

DEVELOPMENT OF FOOD CROP COMMODITIES USING MULTI-FACTOR EVALUATION PROCESS USING GIS IN THE DISTRICT GARUT

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ABSTRACT

Agriculture in Garut has a land area of approximately 306,519 hectares of agricultural commodities under the auspices of the Department of Agriculture agencies. Based on the area of agricultural development, Garut including potential areas for planting a variety of different commodities such as food crops.

This study aims to establish a geographic information system development of food crops in Garut. While the purpose of this study is to assist the Head of Food Crops in determining land food crops in accordance with its geographical situation. Based on test results, it is concluded that the geographic information system development of food crops in Garut is in accordance with the expected goals are to assist the Head of Food Crops in developing food crops in Garut.

The test results of GIS with a resource, can be used as a new strategic and as to facilitate in determining growers of food crops in a specified area.

Keywords: Plant Food, Multi Factor Evaluation, Commodities, GIS approach, Classification Conformity Lahaan ..

1. PRELIMINARY

Agriculture in Garut has a land area of about 306,519 hectares of agricultural commodities under the auspices of the Department of Agriculture agencies. Based on the area of agricultural development, Garut including potential areas for a variety of different commodities such as food crops. Based on geography, there are four areas of Garut regency parts, the Northern Territory Garut most types of soil is the result of a volcanic eruption sedimentation, commodities that thrive are vegetables. South Garut region has several rivers flowing southwards with water does not flow conditions throughout the year, making it less potentially vast dry land for potential development of crops, paddy fields, horticulture, plantation crops, people and large plantation crops and industrial crops. According to Dati mother Widyati SP, MP

Some planning the planting of food crops is less precise because it is not adapted to the condition of the object, layout and land use planning in the development of planting, this could impact on the level of achievement of the production of food crops and occurs discrepancies with the strategic plan of the department of agriculture Garut.

Based on the problems, the use of geographic information systems are needed to assist in planning the sustainable development of food crops, with the geographic information system is expected to simplify the Head of field crops in the decision for the development of food crops in Garut.

2. ISI RESEARCH

2.1. Geographic Information Systems

GIS is a computer-based system that has the ability to handle geographically referenced data, ie data entry, data management (storage and recall), manipulation of data analysis and output as a final result (output). The final result (output) can be a reference for decision-making related problem dengan geographically. SIG is a komponen generally consisting of hardware, software, geographic data and human resources that work together effectively to input, store, repair, update, manage, manipulate, analyze, and display data in a geographic-based information. [1]

2.1.2. Spatial Data

Spatial data is a system of information in it there is exposure to the detail description of the earth including the boss of the earth, under the foundation of the earth, waters or marine or below atmospheric. Spatial data and followers information used to decide the position of the introduction of the elements in the earth's surface. There are two models of the spatial data used for geographic information systems, namely:

1. Vector Data Model

Vector data model is the most commonly used data model, based on the point with the coordinates (x, y) to build a spatial object. Objects are built there are three parts:

a. Point (point)

- b. Line (line)
- c. Area (polygon)

2. Raster Data Model

Raster data is data generated by remote sensing system. In raster data, geographic objects represented as the cell structure of the grid called with pixel (Picture Element). In raster data. [2]

2.1.3. Non-spatial data

This data is the data that describes the aspects of the phenomenon being modeled therein includes items and properties, so that the information submitted more and more, non-spatial data also store attributes of a state for the boss of the earth as well as land that has a component texture, depth and others, Non-spatial or attribute data can be stored in the form of lines (records) and columns (fields) for example non-spatial data are: Village Name, Address office, District, District, website address, name of the mountain [2],

2.2. Crops

Food is everything that comes from biological sources and water, and which have been processed or unprocessed. Food intended for human consumption as food or beverage also includes food additives, food raw materials and other materials, which are used in the preparation, processing, or manufacture of food and beverages. Of food commodities must meet nutrient content consisting of proteins, fats, carbohydrates, minerals and vitamins that can be useful for growth or human health. Class of crop commodity group includes a group of horticultural crops instead of ornamental plants, food crops, and a group of other plants that can produce the raw material products that meet food standards. Restrictions on food crops are a group of plant sources of protein or carbohydrate. But, more specifically food crops are usually restricted from the group of plants that lived annuals. For the standard of food crops at a later date should be remedied this will lead to a source of carbohydrates is limited. [3],

2.3. Land Suitability Classification

Land Suitability can be assessed against the current state or after improvement. More specifically, the Land Suitability seen from the physical properties of the environment such as climate, soil, topography, hydrology or drainage according to the type of farming productive commodities. Land Suitability different with land capability. Land Capability leaning more toward the capacity of various land uses an outline that can be cultivated in the region. The more diverse types of plants that can be developed or commercialized in the region it is the ability of the higher land. For example, in a land has flat topography or relief, in the soil rooting depth, is not affected by floods or fairly wet climate, land capability is generally pretty

good for the development of annual crops or perennial crops. If the depth of soil <50 cm, the land can only be developed for crops or other plants that have a shallow root zone. While the land suitability is the suitability of a plot of land for the specific type of use (land utilization type), then it should consider the management aspect. For example, for rice field irrigation or tidal rice fields, corn, soybean, and cassava / sweet potato [4],

2.4. Decision Support System

Decision support systems are interactive computer-based systems, which help decision-makers to use the data and a variety of models to solve unstructured problems. Decision support system combining the intellectual resources of individuals with computer capability to improve the quality of decisions.

Decision Support System is a computer-based support system for management decision makers who deal with unstructured problems. Decision Support System is a system getting information aiming at a specific problem to be solved by the manager and can help managers in decision-making. Decision support systems are an integral part of the totality of the organization's overall system. [5]

2.4.1. Methods Multi Factor Evaluation Process (MFEP)

Multi Factor Evaluation Process (MFEP) is a quantitative method based on the weighting system. To be able to produce a multi-factor decisions, especially those that are strategic strongly advised to use MFEP for the whole criteria of MFEP method that factors in the decision will be given the appropriate weighting. [6]

The calculation process using MFEP are:

- a. Determining factors and weighting factors. For this stage of each of the criteria of which will be a crucial factor in the consideration of weighting by weighting according to the intuition and subjectivity of decision makers. Ordering the most important factors, the two most important and so by comparing the level of interest from various factors. Weighting called Faktor weighting factor weight. For a total weight of factors must = 1.
- b. Give the weight of each alternative on important factors that have been determined. Values that are loaded are from actual nilai for each alternative and each factor and called evaluation factor factor evaluation. This value is the data that has been processed and will greatly affect the decision-making process.
- c. Furthermore evaluasi weight calculation process (weight evaluation) for each alternative in which the weight of the evaluation is the multiplication of the weighting factors and evaluation factor. $BE = BF * EF \dots\dots (2.1)$

Information :

BE: Weight Evaluation
 BF: Weight Factor
 EF: Evaluation Factors.

The sum of the weights of evaluation for each alternative will produce a total weight of evaluation and the greater the value of the total weight of the evaluation of an alternative then the alternative is someone that the best alternative.

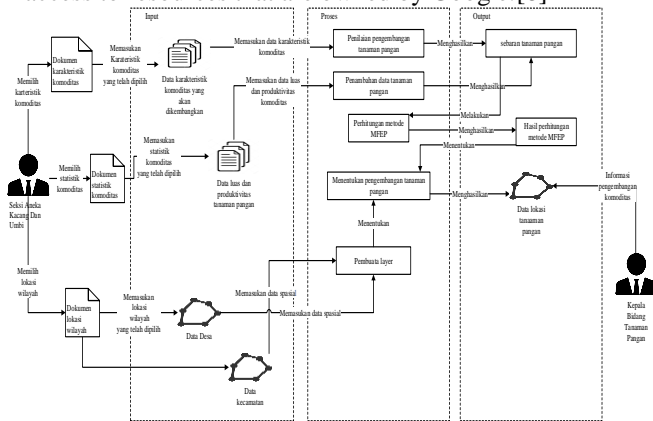
$$TBE = \sum^n *Ben \dots \dots \dots (2.2)j=1$$

Information :

TBE: Total Weight Evaluation
 BE: Weight Evaluasin : many factors.[7]

2.5. Analysis of Geographic Information Systems

Analysis of geographic information system is one of the stages to find out the geographic information system to be built. software built using google maps in which is integrated with the data teristik ready to use for various purposes. Google maps for the purposes of the analysis was undertaken to identify the google maps API. This is because the third-party software is not allowed to have direct access to resources that are owned by Google. [8]



Picture 1 Geographic Information System Model

2.6. Analysis of Spatial Data

Spatial data on the software to be built include the potential for commodities, food crops land criteria. Spatial data are distinguished by the different shapes and colors in order to convey information in more obvious. Here are the specifications of spatial data on the software to be built can be seen in Table 1 Analysis of spatial data.

Table 1 Analysis of Spatial Data

| No. | Monitoring indicators | Description | Spatial Data | Example |
|-----|-----------------------------|------------------------------|--------------|---------|
| 1 | Commodities land Plant Food | Commodity crop land Class S1 | Polygon | |

| | | | | |
|--|--|------------------------------|---------|--|
| | | Commodity crop land Class S2 | Polygon | |
|--|--|------------------------------|---------|--|

Table 1 Spatial Data Analysis (Continued)

| No. | Monitoring indicators | Description | Spatial Data | Example |
|-----|-----------------------|---|--------------|---------|
| | | Commodity crop land Class S3 | Polygon | |
| | | Commodity crop land Class N | Polygon | |
| 2 | sub-district | District located in the district of Garut | Polygon | |
| 3 | Village | Village located in the district of Garut | Polygon | |
| 4 | Farmers | Distribution of farmer groups that are in a village | Point | |

2.7. Non-Spatial Data Analysis

Non-spatial data (attributes), a separate information from each of the data vector digital maps, required non-spatial data in GIS, which will contain information about spatial data. The data captured includes data crop in 2017, the analysis of non-spatial data used to build the software can be seen in Table 2 Analysis of non-spatial data.

Table 2 Non-Spatial Data Analysis

| No. | Name | Description | Attribute |
|-----|----------------|---|--|
| 1 | Area harvested | Contains data harvested area in the district of Garut | kd_luas, kd_kecamatan, kd_komoditi, spacious, year |
| 2 | Food crops | Contains crops in Garut | kd_komoditi, nama_komoditi |
| 3 | Productivity | Productivity data contain commodities in Garut | kd_produkktivitas, kd_kecamatan, kd_komoditi, productivity, year |

2.8. analysis Dashboard

Dashboard include the components of the status of development food commodities and the total area tanman and Productivity food crops in an area.

2.8.1. Objective analysis and KPI Dashboard Design

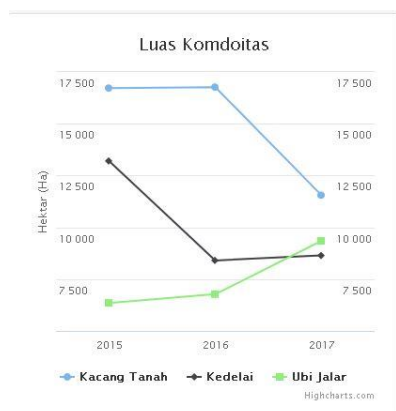
Determining objective Key Performance Indicator (KPI), has the objective to control the spread of food crops that exist in an area. The following is an objective analysis and KPI Dashboard design that will be seen in Table 3 is based on the strategic plan distan Garut district in 2017.

Table 3 Objective analysis and KPI

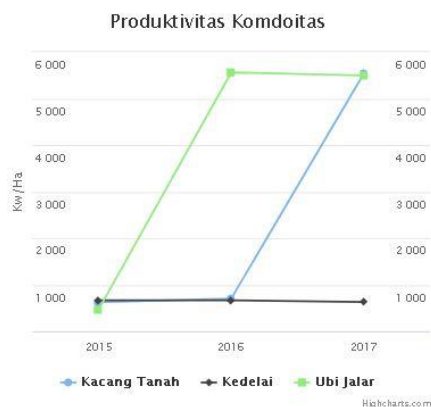
| Primary objective | Sub-Objective | KPI | Target |
|---|------------------------------------|--|--------|
| Supervision of Commodities Distribution of Food Crops | Increased production of food crops | The spread of soybean production of food crops (Ton) | 12,813 |
| | | Spreading the production of food crops peanut (Ton) | 28 227 |
| | | Spreading the production of food crops yams (Ton) | 78 029 |

2.8.2. Chart

The graph in the dashboard will be used to see the visualization and memerlihatkan comparison to total the wide spread of food crops in Garut district, including the area of commodities in 2015 to all districts in Garut district there are peanut area of 16 722 ha, soybeans 13 198 ha, yams 6352 ha, 2016 for an area of 16 766 ha groundnut, soybean area of 83 999 ha, 6775 ha of sweet potatoes and peanuts in 2017 for an area of 11 551 ha, covering an area of 8643 ha of soybean and sweet potato area of 9347 ha.



Picture 2 Size chart Food Crop Commodities



Picture 3 Productivity Graph Plant Food Commodities

2.9. Determiation Analysis of Food Crops Development

Decision support analysis is used to get an overview of the methods used in this study appropriate or inappropriate in resolving the problem. MFEP method is a method that will be used to determine the development of food crops. Here is an example of a plant that will be used based on extensive statistical data harvest or low production in 2017 per districts in Garut:

- Peanuts
- Soy
- Sweet potato

As for the other criteria which serve to determine the development of commodities, namely:

- The availability of water / rainfall
- Texture
- Drainage
- temperatures
- Avalanche danger

From the above criteria can give weight value of each criterion. Furthermore, the weighting is done for each individual plant. For a sample of input data which will be used based on data from farmer groups that Jadimandiri farmer groups in the village along with katrakteristik Panawa food crops in 2017.

Here are a range of factors suitability of which is owned by the peanut plants.

Table 4 Land Suitability Factors Peanut Plant

| No . | Factor | Land Class Range | | Alternativ e weights |
|------|---|------------------|------------|----------------------|
| 1 | The availability of water / rainfall (wa) | S1 | 400-1100 | 100 |
| | | S2 | 1100-1600 | 75 |
| | | S3 | 1600 -1900 | 50 |
| | | N | > 1,900 | 25 |

| | | | | |
|---|----------------------|----|-----------------------------------|-----|
| 2 | Texture (cm) | S1 | > 75 | 100 |
| | | S2 | 50-75 | 75 |
| | | S3 | 25-50 | 50 |
| | | N | <25 | 25 |
| 3 | Drainage | S1 | well, being | 100 |
| | | S2 | rather quickly, somewhat hampered | 75 |
| | | S3 | hampered | 50 |
| | | N | severely hampered, fast | 25 |
| 4 | Temperature (oC) | S1 | 25-27 | 100 |
| | | S2 | 20-25 | 75 |
| | | S3 | 18-20 | 50 |
| | | N | <18 | 25 |
| 5 | Avalanche Danger (%) | S1 | <3 | 100 |
| | | S2 | 3-8 | 75 |
| | | S3 | 8-15 | 50 |
| | | N | > 15 | 25 |

2.9.1. Commodities Development of Food Crops

Application of the method MFEP (Multi Factor Evaluation Process) in the development of food crops.

a. Determining factors and weighting factors

The level of importance of each factor is defined by the shape of the figure for the total weight of the overall factor is 1.

Table 5 Factors Factor Weights For All

| Factor | weighting factor |
|--------------------------------------|------------------|
| The availability of water / rainfall | 0:25 |
| Texture | 0:15 |
| Drainage | 0:2 |
| temperatures | 0:27 |
| Avalanche danger | 0:13 |
| Total Weight Factor | 1:00 |

b. Assigning weights to each alternative

Giving weight to the important factors determined by the number of alternatives that serve as kandidat selection of plants.

Table 6 Evaluation Factors For All Alternative

| Factor | alternative Weight | | |
|--------|-------------------------|-------------------------|--------------------------------|
| | Peanuts (Alternative 1) | Soybean (Alternative 2) | Sweet Potatoes (Alternative 3) |
| | | | |

| | | | |
|--------------------------------------|-----|----|-----|
| The availability of water / rainfall | 75 | 50 | 50 |
| Texture | 100 | 75 | 100 |
| Drainage | 50 | 75 | 75 |
| temperatures | 100 | 75 | 25 |
| Avalanche danger | 25 | 50 | 100 |

c. To evaluate the factors

The process for calculating evaluasi weight (weight evaluation) of each alternative in which the weight of the evaluation is the multiplication of the weighting factors and the evaluation factors.

$$BE = BF * EF \dots\dots\dots(2.1)$$

$$BE_{Ketersediaan\ water / Rainfall} (Alternatif1) = 75 * 0:25 = 18.75$$

$$BE_{Tekstur} (Alternatif1) = 100 * 0:15 = 15$$

$$BE_{Drainase} (Alternatif1) = 50 * 0.2 = 10$$

$$BE_{Temperatur} (Alternatif1) = 100 * 0:27 = 27$$

$$BE_{harmful\ landslide} (Alternatif1) = 25 * 0:13 = 3.25$$

$$TBE(Alternatif1) = 18.75 + 15 + 10 + 27 + 3.25 = 74$$

Evaluasi weight calculation process (weight evaluation) to alternative 1 (peanuts).

Table 7 Weights for the Evaluation of Alternative 1

| Factor | Evaluation Factor (EF) Alternative 1 | Weighting factor (BF) | Weights Evaluation (BE) |
|--------------------------------------|--------------------------------------|-----------------------|-------------------------|
| The availability of water / rainfall | 75 | 0:25 | 18.75 |
| Texture | 100 | 0:15 | 15 |
| Drainage | 50 | 0.2 | 10 |
| temperatures | 100 | 0:27 | 27 |
| Avalanche danger | 25 | 0:13 | 3:25 |
| Total Weight of Evaluation (TBE) | | | 74 |

The first calculation for alternative 1 is peanuts result the total weight of 74.

Evaluasi weight calculation process (weight evaluation) for the second alternative (soy).

Table 8 Weights for the Evaluation of Alternative 2

| Factor | Evaluation Factor (EF) Alternative 2 | Weighting factor (BF) | Weights Evaluation (BE) |
|--------------------------------------|--------------------------------------|-----------------------|-------------------------|
| The availability of water / rainfall | 50 | 0:25 | 12.5 |
| Texture | 75 | 0:15 | 11:25 |
| Drainage | 75 | 0.2 | 15 |

| | | | |
|----------------------------------|----|------|-------|
| temperatures | 75 | 0:27 | 20:25 |
| Avalanche danger | 50 | 0:13 | 6.5 |
| Total Weight of Evaluation (TBE) | | | 65.50 |

The second calculation for alternative 2 is the results obtained soybean total weight of 65.50.

Evaluasi weight calculation process (weight evaluation) for the third alternative (sweet potato).

Table 9 Weights for the Evaluation of Alternative 3

| Factor | Evaluation Factor (EF) Alternative 3 | Weighting factor (BF) | Weights Evaluation (BE) |
|--------------------------------------|--------------------------------------|-----------------------|-------------------------|
| The availability of water / rainfall | 50 | 0:25 | 12.5 |
| Texture | 100 | 0:15 | 15 |
| Drainage | 75 | 0:2 | 15 |
| temperatures | 25 | 0:27 | 6.75 |
| Avalanche danger | 100 | 0:13 | 13 |
| Total Weight of Evaluation (TBE) | | | 62.25 |

Third calculation for alternative 3 is the sweet potato result the total weight of 62.25.

Hasil evaluasi weight calculation process (weight evaluation) for all alternatives.

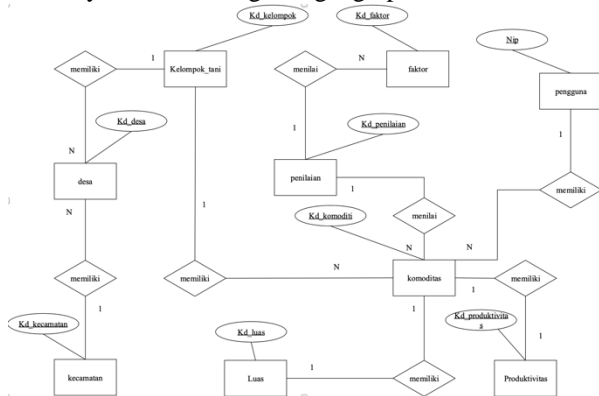
Table 10 Total Weight of Evaluation for All Alternatives

| Rank | Alternative | Total Weight of Evaluation (TBE) |
|------|--------------|----------------------------------|
| 1 | Peanuts | 74 |
| 2 | Soy | 65.50 |
| 3 | Sweet potato | 62.25 |

Recommended alternative is an alternative to the total weight of the largest evaluation that alternative 1 (peanuts) to group of farmers in the village Jadimandiri Panawa.

2.10. Analysis Data Base

Analysis of the data base used to describe and identify data, relating to geographic information



Picture 4 Entity Relationship Diagram

2.11. diagram Context

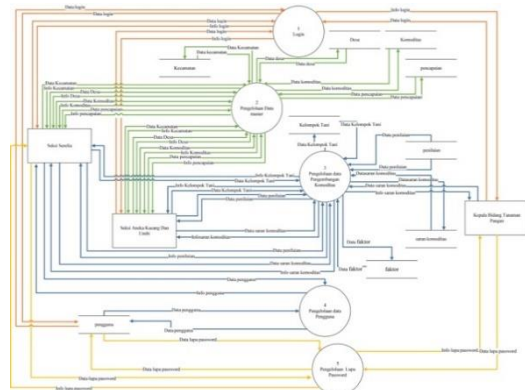
Context diagram is a diagram that shows the relationship between external entities with the software to be built. Where data is dimasukkan by outside component parts will be processed in the system and will generate reports required by external components in accordance with the entered data.



Picture 5 Diagram Context SIG Commodity Development

2.12. DVD Level 1

DFD level 1 Geographical Information System Commodity Food Crops Development in Garut.



2.13. Relationship diagram

Is a relationship diagram of database design. **Picture 6 Level 1 Commodity Development SIG** database development of food crops in Garut.

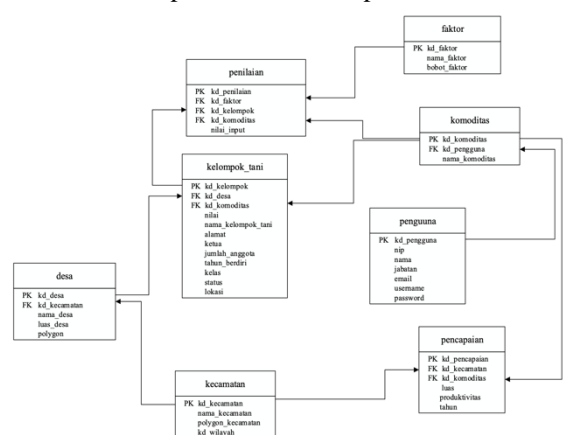


Figure 7 Diagram Relationships

2.14. anatar Advance

Interface design Sexy Assorted Nuts And Bulbs on geographic information system Commodity Food Crops Development in Garut regency are as follows:

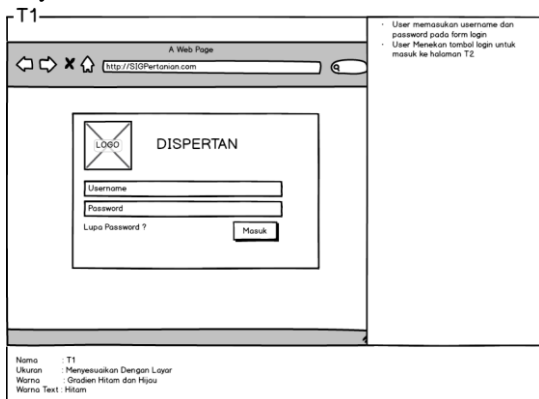


Figure 8 Design Interface Login

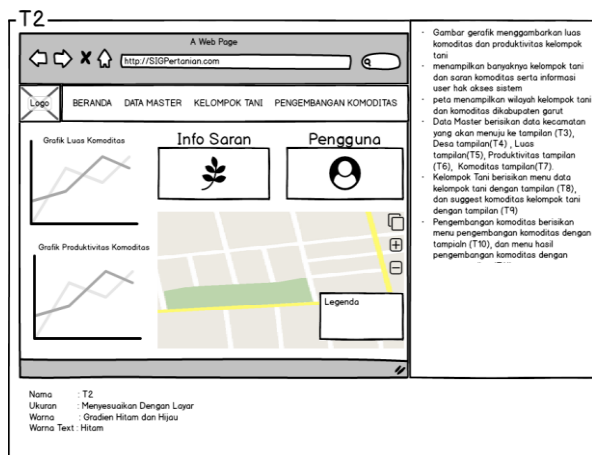


Figure 9 Design Interface Beranda0

2.15. testing Systems

Testing of the system has a goal to find errors or deficiencies in the software being tested. Tests conducted to determine the system has been built fit for use or not. Testing was conducted on the pages Head of Food Crops and Section Assorted Nuts and tubers using blackbox testing strategy.

2.15.1. Conclusion Testing UAT

Based on the results of system testing has been done on the whole it can be concluded geographic information system development of food crops in Garut has been through the stages of repair on each process that generated the expected output.

2.15.2. Conclusion User Acceptance

In this test the software will be submitted kepengguna to know whether the software has been in accordance with user expectations and the work should be expected. Users will provide an assessment of the system using interviews addressed to the mother Dati Widyati, SP, MP who will serve as the geographic information system software development of food crops in Garut

3. COVER

3.1. Conclusion

Based on the results obtained in the preparation of this thesis it is concluded that the presence of geographic information system built to help the Head of Food Crops in developing food crops based on suggestions for suitable land planted with a certain commodity in Garut.

3.2. Suggestion

Based on the results achieved in the development of geographic information system development of food crops still has shortcomings, it is advisable to add things that may include, among others:

- a. For the development of food crops is expected to be equipped with their future to monitor the scope of certain plant diseases and how to handle.
- b. For the future development of this application can be advised to monitor each factor with the original state dilapangannya by integrating tools such as temperature and humidity sensor or soil ph directly (real time).

Similarly, the advice can be given, hopefully these suggestions can be a useful input for a special writer and generally for the Department of Agriculture Garut or others who will develop it.

BIBLIOGRAPHY

- [1] SM Ahmad Adil, Geographic Information Systems, Yogyakarta: Andi, 2017.
- [2] E. Prahasta, Geographic Information Systems Basic Concepts (Perspective Geodesy and Geomatics), Bandung: Bandung Informatics, 2014.
- [3] PPH, 8 Cultivation of Food Crops type Superior, Penebar Governmental 2010.
- [4] PMPN 79 / Permentan / OT.140 / 8/2013, Land Suitability Guidelines On Food Crops Commodities, Jakarta: Minister of Agriculture, 2013.
- [5] ES, "Decision Support System Design Scholarship Reception Method For SAW," 2011.
- [6] PH, Textbook of Decision Support Systems, Samarinda: deepublish, 2016.

- [7] Diana, Methods & Applications Decision Support Systems, Deepublish, 2018.
- [8] RE Mukharil Adam Bachtiar,
"GEOGRAPHIC INFORMATION SYSTEMS MAPPING THE PUBLIC FACILITIES IN THE DISTRICT SUMEDANG WEB," Journal of Scientific Computing and Informatics (KOMPUTA), vol. I, p. 2, 2012.
- [9] SHAIAP, RAISING THE BASIC AGRICULTURAL COMMODITIES FOR PAPERS Grace ,, ,, 2014.
- [10] D. Agriculture Strategic Plan, Garut: Pertiinan Office of Garut, 2017.