

**STATUS OF AGRICULTURE RESOURCES SUSTAINABILITY AND
AGRICULTURAL POLICY IN DENPASAR CITY,
PROVINCE OF BALI, INDONESIA**

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ABSTRACT

Denpasar City as the capital city of Bali Province-Indonesia, is the second largest city in Eastern region of Indonesia. The rapid development of the tourism industry has made Denpasar City as the center of Bali Province's business activities. The conversion of agricultural land is still a serious problem, especially related to the development of agricultural potential in urban areas. This condition certainly requires special attention so that it does not become a threat to the sustainability of agriculture and the lives of the people of Denpasar City. One solution to maintain agricultural activities in conditions of limited agricultural area in urban areas is through a sustainable urban agricultural development approach. Urban agriculture is oriented towards the realization of the ease of fulfilling daily food needs for urban communities. In addition, the urbanization of Denpasar City is so high, thus there was a conversion of agricultural land into residential areas and other purposes to support tourism. The aim of this research was to analyse the status of agricultural resources sustainability and formulate a strategy for sustainable agricultural policy in Denpasar City. The analysis used the Rap-Ur-Agri ordinance method (Rapid Appraisal for Urban Agriculture), the Multi-Dimensional Scaling (MDS) method and prospective analysis. The results showed that the ecological and economic dimensions were in a less sustainable status, while the social, institutional, and technological dimensions were in moderate sustainable status. Policy strategies to support the sustainability of the agricultural sector in Denpasar City include: (a) maintaining productive rice fields and arranging potential home gardens as an alternative to urban farming development; (b) maintaining the safety and security status of production land through flood prevention and control efforts; (c) designing and developing land-saving urban farming models with clean products; (d) providing subsidies and incentives for farming; (e) developing urban agriculture by using environmentally friendly technology; (f) strengthening of agricultural extension institutions; and (g) developing the implementation of the Sustainable Food House Area Model. The recommendations for agricultural sustainability in Denpasar City were maintaining productive rice fields, arranging the yard of the house as an alternative to be development of farming and preparing workers for agricultural sector, especially the young generation (millennial).

Key words: agriculture, Bali, Denpasar, house yard, land conversion, policy, rice fields, sustainable



INTRODUCTION

Based on the area of agricultural land in Denpasar City in 2020, of the 12,778 Ha of land in Denpasar City area, 18.85% (2,409 Ha) was rice field and 3.99% (510 Ha) was non-rice field agricultural land. Since 2005-2016, 4,685 ha of paddy fields have been converted with an average annual reduction of 512,2 ha of paddy fields. The area of paddy fields in Bali Province in 2011 was 80,164 ha, in 2012 it was 79,399 ha, in 2013 it was 78,425 ha, in 2014 it was 76,665 ha, in 2015 it was 75,922 ha, and in 2016 it was 79,526 ha. If this low percentage of agricultural area was not taken seriously, it was predicted that the current agricultural area will continue to decrease sooner or later. The decrease in agricultural area in Denpasar City was mainly due to the resident's urbanization to Denpasar City, which caused an increase in population, resulting in the conversion of agricultural land into residential areas and other non-agricultural uses such as business, industrial and service areas [1,2].

The conversion of agricultural land is still a serious problem, especially related to the development of agricultural potential in Denpasar City area. The conversion of agricultural land in Denpasar has occurred since 2007-[3,4]. This condition was due to the development of tourism sector, urban infrastructure and spatial planning in Denpasar. Furthermore, the determination of South Denpasar and East Denpasar Sub-districts as City Green Open Spaces (CGOS) in Denpasar City's spatial planning and territory was able to reduce the rate of rice field conversion compared to the West, East and North Denpasar Sub-districts, which had a high rate of land conversion because they were determined as non-agricultural areas [5].

One of solutions to maintain agricultural activities in a condition of limited agricultural area in urban areas was through a sustainable urban agricultural development approach. The presence of urban agricultural activities also helped to fulfil and increase the area of CGOS. City Green Open Spaces was important to maintain environmental and ecosystem sustainability, improve air quality, increase aesthetic value which leads to an increase in the economic value of the area, amenities as well as a place for sports, recreation and socialization, thus can improve human's physical and mental health-[6,7,8]. Furthermore, socially, green open space can be used as a medium of social interaction in the community such as recreation areas, sports facilities, and/or playgrounds [9]. This green space must have good accessibility for everyone.



Ideally, urban agricultural areas did not only serve as a place to provide food for the city community, but also can become a center for agricultural education activities for the young generation, and become a recreation infrastructure for the entire community of Denpasar City. Agricultural education was the most important goal in agricultural development, because the general tendency of people's thoughts in Denpasar City was to "cut" the farmers' generation in their families. The young generation especially in Bali tended to choose to work in the non-agricultural sector, such as tourism, due to prestige and wage certainty [10]. Furthermore, the decrease in the young generation's interest to farm may be caused by internal factors such as limited land, education, low economic benefits, and limited access to financial support services (capital) for young farmers, while external factors were: family and community support [11]. To increase the interest of the younger generation in the agricultural sector, a design of intensive and structured policy was needed in order to empower the urban farming, therefore, it will have an effect on increasing agricultural production/productivity [12].

In relation to the context of sustainable agricultural development, the fundamental thing that needed to be considered was the agricultural resources themselves. The potential of agricultural resources will determine the development of agricultural development in the future. Thus, carefully identifying the potential of agricultural resources through a scientific approach was very important, because this activity was the first step in formulating the direction of sustainable agricultural development policies. Policy, especially in agriculture itself, is an important topic that needs to be studied from various perspectives [13].

The innovation of this research was to see the development of agricultural resources in Denpasar, studied through their sustainability in the dimensions of ecology, economy, social, institutional/governance and technology. The influence of these five dimensions will be integrated with multidimensional scaling; therefore, sensitive variables will be seen, which must be fixed immediately to achieve sustainability. From the sensitive variables, it can be seen what strategies should be followed up in interpretive structure modelling, to make it easier for policy makers to determine program priorities. The research aims were: 1) Analysing the status of Denpasar's agricultural resources sustainability, and 2) Formulating a sustainable agricultural policy strategy in Denpasar City.

This research uses Multi Dimensional Scaling analysis. The advantage of MDS is that the measurement is based on the scale of the data to be processed. Multi Dimensional Scaling also has several types of solutions, these types are grouped into two groups, namely metric and non-metric. Multi Dimensional Scaling has

been used in various fields [14]. Research conducted by Yu J.[15] uses MDS analysis in detecting the dimensions of income, standard of living, education, health and social security as variables for the sustainability of people's lives in China.

MATERIALS AND METHODS

The research was conducted in Denpasar City area by using a purposive method, where this location was determined according to the need for scientific information as the policies basis for developing urban agricultural sector in Denpasar City. All stakeholders were the research population, which included: farmers, subak institutions, agriculture offices, agricultural business actors, agricultural financial institutions, NGOs, universities, and agricultural research and development institutions. The sample was determined as research respondents were determined purposively with the consideration that the respondent can provide valid information/data, where the number of respondents was determined on a representative basis. A representative sample was a sample whose characteristics were almost the same as those of the population. This means that the items sampled were similar to items that were not sampled.

The data collected in this research included primary data and secondary data. Primary data were obtained from respondents using interview techniques, in-depth interviews, and focus group discussions (FGDs). Focus group discussions were attended by informants from several stakeholders, such as the Denpasar City Food Crops and Horticulture Office, the Bali Provincial Planning and Development Agency, the Bali Province Central Statistics Agency, Denpasar City Environment Service, Denpasar Fisheries Service, Denpasar Livestock Service, Forestry Service. Denpasar, Irrigation Department of Public Works, representatives of farmer groups, breeders and fishermen in the city of Denpasar were also in attendance. Focus group discussions were conducted twice, namely at the beginning of the initial data collection and at the end of the research report. The primary data collection instruments were structured questionnaires and interview guides. The variables (dimensions) included in the questionnaire were ecology, economic, social, institutional, and technological dimensions. Each was represented by sustainability attributes or variables. Secondary data were collected from Statistics Agency/Office and institution documents. The analytical method used was based on the research aims, in detail the analytical methods used in each aim were: 1) the first aim analysis was to analyze the status of urban agriculture sustainability in Denpasar area, by using the Rap-Ur-Agri (Rapid Appraisal for Urban Agriculture) ordinance technique, which was a technique



modified from Rapfish (Rapid Appraisal for Fisheries). This ordination technique determined something in a measurable order by using the Multi-Dimensional Scaling (MDS) method for urban agriculture. 2) The second aim analysis was the formulation of a sustainable agricultural policy strategy in Denpasar City, conducted with a prospective analysis. Prospective analysis was used to determine the important factors in the development of sustainable agriculture in Denpasar City. Multi Dimensional Scaling is a "multivariate" method that can handle metric data (ordinal and nominal scale) and statistical techniques that try to transform multi dimensions into lower dimensions. In the dimension there are several attributes. The ecological dimension has attributes, such as: green open space area, yard area, land conversion rate and other attributes that can be seen in the leverage image. Attributes of each dimension as well as good and bad criteria with scores according to the opinions of experts and stakeholders related to the system under study. For each attribute in each dimension, a score is given that reflects the condition of sustainability. The score range is determined based on criteria that can be found from the results of field observations and secondary data. The range of scores ranges from 0-3, depending on the condition of each attribute, which is interpreted from bad to good. Bad values reflect the most unfavorable conditions for development, otherwise good values reflect the most favorable conditions for sustainable urban agricultural development. The sustainability index values in this analysis are grouped into 4 categories of sustainability status based on the Rap-Ur-Agri (Rapid Appraisal for Urban Agriculture) index values listed in Table 1. The four sustainability statuses can be formulated as a percentage (%), so that the categories and statuses are as follows: 00.00%-25.00% (bad/not sustainable); 25.01%-50.00% (less/less sustainable); 50.01%-75.00% (enough/moderate sustainable); 75.01%-100.00% (good/very sustainable).

RESULTS AND DISCUSSION

The Status of Agriculture Resources Sustainability in Denpasar City

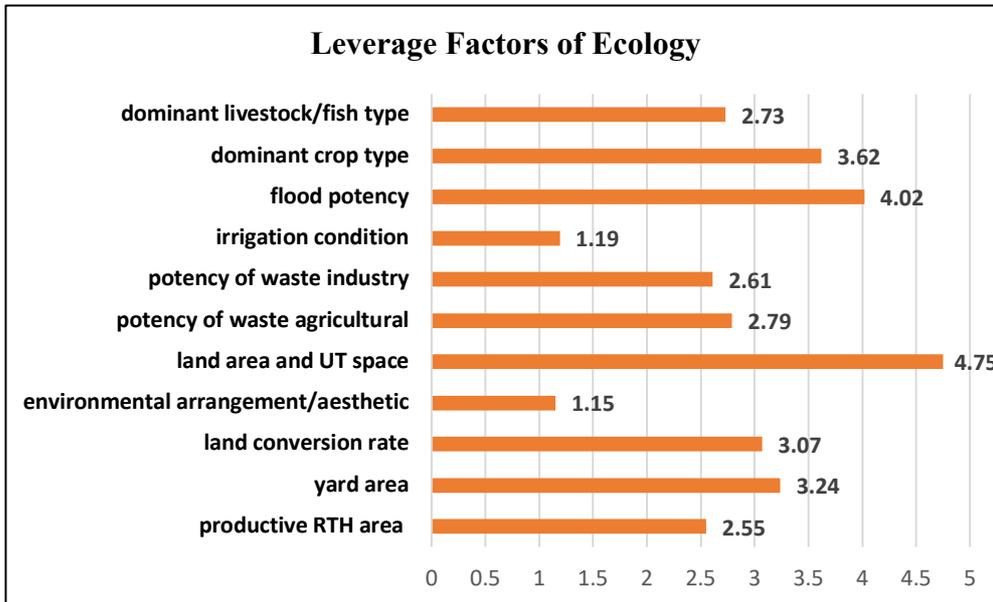
The sustainable level of urban agriculture development was expected based on the analysis result of five dimensions, which were ecology, economy, social, institutions and technology dimension.

The Status of Ecology Dimension Sustainability (Environmental)

Based on the Rapfish Ordination, it can be seen that the position of the ecological dimension was at a value of 48.82%. This condition indicated that the ecological dimension had a 'less sustainable' status. In Figure 1, it can be seen that the sensitive attributes (which affect ecological sustainability) are those with index values above 2.5. Index values less than or equal to 2.5 are not sensitive to the



sustainability of the ecological dimension. Of these attributes, land area and farming space occupy the highest sensitive value (4.75) [16].



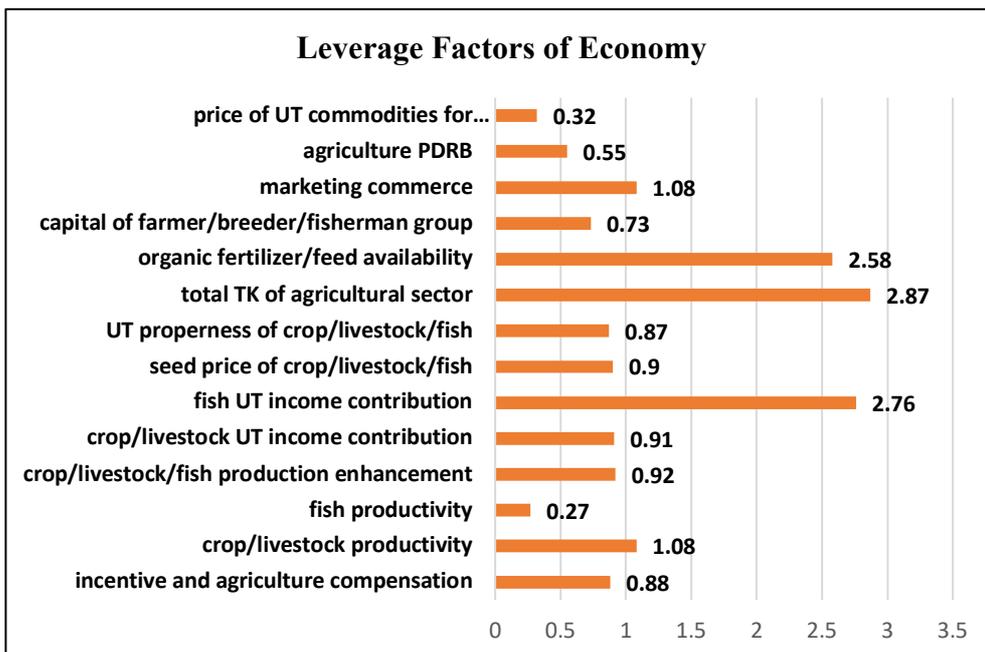
Picture 1: Leverage Analysis Result on Ecology Dimension (Environmental)

An important finding was that the land area and farming space in Denpasar City was relatively low, which was below 10%. The limitations of agricultural land in urban areas can be overcome by utilizing narrow land, such as yards for agricultural cultivation by using hydroponics system, vertical and furthermore, strengthening the social network of farming communities [16, 17, 18, 19, 20]. The exploration of the potential use of areas and agricultural activities in urban areas for recreation was also an alternative to maintain the sustainability of agricultural land that still exists [21]. The policy/planning of land usage to prevent a decrease in agricultural land area was also needed. The Regional Government should revitalize a balanced development policy between tourism and agriculture, which has been considered to be tourism/city bias [22]. In addition, local governments should be aware that formal regulations will not be effective in suppressing the conversion of rice fields, because it needs to be integrated with local rules (local wisdom) that exist in the community, such as the subak system in Bali.

The Status of Economy Dimension Sustainability

Based on the results of the Denpasar City Rap.Ur-Agri analysis and the MDS analysis, the sustainability index value was 43.99% with the status of 'less sustainable' [24]. In Figure 2 it can be seen that the attributes that have an index value of more than 1.75 are sensitive attributes, while those with an index value of less than or equal to 1.75 are not sensitive to the sustainability of the economic

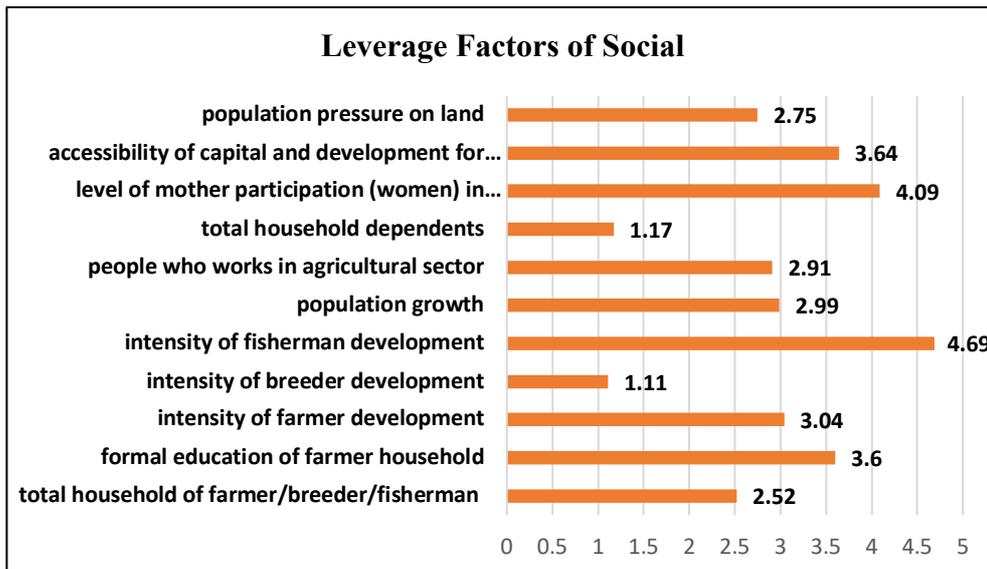
dimension. Among the sensitive attributes, the most sensitive attribute is the number of workers in the agricultural sector (2.87). The main problem in the field of agricultural employment was the change in the demographic structure that was less profitable for the agricultural sector, such as the number of older farmers (over 55 years) increasing, while that of young workers was decreasing. There was a phenomenon of the aging farmer and the decreasing interest of young workers in the agricultural sector [23].



Picture 2: Leverage Analysis Result of Economy Dimension

The Status of Social Dimension Sustainability

Socially, the development of land-based agriculture encountered very serious obstacles, because land in urban areas has various interests compared to other resources. The results of the Rap.Ur-Agri analysis of Denpasar City area on the attributes of the social dimension with the MDS simulation, obtained a sustainability index value of 51.84% with the status of "moderate sustainable". The results of the leverage analysis show that the attributes that have a sensitive index value are those with a value above 2.5. Meanwhile, attributes that have an index value less than or equal to 2.5 means that they are not sensitive to the sustainability of the social dimension. Among the sensitive social attributes, the intensity of fisherman development (4.69) is the most sensitive attribute to the sustainability of this dimension.

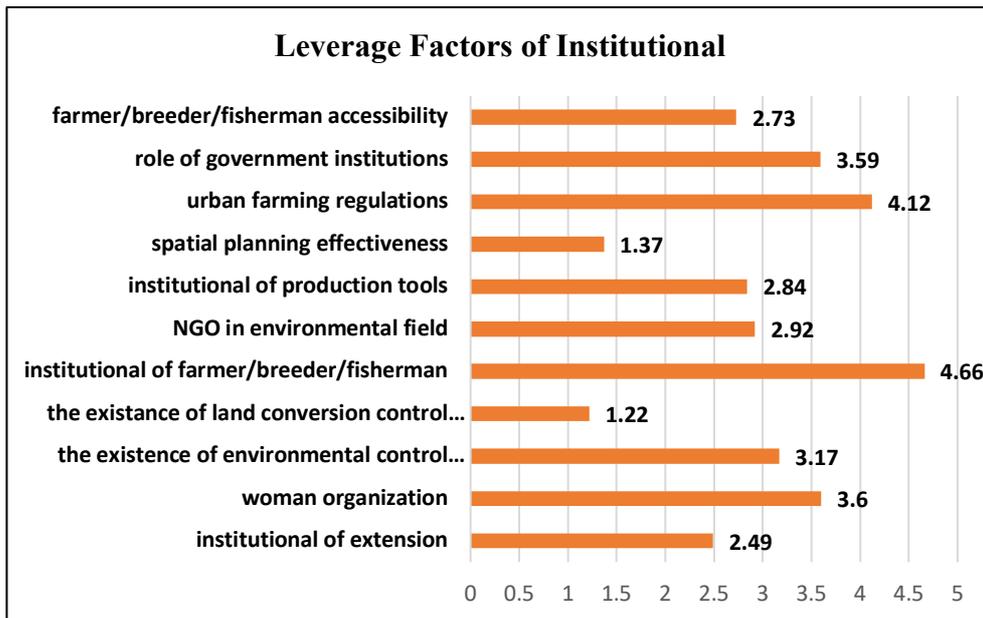


Picture 3: Leverage Analysis Result of Social Dimension

An important finding was the intensity of fisherman development. Fishermen as coastal human resources need to be strengthened and developed in the form of Human Development, Environmental Development, Resource Development and Business Development [24]. Fishing groups development can improve knowledge, skills and access to productive sources as well as information related to capital, markets, technology or networks for members, which has a positive impact on fishery business productivity in the future [25]. The intensity of fisherman development was realized through the formation of fishing groups, fisherman groups were formed with purpose to strengthen integrated institutions and human resources [26].

The Status of Institutional Dimension Sustainability

The results of the Rap.Ur-Agri analysis of Denpasar City area on the attributes of the institutional dimensions with the MDS simulation, obtained a sustainability index value of 72.45%, with the status of “moderate sustainable”. The results of the leverage analysis show that the attributes with an index value greater than 2.5 are sensitive, while those with a value less than or equal to 2.5 are not sensitive to the sustainability of the institutional dimension. The attribute that has the highest index value is farmer institutions (4.66).

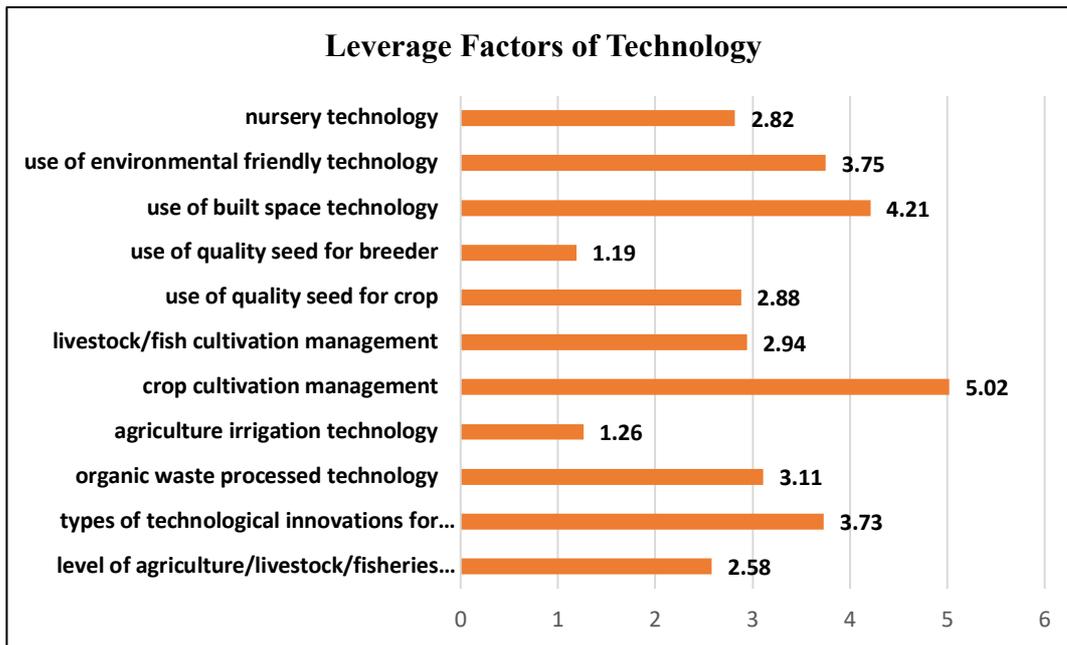


Picture 4: Leverage Analysis Result of Institutional Dimension

Farmer institutions had a strategic point in moving the agribusiness system in rural areas [27]. Farmers who tried individually will continue to be on the weak side because farmers managed their business with a narrow land area and low capital. Therefore, agricultural extension that is facilitated by the government should be directed at strengthening farmer institutions. Furthermore, in Ciamis sub-district, West Java, based on regression analysis, showed that farmer groups had a real influence on the development of farmer institutions into farmer economic institutions [28].

The Status of Technology Dimension Sustainability

Based on the results of the Rapfish Ordination, a value of 74.56% was obtained with the status of “moderate sustainable” for technology dimension. Figure 5 shows that the attributes that have an index value greater than 3.0 are sensitive, while smaller or equal to 3.0 means that they are not sensitive to the sustainability of the technology dimension. Among the sensitive attributes, plant cultivation management (5.02) is the most sensitive attribute to the sustainability of the technological dimension.



Picture 5: Leverage Analysis Result of Technology Dimension

The management of agricultural cultivation as one of the tools of agricultural sustainability can be pursued through the dissemination of the use of appropriate technology. Research that was conducted in South Tangerang, found that the management can be applied through training and technical guidance as well as collaboration with research institutions or other parties [29].

The management of agricultural cultivation can be applied through agro-biodiversity management. Agro-biodiversity included all components related to food and agriculture. This included all types of plants, animals, and microbes at the gene level, species and ecosystem that were needed for the continuity of the main functions, structures and processes in the agro-ecosystem. The existence of agro-biodiversity directly determined the productivity, sustainability, and resilience of agro-ecosystems to the biotic and abiotic interferences [30].

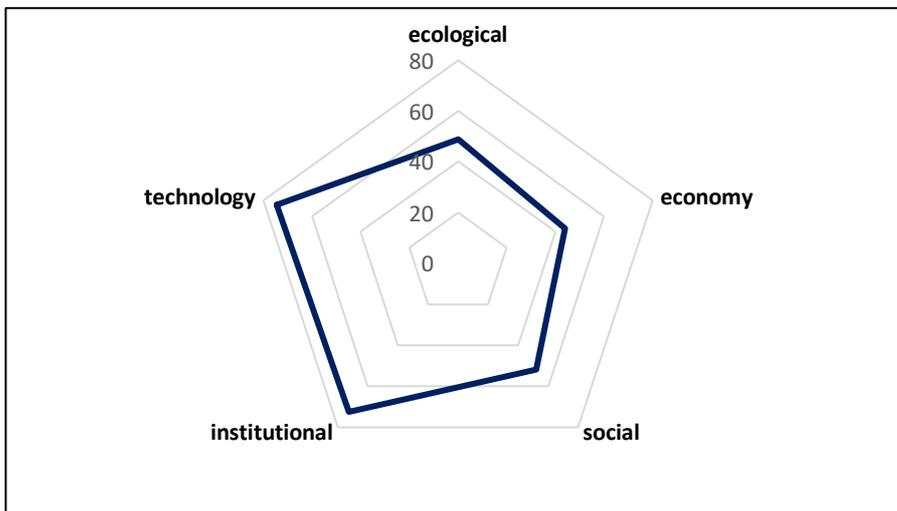
Multi-dimension Sustainability Index

The results of the Rap.Ur-Agri analysis with MDS simulations based on the formulation of the sustainability index in percentage (%), show that the current condition of urban agriculture in Denpasar City obtained the sustainability index value for each dimension as follows:

1. The ecological dimension of 48.82% (sustainability index was between 25.01-50.00%) means less sustainable.
2. The economic dimension of 43.99% (sustainability index was between 25.01-50.00%) means less sustainable.

3. The social dimension of 51.84% (sustainability index was between 50.01-75.00%) means moderately sustainable.
4. The institutional dimension of 72.45% (sustainability index was between 50.01-75.00%) means moderately sustainable.
5. The technology dimension was 74.56% (sustainability index was between 50.01-75.00%) which means moderately sustainable.

The value of the sustainability index of the five dimensions showed that the ecological and economic dimensions were less sustainable (Picture 6). Since the social, institutional, and technological dimensions were moderately sustainable, thus, intervention or improvement of attribute performance was needed.



Picture 6: Kite Diagram of the Status of Urban Agriculture Sustainability in Denpasar City

The Policy Strategy for Sustainable Agriculture in Denpasar City

The development of the agricultural sector in Denpasar City was very strategic; therefore, it must be planned, implemented, and monitored properly. The results of agricultural development not only have an impact on the fulfilment of the population's food [31, 32, 33, 34], but more than that, such as: the sustainable availability of green open spaces, healthy oxygen circulation, maintained water and environmental management, and the availability of employment opportunities for city residents [35, 36, 39]. Based on the research results, several important things can be formulated, that can be considered as a policy substance to encourage the realization of sustainable agriculture in Denpasar City; those were as follows:

1. Improve and strengthen the implementation of urban agricultural technology by the community. The types of urban agricultural technology that can be offered

- include: hydroponic system technology, verticulture, pots and polybags, as well as propagation technology in built areas (terrace, walls, and roofs).
2. Support for the development of livestock businesses such as native chickens, ducks, and catfish cultivation, because these businesses can earn quite a lot of income.
 3. Support for a conducive physical environment for the development of agricultural activities needs to be increased. One of the efforts that can be done is to maintain productive agricultural land through the establishment and implementation of the Regional Regulation on Sustainable Food Agricultural Land (LP2B) Denpasar City.
 4. Better arrangement of agricultural institutions (institutional development, services, business), especially the implementation of strengthening community institutions, both social, economic, and technical.
 5. Facilitation of agricultural community activities (farmers, agricultural business actors, agriculture lover groups, households, etcetera) in the form of access to information, access to business capital, access to agricultural production facilities, market access, mentoring and advocacy.

CONCLUSION

The results of the Rap-Ur-Agri analysis and the MDS simulation showed that the ecological dimension and the economic dimension were in a less sustainable status with index values of 48.82% and 43.99%, while the social, institutional and technological dimensions were in the status of moderately sustainable with index values of 51.84%, 72.45%, and 74.56%. Based on the research results, the important things that can be suggested to the Denpasar City Government are 1) Maintaining productive rice fields in each sub-district, 2) Arranging potential land and settlements or home yards as an alternative to urban farming development, 3) Determining of agricultural commodities types to be cultivated in accordance with regional superiority and competitiveness, 4) Facilitating the provision of production facilities and machinery (agricultural tools and machinery) that are needed by farmers with the principles of the proper type, proper time, proper amount and proper use, 5) Preparing workers in the agricultural sector, especially the young generation (millennial) who were motivated by: interest or hobby in agriculture, obtaining income certainty and livelihood from agriculture, and the intention to realize a sustainable agricultural sector.



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