

## Sustainability of the Sawah Surjan Agricultural Systems in Depok Village, Panjatan Subdistrict, Kulonprogo Regency, Yogyakarta Special Province

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**Abstract.** The south coastal region of Yogyakarta Province (YSP) in Indonesia has inherited a unique farming system called sawah surjan, which is considered as a cultural heritage that demonstrates a form of local wisdom in managing land resources with poor drainage. The local residents have succeeded in realizing their desire of making the farming system ecologically stable and capable of providing a decent living. As a cultural heritage, however, sawah surjan has been under an increasing threat of conversion resulting from the infrastructure development and spreading of urban developments. This study assessed the prospect of sawah surjan in the rural household economy and its sustainability within the context of changing wider environment. To do so, a household survey was conducted covering 41 farmer households in Depok Village, Panjatan Sub-district, Kulonprogo Regency, Yogyakarta Special Province where the existence of sawah surjan is threatened by the large-scale investments. The research show that sawah surjan contributes to employment generation, diverse sources of income, food security, and income redistribution. It is generally sustainable but the excessive use of pesticides and chemical fertilizers will have adverse effects on its sustainability. The research confirms that the most significant threat is the infrastructural development, especially the prospective construction of a new international airport as increased land prices may lead to uncontrolled conversion of sawah surjan into non-agricultural uses. This is also in coincidence with the stagnant regeneration of farmers in the area that lead to a bleak future of the system.

**Keywords:** sawah surjan, farming systems, sustainability, large-scale infrastructure development, Indonesia.

**Abstrak.** Wilayah pantai selatan Daerah Istimewa Yogyakarta memiliki system pertanian tradisional yang dikenal dengan sistem sawah surjan sebagai warisan budaya yang menunjukkan satu bentuk kearifan lokal dalam pengelolaan sumberdaya lahan dengan drainase yang buruk. Masyarakat setempat telah berhasil mengembangkan sistem pertanian yang stabil secara ekologis dan mampu memberikan penghidupan yang layak. Sebagai warisan budaya, sawah surjan tengah mengalami ancaman konversi akibat pembangunan infrastruktur dan perkembangan kota di masa depan. Penelitian bertujuan mendeskripsikan praktek bertani di sawah surjan, menilai prospek dan keberlanjutan sawah surjan. Penelitian ini menggunakan metode survey rumah tangga. Sebuah survei rumah tangga mencakup 41 responden rumah tangga petani sawah surjan dilaksanakan di Desa Depok, Kecamatan Panjatan, Kabupaten Kulon Progo yang terancam konversi akibat adanya investasi infrastruktur skala besar di desa-desa sekitarnya. Hasil penelitian menunjukkan bahwa system sawah surjan memberikan sumbangan pada penciptaan kesempatan kerja, ketahanan pangan, dan distribusi pendapatan yang baik. Petani pada sawah surjan umumnya menunjukkan praktek bertani yang berkelanjutan, kecuali dalam pemanfaatan pestisida dan pupuk buatan yang berlebihan. Ancaman keberlanjutan yang sangat nyata muncul dari pembangunan infrastruktur, khususnya bandara internasional yang dapat mendorong terjadinya konversi sawah surjan ke dalam bentuk penggunaan lahan non-pertanian. Regenerasi petani yang lambat juga akan memperburuk masa depan system sawah surjan.

**Kata kunci:** sawah surjan, system pertanian, keberlanjutan, pembangunan infrastruktur skala besar, Indonesia.

### 1. Introduction

*Sawah surjan* is a system of paddy field management that is specifically adopted by the farmers in the coastal area of Kulonprogo regency, especially in the Subdistricts of Temon, Wates, Panjatan, and Pengasih (Sulistyo, 2017). The *Sawah surjan* systems are one form of the local wisdom in adapting to the environmental condition with poor drainage. The areas of *sawah surjan systems* are geomorphologically fluvio-marine plains that were formed through a combination of the process of erosion and sedimentation. The existence of *sawah surjan* in Kulonprogo regency has been considered a form of local wisdom in the management of marginal land resources which are liable to natural conditions with bad drainage. Morphologically *sawah surjan* belongs to the fluvio-marine type of land situated in the back swamp zone along the

coastal area of Kulonprogo regency (Marwasta and Priyono, 2007).

As a local genius *sawah surjan* can be equated with the *polder* system in the Netherlands, which is the product of the innovatory genius of the Dutch in expanding the land area of their country. The 'cut and fill' principle applied in the cultivation of *sawah surjan* has apparently been familiar to the farmers in the rural areas of Kulonprogo regency for generations. It is cultivated through a process of cutting and dredging the parts of the watery swampland to be heaped up in parallel with each other and form a *guludan* (seedbed) alternating with a basin. It is this seedbed with a basin that forms a multi-colored representation (signifying difference of plant types) so that it bears resemblance to the decorative design on an indigenous coat called *surjan* (Figure 1).

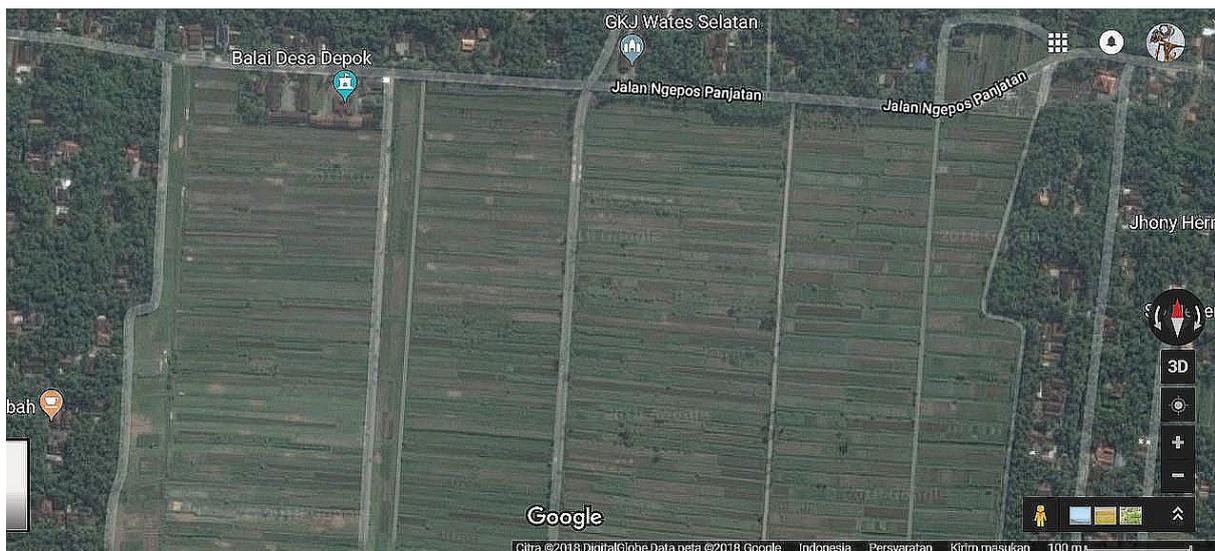


Figure 1. Google Map Caption of *Sawah Surjan* Systems around Depok Village Office.

Table 1. Dimensions and Variables of *Sawah surjan*'s Sustainability.

| Sustainability Dimensions | Variables   |
|---------------------------|---|
| Ecological                | Utilization of organic fertilizers                              |
|                           | Practice of traditional control of weeds                        |
|                           | Disuse of pesticides  |
| Social                    | Disuse of chemical fertilizers                                  |
|                           | Cultivation by intercropping                                    |
|                           | Utilization of manpower from outside households                 |
| Economics                 | Orientation to utilization of agricultural commodities          |
|                           | Sufficiency of incomes from agriculture                         |
|                           | Ability to save from surplus of products                        |
|                           | Percentage of food expenditure against provincial minimum wage) |

From the ecological perspective, *sawah surjan* has important superiority. Results of research by Aminatun *et al.* (2012) shows that it has greater biodiversity as evidenced by the richness of cultivated plants and weeds, insects and their natural enemies. This is also evident in the pattern of interaction between plants (including weeds) and herbivorous insects, and interaction between herbivorous insects (pests) and their natural enemies. The agricultural cultivation in *sawah surjan* mostly adopts a polyculture planting pattern that capitalizes on the existence of the two aquatic and terrestrial ecosystems, i.e. by growing rice in the basin and a mixture of second crops or vegetables in the seedbeds. This is consistent with a statement by Odum (1998) that the polyculture pattern has more biodiversity, thus resulting in a more stable ecosystem. Reijntjes *et al.* (1999) also points out that ecologically the polyculture pattern has a positive effect on the reduction of the population of insects, plant disease, and weeds. Natural enemies of plants tend to outnumber on an intercrop because they provide more varied microhabitat and source of feeds. Aminatun *et al.* (2014) also shows that there are more links of interaction in *sawah surjan* than in the conventional paddy field so that there is no population explosion or dominance of a particular type of pest.

*Sawah surjan* in the regency also has a vital role as a provider of subsistent needs with a high level of variety, which serve to fulfil food requirements in the form of carbohydrates, proteins, vitamins and other nutrients. Therefore, *sawah surjan* performs a strategic function of ensuring the sustainability of the people's livelihood in the rural areas of Kulonprogo Regency. This also in line with the most recent work of Widiyanto (2018) in the same district that this research village is a part of the eastern section showing various local food crops such as cassava, arrowroot, birch rim yam, tuber, and breadfruit to sustain the local household livelihood.

This research aims to assess the prospect of *sawah surjan* as part of the traditional agricultural system in the Regency of

Kulonprogo and assess its sustainability as an agricultural system that has been practiced for many generations.

## 2. Research Method

The research was conducted in the rural areas of Kulonprogo regency as part of the Province of YSP hat has an expanse of *sawah surjan* agricultural system. Many farming households there cultivate the land of *sawah surjan* inherited from previous generations. In order to answer the research question, this research adopts the survey method. The unit of analysis adopted was the household as the smallest unit of the rural communities and the aspects studied were the dimensions associated with the sustainability of the *sawah surjan* system. Depok Village in Panjatan Subdistrict was purposively selected as part of the regency with the system that is currently undergoing a big challenge for conversion as a result of large-scale investments along the coastal area.

A household survey was carried out in Depok Village the village representing the greatest existence of *sawah surjan* and which has the potential of being affected by the large-scale investments. A total sample of 41 households were taken systematically from the village registration book. Data analysis was done using a descriptive statistics method with the aid of the SPSS software. The collection of information is classified into four broad outlines, i.e. identity, social, economic, ecological aspects, and additional questions that can help analyze the sustainability of a *sawah surjan* system. The general identity such as age, status in the household, education, number of children can help analyze household needs and the influence of agricultural activity. In general, the rural communities have enough children who are projected to carry on the parents' work (or at least to assist them). In this way it is possible to dig up information on the relationship between productivity and the socio-demographic conditions of households. The JJLS project, iron ore mining, and construction of the new international airport, which is not carried out in Depok

village, will certainly give a significant effect. For a region where things are interconnected/interdependent and subject to indirect effects, this information is worth considering because it will affect the sustainability of the *sawah surjan* system.

Questions surrounding the social, economic, and ecological aspects refer to an article in an international journal written by Hayati *et al.* (2010). The social aspects covers things like manpower, the area of a paddy field, commodities, and vehicles. The economic aspect includes earnings, savings, side jobs, distribution of products and traditional marketing. This is different from the ecological aspect, which comprises facilities and infrastructure, supporting tools, chemical/organic fertilizers, planting patterns, pests, and water availability all of which are inter-related starting from the planting process and plant management to the sale of plants.

The data collected include various variables expounded from concept of sustainability put into practice by Dueterhaus (1990), in which the scope of data collection that is relevant to the research questions to be answered encompasses the following dimensions:

1. *The economic aspect* of the *sawah surjan* agricultural activity: its ability to fulfill the households' food and fiber requirements.
2. *The ecological aspect* of the agricultural activity in terms of its ability to enhance the quality of the environment and the basis of natural resources on which the agricultural economy depends.
3. *The ecological aspect* in terms of the ability of the *sawah surjan* system to provide an opportunity of the utilization of non-renewable resources and agricultural resources, and if possible to integrate the natural biological cycle and control.
4. *The ecological aspect* in terms of its ability to maintain the economic viability of an agricultural unit.
5. *The social justice* aspect in terms of its ability to improve the quality of life of the farmers and society at large.

Table 1 is the list of variables in detail covered to assess the condition of the sustainability of the *sawah surjan* system.

Data analysis was done by producing a table of frequency and/or a graphic/diagram to show the distribution of attributes of each chosen variable with the purpose of describing the characteristics of the respondents involved in the economic activity of the *sawah surjan* system based on certain variables. From the various descriptions, more detailed information was obtained and used to understand the characteristics of sustainability of the economic activity of the *sawah surjan* system. Data analysis was not directed to an evaluation to obtain an index or figure as the value of the sustainability of *sawah surjan* activity because the complexity of available variables in various data size did not enable the making of a composite index without compromising details. Data analysis was directed to the exploration of the composition diversity of values from various variables of sustainability which reflect the ecological, economic, and social dimensions of the *sawah surjan* system. In order to help visualize the composition diversity of value of the sustainability variables, a spiderweb diagram was composed which systematically shows the value of each variable in the sustainability dimensions. In this way, a comprehensive interpretation of the condition of the sustainability of the economic activity could be made accurately.

### 3. Results and Discussion

In general, the farmers do not know the difference in the definitions of *sawah surjan*, irrigation, rainfed or conventional paddy fields. But they encounter different problems in farming practices in dealing with extreme weather conditions in the normal rice fields, which directly affect crop yields. When it rains, the normal paddy fields are waterlogged, and when there is a dry spell, they rely on wells and irrigation canals. But for the *sawah surjan* farmers, however, there is no specific significant problems that hinders their performance.

The commodities they usually grow are rice, maize, pepper, *kangkung* (*Ipomoea Aquatica*), mustard greens, amaranth, melon etc. Harvest time is uncertain, depending on the weather. The farmers prefer to plant according to their needs, and market demand adjusts itself to the climatic conditions but on average harvest happens a minimum of two times a year for all commodities.

The side job that they do is generally as laborers with a minimum daily wage of Rp 40,000. This is because their earnings from farming are insufficient to meet their basic necessities of life by household standards. Savings that could serve as reserve funds in a financial predicament are lacking. Their condition can be described as subsistence farming. Specifically for manpower, they prefer to employ their own children rather than hiring other people outside the households with daily wages. Apart from being economical with expenditure, they hope that their children will function as a succeeding generation who can continue the agricultural activity. Supporting tools for their mobility in agricultural activity are bicycles and motor-cycles, which have an effect on their productivity. The planting pattern is not done successively as they are heavily reliant on the weather conditions. When widespread flooding occurs, the farmers cannot cultivate anything at all. Flooding occurs in the period of September to January. The dry season occurs from May to September, which is an appropriate time for the farmers to plant various kinds of *palawija* (second crops). This fieldwork coincided with the farmers' planting time, so that many of them began clearing their farmland, ploughing, fertilizing, scattering seeds and drawing water for watering plants and fertilizing. The constraint they encounter is when there is an attack of plant disease and weeds: they generally weed manually or just let it as it is. However, there are also farmers who are efficient by spraying the plants with chemical substances. Farming tools generally used are hoes, sickles, buckets, and baskets, as

well as water-pumps and tractors (owned by farmers who have a larger size of land). The average cost can reach IDR 4,000,000 per year, but afterwards the cost for maintenance of plants is about IDR 2,000,000 per month.

Fertilizers used are mostly a mixture of animal manure and chemical fertilizer. The farmers use about 150 kilograms of fertilizer per annum for a land size of 1,000m<sup>2</sup>. Pesticides are also used to increase productivity of the farmland. Availability of water in the dry season poses a problem, particularly if the construction of the *JJLS* and the new international airport (NYIA) cuts across the irrigation canals. These projects are deemed unfavorable by some farmers, but some others feel that they will benefit from the soaring prices of land. The farmers have networks and their own ways of marketing their crops. Unfortunately, Depok village does not as yet have *KUD* (village cooperative) or *BUMDes* (villages-owned corporation) that provides a place for the accumulation of products, so that what they can do is marketing directly to the wholesale market, stalls, or traders.

In conclusion, to measure the sustainability of the *sawah surjan* system there is a need to further examine the three dimensions of sustainability. Its sustainability is reflected in the fact that the farmers are able to meet their necessities of life, to maintain the local wisdom for generations in the management of farmland, and to pay attention to the environment. The system has been known to people as one that gives an economic advantage because land can be utilized for two or more types of plant. It is a strategy to cope with the rainy season and minimize a possible crop failure, thus making it more effective and productive. Food diversity is the main aim of an area in fulfilling the needs of its villages, and so much the better if it is able to meet not only its own need but also the needs of other areas, thereby creating mutually profitable interactions among the areas in the regency.

Table 2. Recapitulation of the Values of the Sustainability Variables, Practice of *Sawah surjan* Agriculture in Depok Village, Panjatan Sub-district, Kulonprogo Regency, 2017.

| Sustainability Components   | Percentage |
|---|------------|
| Utilization of organic fertilizers                                | 92.7       |
| Traditional weed control  | 14.6       |
| Disuse of pesticides  | 22.0       |
| Disuse of chemical fertilizers                                    | 7.3        |
| Cultivation by intercropping                                      | 31.7       |
| Use of manpower from outside households                           | 22.0       |
| Orientation to use of agricultural commodities                    | 90.2       |
| Sufficient earnings from agriculture                              | 51.2       |
| Ability to save from production surplus                           | 26.8       |
| Percentage of expenditure on food against provincial minimum wage | 45.0       |

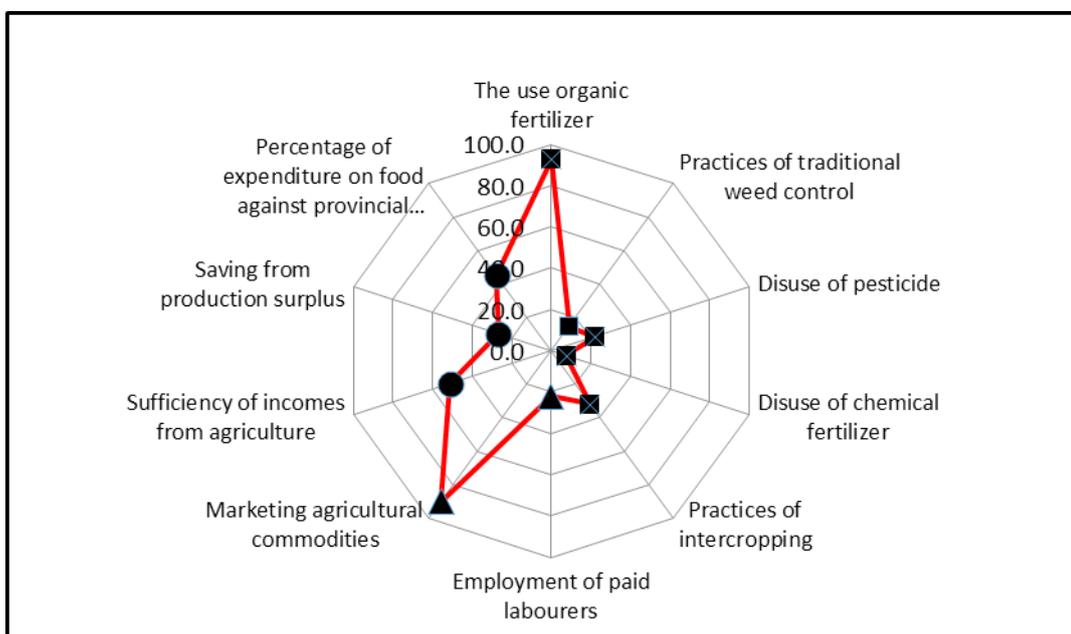


Figure 2. Relative positions of Sustainability Components of *Sawah surjan*.

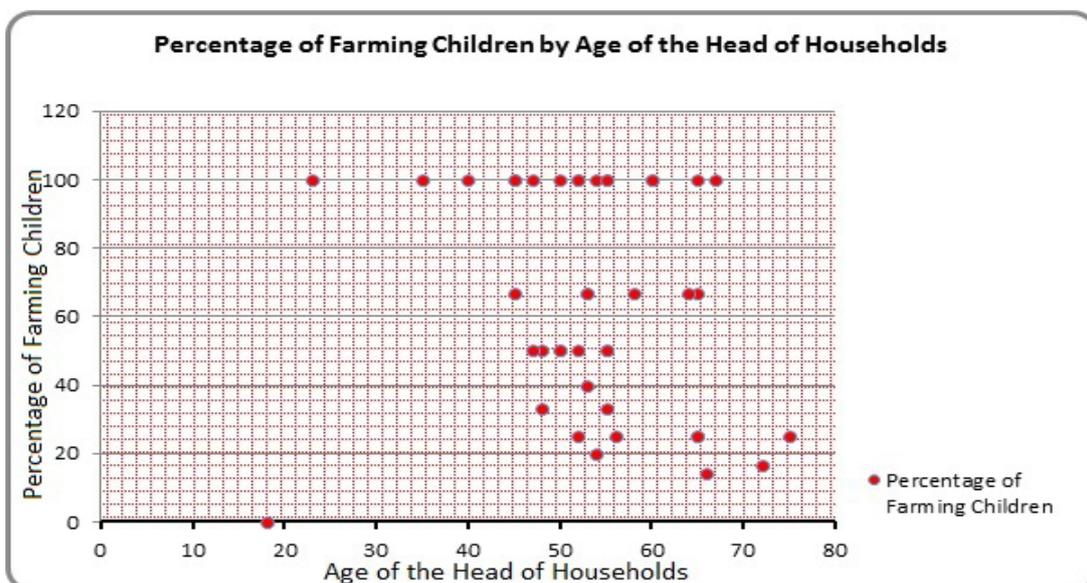


Figure 3. Regeneration Slowdown of *Sawah surjan* Farmers in Depok in 2017.

In this research the sustainability of the *sawah surjan* systems are measured by three complementing dimensions, namely as a production system that is able to meet the communities' needs, is ecologically safe, and socially equitable. From the three dimensions it is apparent that the *sawah surjan* system is valuable as a system that provides employment opportunities and food commodities for everyone. More than 22 percent of households have reported that they have given jobs to other people, and more than 90 percent of households have marketed their merchandise to fulfill the local market demand, which means that the various agricultural products from *sawah surjan* are consumed by the surrounding communities, thereby contributing to food availability in the food security systems. Likewise, in the context of small-scale agricultural area, the percentage of households with more than 20 farmlands can be categorized as quite high.

The high level of welfare is shown by the number of respondents who report that earnings from *sawah surjan* are sufficient for their livelihood (51.2 percent) and some respondents (26 percent) say that they obtain surplus from the agricultural production and are able to save from their earnings. The ability of the *sawah surjan* system to support the rural communities' welfare is also reflected in the considerable contribution of earnings from *sawah surjan* to meet the basic needs, as represented by the local provincial minimum wage. Almost half (45 percent) of the households report that earnings from *sawah surjan* can be used to meet their basic needs. The production level that can be reached by the system is currently reached by the deployment of traditional agricultural input and several types of modern input, signifying that the agricultural practice of *sawah surjan* is extremely concerned with the farming methods that are in harmony with nature, but are also combined with input intensive agriculture. Nevertheless, in practice there are still many elements of this system that are not conducive to sustainable agricultural activity. Table 2 shows in detail the data that show this fact. It also depicts comprehensively

the dimensions of the sustainability of *sawah surjan* in the research location.

The use of organic fertilizers is one outstanding characteristic in *sawah surjan* agriculture: almost all households (92.7 percent) in this village apply the use of organic fertilizer, thus minimizing the use of chemical fertilizers (7.3 percent). About 31.7 percent of households practice intercropping, which ensures the availability of various commodities all the year round, and at the same time serves as a safety valve in case of a crop failure of one of the commodities. There are less favorable situations from the point of view of sustainability of *sawah surjan* agriculture, i.e. the use of chemical fertilizers by more than 90 percent of the households, the use of pesticides by almost 80 percent and about less than 14.6 percent who use the traditional technique of weed eradication in the research areas. In summary, one can say that on the one hand the farming method in the research areas shows the practice of sustainable agriculture but at the same time it also shows the practice of unsustainable agriculture. The level of production reached at the present time is a combination of an engagement in farming that is in harmony with nature and at the same time an engagement in farming that does not accord with nature.

Figure 2 shows the composition of the achievement of the practice of sustainability agriculture in *sawah surjan*, which comprises the aspects of sustainability, namely the ecological, economic, and social dimensions. When considered as a whole the ideal sustainability of *sawah surjan* can be reached if all the variable components approach the figure 100 percent or are situated on the outlying parts of the diagram. The facts at present, however, are that most of the components identified are still at the lower figures. Since the *sawah surjan* system has been agreed on as an element of the special status of the stretches of land in YSP there is a need for efforts to legitimize this consensus so that there is a strong legal basis for the preservation of *sawah surjan* as part of the local cultural heritage.

Most of the *sawah surjan* in YSP still belong to the category of the area of agricultural cultivation in the Regional Spatial Plan (*Rencana Tata Ruang Wilayah* = RTRW) at both provincial and regency levels. This means that the spirit to maintain the existence of *sawah surjan* land as a form of local wisdom should begin with a specific designation as an area that must be protected especially in the more detail spatial plans under the provincial spatial plan. The best opportunity to do is when there is a review or reassessment RTRW at the provincial and regency levels. The government at various levels seems to have been aware of the important role of *sawah surjan* and its historical, economic, and ecological positions. At the provincial level, there have been efforts to include *sawah surjan* in one of the aspects of the special administrative status of Yogyakarta. The *sawah surjan* systems are considered to comply with the standard of GIAHS (*Globally Important Agricultural Heritage Systems*) as an international reference for heritage conservation (Dinas Pertanahan dan Tata Ruang DIY, 2016). In this way, preservation and conservation of the function and historical merit of *sawah surjan* can be maintained through various forms of government intervention. Meanwhile, at the regency level, there have been efforts to foster public awareness of the true significance of *sawah surjan* ecologically and economically.

The sustainability of *sawah surjan* agriculture at present is threatened from two standpoints, i.e. (1) regional development that is oriented to urbanization, which exists as its nucleus the international services such as the new international airport, which is likely to convert *sawah surjan* land into non-agricultural land, and (2) the slow regeneration of farmers resulting in the declining intensity of agricultural activity and the attraction of non-agricultural jobs for the younger generation, which sooner or later will emerge in the region. If the two standpoints exist simultaneously, the sustainability of agricultural activity, particularly *sawah surjan* agriculture will be brought to an end. The development of NYIA, which is projected as the nucleus of the new city, is one of the real threats to the sustainability of

*sawah surjan* agriculture. With the development of new localities around the airport, demand for land for urban residential areas will increase dramatically. In this situation, *sawah surjan* will become the third target after backyards and dry fields to be converted into urban residential areas.

The construction of the new airport will be followed by other investments that capitalize on its presence as a gate to the international market. The *sawah surjan* are located within a radius of 4-5 kilometers from the airport, and they are undergoing the threat of conversion. The growth of ancillary facilities of the airport will gradually reach the area of this unique agricultural cultivation. Furthermore, the operators of large-and medium-scale investments from the business world are part of the business operators who will be seeking for land to open new enterprises around the airport. *Sawah surjan* land along with its natural resources that serves as a system that supports primary production is valued very cheaply and will be converted to a new locus of production oriented to non-agriculture.

The change in land use from agriculture-oriented land to non-agriculture is generally an irreversible change and is thereby regarded as a permanent loss from the perspective of primary production. This fact is usually followed by a change in ownership, i.e. from the local community to the business operators that come from outside the affected area, so that this change in land use is often seen as a process of marginalization of the farmers and agricultural activity. The emergence of property transactions within a radius of 4-5 kilometers from the airport location, besides being a positive response to the development of new infrastructure, indicates a speculation in land for residence and other purposes. This has prompted a rise in land prices at a very high level (almost fivefold) in comparison with the condition 2-3 years ago. Price of lands has been increasing tremendously since payment of compensation of lands for NYIA in the early of 2017 (Rijanta, 2017).

Another important factor that threatens the sustainability of *sawah surjan* in the research

location is the delayed regeneration of farmers. Out of 41 interviewed respondents, only 12 household heads can ensure that they have their offspring to carry on farming. However, the majority of household heads with signs of ageing are much less certain about the next generation who are willing to continue working on *sawah surjan*. The clustering of the red dots on the right in Figure 2 shows the slowdown of regeneration in the area. If the second generation after the respondents' are no longer interested in farming, there will surely be a transfer of ownership of *sawah surjan* land. In a situation when land prices are increasingly high, the conversion of ownership and land use will be very likely to happen.

#### 4. Conclusion

The agricultural activity of *sawah surjan* in the research area has a vital role as a provider of employment opportunities for the owners and the farm laborers. Besides, the crop yields are marketed to the surrounding villages, thus contributing to availability fresh foodstuff and at the same time helping to improve food security at the local level. Farming that is in harmony with nature is much practiced rather than using modern means of production, which are costly, so that most farmers utilize environmentally friendly substances like organic fertilizers and animal manure. Nevertheless, the current practice at the present time is deemed incompatible with the norms of sustainable

agriculture practices because there is excessive utilization of pesticides and chemical fertilizers to increase production. In conclusion, there exist simultaneously signs of sustainability and signs of unsustainability. A more serious threat come from the dynamics of regional development, which will shift to the development of an urban area with a core of an international airport with all its concomitant effects, which will impinge on the agricultural land of *sawah surjan*. In addition, the regeneration slowdown runs the risk of unsustainability because without new farmers who carry on the *sawah surjan* system, the unique cultural heritage will end up in conversion. A combination of the forces of a spatial transformation with a tendency towards urbanized areas and the delayed regeneration of farmers will concurrently accelerate the conversion of *sawah surjan* land to new uses that are oriented to non-agriculture.

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