

# The Impact of Climate Variability on Economic Sustainability on Urban Agriculture: A Case Study in Yogyakarta City, Indonesia

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## ABSTRACT

The impact of climate variability on life has been widely studied. Climate variability has an impact on urban agriculture. It is suspected that the level of knowledge and the impact of climate variability would influence the sustainability of urban agriculture in the economic aspect. This study aims (1) to determine the level of knowledge of urban agricultural actors about climate variability, (2) to know the perceptions of urban agricultural actors about the impact of climate variability on urban agriculture, (3) to measure the level of economic sustainability of urban agriculture based on the perception of urban agricultural actors in Yogyakarta city (4) to analyze the effect of the level of knowledge on climate variability and perceptions of the impact of climate variability on economic sustainability on urban agriculture. The research sample was taken using a simple random sampling method. This study was designed as a descriptive study with a sample of 97 urban farming actors in Yogyakarta city, Indonesia. Data were collected using interview, observation, and recording methods, then analyzed using qualitative descriptive analysis and multiple linear regression analysis. The results showed that the level of knowledge of urban agricultural actors about climate variability was medium with a score of 3.77. The perception of the impact of climate variability on urban agriculture is high with a score of 3.67. The perception of urban agriculture actors to economic sustainability in urban agriculture in Yogyakarta City is sufficient with a score of 73.45. Then the level of knowledge of climate variability and the perception of the impact of climate variability simultaneously affect the sustainability of urban agriculture in the economic aspect.

**Keywords:** *Urban Agriculture, Level of Knowledge, Perception, Climate Variability.*

## 1. INTRODUCTION

The condition of population growth is greater than the production of food, so there will be a food crisis disaster. The amount of food that cannot be fulfilled by its territory will have an impact on the dependence on other regions [4]. Food shortages in urban areas encourage the city government to hold a “program lorong sayur” to achieve food security in the city of Yogyakarta. This activity is carried out by utilizing narrow land to produce agricultural products. The results of urban agriculture can be utilized by the city community to save household food expenditures and can

be marketed with the help of the Jogja City Agriculture Office [2].

According to Fauzi *et al.* (2016), the presence of agriculture in urban areas can provide positive value that has an impact on the ecological and economic sustainability of urban areas [4]. According to Gusfarina research (2018) z explained that the level of agricultural sustainability in Yogyakarta city is seen from the ecological, economic, and social dimensions included in the category of good or very sustainable [5]. According to Dewanggi (2020), the level of sustainability of vegetable farming in urban agriculture based on the perception of farmers in Yogyakarta City is seen from the

ecological, economic, and social dimensions included in the category of sufficient sustainability. The level of sustainability of urban agriculture can be influenced by various factors, namely the age of farmers and yard area used for vegetable farming is a factor that affects the sustainability of vegetable farming in urban agriculture in Yogyakarta City [3].

One of the sectors that is majorly affected by climate variability is the agricultural sector. According to Adiyoga & Basuki research (2018), there are impacts of climate change whose significance ranks first, namely the risk of crop failure (production) is getting higher, the risk of agricultural losses is getting higher, and has a direct effect on the sustainability of the business concerned, and the increasingly high-temperature causes pest attacks to increase and the emergence of new pests. The importance of this study was conducted to find out the level of knowledge of urban agricultural actors and the impact of climate variability that affects the economic sustainability of urban agriculture in Yogyakarta city that has never been studied before [1].

**2. METHOD**

The basic method used in this study is descriptive method. The study was conducted in the city of Yogyakarta with a sample of 97 urban agricultural actors conducted using simple random sampling methods. Then data retrieval is done by interview methods, observation, recording, and library studies. Before the data is analyzed, it is conducted a test of validity and reliability.

**2.1. Knowledge Level of Urban Agriculture Actors about Climate Change**

First, the study measured knowledge level of urban agriculture actors about climate variability based on the summation scores of climate variability indicators. The minimum score is 1.0 and the maximum score is 5.0 which is formulated as follows [7]:

$$P_n = \sum PI_i \tag{1}$$

Information:

$P_n$  = Urban agriculture actor's knowledge score on climate variability

$PI_i$  = Urban agriculture actors' knowledge scores on climate variability according to trends over 30 years

The next stage is to calculate the interval class by means:

$$TP = \frac{Sb - Sa}{I} \tag{2}$$

Information:

TP = Level of Knowledge

Sb = Maximum Score

Sa = Minimum Score

I = Interval Class

Assessment of knowledge level:

1.0 – 2.2 = Low level of knowledge

2.3 – 3.6 = Medium level of knowledge

3.7 – 5.0 = High level of knowledge

**2.2. The Perception of Urban Agricultural Actors about the Impact of Climate Variability on Urban Agriculture**

The second part of the study measured the perception of urban agricultural actors about the impact of climate variability on urban agriculture in Yogyakarta City. Urban farmers' perception of the impact of climate variability is measured on a likert scale, with a minimum score of 1.0 and a maximum score of 5.0. The impact of climate variability on urban agriculture perceived by urban agricultural actors can be formulated as follows [1]:

$$PD_n = \sum PD_i \tag{3}$$

Information:

$PD_n$  = Impact of climate variability on urban agriculture

$PD_i$  = The impact of climate variability perceived by urban agriculture

The next stage is to calculate the interval class by means:

$$DP = \frac{Sb - Sa}{I} \tag{4}$$

Information:

DP = Impact of climate variability

Sb = Maximum score

Sa = Minimum score

I = Interval Class

Climate variability impact assessment:

1.0 – 2.2 = Low climate variability impact

2.3 – 3.6 = Medium climate variability impacts

3.7 – 5.0 = High climate variability impact

**2.3. The Level of Economic Sustainability of Urban Agriculture**

The third part of this study measured the level of economic sustainability of urban agriculture based on the perception of urban agricultural actors in Yogyakarta city. The perception of urban farmers to the sustainability of urban agriculture in Yogyakarta City is measured by the likert scale, a minimum score of 1.0 and a maximum score of 5.0. The sustainability level of urban agriculture is measured using the sustainability index. The sustainability index can be formulated as follows [6]:

$$IK = \frac{Sc}{Sb} \times 100\% \quad (5)$$

Information:

IK = Sustainability index (%)

Sb = Maximum score

Sc = Score obtained

Sustainability status category (Nurmalina, 2008):

1. Index value 00.00 – 25.00 (Bad: unsustainable)
2. Index value 25.01 – 50.00 (Less: less sustainable)
3. Index value 50.01 – 75.00 (Sufficient: quite sustainable)
4. Index value 75.01 – 100.00 (Good: very sustainable)

**2.4. Factors Affecting Economic Sustainability in Urban Agriculture**

The fourth part looks at the impact of the knowledge level factor of climate change knowledge and the perception of the impact of climate variability on the perception of economic sustainability of urban agriculture in Yogyakarta city. The determinants of the sustainability rate of urban agriculture are analyzed with multiple linear regressions. The model equation of factors affecting the sustainability of urban agriculture can be structured as follows:

$$Y_1 = a + b_1 \cdot X_1 + b_2 \cdot X_2 \quad (6)$$

Information:

$Y_1$  = Sustainability of urban agriculture (index)

a = Constant number

$b_1$ -  $b_2$  = Regression coefficient

$X_1$  = Level of knowledge of climate variability (indicator)

$X_2$  = The impact of climate variability (impact)

**3. RESULT AND DISCUSSION**

**3.1. Knowledge Level of Urban Agriculture Actors about Climate Variability**

Knowledge is essentially all that man knows about a particular object that can enrich mental characteristics directly or indirectly, enrich human life, and as a source for questions that arise in life. Knowledge has specific characteristics of what (ontology), how (epistemology), and for what (axiology) the knowledge is compiled. Climate change can be explained as the average change in one or more weather elements in a given area over a long period. Climate change makes changes in the physical condition of the Earth's atmosphere that have a wide impact on various sectors of human life [11].

Based on Table 1. The average level of knowledge of urban agricultural actors in Yogyakarta City about climate variability with a value of 3.54 falls into the high category. Knowledge of climate variability is the result of the thinking and experience of urban agriculture actors on climate variability that can be reviewed from indicators of climate variability, such as the rainy season period, the length of the rainy season, annual rainfall, frequency of rainfall, extreme rainfall, annual air temperature, extreme air temperature, drought, and wind speed. The higher level of knowledge of urban agriculture actors on climate variability means that urban agriculture's understanding of climate variability is increasing.

**Table 1.** Knowledge Level of Urban Agriculture Actors in Yogyakarta City on Climate Variability

Indicators	Number of Scores	Average Score	Category
Rainy season period	328	3.38	Medium
The length of the rainy	316	3.26	Medium
Annual rainfall	319	3.29	Medium
Frequency of rainfall	358	3.69	High
Extreme rain	367	3.78	High
Annual air temperature	362	3.73	High
Extreme air temperature	371	3.82	High
Drought	328	3.38	Medium
Wind speed	341	3.52	Medium
<b>Sum</b>	3090		
<b>Average</b>		3.54	
<b>Level</b>			Medium

Source: Primary Data Analysis, 2021

### **3.2. The Perception of Urban Agricultural Actors about the Impact of Climate Variability on Urban Agriculture**

Climate variability occurs due to global warming that harms life. Indicators of climate variability based on farmers' perceptions of difficulty predicting the growing season, the quality of agricultural products decreased, the increased cost of irrigation, changes in the way of cultivation, natural enemies difficult to develop, pest and disease attacks increased, the emergence of pests and new forecasters, decreased productivity, the cost of handling crops increased, marketing costs increased, the risk of losses increased, the risk of sustainability, and the risk of crop failure increased.

According to research by Nuraisah & Kusumo (2019), one of the sectors affected by climate change is the agricultural sector. The magnitude of the impact of climate change on the agricultural sector depends on the rate and pace of climate change, the nature and flexibility of resources, and the agricultural production system. Based on table 2. The perception of urban agricultural actors in the city of Yogyakarta to the

impact of climate variability has obtained a value of 3.77 which falls into the high category. The impact of climate variability on urban agriculture in Yogyakarta City has a bad influence on the continuity of agricultural cultivation in Yogyakarta City.

### **3.3. The Level of Economic Sustainability of Urban Agriculture**

Economic sustainability is related to aspects of meeting the needs of the human economy in current and future generations [10]. Table 3. describes the perception of urban agricultural actors to economic sustainability in urban agriculture in Yogyakarta City with a sustainability index of 73.45 categorized in fairly sustainable status. In table 3. Showing that urban agricultural actors in Yogyakarta city have a good perception of the sustainability of the urban agriculture economy in Yogyakarta City. Urban agriculture actors have a view if urban agriculture has opportunities in economic development in urban areas. Ease of access to capital and willingness in doing urban agriculture support urban agricultural actors to meet needs and benefits.

**Table 2.** Perceptions of the Impact of Climate Variability on Urban Agriculture

<b>Indicators</b>	<b>Number of Scores</b>	<b>Average Score</b>	<b>Category</b>
It is difficult to predict the growing season.	362	3.73	High
The quality of agricultural products is declining	369	3.80	High
Cost of watering increases	390	4.02	High
Changes in the way cultivation is cultivated	370	3.81	High
Natural enemies are difficult to develop	350	3.61	Medium
Pest and disease attacks on the rise	369	3.80	High
The emergence of new pests and disease	354	3.65	Medium
Decrease in productivity	370	3.81	High
Crop handling costs are increasing	339	3.49	Medium
Marketing costs are rising	333	3.43	Medium
Risk of loss increases	378	3.90	High
Impact on sustainability	380	3.92	High
Risk of crop failure increases	388	4.00	High
<b>Sum</b>	4752		
<b>Average</b>		3.77	
<b>Level</b>			High

Source: Primary Data Analysis, 2021

**Table 3.** Perception of Urban Agriculture Actors to Economic Sustainability in Urban Agriculture in Yogyakarta City

Indicators	Number of Scores	Average Score	Index	Sustainability Status
Increased land productivity	352	3.63	72.58	Sufficient
Increased production	355	3.66	73.20	Sufficient
Increased product price	364	3.75	75.05	Good
Increased agricultural land area	316	3.26	65.15	Sufficient
Ease of capital acces	357	3.68	73.61	Sufficient
Willingness to access seeds at high prices	370	3.81	76.29	Good
Willingness to access organic fertilizers at high prices	338	3.48	69.69	Sufficient
Willingness to access organic pesticides at high prices	327	3.37	67.42	Sufficient
Willingness to access organic agricultural machine at high prices	320	3.30	65.98	Sufficient
Use of superior varieties	389	4.01	80.21	Good
Ability to cultivate agricultural products	358	3.69	73.81	Sufficient
Post-harvest action is done appropriately	375	3.87	77.32	Good
Actively marketing products	356	3.67	73.40	Sufficient
Benefit	384	3.96	79.18	Good
Can meet the needs of the family	348	3.59	71.75	Sufficient
Reduce food expenditure	391	4.03	80.62	Good
<b>Sum</b>	5700			
<b>Average</b>		3.67		
<b>Index</b>			73.45	
<b>Sustainability Status</b>				Sufficient

Source: Primary Data Analysis, 2021

### 3.4. Factors Affecting Economic Sustainability in Urban Agriculture

Multiple linear regression analysis was conducted to determine the influence of the level of knowledge of climate variability and the perception of the impact of climate variability on economic sustainability on agricultural agriculture in Yogyakarta City. Data processing is done with the SPSS program. Here are the results of multiple linear regressions (Table 4).

From the results of the calculation above obtained the linear regression equation as follows:

$$Y = 2,063 + 0.141X_1 + 0.256X_2 + e$$

The coefficient of determination ( $R^2$ ) is used to measure the model's ability to explain variations of independent variables, namely perceptions of economic sustainability. The results of the SPSS calculation obtained a value of  $R^2 = 0.236$  which means that 23.60% perception of economic sustainability can be explained by variables of Climate Variability Knowledge Level and Climate Variability Impact Perception. The remaining 76.40% was affected by variables outside the model studied.

**Table 4.** Regression Analysis Results

Variable	Regression Coefficient	t	Probability t
Constant	2.063	7.315	0.000
Knowledge Level of Climate Variability	0.141***	1.744	0.084
Perception of the Impact of Climate Variability	0.256*	4.196	0.000
<b>R<sup>2</sup></b>	0.236		
<b>Adjusted R<sup>2</sup></b>	0.220		
<b>F</b>	14.500*		
<b>Probability F</b>	0.000		

Source: Primary Data Analysis, 2021

Information = \*\*\* significant at level  $\alpha = 0.1$   
 \*\* significant at level  $\alpha = 0.05$   
 \* significant at level  $\alpha = 0.01$

Based on the table above obtained F calculated 14,500 with a significance value of  $0.000 < 0.05$  ( $\alpha = 5\%$ ). From the results, it can be concluded that the Level of Knowledge of Climate Variability and The Perception of The Impact of Climate Variability simultaneously affect the Perception of Economic Sustainability.

Based on the table above the significance value of the Climate Variability Knowledge Level t tested  $0.084 < 0.1$ . This suggests that  $H_a$  failed to be rejected so that the Climate Variability Knowledge Level variable had a partially significant effect on perceptions of economic sustainability. The results of the analysis showed a positive influence of the Level of Knowledge of Climate Variability on perceptions of economic sustainability. This means that the higher the Level of Knowledge of Climate Variability of urban agriculture actors in the city of Yogyakarta, it will increase the perception of economic sustainability in urban agriculture. If urban agriculture actors always increase knowledge about climate variability, it will increase the perception of sustainability of the urban agricultural economy of Yogyakarta City.

The knowledge of climate variability owned by urban agriculture actors will affect the adaptation of urban agricultural actors. Farmers' adaptation to climate variability has a positive relationship to climate variability knowledge. Adaptation of farmers in cultivating agriculture will reduce the impact of climate variability that is felt so that urban agriculture in Yogyakarta city has economic benefits or can meet needs.

Then the significance value of climate variability impact perception test t amounted to  $0,000 < 0.1$  and  $0,000 < 0.05$ . This suggests that  $H_a$  failed to be rejected so that the Climate Variability Impact Perception variable had a partially significant effect on perceptions of economic sustainability. The results of the analysis showed a positive influence of the Perception of The Impact of Climate Variability on perceptions of economic sustainability. This means that the higher the Perception of the Impact of Climate Variability by urban agricultural actors in the city of Yogyakarta, the perception of economic sustainability in urban agriculture will increase. If the impact of climate variability increases, then the perception of economic sustainability in urban agriculture in Yogyakarta City will increase.

Economic sustainability in urban agriculture in Yogyakarta city will continue to increase even though the negative impacts of climate variability are also increasingly felt. According to Gusfarina research (2019), explaining the level of economic motivation in the city of Yogyakarta is classified as high in utilizing the yard to plant vegetables and/or fruit. Although the negative impact is increasingly felt, urban agricultural

actors still carry out urban agriculture that can meet the needs.

#### 4. CONCLUSION

Based on the results and discussion, it can be concluded as follows:

1. The level of knowledge of urban agricultural actors in Yogyakarta city about climate variability falls into the high category.
2. The perception of urban agricultural actors in the city of Yogyakarta to the impact of climate variability falls into the high category.
3. Perception of economic sustainability in urban agriculture in Yogyakarta City with a sustainability index categorized sufficient sustainable status.
4. Climate Variability Knowledge Level and Perception of Climate Variability Impacts simultaneously or partially influence Perception of Economic Sustainability.

#### SUGGESTION

The advice given by the researcher is, as follows:

1. Farmer groups and women's farmer groups that continue to be active can improve relations between members so that sales of agricultural products can be wider
2. Urban agriculture actors should always look for the latest information on climate variability to improve economic sustainability in urban agriculture.

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