

Analysis of landscape structure and function of Paseh Kidul, Sumedang Regency, West Java

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ABSTRACT

Research on the analysis of the structure and function of the landscape was carried out in Paseh Kidul, Sumedang Regency. Paseh Kidul is a village passed by the national road as a link between provinces, making this village has high mobility. The purpose of this study was to determine the types of landscape structures and land use in the area, as well as changes in land cover and land use from year to year. The research method used was qualitative with descriptive analysis, and the data were collected by direct observation through ground check to the research site using a purposive sampling method, as well as digital observation through the Google Earth Pro. The results showed that there were three main structures in the landscape: matrices, fragments, and corridors. The compositions of the matrices were talun, mixed gardens, and gardens, the fragments were settlements, rice fields, fields, shrubs, and huma, and corridors were roads, ditches, and rivers. Most of the land use in the village was to produce wood to be traded, then spices, rice, and other consumptive crops for personal consumption. Changes in land use could be seen over a five-year period, from 2011 to 2021.

Keywords: land use, landscape function, landscape structure, Paseh Kidul

INTRODUCTION

A landscape is the entire form on the earth's surface that can be seen through aerial photos and satellite imagery. A landscape is the main key to the diversity of ecosystems on earth: different types of landscapes cause different habitats, followed by different ecosystems, and different biomes. The entire landscape space on earth has a different structure and composition, which causes humans to study their forms and types to then find out the advantages and disadvantages of a space. It is the diversity of space makes humans use landscape space to meet the needs of life in the world.

Landscape structure is related to the size, shape, type, and configuration of the ecosystem of the elements that make up the landscape such as matrices, fragments, and corridors. The landscape function examines the flow of energy, matter, and species between ecosystem components (the elements that make up the landscape) [1]

Landscape space in Indonesia is dominated by tropical rain forests and agriculture, but over time, land use has shifted into settlements, plantations, reservoirs, yards, and rivers. These landscape changes can be structural or functional, and can be caused by natural events or human activities. Changes in the function do not necessarily change the structure of the land, but changes in the structure will change the function of the land. For instance, the change in the structure of a forest area experiencing deforestation changes the function as the land is no longer a forest.

Humans as living beings who create and respond to the heterogeneity of spatial space need to understand the basis of landscape ecology. Human knowledge about landscape ecology and its specific structure is needed to determine the spatial layout of a landscape and its possible use to support human needs. Knowledge of landscape ecology can pave the way for other aspects such as economics, spatial planning, geography, landscape architecture, and forestry [2].

The landscape of Paseh Kidul is dominated by 3 main matrices: settlements, rice fields, and talun (mixed gardens). These three main matrices are side by side and spread throughout the area. Paseh Kidul Village was selected as the research location due to its potentials for village development with livelihood sources, such as the sale of wood and rice, for its residents. So far, there has been no data collection

regarding the renewal of the structural plan in Paseh Kidul and the type of land use. Therefore, this analysis of landscape structures and functions at Paseh Kidul, Sumedang Regency, West Java is essential to do.

METHODS

Study Area

Paseh Kidul is a village belonging to the Paseh District in Sumedang Regency, West Java. Paseh Kidul is the center of Paseh sub-district because there is a sub-district office in the village. Paseh Kidul village is surrounded by Paseh Kaler and Bongkok villages in the north, Padanaan and Pasireungit villages in the east, Cijambe villages in the south, and Legok Kidul villages in the west. The Paseh Kidul Village area is divided into three hamlets, including Paseh Hamlet, Sukamulya Hamlet, and Silegok Hamlet [3].

The agricultural sector in Paseh Kidul Village is supported by plantations and rice fields; the latter of which do not yet have a proper irrigation system, but their productivity is still running and has positive results on rice production [3].



Fig. 1. Map of Paseh Kidul, Sumedang Regency, West Java (Google Earth, 2021)

Recorded in 2013 by the Central Statistics Agency (BPS) of Sumedang Regency, Paseh Kidul Village has an area of 187 hectares divided into several types of land use. Agricultural land covers an area of 57.66 hectares, residential land covers an area of 17.4 hectares, and

the remaining 111.94 hectares is used for other land uses such as plantations [3].

Tools and Materials

The tools used in this research included writing instruments, Global Positioning System (GPS), cameras, and worksheets. Stationery and worksheets were used to write down the data obtained while in the field, the camera was used to document the land use condition so that it could be attached to the results, and GPS was used to mark the coordinates of the location.

Methods

The method used in this research was a survey with a qualitative and descriptive analysis approach. This research was divided into three stages: preliminary survey, intensive survey and map making, and analysis of landscape structure and function data. A preliminary survey was conducted to determine the condition of the location through satellite imagery from the Google Earth application. Intensive surveys were carried out by checking points of unknown land use (ground check), and data taken during these processes were in the form of location coordinates, types of plants (on the garden structure), and a brief history of landscape change through brief interviews with the local residents, while secondary data were in the form of area, slope of the area, elevation of the area, as well as topographic maps (RBI) from Paseh Kidul. Map making based on ground check results was carried out after all data were collected in the Google Earth and ArcGIS applications.

Preliminary Survey

The preliminary survey was conducted to gain an initial mapping of the landscape in Paseh Kidul using a GPS-based application: Google Earth. Mapping was done by making polygons on the type of lands that could be identified from the satellite. There were 3 main matrices in Paseh Kidul Village, namely talun (mixed gardens), rice fields, and settlements.

Intensive Survey

Intensive survey in the field was carried out by conducting daily ground checks with different time implementation. Ground check was conducted to analyze secondary data with the primary data in the field based on the purposive sampling method. As additional data, interviews with the local residents were also conducted regarding the history of the landscape, land ownership, and the types of plants found on the land in Paseh Kidul. Documentation was also carried out by taking photos at locations that had marked coordinates to facilitate the process of analyzing land data.

Data Analysis

The results of the data collection were used for data analysis of the village landscape and for the creation of the map of the landscape structures and functions of Paseh Kidul Village using Google Earth and ArcGIS software. Observational data analysis was carried out by formulating the type of land structures and the components within, the function of land according to communities, and the changes in land function that occurred.

The analysis of landscape functions was carried out by examining the relationship of the elements that made up the landscape, in this study, the presence of matrices, fragments, and corridors with natural processes, such as the flow of energy, matter, and species between the ecosystem components. Furthermore, the changes in the structure and function of the landscape, along with the spatial changes, were also studied [1].

The spatial analysis technique used in this research was the superimpose or the overlapping technique of various units of information. Superimpose is a technique of combining several maps or

information on spatial conditions [4]. Superimpose is also often called an overlapping technique that can be used as a data handling system by combining some of the information indicated or by matching the desired criteria or requirements in the characteristics of the research [5]. In this study, the superimpose technique was carried out by combining a digital map with the attribute data which were compiled with the end result in the form of a digital map of Paseh Kidul Village.

RESULTS AND DISCUSSION

Paseh Kidul Overview

Paseh Kidul Village is located at the coordinates 6°47'54.20" South Latitude and 108° 0'5.09" East Longitude. Based on the history quoted from Imanuddin (2017), at first Paseh Kidul Village was a part of the Paseh Village area which was united with the Paseh Kaler Village area. Paseh District was still a part of the Conggeang District area in 2017. After the division of the Conggeang District and the formation of the Paseh District, the four villages were divided into eight village areas, including Paseh Village. In 1982, Paseh Village was divided into two village areas, namely Paseh Kaler Village and Paseh Kidul Village. As the name suggests, Paseh Kidul Village is located in the southern part of the former main village area.

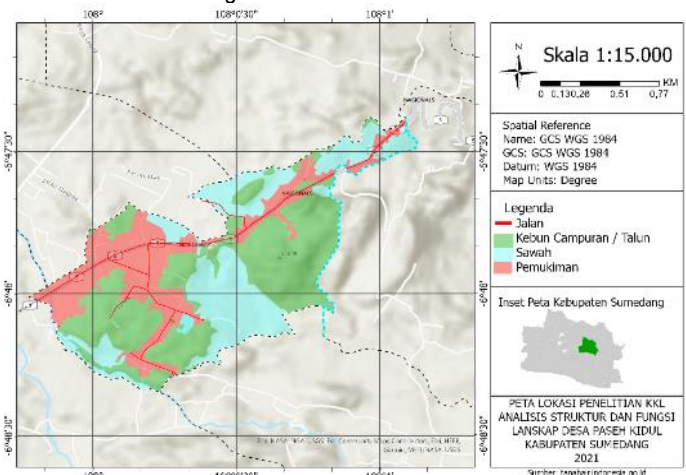


Fig. 2. Map of research site in Paseh Kidul

According to the 2019 Sumedang Regency Central Statistics Agency, Paseh Kidul Village was included in the type of self-employed or transitional village, meaning that it was considered to be developed in terms of technology, culture, and economy. The change in the status from village to the transitional village could be seen from its characteristics in the indicators of livelihoods, production, education, institutions, facilities and infrastructure, application of new technology, and customs [6]. Self-employed villages are ones starting to adapt to more sophisticated technology, while still preserving the customs but not being tied down. They are located not far from the city, making it easier for the residents to access the financial hub and transportation.

Paseh Kidul village has a total area of 187,50 hectares. The area was divided into settlements (17.40 ha), rice fields (58.90 ha), and others, including talun (mixed gardens), fields, roads, and others (111.20 ha) [7]. Based on the data from the Central Statistics Agency for Sumedang Regency, there were no significant changes in the distribution of areas and land types for Paseh Kidul village from 2010 to 2019 (Fig. 2.).

Landscape Structure in Paseh Kidul Village

The types of landscape structures found in Paseh Kidul Village were in the form of matrices, fragments, and corridors. Talun or mixed gardens were included in the matrix in this village because of their natural presence. They were also the largest area value among other landscape structures. However, they also experienced fragmentation due to land use changes. This fragmentation caused the types of talun compositions in this village to be very diverse (Fig. 3.)

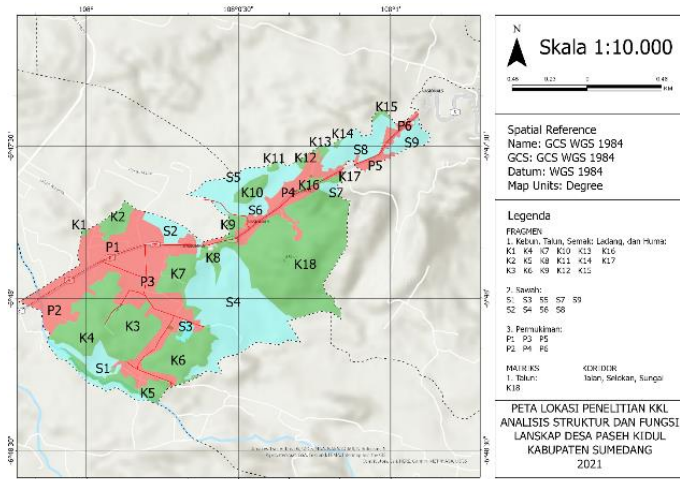


Fig. 3. Map of Landscape Structure in Paseh Kidul (Primary data processed using ArcGIS, 2021)

Matrix

The matrix structure in Paseh Kidul was in the form of a talun or mixed garden. The area of the landscape composition was the widest, and the start of the land changes began with the changes in the talun landscape. There were various types of talun phases in this village, ranging from talun phases one, two, three, to perfect talun. The talun phase is determined from the structure, composition, and human intervention as indicated by the presence or absence of arable land in the form of gardens. Talun with crop rotation system has a combination of three-phase successions: garden, mixed garden or talun, and perfect talun. Talun undergoes a rotation cycle that takes approximately 6-8 years in one rotation [8].



Fig. 4. Mixed garden (talun) in research area (primary data, 2021)

Talun, mixed gardens, and gardens were the largest landscape patch in Paseh Kidul village (Fig. 4.). Some had been converted into settlements or rice fields, some have been converted into homogeneous gardens.

Fragment

The structure of fragments or patches is a form of fraction of the matrix which then undergoes changes in the structure and function of the landscape. In Paseh Kidul, the types of landscape compositions classified into fragments were settlements, rice fields, fields, shrubs, and huma (dryland) (Fig. 5.). Although the rice fields had a large area, the composition was still classified as fragments because of the unnatural changes, and because the origin of the land was from talun (mixed gardens).

The shape of the entire fragment was highly diverse and irregular. Rice fields were the fragments with the largest area, followed by settlements. In the rice field fragment, there were fields that had not been harvested, would be harvested, and had been harvested. Harvest time from the rice fields in Paseh Kidul Village varied so that it could meet the primary needs of the villagers in each season.



Fig. 5. a) Rice fields; b) corn fields; c) peanut gardens, d) shrubs (primary data, 2021)

Corridors

Paseh Kidul village is passed by the national road which connects the provinces in Java island (fig 6.). Therefore, Paseh Kidul Village has a high level of mobility due to the influence of the road. The national road stretches from east to west, cutting Paseh Kidul Village into two parts. This national road dividing Paseh Kidul Village could be considered as a corridors as important structures in a landscape because of their function as a pathway for energy, commodities, and transportation.



Fig. 6. Road (2021)

Corridors are not limited to roads, but include rivers and drains. In Paseh Kidul, there were adequate drains in residential areas, while around the national road the drains did not function as they should have. The ditch extended from the residential area to the rice field in the south, making it a dumping ground for the irrigation of rice fields which then flowed into the talun to the river.

Land Use Classification in Paseh Kidul

The land use was divided into six classes, namely talun (mixed gardens), settlements, rice fields, fields, shrubs, and huma. The people of Paseh Kidul used all available land to meet their primary needs and to be a source of income. From the talun gardens found, there were mahogany, teak, and alba trees planted in adjacent locations. The three trees were a source of income for the residents of Paseh Kidul village, either by selling the logs wholly or by crafting them.

Talun also contained fruit plants, medicine, and spices because apart from being a source of income, talun was used as a food source for the community. Cassava was also a plant that was often found in talun and mixed gardens. This was because cassava, apart from rice, was the people's staple food.



Fig. 7. Place of the Woodworker in Paseh Kidul (2021)

Rice fields were also one of the lands that were the pillars of the lives of the residents of Paseh Kidul. The rice fields in this village were intended for private consumption by the community.

Huma found in Paseh Kidul village was dry lands, formerly rice fields that were no longer productive. The average huma in this village was empty land or planted with beans, taro, and onions.



Fig. 9. Drylands (Huma) (Primary data, 2021)

Land Use Changes in Paseh Kidul

Based on data obtained from Google Earth Pro, Paseh Kidul experienced significant changes to the composition of the land. This also affected changes in land use by individuals. Rapid population growth and the increasing demands of community needs for land often resulted in a conflict of interest over land use and a mismatch between land use and the designated plan [9].

The photos taken in 2011, 2016 and 2021 above show changes both in the land structure and the use occurring in Paseh Kidul Village. According to the Central Statistics Agency of Sumedang Regency, the area of rice fields increased from 106 hectares to 121 hectares in three years. This proves that there was a change in land use from talun or mixed gardens to rice fields, as shown in the picture above. Based on Google Earth imageries, in 2011, the area of rice fields was 58,9 ha, whereas mixed gardens had an area of 111,2 hectares. The increase of rice field area occurred from 58,9 hectares in 2011 to 121 hectares in 2021. The area of rice fields increased over time, as were the settlements. The expansion of settlements was also a sign of changes in land use by residents as the population increased.

Landscape fragmentation in Paseh Kidul Village was included in the type of fragment formed due to disturbance (disturbance patch). It was based on the existence of settlements and rice fields that were formed irregularly and caused the talun or mixed garden area to experience fragmentation. The fragments were created as a result of disturbance to the matrix, such as settlements or land acquisition for oil palm and rice fields [10].

The rice fields in Paseh Kidul had undergone a change of irrigation method for rice fields: technical and non-technical irrigation. Technical irrigation is a separation system between the irrigation network and the drain network. The irrigation channels direct irrigation water to the rice fields and the drainage channels carry water from the rice fields to natural ditches which will then discharge it into the sea. Non-technical irrigation is an irrigation and drainage system that is still combined into one line. This can happen if the location of the rice fields has abundant water sources and is located on steep hills [11].

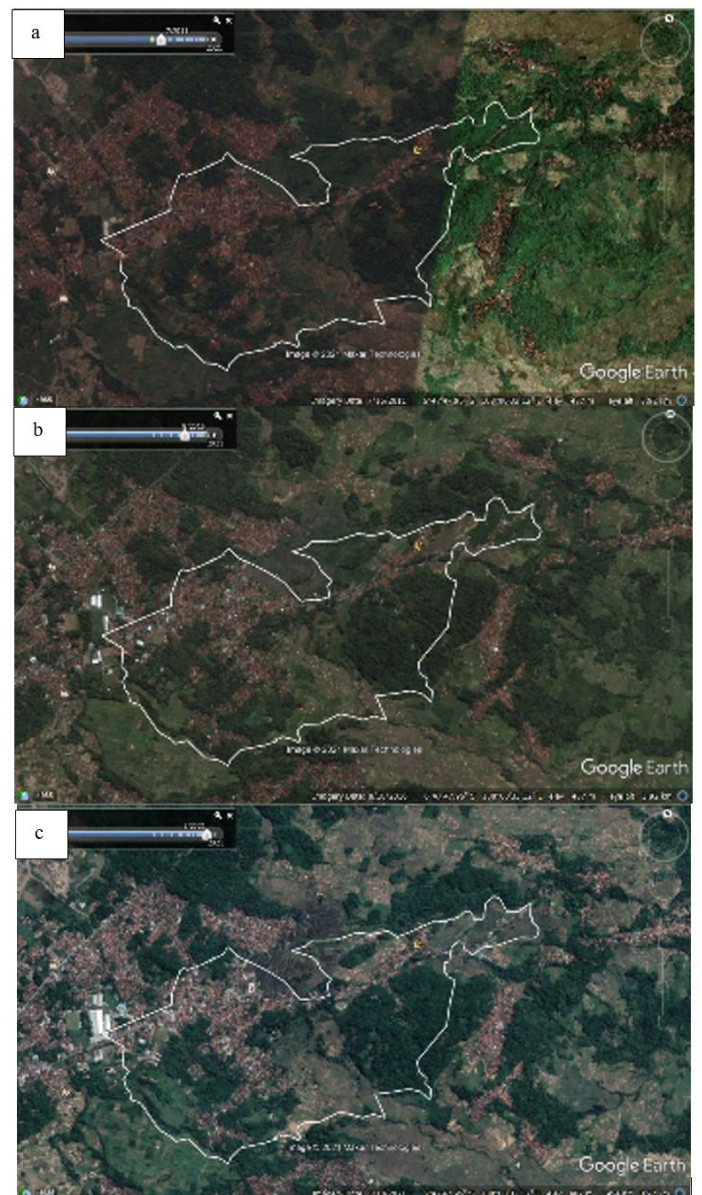


Fig. 10. Land Use Land Cover Changes in Paseh Kidul in a) 2011; b) 2016; and c) 2021

In 2014, there were 58 types of non-technical rice fields and no types of technical rice fields in Paseh Kidul Village, but in 2018, there were 121 hectares of technical rice fields and no non-technical types of rice fields. It was concluded that the irrigation system in Paseh Kidul experienced a good development so that the local government was able to improve it.

Brief interviews regarding the condition of the land were also carried out and information was obtained about the composition of the natural land, namely talun. Respondents provided information that the existing rice fields and settlements used to be in the form of talun which became the habitat of many mammals and birds. Over time, the composition of the land changed and the previously existing animals moved.

CONCLUSION

Talun (mixed gardens) and gardens were the largest matrices found in Paseh Kidul Village, with the diversity of plants contained in them. Settlements, rice fields, fields, shrubs, and huma were fragmented structures within the Paseh Kidul Area. Roads, ditches, and rivers were part of the corridor structure that functioned in the movement of energy from one place to another;

Land use in Paseh Kidul Village was divided into sources of income and personal consumption. In the talun, the presence of mahogany, teak, and albasia trees was intended to be traded, either wholly or in the

form of crafts. Not only that, there were also types of spice plants, trees, and others that were used for personal consumption by individuals. The rice fields in this village were mostly harvested for personal consumption as basic food needs;

Changes of land use and land cover could be seen per five years from the Google Earth Pro. The results of short interviews with communities also provided an explanation of the natural composition of the village, namely talun or mixed gardens. The area of rice fields increased over time, as were the settlements.

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