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Appraisal of shallot farming sustainability in Brebes Regency, Central Java Province, Indonesia

Dina Martha Susilawati[1*], M. Syamsul Maarif[2], Widiatmaka[3] and Iskandar Lubis[4]

[1]*Natural Resources and Environmental Management, Bogor Agricultural University, Bogor 16680, Indonesia*
[2]*School Bussiness of Bogor Agricultural University (SB-IPB), Bogor 16151, Indonesia*
[3]*Department of Soil Science and Land Resources, Bogor Agricultural University, Bogor 16680, Indonesia*
[4]*Department of Agronomy and Horticulture, Bogor Agricultural University, Bogor 16680, Indonesia*
Corresponding author: dina0603@yahoo.com

Abstract

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Shallot farming in Brebes Regency faces some problems to reach the sustainability. The objective of this study was to analyse index and sustainability status of shallot farming in Brebes Regency. The analysis used modification of Rapfish method by using Multidimensional Scaling that we called RAP-SHALLOT. The analysis of sustainability of shallot farming in multidimensional revealed that shallot farming carried out by farmer was less sustainable with the sustainability index was 46.18. This index was contributed from ecological, technological, and institutional dimension which was in less sustainable category with index as 46.72; 43.24; and 37.52, while the economic and social dimension were fair sustainable with index as 52.99; 50.43. According to attribute leverage analysis showed that from 45 existing attributes, there were 17 sensitive attributes as leverage factor. They were no yield shallot caused by pests, no yield shallot caused of flood occurs, rainfall per year, the use of chemical fertilizers per ha, the capacity of farmer capital, farmer exchange rate of horticulture sub-sector, prices fluctuations, inter-cropping plants, time allocation, shallot management system, time of fertilization, application of fertilization, integrated pest management, the existance of agricultural extension, the initial capital of shallot farming, the existance of broker/middleman, and farming main partner. Government intervention is needed to improve the performance of sustainability by prioritizing the sensitive attributes in ecology, technology and institutional dimensions that were categorized as less sustainable to be fair sustainable, while the economic and social dimensions which was categorized as fair sustainable should be developed well for getting a balancing and integrated sustainability.

Keywords: attribute; dimension; shallot farming; sustainability

Introduction

One of the horticultural strategic commodities is shallot (*Allium ascalonicum* L.) that share to the national inflation in 2015 of 0.14 percent (CBS, 2016). Inflation is impacted from the high public demand for the commodity while its availability is disrupted due to the seasonal system of production of this commodity which has an impact on the continuous availability pattern. Shallot farming through the concept of agribusiness takes an important role to the national economy, because it covers various activities from upstream to downstream. Shallot agribusiness has a linkages among of various actors, from small scale individual farmers to large-scale farming and also involves suppliers of production facilities, local traders and wholesalers, even leading to international trades through export and import activities. Sustainable farming is described as a huge issue that it includes the roles of farming in rural communities, the need to protect and conserve the environment, the use of rural land, livestock, development of local food markets, and agricultural needs encourage other sectors such as tourism. Sustainability is described in four pillars, as: (1) economically feasible to create a long-term production systems, refers to build some improvements in crop productivity, (2) the use of technologically appropriate, (3) environmentally sound and sustainable, (4) socially and culturally acceptable and referring to justice, and socially and culturally acceptable (Munasinghe, 1993).

National shallot production from 2011-2015 has an average increase of 11.62 percent, but in 2015 decreased by 0.39 percent compared to 2014. Its production was respectively 893,124 tons; 964,195 tons; 1,010,773 tons; 1,233,984 tons; 1,229,184 tons (CBS, 2016). The largest production contribution for 2015 comes from Central Java Province as 38.33 percent. The largest share to this province is Brebes Regency which share of 66.01 percent to Central Java Province shallot production or 25.30 percent to national shallot production (Information and Data Center, 2016).

The pattern cultivation of shallot farming in Brebes Regency tends to prioritize high production with less consideration in conservation of natural resources and environment. Bahar (2016) mentions how the behavior of farmers shallot cultivation in Brebes Regency still depend on the use of chemical fertilizers and pesticides to avoid excessive harvest failure. The impact of inappropriate use of chemical pesticides is not only on land and water, but also on shallot farmers. Research a study in Wanasari and Brebes sub-districts in Brebes Regency by taking the blood of shallot farmers, which resulted in a decrease in the activity of Acetylcholinesterase (AChE) enzyme in shallot farmers. The decrease of this enzyme activity in farmers due to pesticide poisoning, especially organophosphat and carbamate type which inhibit the acetylcholinesterase activity, resulting in the accumulation of acetylcholine (ACh) consequently causing tremor induction, incoordination, convulsions and others. Las et al. (2006) reported the negative effects of excessive fertilizer use that could contaminate some land, water and environmental resources. Economically, shallot farming when viewed from the ratio of revenue and cost (R/C) value has a value greater than 1 with a profit of 6.83 million (Nurasa and Darwis, 2007) means that economic aggregation is profitable, but this value is still not enough to be used to fulfill the economic needs of the family and for the cost of next planting, especially for labor and seed costs. Barakade et al. (2011) reported that shallot farmers throughout the Regencys of Satara, Phaltan, Khandala, Khatav, Koregaon, Wai, Satara, Patan, Jaoli and Karad Tahsils, showed variable cost components absorbing 91.09 percent and fixed costs 8.90 percent of total production costs. For land preparation of 3.09 percent, seed purchase 6.15 percent, nursery cost 1.13 percent, fertilizer 14.72 percent, pesticides 5.65 percent, 4.77 percent irrigation, 5.06 percent planting labor, weeding and hoeing 3.84 percent, harvesting and storage 6.67 percent, other maintenance 1.71 percent, interest on variable costs 3.75 percent and transportation and marketing costs 34.49 percent of total production costs. The cost of fertilizers and marketing transportation is the largest percentage of all product costs, followed by substantial expenditure on post-harvest components, seeds, and pesticides.

Considering the above conditions, it is necessary to understand the concepts of sustainability to pursue the farming that can fulfill the needs of economic, social community by using environmentally friendly technology and community empowerment so that natural resources and the environment is maintained its sustainability. If we are not aware, it is feared that the natural resources will decline in function, both ecological, economic, social, and cultural functions because natural resources have limitations in the provision of environmental supporting capacity. To achieve a sustainable agriculture, the farmer should be oriented towards a profitable and efficient production achievement process with emphasis on improved management, disease prevention and conservation of soil, water, energy and biological resources (Tathdil et al., 2009).

In this research, we will study on sustainability of shallot farming in order to: (1) analize the index of sustainability of ecological, economic, social, technological, and institutional dimension of shallot farming; (2) identify the sensitive attributes that influenced on the shallot farming sustainability; (3) analize the index and status multidimensional sustainability of shallot farming.

Literature Review

Farming is an activity that uses the production factors in the form of land and surrounding objects as capital to produce a benefit for the surrounding environment. Shavgulidze et al. (2017) states that farming is to be effective if farmers or producers can allocate their resources as well as possible, and is to be efficient if the utilization of such resources produces some output more than inputs. In the farming, there are known the concept of technical efficiency and allocative efficiency. According to Waryanto (2013), technical efficiency will be achieved if farmers are able to allocate the production factors for getting a high production, and if farmers get big profits in the farm, it is said that allocation of production factors efficiently allocative. According to Soekartawi (2006), farming analysis is intended to know: (a) comparative advantage, (b) low of diminishing returns, (c) substitution effect (e) opportunity cost, (f) ownership of business branch (what kind of other crops can be cultivated), (g) the weighing book of destination (good trade off). Farming is expected to be a farming business, not only generate revenues and profits for agribusiness, but also must prioritize environmental sustainability.

Doing farming well, we have to concern about land, availability of seeds, utilization of fertilizers and pesticides. Land is a dominant factor, meaning that the area of land is a guarantee to increase efficiency but increase of land area without followed by improvement of land quality especially on high slope land with high erosion and without conservation, it will decrease both technical and allocative efficiency (Wibowo, 2008). Meanwhile, according to Olpaluwa et al. (2014), to produce technically efficient outputs, we should arrange from balanced inputs between seed, fertilizer and other chemicals used in farming, while Sangurjana et al. (2016) emphasizes the availability of quality seeds.

Generally, some producers of shallot seeds in production centers are usually from farmers who have a relatively large scale of business or individual farmers who keep aside some of the crop to be used as seeds of the next planting season. The diversity of knowledge and technology of seedling developed in the system, causing the variation of the quality of seeds. One effort to increase the production of red shallot seed is by arranging the planting spacing (15 cm x 20 cm) and applying a potassium fertilization of 200 kg/ha as the optimum dose for vegetative growth of shallot (Mariawan et al., 2015). For fertilization, we have to concern in the use of doses of inorganic fertilizers where generally the application of doses is very different when compared with recommended doses. The use of inorganic fertilizers in high concentrat actually has the high potential to pollute the environment. Las et al. (2006) reported the negative effects of excessive fertilizer use that could contaminate some land, water and environmental resources, and also mentioned that N-fertilizer residues of nitrates (NO_3) have polluted some water resources, both irrigation and ground water (wells), even agricultural products. Pesticides also need special attention. Harsanti et al. (2015) stated that pesticide residues on soil and water are positively correlated with pesticide residue content in products in agricultural land in Bantul Regency, Yogyakarta Province.

Shallot farming in Hawaii is classified into three types (Valanzuela et al., 1999). The three types of shallot planting are: 1) short day type, ie shallot planting on an area that has sun exposure 12 hours to 13 hours. This type is also called „European Type" and is not suitable for long-term storage, typically planted in the latitudes 350 down, 2) medium-day type, ie shallots grown on areas with a 13.5 hour-to-14-hour day. This shallot has a soft texture and is sold for the market needs of fresh shallot products, usually growing at altitudes 320 to 380, and 3) long day type, to grow, this type of shallot requires a length of more than 14.5 hours. If attributed to this type, the shallot type in Indonesia tends to be in the short day type.

Materials and Methods

Study area

The research was conducted in Brebes Regency, Central Java Province with the total area of the regency is 1,662.96

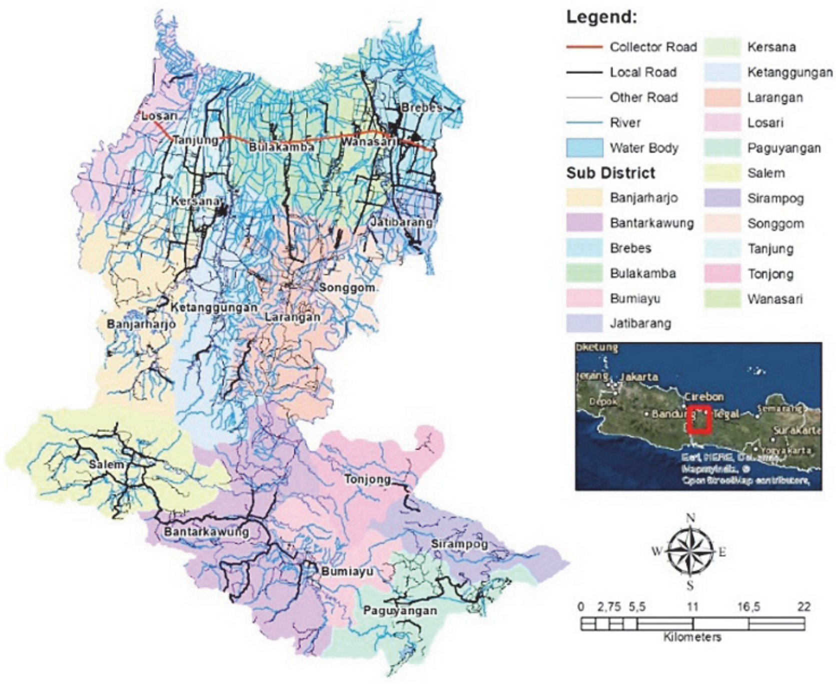

Fig. 1. The map of Brebes Regency, Central Java, Indonesia

km², consisting of paddy fields of 627.03 km² (37.70 percent) and non-rice fields of 1,035.93 km² (62.30 percent). The average amount of rainfall in 2015 is 2,101 mm with the average number of rainy days per month is 9 days. Brebes Regency has a population of about 1,781,379 people in 2015 spread over 17 sub-district and 297 villages with a population growth of 0.51 percent per year. Geographically, Brebes Regency is located at approximately 06054'S and 109002'E (Figure 1).

Procedures

The sustainability analysis is done by using MDS with Rapfish Modification Application that we called Rap-SHALLOT starting with the determination and identification of sustainability attribute on five dimensions, ie ecology, economy, social, technology, and institutional dimension followed by scoring on each attribute. Each dimension has attributes or indicators related to sustainability, as indicated in the FAO-Code of Conduct. The sustainability index scale has a 0-100 percent interval with the category of sustainability status can be seen in Table 1 (Fauzi and Anna, 2005a). The complete stages of sustainability analysis of the research can be seen in Figure 2.

Table 1. Category of sustainability category

Index value	Category
0.00 – 25.00	Poor, unsustainable
25.01 – 50.00	Less, unsustainable
50.01 – 75.00	Fair, unsustainable
75.01 – 100.00	Good, sustainable

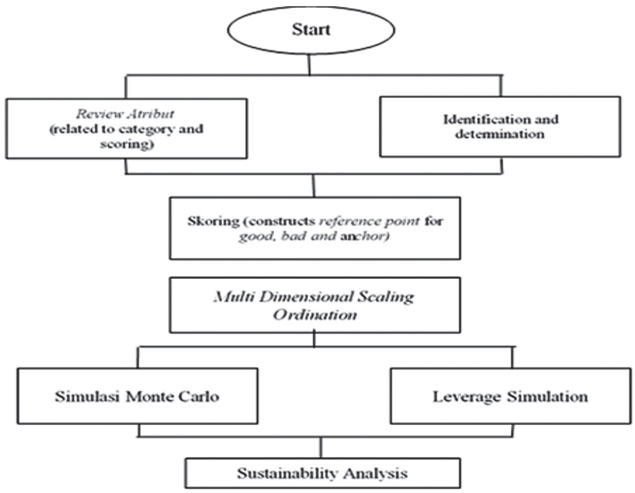

Fig. 2. Sustainability analysis with MDS-Rapfish modification

Method

Rapfish is based on ordination techniques (putting something in order of measured attributes) with MDS which itself is basically a statistical technique that tries to do multidimensional transformations into a lower dimension. Dimensions in Rapfish concern the ecological, economic, technological, social, and institutional aspects of sustainability. MDS will map the objects or dots observed in a space, where the same object or point will be mapped close together while the different ones are mapped apart. Multi-dimensional transformations will be made into lower dimensions, and visualize the dots, ordinate and project those points in the extreme line between bad and good with a scale of 0 to 100 percent. In addition, in this RAP-Multidimensional ordination technique there is sensitivity analysis (laverage analysis) to determine the level of significance of the effects of each attribute on sustainability or to see the sensitive variables that affect sustainability and Monte Carlo analysis to take into account the uncertain aspects (Fauzi and Anna, 2005b).

Each attribute in each dimension is given a score that reflects sustainability. This score shows good and bad values. Good values reflect the most favorable conditions while bad values reflect the most unfavorable conditions. Between these two extreme values there is one or more values between depending on the number of ratings on each attribute. The point or object configuration in the MDS will be approximated by regressing the Eucledian distance (dij) by the Least Square Method by the Alternatif Least Square Scaling (ALSCAL) technique. ALSCAL stress is a measure of error (Lack of fit or error). The smaller stress value will give an indication that the smaller error between the distance and the similarity value of the space presented. Goodness of fit in MDS is reflected from the calculated value of S-Stress. A low stress score indicates good fit (stress <0.25), while a high S value indicates the opposite (stress> 0.25).

The sensitivity analysis in this study was conducted to see which attributes are very dominant or sensitive to influence sustainability compared to other attributes. This sensitivity analysis is done using attribute leveraging to see the change of MDS analysis result by looking at root mean square (RMS). The Monte Carlo analysis is performed in order to evaluate the effect of the error by guessing a certain statistical value. The Monte Carlo analysis results show a small value difference between the sustainability index value of MDS and Monte Carlo at 95 percent confidence interval.

Results and Discussion

Ecological Sustainability of Shallot Farming

RAP-SHALLOT analysis showed that the index sustainability for ecological dimension is 46.72, which can be

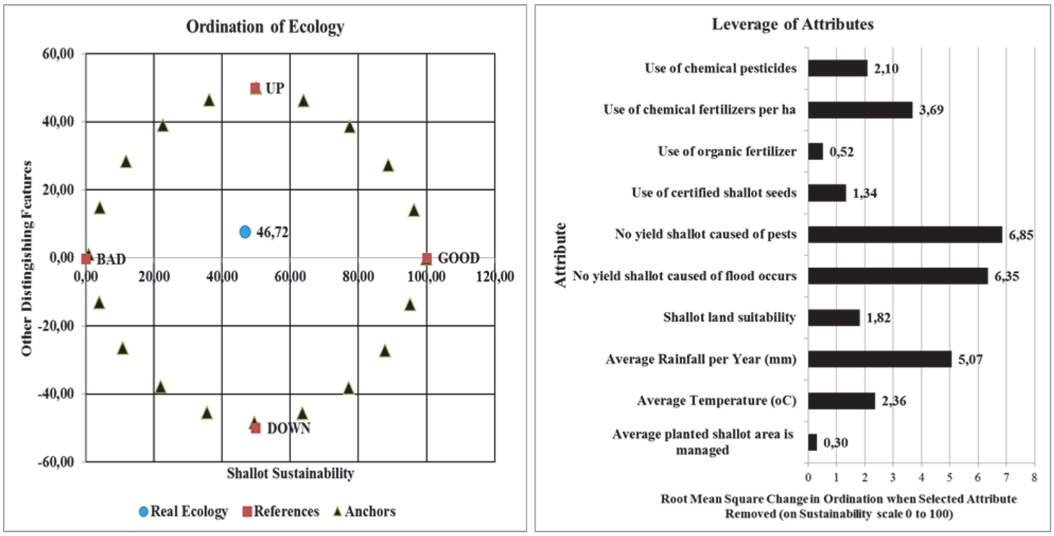

Fig. 3. Sustainability index and leverage score of ten ecological atributes on ecological sustainability

categorized as less sustainable. Sustainability index of ecological dimension and sensitive atributes of farming system is shown on Figure 3. The sensitive attributes in determining the shallot sustainability are : a) no yield shallot caused by pests (RMS = 6.85); b) no yield shallot caused of flood occurs (RMS = 6.35); c) average rainfall per year (mm) (RMS = 5.07); d) use of chemical fertilizers per ha (RMS = 3.69).

Economic Sustainability of Shallot Farming

RAP-SHALLOT analysis showed that the index sustainability for economic dimension is 52.99, which can be categorized as fair sustainable. This dimension is still quite good, but need to be aware especially in production costs and production results, it can lead to get a fluctuation price for down stream as well for up stream products. Sensitive attributes that affect the sustainability of shallot farming are : a) the capacity of farmer capital (RMS = 7.00); b) farmers exchange rate of horticulture sub-sector in Brebes Regency (RMS = 6.10); c) price fluctuations (RMS = 5.77); and d) inter-cropping plants in farming (RMS = 5.55). Sustainability index of economic dimension and sensitive atributes of farming system is shown on Figure 4.

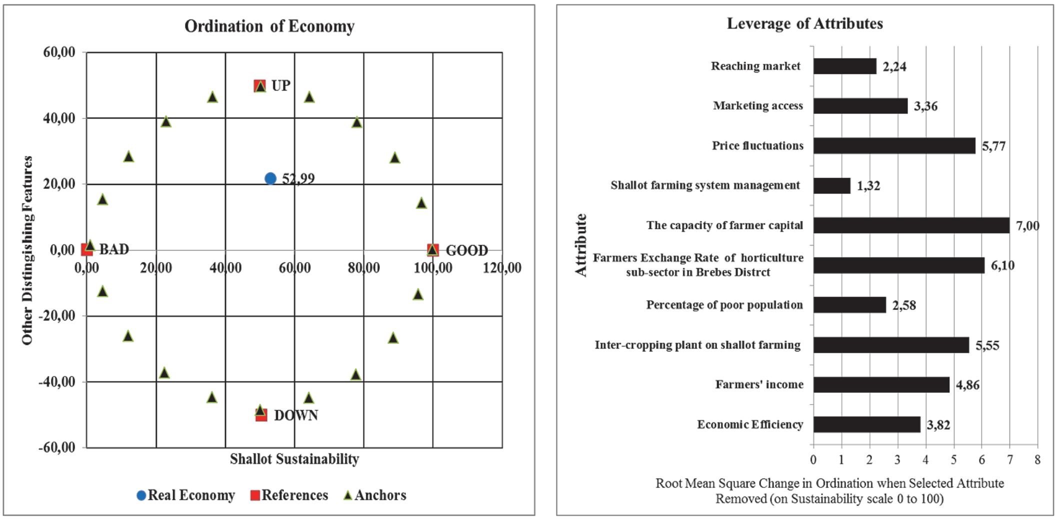

Fig. 4. Sustainability index and leverage score of ten economic atributes on economic sustainability

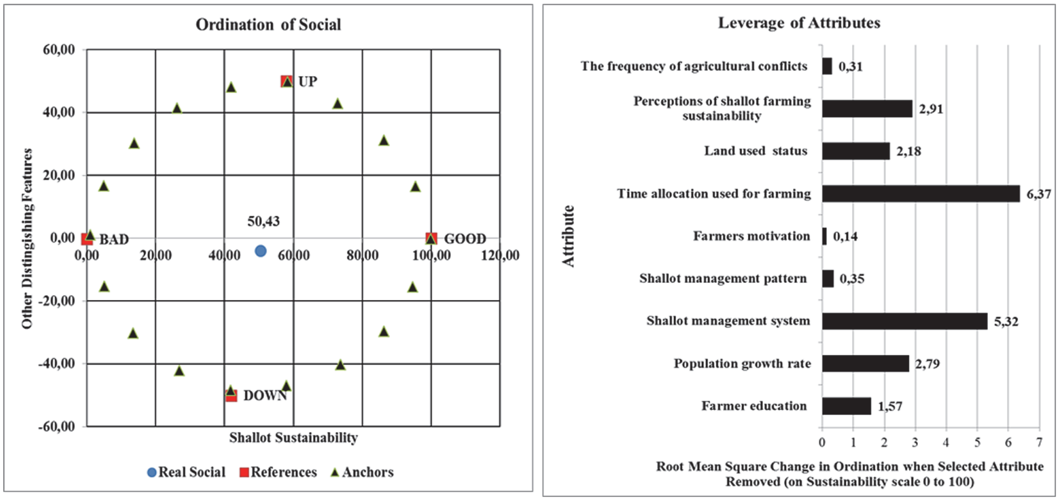

Fig. 5. Sustainability index and leverage score of nine social atributes on social sustainability

Social Sustainability of Shallot Farming

RAP-SHALLOT analysis showed that the index sustainability for social dimension is 50.43, which can be categorized as fair sustainable. This means that the sustainability of this dimension is still socialy quite good, though it is almost close to the less sustainable category. They are 2 (two) sensitive attributes that influence sustainability based on leverage analysis. They are time allocation used for farming (RMS = 6.37) and shallot management system (RMS = 5.32). Sustainability index of economic dimension and the sensitive atributes of farming system is shown on Figure 5.

Technological Sustainability of Shallot Farming

RAP-SHALLOT analysis showed that the index sustainability for technological dimension is 43.24, which can be categorized as less sustainable. Sensitive attributes that influence sustainability in technological dimension based on leverage analysis are: a) time of fertilization (RMS = 5.06); b) application of fertilization (RMS = 4.57); and c) Integrated Pest Management/IPM (RMS = 4.27). Sustainability index of economic dimension and sensitive atributes of farming system is shown on Figure 6.

Institutional Sustainability of Shallot Farming

RAP-SHALLOT analysis showed that the index sustainability for institutional dimension is 37.52, which can be categorized as less sustainable. Sensitive attributes that affect the sustainability of shallot farming are : a) the existance of agri-

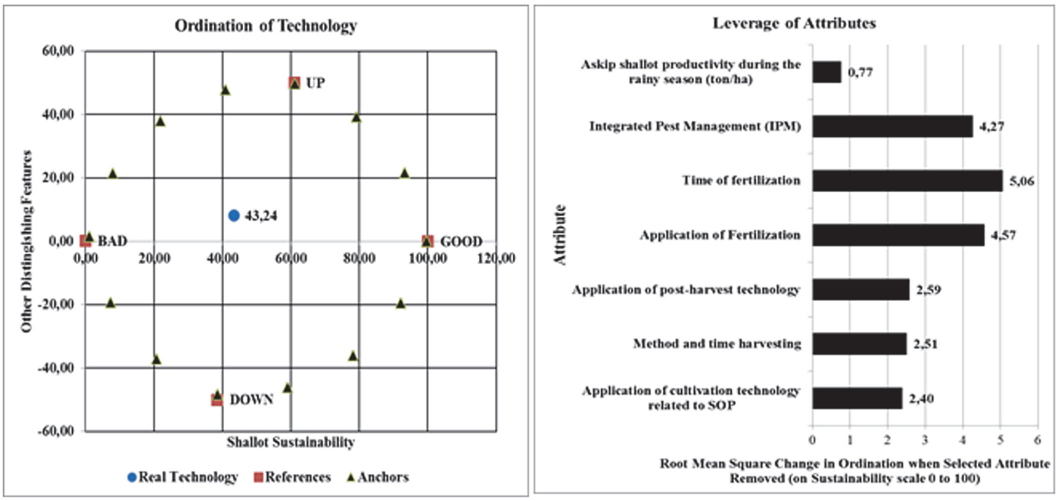

Fig. 6. Sustainability index and leverage score of seven technological atributes on technological sustainability

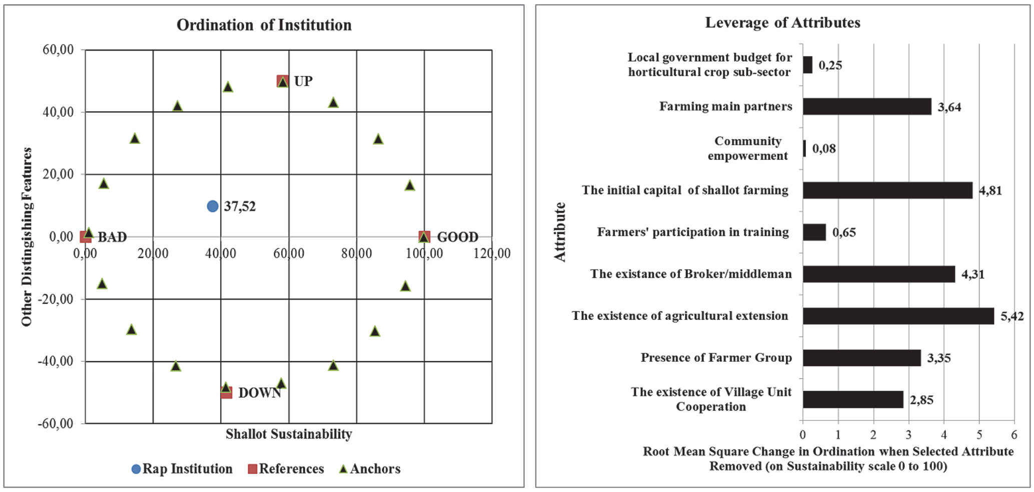

Fig. 7. Sustainability index and leverage score of nine institutional atributes on institutional sustainability

cultural extension (RMS = 5.42); b) initial capital of shallot farming (RMS = 4.81); c) the presence of intermediary trader/ middleman (RMS = 4.31); and d) farming main partners (RMS = 3.64). Sustainability index of institutional dimension and sensitive atributes of farming system is shown on Figure 7.

Accuracy of Analysis (Goodness of fit) and Level of Trust (Monte Carlo)

The statistical accuracy can be seen from the value of Stress in each dimension and the coefficient of determination R^2, whereas the validation or trust level is indicated by the difference of the ordinance value of MDS and Monte Carlo results indicating the level of occuracy analysis. Statistical parameters such as the value of stress, coefficient of determination R^2, and the difference of ordination and Monte Carlo values in each dimension can be seen in Table 2.

Multidimensional Sustainability of Shallot Farming

Rap-Shallot multidimensional analysis showed that shallot farming in Brebes Regency is 46.18. This value can be categorized as less sustainable. The value of the multidimensional sustainability index is based on an assessment of the 45 attributes that are included into five dimensions, ie: the ecological dimension (10 attributes), the economic dimension (10 attributes), the social dimension (9 attributes), the technological dimension (7 attributes), and institutional dimensions (9 attributes). Kite diagram of five dimensions showing status score of shallot faming sustainability can be shown in Figure 8.

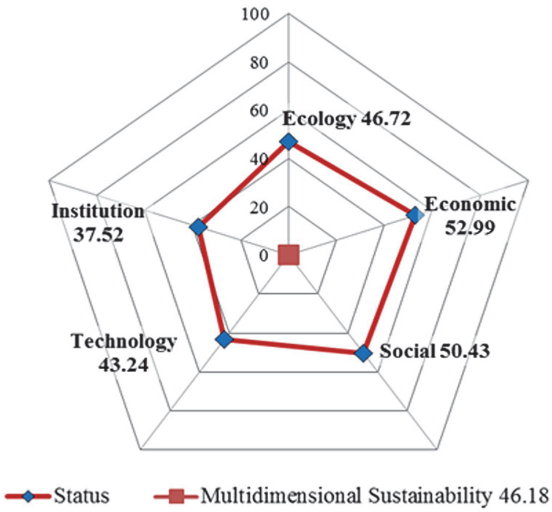

Fig. 8. Kite diagram of five dimensions of shallot faming sustainability

Table 2. Statistical parameters on shallot farming sustainability in Brebes Regency

Dimensi	MDS	Monte Carlo	Differences	Stress	R^2
Ecology	46.72	47.04	0.32	0.1344	0.9473
Economic	52.99	52.90	0.09	0.1343	0.9497
Social	50.43	50.15	0.28	0.1356	0.9473
Technology	43.24	43.54	0.30	0.1524	0.9414
Institution	37.52	38.39	0.58	0.1393	0.9494

Discussion

Based on result from ecological sustainability, these atribut sensitive have some linkages to each other. No yield shallot caused by pests and floods have a link with high rainfall in Brebes Regency. Some insects and diseases have got some explosions and pressures during certain seasons. Generally disease attacks will occur in the rainy season (high rainfall) while insects attacks in the dry season (DOA-FHC, 2011). This is caused in the rainy season, air humidity is higher than the dry season so that the intensity of disease attacks is higher. While in the dry season, air temperature is higher than the rainy season so that the intensity of insect attacks is higher than the intensity of disease attacks. Therefore, productivity in the rainy season is getting decreased and then production also decreases. That implicate to fluctuation of price. Pest attaction can be controlled by management of farming through adjusting to the month of planting. Generally farmers will plant some rice farming at the beginning of the rainy season, then just turn to shallot farming with monoculture or inter-cropping patterns. If the farmer cultivates shallot at high rainfall, the tubers shallot will get rotten and cause some disturbing in the vegetative phase of the plant. In addition, during the rainy season, high pest attacks will cause a high production costs so that the break even point (BEP) value in farming analysis is also higher compared in the dry season (MOA, 2015).

Shallot farmers in Brebes Regency generally use the seeds of Bima Brebes varieties, whereas based on the results of research Ambarwati and Yudono (2003) mentioned that this varieties adapt ugly and sensitive to environmental changes and impact to the shallot productivity. Therefore, need to observe and consider the agroclimate conditions when doing farming. The treatment of chemical fertilizer is also important in the cultivation of shallot farming. Napitupulu and Winarto (2010) mentioned that the application of fertilizer technology can increase the production of shallot of 64.69 g/clump with the application of fertilizer N 250 kg/ha and K 100 kg/ha that increase the number of tillers per plant, the number of tubers, wet bulb weight , and provide high production on shallots. To improve the status of sustainability of shallot farming in the ecological dimension, setting of the plant management system should be done and increasing the capacity and competence of onion farmers.

Related to economic sustainability, capital is the significant and important thing for shallot farming, caused shallot farming has needed the high production cost, especially in the use of seed as input production and labor. Based on MOA (2015), the capital of shallot farmers in Brebes Regency is mostly sourced from agricultural equipment shops or broker with harvesting system, profit sharing system, and banks. The harvesting system is a loan system provided by the owner of a farming facility or a dealer who is also sometimes a middleman. Loans are provided by facilitation of agricultural inputs with prices that have been raised 10-20 percent of the cash price. Payments are given by the cash payment system or the sale of the crop to the owner of the capital by directly deducting the debt from the selling price. The profit sharing system usually occurs between the land owner and the crop keeper after harvesting, the keeper will get a 1/8 part of the gross sales, while the land owner will get 7/8 parts.

Farmer Exchange Rate (FER) is calculated from the comparison between the price received by farmers (FR) to the price paid by the farmer (FP). If the rate of increasing of FR is higher than FP then FER will increase, or vice versa. The movement of FER identifies the movement of farmers‘ welfare level. The concept of FER is developed by CBS calculated from the ratio of prices received by farmers (FR) to the price paid by farmers (FP). This concept can describe the purchasing power of farmers. We used Laspeyres index to calculate the FER, where the index value is weighted against a certain base year quantity and index movement is determined by price movements (NDPA, 2013). On the basis of this assumption, the ratio of prices received by farmers to the price paid by farmers is used as an indicator of the purchasing power of farmers‘ income on their expenditures, and the indicators are used as indicators of the welfare of farmers. The FER indicator built by CBS has a national analysis unit and is an aggregation of provinces and sub-sectors/commodities. Besides we know the purchasing power of national farmers, can also know and compare the purchasing power of farmers between provincial regions and between subsectors. The value of FER of horticulture subsector in Brebes Regency for 2015 is 101.9 which is higher than national FER of horticulture subsector. This means that the value of the price received by horticultural farmers in Brebes Regency is better than the national average with the largest contributor to horticulture is the commodity of various chili and shallot. To enhance the sustainability of shallot farming in economic dimension should be supported by strenghtening capital institution as a source of capital of farmers and price stabilization so can provide sufficient income to shallot farmer.

Generally, farmers in Brebes Regency do full-time farming, but the management system is still more focused on achieving high production targets with less attention to good cultivation techniques according to GAP and SOP of shallot in both cultivation and seed processing. Farm management system still tends to use conventional system, with the pattern that has been passed down from generation to generation so that the local knowledge of farmers in conducting cultivation activities adapted to the condition of the land and the environment to be planted. For example in shallot seed breeding, conventionally, farmers breeder of shallot seeds do seed selection by observing healthy planting during cultivation, choosing varieties that have not been mixed with others and not detected to plant pests and diseases, form of healthy tubers, pithy and fresh. Seed can also be obtained by setting aside part of the harvest after the drying process for 3-5 days, then stored in seed storage for three months. There are also farmers who deliberately keep aside some plant areas to be specially prepared as a seed by extending the planting period until the age of 70-80 day after planting and tuber size reaches the size of about 5-10 grams with healthy and strong conditions. Or if not done, the farmers get the seed from the shallot farmers around Brebes are considered appropriate and quality, so there was a purchase of seed among farmers/traders (jabal seed system).

The sustainability of technology is categorized as less sustainable. This means, although the development of agricultural technology related to shallot cultivation is growing, but in Brebes Regency, this utilization does not get a high response from the shallot business actors because it prioritizes local customs patterns (local wisdom) in the utilization of resources so that the application of technology is only as a demonstration plot or study oriented. It needs some effort to change the shallot farmers mindset in Brebes Regency to practice the environmentally friendly technology, especially for reducing some fertilizer and pesticide application. This is in line with the status of sustainability in social dimension which has sensitive attribute of shallot farming management system (conventional system). Farmers generally understand a good cultivation technology according to GAP/SOP but are unconscious to implement it.

Farmers generally use inorganic fertilizers and rarely use organic fertilizer as a basic fertilizer. The time and dose of fertilization is generally adjusted to the condition of the cropping with the dosage of NPK 300 kg/ha, ZA:100 kg/ha, then the next fertilizer given the plants aged 10-15 days after planting with dose NPK 250 kg/ha, ZA:150 kg/ha, then ended with second fertilizer at age 30 days after planting with dose of NPK 250 kg/ha and ZA:150 kg/ha. But this dose and time is adjusted to the climatic conditions and the amount of rainfall and plant growth conditions.

Pest control generally uses chemical pesticides. Farmer behavior in the use of pesticides is mainly influenced motivation to avoid crop failure due to pests and diseases earlier, even the utilization tends to pay less attention to the time and dose of pesticides. Despite the socialization and introduction of pest control models with environmentally friendly techniques, for example with the concept of Integrated Pest Management (IPM). The Ministry of Agriculture has issued Regulation of the Minister of Agriculture No.48/2009 on Good Fruit and Vegetable Cultivation to produce safe and good quality products that are produced in an environmentally friendly practices and conservation of natural resources so the products have food security and competitiveness. IPM system was introduced to reduce the use of chemicals in pest control (MOA, 2015) such as sex pheromone, light trap. Sustainable agriculture systems are a long-term goal of IPM with high achievement of production goals, quality products, protection and enhancement of land, water and other resources, development of a prosperous village economy and a better life for farming families and agricultural communities. The concept of IPM is a further development concept through the 21st Earth Summit agenda in Rio de Janeiro in 1992 and FAO. The purpose of IPM technology is to limit the use of synthetic insecticides by introducing the concept of economic threshold as the basis for determining pest control. This approach encourages the replacement of chemical pesticides with alternative control technologies, which use more of biological materials and methods, including natural enemies, biological pesticides, and pheromones. In this way, the negative impacts of pesticide use on health and the environment can be reduced. However, until now, the concept of IPM is not in line for both farmers and officers and generally the implementation of IPM is implemented only for one planting season, not throughout the farming year so that the impact to agro-ecosystem less sustainable.

In institutional sustainability, the existance of agricultural extension is considered to be very important, especially in assisting dissemination of agricultural technology information equally and in accordance with the needs of farmers, empowerment and independence of farmers/farmer groups/association, helping farmers access to financial institutions, establishing business partnerships between farmers and business actors/stakeholders related (Sunartomo, 2016).

The shallot marketing in Brebes Regency has a relatively long chain marketing. The dependence of farmers to the middlemen/broker is still high. Farmers is difficult to market their goods without going through these middleman because the farmers feel secure if the goods are marketed by them although price differences between at the farm level and at the consumer level are still quite high. According to Nurasa and Darwis (2007), the high price difference between farmer and consumer indicated that the price is not transmitted properly to farmer level, so farmers still get a small and fluctuating price. This condition is consequenced of the weak bargaining position between farmers as producers and middleman/broker.

According to Rosyadi and Purnomo (2014) mentioned that the farmer share to various levels of marketing institutions in sequence is 81.63 percent in collecting traders/broker/middleman, 75.83 percent in Klampok Market in Brebes, 66.06 percent in wholesalers, 56.62 percent in traders retailers Kramat Djati Market in Jakarta, 54.13 percent in the retail market, and 38.10 percent in supermarkets or it can be said that high prices at retailers and supermarkets did not have a significant impact on profits earned farmers.

The accuracy of analysis which is shown in Table 2 shows that the stress value of all dimensions in shallot farming sustainability analysis is less than 25 percent and the coefficient of determination R^2 is close to 1. It is indicating that all attributes in each dimension are good enough to explain the sustainability of the farming and the prediction model of sustainability is appropriately to be used (Pitcher and Preikshot, 2001). The calculation result of MDS ordination value and Monte Carlo analysis has value less than 5 percent meaning confidence level of sustainability index value at each high dimension with 95 percent confidence interval. This indicates that the error in making scores of each attribute is relatively small, the variation of scores from expert judgement are relatively small, error data entry and data loss can be avoided, and repeatly analysis is stable. From this statistical parameters, we can determine that the shallot farming sustainability in Brebes Regency has high levels of trust and certainty.

The multidimensional value of shallot farming sustainability in Brebes Regency is categorized as less sustainable with index 46.18 This value was contributed from ecology, technology and institutional dimension which is in less sustainable category with index as 46.72; 43.24; and 37.52, while the economic and social dimensions are fair sustainable with index as 52.99 and 50.43. Government intervention is needed to improve the performance of sustainability by prioritizing sensitive attributes on the three dimensions that are categorized as less sustainable and increasing to be fair sustainable. Some improvement are supported by decreasing some losses due to pest and flood, observation of annual rainfall associated with the pattern and time of planting, setting the use of time and techniques of fertilization, improvement of IPM in pest control management, increasing the role of agricultural extension, facilitation some access for acquiring initial capital, increasing the role of government farming partners so that the role of intermediary traders/middlemen can be reduced .

For dimension categorized as less sustainable (economic and social dimension), should take a high performed improvement so sustainable category is getting higher become good sustainable . Efficiency of intervention can be done on the sensitive attributes by facilitating some incentive and capital farming, stabilization and increasing the farmer exchange rate, stabilization of shallot price especially on religious special days where demand is increasing, enhancing of inter-cropping plants in order to increase farmer income, optimization of time farming allocation, and strenghtening a system revitalization management of shallot farming.

Conclusion

The multidimensional value of shallot farming sustainability in Brebes Regency is categorized as less sustainable with index 46.18. This value is main sourced from ecology, technology and institutional dimension which is in less sustainable category with index as 46.72; 43.24; and 37.52, while the economic and social dimensions are fair sustainable with index as 52.99 and 50.43.

Leverage analysis results showed that from 45 existing attributes, there were 17 sensitive attributes which influence on the shallot farming sustainability index, such as no yield shallot caused by pests, no yield shallot caused of flood occurs, rainfall per year (mm), the use of chemical fertilizers per ha, the capacity of farmer capital, farmer exchange rate of horticulture sub-sector, prices fluctuations, inter-cropping plants in farming, time allocation used for farming, shallot management system, time of fertilization, application of fertilization, integrated pest management, the existence of agricultural extension, the initial capital of shallot farming, the existance of broker/middleman, farming main partner.

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