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Agricultural Land Use Mapping Analysis Using the Geographic Information System in Temu Village

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Abstract

The agricultural sector remains a significant source of income for the people of East Sumba, particularly in Temu Village, Kanatang District, which spans 46.50 km². In Temu Village, a large portion of the population engages in farming and gardening, utilizing agricultural land that includes rice fields, fields, and plantations. Analyzing the current use of this land is crucial for predicting agricultural yields and proposing optimal land use strategies to ensure sufficient local food production. However, the distribution of agricultural land has not been thoroughly mapped, leaving gaps in information regarding the location and potential of these lands. This research aims to map the agricultural potential of Temu Village using Geographic Information System (GIS) technology through overlay and scoring methods, resulting in informative land use maps. The findings reveal that fields dominate the agricultural landscape with 1.648903 km² or 81.10% of the total agricultural land, highlighting the primary focus on field crops. Rice fields cover 0.270512 km² or 13.30%, while gardens occupy the smallest area of 0.113825 km² or 5.60%. These results demonstrate the potential for effective geographical management of plantations, rice fields, and agricultural fields based on their respective areas.

Keywords: *GIS, Agricultural Land, Temu Village, Overlay & Scoring.*

1. Introduction

GIS has an important role in the development of the agricultural sector aiming to meet the needs of local communities. In addition, the diversity of food sources in the existing agricultural sector may also be a special attraction for tourists from outside the region.
Kanatang District is located on the northern part of East Sumba Island, East Sumba Regency. The area of Kanatang District is 279.4 or 27 940 Km2 hectares with a very common location along the north coast of lowlands and very low and uneven rainfall every year. Where the rainy season is relatively short when compared to the dry season. Kanatang District has 1 Village, 4 Villages and 2 Preparatory Villages with a total of 7 Villages/Villages, especially Temu Village with an area of 46.50 Km2. With a large area of livelihood for the people of Temu Village, some of them are dominant in farming and gardening. The average crop production planted by the community is Rice Fields, Field Rice, Corn, Peanuts, Green Beans, Cassava, Sweet Potatoes, Yasava, Sorghum. Analyzing the current use of agricultural land is very important, because knowledge and understanding of agricultural land allow prediction of agricultural products and raw materials, as well as proposals for the appropriate use of agricultural land, so as to ultimately ensure the maximum availability of agricultural raw materials to meet local food needs in an area. However, the distribution of agricultural land has not been mapped, which can provide information about indicators of the distribution of the location and potential area of agricultural land, especially in Temu Village, Kanatang District

Based on the description above, it is necessary to map the potential use of agricultural land in Temu Village using GIS to provide information related to land use in the form of maps, so that it makes it easier for the government and land managers to identify the potential of agricultural land that produces good crops even in hot weather conditions and agricultural land that has the possibility of drought so that the government can find solutions to face drought and food shortages in the future, because if a lot of agricultural land experiences drought and is no longer used due to the absence of sufficient water sources.

2. Literature Review

2.1. Geographic Information System (GIS)

Geographic Information System (GIS) is an information system specifically designed to process spatial data (in the form of geographical coordinates) and non-spatial data. GIS can be likened to a database system that has a special ability to handle spatial and non-spatial data simultaneously with various work operations [1].

2.2. Overlay

Overlays are an important step in GIS (geographic information system) analysis. An overlay is the ability to place one map graph on top of another and display the results on a computer screen or graph. In other words, the overlay superimposes the digital map and its attributes onto another digital map, resulting in a combined map of the two that contains the attribute information of the two maps. Overlay is the process of combining data from different layers. Simply put, overlay is a visual operation that requires a physical combination of several layers [2].

2.3. Scoring

During the evaluation, each class is assigned a score for each parameter. The score is based on the influence of the class on the event. The greater the impact on the event, the higher the score [3]. To obtain the overall score/score, a value and weight must be given so that the comparison of the two produces an overall value that is commonly called a score. The value given to each parameter is the same from 1 to 5, but the weight varies depending on the influence of each parameter that has the greatest impact on the degree of flood vulnerability [2].

2.4. ArcGis

ArcGis is an open-based geographic information system (GIS) software *Source.* ArcGis provides common features and functions that are easy for users to use. ArcGis runs on Linux (Ubuntu), Unix, Mac OS, Windows, and Android operating systems and supports many vector, raster, and database data processing formats and functions [4].

2.5. Map

According to Baski [5], a map is a traditional image made by depicting the elements that exist on the earth's surface and the symptoms related to those elements. A map is one of the images of the earth's surface that is intended to explain and inform, by using symbols and graphs for information, various manifestations and phenomena that occur on the earth's surface, in accordance with the regulations in force today [5].

2.6. Farmland

Land is one of the main production factors in agriculture. The definition of land according to Article 1 Paragraph 1 of Law Number 41 of 2009 concerning Sustainable Agricultural Land Protection is land that is part of the earth's surface as a physical environment that includes the entire land and everything that affects its use. Climate, relief, geological aspects, hydrology, etc., are shaped by natural or human influences. According to Purwowidodo (1983), soil refers to the physical environment, including climate, soil relief, hydrology, and vegetation, which to some extent affects the ability to use the soil. FAO's definition of agricultural land has almost the same meaning as the previous definition of land. In other words, the definition of land is a region on the earth's surface that has certain characteristics, such as the biosphere, atmosphere, soil, geological formations, and geological formations. etc. belonging. As a result of hydrology, plant and animal populations, and long-term and current human activities, these characteristics have a significant impact on current and future human land use. From the above understanding, it can be concluded that agricultural land is land used for the cultivation of various agricultural crops and other types of plants, or for farming. Agricultural land is needed for farming [6].

2.7. Wetland Agriculture

Wet farming refers to agricultural activities that utilize wetlands. Wetlands referred to as this type of wetland agriculture are soil whose soil contours are a type of water-saturated soil. According to Maltby (1986), wetlands are a term that describes an ecosystem that is formed by the dominance of water and its properties and processes are controlled by water. This means that wetland soils have a high moisture content and are always waterlogged. Examples of wetland agriculture include rice fields (rice), peatlands, wetlands, and mangrove forests [6].

2.8. Dryland Agriculture

Dryland agriculture is a form of agriculture that is carried out on land without water. Dryland is an area that tends to be dry and does not have a clear water source, such as rivers, lakes, or irrigation canals. According to Hidayat et al., (2002) dry land is defined as land that is not flooded throughout the year or all the time. Examples of dry agriculture also include legume cultivation, tuber cultivation, horticulture, fruit tree planting, ornamental tree planting, and shade trees [7].

3. Research Methodology

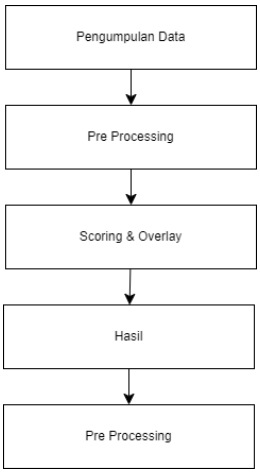

Fig. 1: Research Flow

Information:

1. Data Collection
   Data collection was carried out in Temu Village related to agricultural land data, there was a type of data obtained in the form of excel format obtained from the Agricultural Extension Officer of Temu Village and several farmers. The study used data in 2023-2024 as many as 15 agricultural land data.
2. Pre Processing
   Data analysis is very important because after collecting data, it is necessary to re-check the data that has been collected, and data initialization has been carried out. The following dataset has been prepared for overlay and scoring using the ArcGIS application.
3. Overlay dan Scoring
   The method used to process the data in this study uses the overlay method for evaluation between existing parameters, namely wetlands or rice fields, namely rice, Tegalan or gardens such as corn, sorghum, and other Holtikutura. All of these parameters will be evaluated by determining weights and values according to their respective classifications and overlayed using ArcGIS software.
4. Result
   The results of the classification with field conditions. The classification results were used to see land use in Temu Village, as well as to see land use patterns. This result is expected to be input for related agencies.
5. Conclusion
   A conclusion is a final statement that summarizes the main findings of an analysis, providing a brief explanation of the results and their implications. In the context of mapping analysis.

4. Results and Discussion

This research was carried out in Temu Village, Kanatang District, East Sumba Regency. which has an area of 279.4 Km2. Temu Village which is about 6 Km from the capital city of Waingapu.

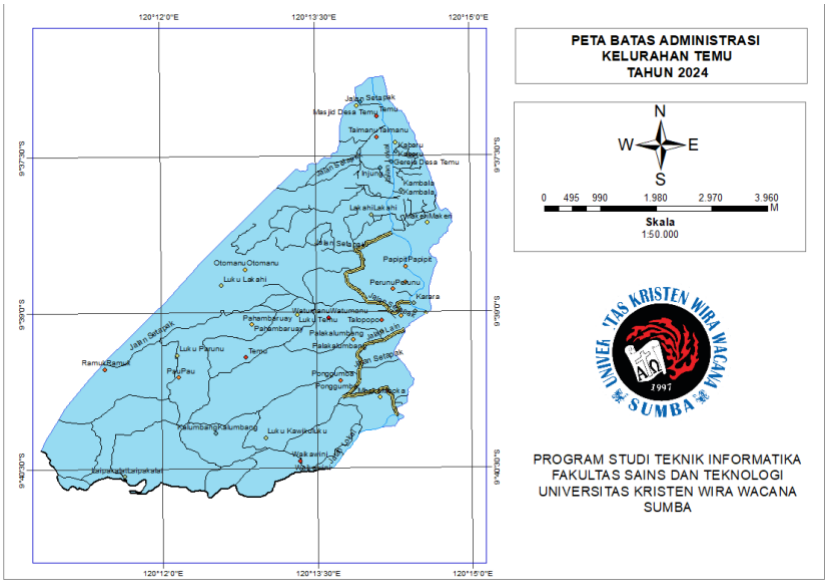

Fig. 2: Administrative Map of Temu Village

In this study, data will be analyzed and processed using scoring methods and overlay techniques. The scoring in this study refers to 3 variables. These variables include Rice Fields, Fields, and Plantations. Each parameter is given a success assessment with existing conditions, the following parameters:

Table 1: Determination of Parameter Weight Value

Parameter	Weight
Paddy	33,3%
Garden	33,3%
Field	33,3%
Total Weight	**100%**

The following are the score values of each parameter:

Table 2: Determination of Parameter Score Value

Parameter	Description	Class	Score
Field	The higher the land use level, the lower the weight of the score	Highly Promising	1
Paddy	The less land use level, the lower the score weight	Potential	2
Garden	The lower the land use level, the lower the score weight	Less Potential	3

4.1. Results of Rice Field Land Use

From the results of the classification of types of rice fields, the weighting can be seen in the following table:

Table 3: Weighting/ Rice Field Score

No.	Parameter Map	Classification/Class	Score	Weight	Weight Score
1.	Rice Field	Paddy	2	33,3%	66,6
2.	Rice Field	Rainfed Rice Fields	2	33,3%	66,6

The weighting and score carried out in the study obtained a map of the types of land in Temu Village, namely rice fields and rainfed rice fields. The score in the table above shows the value based on the land use parameters, the rice field obtained a score of 2 with a weight of 33.3% obtained from three land classes, thus obtaining a weight score of 66.6 which is obtained from the result of the multiplication of the score and weight the following state of the type of land that has been given weighting can be seen in figure 3.

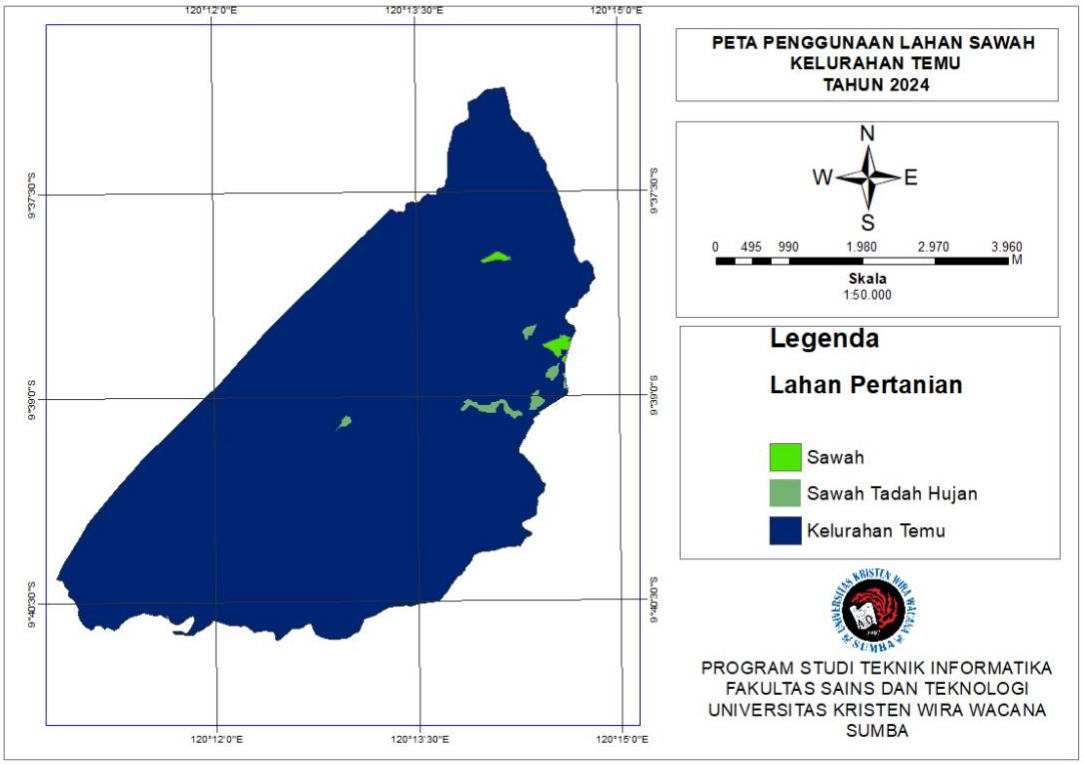

Fig. 3: Rice Field Land Use Map

The figure above is an analysis of the appearance of rice fields and rainfield fields based on the results that have been scored and given each weight on the parameters. So it is known that the potential for the use of rainfed rice fields is greater with a total area (17.788772 Ha) compared to the use of rice fields that only have an area (9.262425 Ha).

4.2. Results of Garden Land Use

From the results of the classification of types of rice fields, the weighting can be seen in the following table:

Table 4: Weighting and Score of Plantation Land

No.	Parameter Map	Classification/Class	Score	Weight	Weight Score
1.	Plantation Land	Plantation	3	33,3%	99,9

The weighting and score carried out in the study obtained a map of the type of land in Temu Village, namely Plantation Land. The score in the table above shows the value based on the land use parameters, the plantation obtained a score of 3 with a weight of 33.3% obtained from three land classes, thus obtaining a weight score of 99.9 which is obtained from the multiplication of the score and weight The following state of the type of land that has been given weighting can be seen in figure 4.

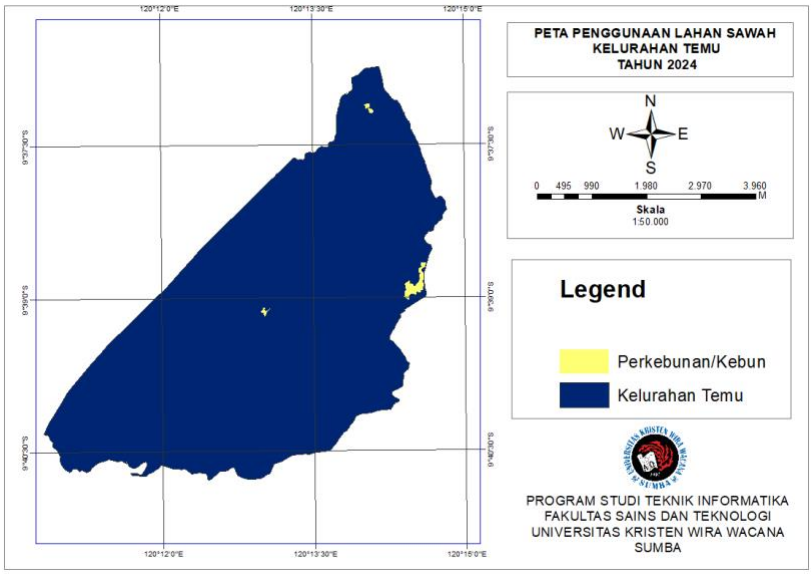

Fig. 4: Plantation Land Use Map

The figure above is an analysis of the appearance of plantation land based on the results that have been scored and weighted on the parameters. So it is known that the potential for plantation land use is very small with an area (11.382458 Ha) in Temu Village.

4.3. Results of Farm Land Use

From the results of the classification of the type of field land weighting, it can be seen in the following table:

Table 5: Farmland Weighting/Score

No.	Parameter Map	Classification/Class	Score	Weight	Weight Score
1.	Farmland	Field	1	33,3%	33,3

The weighting and score carried out in the study obtained a map of the type of land in Temu Village, namely Lahan Ladang. The score in the table above shows the value based on the land use parameters, the field obtained a score of 1 with a weight of 33.3% obtained from three land classes, thus obtaining a weight score of 33.3 which is obtained from the result of the multiplication of the score and weight The following state of the type of land that has been given weighting can be seen in figure 5.

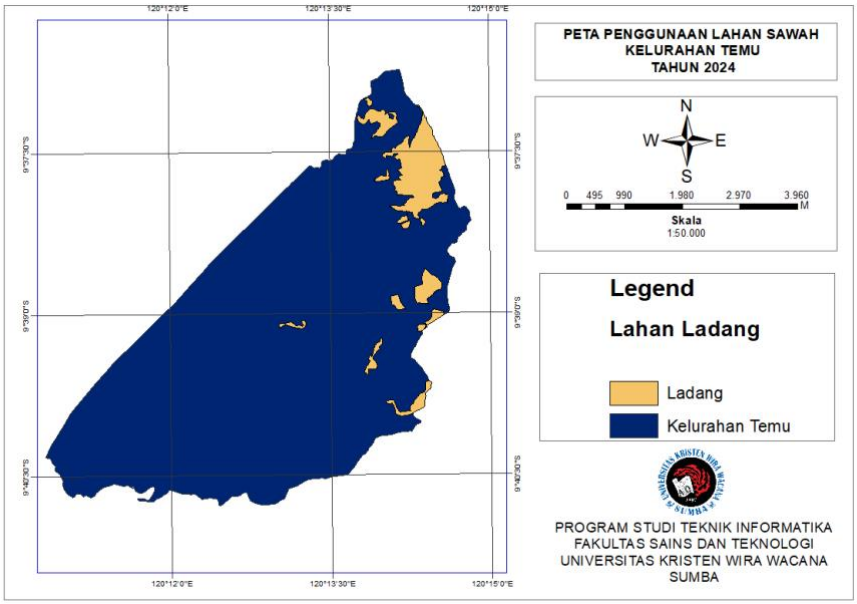

Fig. 5: Farm Land Use Map

The figure above is an analysis of the appearance of plantation land based on the results that have been scored and weighted on the parameters. So it is known that the potential for land use of the field is very large with an area (164.890308 Ha) in Temu Village.

4.4. Overlay Results

After each parameter is assigned a score or value and weight based on the reference table, the next step is to overlay using intersect and union on all premeter maps and then calculate the land use index. The results of Overlay and Scoring of agricultural land use are as follows:

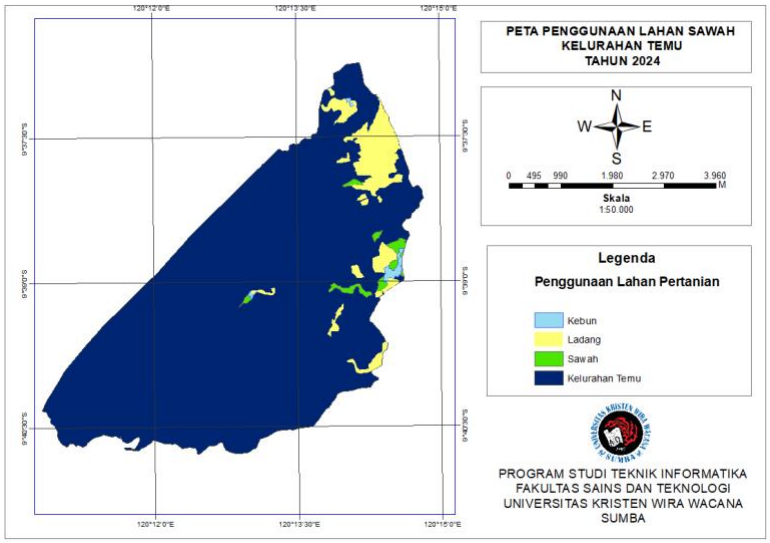

Fig. 6: Overlay Result

The map above shows the use of agricultural land in Temu Village in 2024 after being overlayed. Here is an explanation of the map:

1. Green (Rice Fields): Areas colored green on the map indicate the location of rice fields. Rice fields are scattered in several areas, but it can be seen that most of the rice fields are in the central and northern parts of Temu Village.
2. Yellow (Farm): Areas colored yellow indicate the location of the farm. Fields are the most dominant type of land use, spread across almost all parts of Temu Village. This is in accordance with data that shows that 81.10% of the total agricultural land is used for fields.
3. Blue (Garden): The area colored blue indicates the location of the garden. The gardens are found in several small scattered areas, with most of them concentrated in the southeast and several points in the eastern part of Temu Village. Gardens have the smallest area and percentage of land use compared to rice fields and fields.

From this map, it can be concluded that fields are the most widespread type of land use and are spread in Temu Village, while rice fields and gardens occupy a smaller area and are spread unevenly.

4.5. Result

Table 6: Result

No.	Parameter Map	Classification/Class	Score	Weight %	Weight Score	Class
1.	Field	Palawija	1	33,3	**33,3**	Highly Promising
2.	Paddy	Rice Fields and Rainfed Rice Fields	2	33,3	**66,6**	Potential
3.	Perkebunana	Horticulture	3	33,3	**99,9**	Less Potential

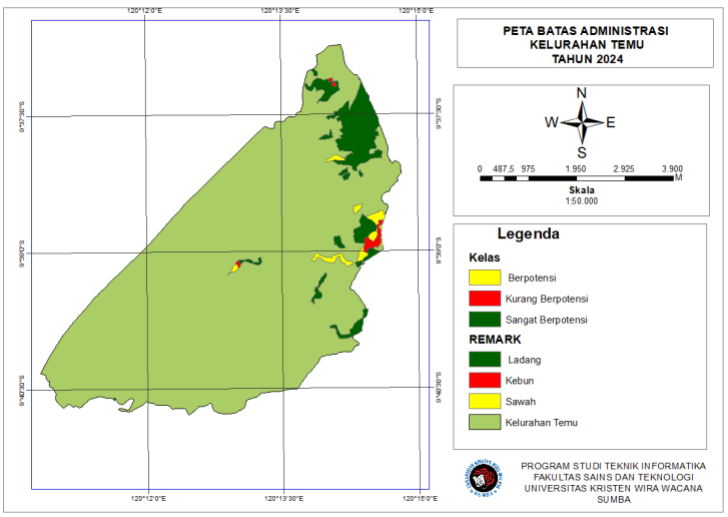

Fig. 7: Map of Land Use Potential Analysis

Presentation of land use area in Temu Village:

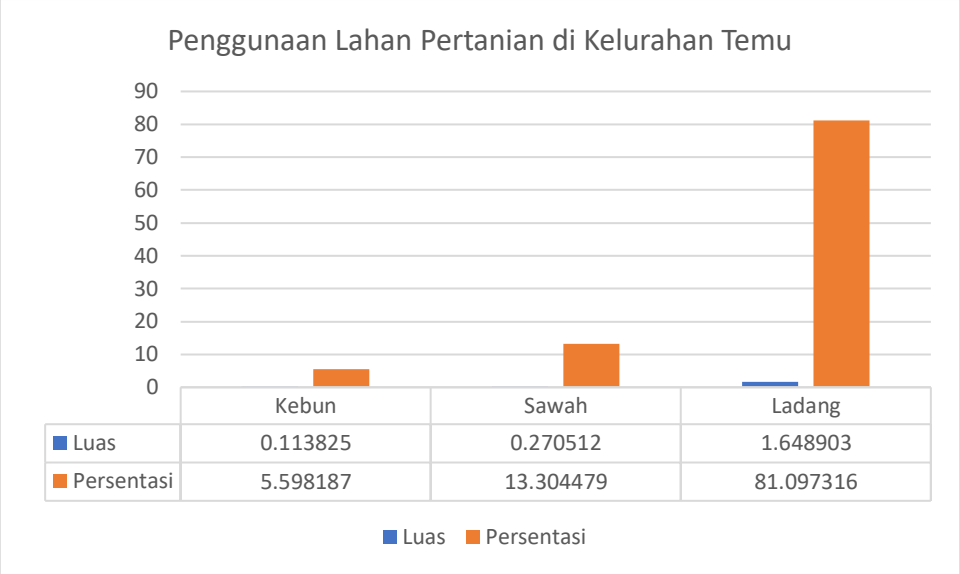

Fig. 8: Presentation of Land Use Area

The diagram above shows the use of agricultural land in Temu Village, which is divided into three types of land: gardens, rice fields, and fields. From the diagram, it can be seen that fields dominate land use with an area of 1.648903 and a percentage of 81.097316%. This shows that most of the agricultural land in Temu Village is used for fields. Rice fields occupy the second position with an area of 0.270512 and a percentage of 13.304479%, which means that only a small part of agricultural land is used for rice fields. Finally, the plantation has the smallest area and percentage of land use, which is 0.113825 and 5.598187%. From this data, it can be concluded that agricultural activities in Temu Village are more focused on the use of fields, with rice fields and gardens taking up smaller portions.

5. Conclusion

Temu Village in Kanatang District, East Sumba, has a large potential for agricultural land with an area of 46.50 km². Most of the people in Temu Village rely on the agricultural sector as their main livelihood, with land consisting of rice fields, fields, and gardens. Based on land use analysis, fields dominate with an area of 1.648903 km² or 81.10% of the total agricultural land, indicating the main focus of agricultural activities on the field. Rice fields occupy the second position with an area of 0.270512 km² or 13.30%, and the garden has the smallest area of 0.113825 km² or 5.60%. Therefore, agricultural activities in Temu Village are more focused on fields, with rice fields and gardens taking up smaller portions. To ensure optimal land use and sustainability of food production, it is important to map land potential using the Geographic Information System (GIS) with *overlay* and *scoring* methods, which will assist the government and land managers in identifying and maximizing agricultural potential in Temu Village.

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