and give the greatest synergistic effect; and (2) the use of external inputs, which is only made when necessary, to supplement the less elements in the agro-ecosystem and increase biological, physical, and human resources. In utilizing external inputs, the main concern is given to the mechanism of recycling and minimization of environmental damage.

Agribusiness system of LEISA model, which integrates agriculture, livestock, fisheries, and other locally available resources, will support sustainable agriculture. This is in line with the results of research conducted by [12-14], which found that the combination model of crops, livestock and fish has been strongly recommended to ensure the sustainability of intensification, and support the development of rural areas.
4. Conclusion
Ecologically, the agricultural resources of Surian Subdistrict have supported sustainable agriculture of LEISA model, but technically and socially, constraints still exist especially in the limited human resources (skill) and infrastructure (market and street). Agribusiness model of LEISA seeks to optimize the utilization of local resources through the subsystems of production, post-harvest and processing, processing and utilization of wastes, widespread distribution of local food through community empowerment and the provision of ecosystem services conducted by local communities involving micro-economic institutions. Thus, the agribusiness model of LEISA can develop regional economic activity.

References
[1] Reintjes et al 1999 Pertanian Masa Depan: Pengantar Untuk Pertanian Berkelanjutan dengan Masukan Luar Rendah Edisi Indonesia Terjemahan Sukoco Kanisius Yogyakarta
[2] Das A 2013 Integrated farming: an approach to boost up family farming LEISA India 15(4)
[3] Wikarta K 2015 IbM Membangun Ekobisnis Model LEISA Laporan Akhir Ipteks Bagi Masyarakat (IbM) DRPMI Unpad Bandung
[4] Cresswell J W 1998 Research Design: Qualitative and Quantitative Approaches London: SAGE Publications
[5] BPS Kabupaten Sumedang 2016 Kecamatan Surian dalam Angka
[6] Sarlan A et al 2013 Sistem Tanam Legowo Badan Penelitian dan Pengembangan Pertanian Kementerian Pertanian Jakarta
[7] Mayrowati H and Ashari 2011 Pengembangan agroforestry untuk mendukung ketahanan pangan dan pemberdayaan petani sekitar hutan Jurnal Forum Penelitian Agro Ekonomi Pusat Sosial Ekomi dan Kebijakan Pertanian Bogor
[8] Evans A J and Setioko A R 1985 Tradisional System of Layer Flock Management in Indonesia. In Duck Production Science and World Practise. D J Farrell and P Stapleton (Eds) University od New England pp 306-322
[9] Abduh U et al 2003 Integrasi ternak itik dengan sistem usahatani berbasis padi di Kabupaten Sidrap Sulawesi Selatan (Duck-rice integration in farming system in Sidrap Regency, South Sulawesi) Balai Pengkajian Teknologi Pertanian
http://peternakan.litbang.pertanian.go.id/fullteks/lokakarya/loli04-28.pdf

[10] Wasito and Khairiah 2004 Peranan itik diintegrasikan dengan padi lahan sawah irigasi untuk mengendalikan keong emas di Sumatera Utara Proc. Seminar dan Eksposen Nasional Sistem Integrasi Tanaman-Ternak. Denpasar, Bali. 20-22 Juli 2004 Puslitbang Petersnakan, BPTP Bali dan CASREN. pp. 186-194

[11] Tuhpawana et al 2016 Pembangunan Ekonomi Perdesaan Berkelanjutan di Kabupaten Sumedang Laporan Academic Leadership Program (ALG) DRPMI Universitas Padjadjaran Bandung

[12] Surahman M and Sudrajat 2009 Sistem Pertanian Terpadu Naskah Akademis: Pengembangan Model Ecovillage, pp 63-82, LPPM dan Fakultas Ekologi Manusia IPB Bogor

[13] Priyanta and Djadjanevraga A 2004 Pengembangan usaha sapi potong pola integrasi Prosiding Lokakarya Nasional Sapi Potong Menuju 2020 Strategi Pengembangan Sapi Potong dengan Pendekatan Agribisnis dan Berkelanjutan. pp. 63-82, Yogyakarta, 8-9 Oktober 2004 Badan Litbang Pertanian Puslitbang Petersnakan Bogor

[14] Davendra C 2007 Perspectives on Animal Production Systems in Asia Livestock Science 106