Landform analysis to arrangement “Land Utilization Type” in Galur Sub-District, Kulonprogo

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Abstract. Galur is one of the sub-districts in Kulonprogo Regency. Its land usage is dominated in intensive agricultural usage. The various types of the agricultural activities in study area has different type of land productivities depends on its land capabilities. Land capability analysis with landform approach become the base in this study to identify the sustainable “land utilization type” (LUT) and the land productivity optimal value in Galur sub-district. Observation, measurement, and interview was done by using the Land Classification and Land use Planning (LCLP) tool. Landforms that has productive value identified in this study are: alluvial plain (IIId-3), beach ridge (IIIP-2), and beach (VIIIP). The usage of alluvial plain could be rice-corn/nuts-rice or could be replaced with rice-chili-rice. The usage of beach ridge could be the planting of plantation crops such as melon, onion, and chili, and could be the farming of goat and chicken. Land usage type in beach is left naturally because it has land capability type VIII (low capability).

1. Introduction

Galur Sub-district is one of the sub-districts in Kulonprogo Regency. It has seven villages with total area of 3,291.23 hectares. Its land morphology shape is flat terrain with a slope ranging from 0-3% and some area is belong to the southern coastal region of Kulonprogo Regency. The dominant land use in this area is agricultural usage. The details are: 36,57% rice field, 34,79% is dry land, and 28,65% is buildings, roads, etc. [1]. Those land characteristics support intensive agricultural activity because it is easy to cultivate land and has sufficient water availability.

Various agricultural activities in study area has different type of land productivities depends on its landform characteristics and geomorphological processes. The optimal land use effort requires a planning that takes the capabilities and types of land use into account. The planning hopefully could reduce land degradation [2] and could achieve optimal land productivity [3].

Landform-based land capability evaluation is carried out to provide an understanding of the relationship between land conditions related to land capability and land use. The results of the evaluation of land capability could provide management information related to land use guidelines that are appropriate, optimal and sustainable so that it is also necessary to determine land use in accordance with economic and social conditions[4]. Detailed information on land use is carried out using the land utilization type approach.
This study aims to evaluate land capability and land suitability in Galur District, Kulonprogo Regency. The land evaluation activity carried out has three specific objectives, namely: (1) assessing the landscape and its characteristics; (2) arrange agricultural land utilization. (3) and evaluate land for allocation of potential land use.

2. Method

Analysis of landform characteristics and its land use is done by observation, measurement, and direct interviews in the field with a purposive random sampling method. Samples were selected based on landforms as a result of interpretation of slope, river and land use data obtained from DEMNAS data and RBI Map 1:25000. In addition to landforms, land use aspects also determine the sampling to determine potential agricultural land according to land capability and land productivity.

Data collected includes parameters of land capability, namely slopes, soil texture, drainage, erosion sensitivity, effective depth, gravel / rock distribution, and the threat of flooding. Observations and measurements in the field are done by quick and qualitative way. While the interview was carried out incidentally.

The land capability classification refers to Hockensmith and Steele (1943); Klingebiel and Montgomery (1973); [3] which is explained based on the intensity of the inhibiting factors, namely the threat of erosion, excess of water, barrier of plant roots development, and modification such as the threat of landslides. Land is classified into eight classes expressed in Roman numerals (I until VIII).

Land capability analysis is performed using LCLP (Land Classification and Land Use Planning) software. The method used in the LCLP software to determine land capability classes is the matching method. This method is done by matching or comparing the characteristics of each landform with the land capability class criteria determined through consideration of limiting factors [5].

Land-use preparation is done by using a land-use type table (Land Utilization Type). The detailed information described includes physical, social and economic conditions in a type of land use[4]. Data collection is done through land use incidental interviews on each form of land and different land-use businesses. Data collected in the interview activities are the area of land used, the business capital used, the technology used to the yields obtained annually.

3. Results and Discussion

The landform in Galur Subdistrict, KulonProgo Regency is largely controlled by fluvial and marine processes. Two types of landforms are classified based on geomorphological characteristics, namely genesis, surface morphology, and geomorphological processes. Morphological data, land use and imagery are the basis for landform classification interpretation.

Interpretation of land surface morphology using DEMNAS with 8m resolution shows that the study area is dominated by flat relief with a slope of 0-3%. Geomorphological processes that occur have an association with the existence of rivers, which include the downstream part of the Progo Watershed and the sea, which is dealing directly with the Indian Ocean. This condition is characterized by the presence of material produced from the river flow in the western part of Galur District, partly due to the eruption of Mount Merapi [6] and in the southern part is characterized by the presence of a beach that has loose soil material (Figure1).

Fluvial landforms found in Galur Subdistrict such as alluvial plain, natural embankments, flood plains, charred rivers and river valley. Most of the northern part of Galur Subdistrict is dominated by alluvial plains with a slope of 0-3%. The soil characteristics in the upper layer show the dominance of the texture of the dusty loam. This condition is used by local people for productive agricultural land. Alluvial plains have high soil fertility so that they are used as intensive irrigated agriculture [7].
**Figure 1.** Map of Landform in Galur Subdistrict.

| Landform       | Land Utilization | Description Land Utilization Type (LUT) | Commodity | Labour | Land Status | Capital | Technology |
|----------------|------------------|----------------------------------------|-----------|--------|-------------|---------|------------|
| Alluvial Plain | Rice Fild        | Self-made (Corn/Nuts)-Rice             | Rice-     | Help   | Right of ownership | Seeds, fertilizer, etc. | Tractor |
|                |                  | Chili helix and Melon                  | Staff     | Help   | Ownership   |         |            |
| Beach Ridge    | Chili Plantation | Self-made and Help Staff               | Local Onion and Melon | Help   | Usage rights | Seeds, fertilizer, etc. | Modern with the help of machines |
| Beach Ridge    | Onion            | Self-made and Help Staff               |           |        |             |         |            |
| Beach          | Shrimp           | Help Staff with monthly salary and meals |           |        | The Sultan's | Preparation of ponds, seeds, vitamins, feed etc. | Watering with bore wells Diesel for waterwheels |
| Beach Ridge    | Goat Cattle      | Self-made                               | Goat      |        | Private property | Goat 10 months, Coop | Nothing |
| Beach Ridge    | Chicken Farm     | Self-made                               | Chicken   |        | The Sultan's | Equipment, chicks (from PT Tanjung Mas), feed etc. | Lighting |
Table 1b. Table of Land Utilization Type.

| Landform       | Land Utilization | Description Land Utilization Type (LUT)                                      | Land Capability Class |
|----------------|------------------|--------------------------------------------------------------------------------|-----------------------|
| Alluvial Plain | Rice Field       | Rice; 75 ha= 100 kg (7500/kg), (Corn/Nuts); 80 kg (6500/kg) Sold to traders and stalls. Palawija sold in the market | IId-3                 |
| Beach Ridge    | Chili Plantation | Chili = 12 million per harvest.Melon=7-8million per harvest 700m2 Chili is sold in traders,melons bought | IIP-2                 |
| Beach Ridge    | Onion            | Onion = testing. Melon = 7-8 million per harvest 700 m2 Sold to merchants     | IIP-2                 |
| Beach          | Shrimp           | Once harvest = 52.5 million (35000/kg, once harvest 1.5 ton) Sold to merchants | VIIIP                 |
| Beach Ridge    | Goat Cattle      | 25 goats in 1 cage. 1 year sold 5-7 tails at a price of 2 million for large goats and the price of 800-1million for medium goats. There are 5,000 chickens, harvested 35-40 once a day harvesting 1,000 chickens, with the price of 19 thousand / kg one chicken, for one chicken to reach about 2kg-2.5 kg in weight. Sold to the market / sold to traders directly | IIP-2                 |
| Beach Ridge    | Chicken Farm     | Directly purchased by PT Tanjung Mas Crop failure is caused due to disease when it is affected by the disease. It will be harvested and once harvested weight per head is only 1kg | IIP-2                 |

The southern part of Galur Subdistrict which is dominated by marine activities consists of several beaches, such as Trisik Beach, Baru Beach and Bugel Peni Beach. One landform produced by marine activity is the existence of beach consisting of young beach and old beach. Beach is a landform that has a flat topography and is composed of loose material [8]. Beach is bounded by the lowest line from low tide to the highest tide[9].

Old beach is classified based on the image interpretation depicting the appearance of accretion [10].
as a result of deposition of sand material in the highest tidal wave area, but now it is no longer affected by tides [11]. The old beach area found in Galur District is almost a quarter of the study area. With the existence of these landforms, the surrounding community will make maximum use of the plantation area because it is considered quite safe from sea wave interference. Whereas, young beach are used for shrimp ponds and are still affected by tides.

Data processing results from ten parameters of land capability, namely slope topography, gravel / rock, soil texture of lower and upper layers, soil permeability, soil depth, soil drainage, erosion hazard level, flood threat, salinity, and landslide threat in Galur District produced three land capability classes, namely class II, III, and VIII (Figure 4). The percentage of land capability classes II, III, IV, V, and VIII were 70.78%, 19.57%, 3.22%, 1.97%, and 4.45% respectively as listed in (Table 2). In addition, information on the distribution of land capability classes is also presented in (Figure2).

| Landform                              | Land Capability Class | Percentage of Land Area (%) |
|---------------------------------------|-----------------------|-----------------------------|
| Alluvial Plain                        | II                    | 70.78                       |
| Flood Plain, Beach Ridge dan Riverbank| III                   | 19.57                       |
| Natural Dykes                         | IV                    | 3.22                        |
| River Valley                          | V                     | 1.97                        |
| Lagoon, beach, and breaker zone       | VIII                  | 4.45                        |
| Total                                 |                       | 100.00                      |

Landform identification and land capability classification are used as a basis for making Land Utilization Type (LUT). The information contained in the LUT can be used for land evaluation which consists of general land use and land utilization types [4], including their production results (as listed in Table 1).

Table 3 shows the land productivity resulting from landforms that have been calculated for land capability classes. There are three productive landforms that produce farm and agricultural products, namely alluvial landforms with IId-3 land capability class, old beach with IIIP-2 land capability class, and young beach with VIIIP land capability class.

Alluvial plain is included in the land capability class IId-3 (arable land class). In land capability
class IId-3, the land productivity value could be increased by taking conservations to minimize “barriers” in the form of drainage [12]. The use of the land is suitable for medium-to-intensive agricultural activity, such as rice and (corn/nuts) as secondary crops for plant rotation during the dry season. Apart from the reduced availability of water due to the dry season, land nutrient recovery is also a reason for crop rotation [13] so that it will have an impact on the sustainable land productivity value.

The yield of rice productivity in the alluvial plain in one year reaches IDR 700,000.00 for a 75-ha area, while for secondary crops (corn/nuts) in a year it produces IDR 320,000.00 in the same area (Figure 3). The difference in production yields between the two commodities is influenced by the higher economic value of rice compared to secondary crops because the need for more rice yields than secondary crops. Optimization of land use in alluvial plains in crop rotation can be modified by replacing rice- corn/nuts crops rotation into rice-chili crops rotation because based on the productivity results, chili plants have a higher value than the corn/nuts plants, which is IDR 33,900,000.00 for one harvest. When viewed from the land suitability, both chili and corn/nuts plants are suitable in alluvial plains so both of them can be applied (Graph 1). But on the other hand, chili requires relatively high operational costs starting from the price of chilli seeds, tractor rental and fertilizer which reaches IDR 700,000.00 in one planting period.

Old beach landforms are the land with capability class IIIP-2. It is land that has a heavy “barrier” so it needs a special soil preservation [12]. The inhibiting factor (or the barrier) is permeability, where the soil is very easy to escape water because the texture of the soil is dominated by sandy grains that have loose soil. The processing is optimal when the soil is wet and the organic matter is abundant[12].

| Table 3. Land Productivity and Land Capability Class. |
|---------------------------------------------|------------------|-----------------|------------------|
| Landform          | Land Capability  | Type of Plant   | Land Productivity |
|                  | Class            |                 | Per Year         |
| Alluvial Plain    | IId-3            | Rice            | 700000           |
|                  |                  | Corn/Nuts       | 320000           |
| Beach Ridge      | IIIP-2           | Chili           | 33900000         |
|                  |                  | Melon           | 21750000         |
| Beach Ridge      | IIIP-2           | Big Goat        | 9600000          |
|                  |                  | Medium Goat     | 3600000          |
|                  |                  | Chicken         | 78000000         |
| Beach            | VIIIP            | Shrimp          | 140100000        |
Old beach landform has different land use and productivity, between agriculture and animal husbandry. The land uses are derived into agricultural and farming activities. In agricultural activities, the land uses are chili and melons plants, while in farming activities are goat and chicken farms. Of the four types of land use, the most productive land use is chicken farming (Figure 4), which reaches IDR 20,000,000.00 for a single harvest of 1,000 chickens. In one year the chicken farm can harvest six times, meaning that the income earned from poultry for a year reaches IDR 120,000,000.00. However, after deducting the cost of production starting from the initial capital of making cages, chicken feed, chicken breeds, and other equipment which reaches IDR 17,000,000.00, in a year, the productivity generated from the chicken farm is around IDR 78,000,000.00 (Graph 2).

Graph 1. Land Productivity of Alluvial Plain.

Figure 3. The appearance of secondary crops land.

Figure 4. The appearance of chicken farming.
Other kind of farm exist in old beach landform is goat farms. This goat farms are only on a home-scale or small-scale so that in one cage, it only reaches 25 goats. Within a year, the local residents only sells around 5-7 goats at a price of IDR 2,000,000.00 per goat for large goats, while for medium sized goats it only reaches IDR 1,000,000.00 per goat. This means that in a year the income generated from goat farming reaches IDR 6,000,000.00 - IDR 12,000,000.00. These conditions differ greatly from the results of chicken farms. Thus, goat farms could be converted into chicken farms in order to obtain greater land productivity. The reason for this change can be supported because the usage of farm does not regard the quality of land capabilities. On the other hand, local residents must have a wide-enough land to accommodate approximately 1000 chickens to achieve high land productivity.

Utilization of agricultural land contained in old beach landforms are chili and melon plants, resulted in land productivity of IDR 33,900,000.00 for chilli plants and IDR 21,750,000.00 for melon plants (Graph 3). From the difference, it is estimated that chili crop is more productive compared to melon plants (Figure 5 & 6). This condition is supported by lower chili production costs (around IDR. 700,000.00) for rental of tractors, purchasing seeds, fertilizers and others. It is slightly different from the cost of melon production which reached IDR. 750,000.00. However, in the process of planting chili, there are problems occurred including the presence of yellow pests on the chili leaves which can spread to the chili plants next to them and could cause the plant to die. So, when allocating the land to remain as chili farming land, it is necessary to carry out further management to minimize crop failure due to the yellow leaf pest.
Graph 3. Land Productivity of Beach Ridge.

Figure 5. The appearance of chili land.

Figure 6. The appearance of chili land productivity.
The next land use is the land use located in the young beach landform. This land use located relatively close to the coastline or the wave breaker zone. The usage type of land found in this young beach landform is shrimp pond. The young beach landform has land capability class VIIIP. It suggests that the shrimp pond is not appropriate in this landform, because the landform in the land capability class VIIIP must be left in a natural state [12]. Although, the shrimp pond has a high enough production value.

Land productivity produced in young beach from shrimp ponds is IDR. 78,000,000 per year, with three harvest times. However, those ponds often experienced failures when sea water enter the pond causing shrimp easily affected by disease. This condition can occur because the young beach landform area is still affected by tidal zones. Besides, the Indian Ocean waves could cause abrasion [14]. In fact, according to local pond farmers, large waves could cause the collapse of pond embankment which results in the drift of shrimp into the sea. This problem can certainly be overcame by raising and strengthening the pond embankment building so that it is not easily destroyed by the waves.

4. Conclusion

The landforms found in Galur Subdistrict is generally controlled by fluvial, namely alluvial plain, natural embankments, flood plains, charred rivers and river valley and marine processes, namely young beach and old beach. The compilation of land utilization type (LUT) aimed to determine land productivity is conducted by looking at the aspects that describe the land usage such as cropping patterns, capital expended, technology used and the land ownership status. Evaluation and allocation suggestion of potential land use refers to the description of land capability and land productivity values exists in every landform. Rice-crops-rice cropping pattern in alluvial landforms could be replaced to rice-chili-rice pattern. Then, in the young beach landforms, the highest land productivity in agricultural commodities found in chili plants, while in animal husbandry found in chicken farms.

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