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# GEOMORPHOLOGICAL ANALYSIS FOR ASSESSMENT OF COASTAL RECREATION SITES IN THE COASTAL AREA OF TRISIK, KULON PROGO REGENCY, YOGYAKARTA PROVINCE*

by
**Suratman Woro and Tukidal Yunianto****

## ABSTRACT

*The sand dunes and beach ridges area along the south coast of Yogyakarta Special Region are partly potential for a recreation site. The development of the Trisik Coast in Kulon Progo as a recreational area, is feasible for its natural landscape condition and its location, close to the outlet of Progo River. For this purpose, a basic survey should be carried out, in which case, a geomorphological survey may be a part of the survey that contributes to the study of landforms and their processes. Relevant geomorphological aspects, such as morphodynamics of the tidal zone, wind-erosion and flood hazard in the assessment of physical potential of the Trisik coast for recreation have been analysed. Aerial-and ortho-photo interpretation proved to be a useful tool in delineating landforms.*

## INTRODUCTION

Geomorphological reconnaissance are essential prequisites for almost any kind of applied geomorphological work. The field of geomorphology encompasses landforms, processes, genesis in their environmental context (Verstappen, 1960). By analysing these geomorphological data, the geomorphologist may contribute the solution of current development problems.

To develop the coastal area of Trisik as a recreational area, a physical survey should be carried out evaluate its potential. Geomorphological surveying can applied to delineate landforms, because landforms are more recognizable features in the field and on aerospace imagery. By interpreting ortho-photos (1981) and aerial

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photographs of 1971, landforms and related geomorphological aspects for recreation can be identified. The landforms are classified according to their genesis.

Aerial-photo and/or ortho-photo interpretation is a convenient technique that can be adopted in determining inherent characteristics and mapping land units. As considered from its physical characteristics and historical context, the Trisik coastal area is potential for such recreational forms as camping, fishing, and cultural performances.

In the assessment of coastal recreation in the Trisik coastal area, other geomorphological aspects are considered, such as wind erosion, morphodynamics of the tidal zone and the Progo River flood hazards. These geomorphological aspects are analysed in order to determine zones for coastal-recreation.

## OBJECTIVES AND METHODOLOGY

The objective of this paper is to analyse the relevant geomorphological aspects for the assesment of the coastal recreation in the Trisik coastal area, Kulon Progo Regency, Yogyakarta. Aerial-photo and Ortho-photo interpretation has been carried out during the geomorphological surveying and mapping. A geomorphological field survey has been done on the beach for morphodynamic studies.

## LOCATION AND PHYSICAL ASPECTS

The Trisik coastal area is situated in the Galur sub-district, Kulon Progo Regency, Yogyakarta. It is closed to the mouth of the Progo River (Figure 1).

Climatologically, it has a humid tropical monsoonal climate. The characteristic of the climate is reflected by a pronounced dry season which normally lasts from June to October, and wet season which prevails from November to April. The annual rainfall is about 1,994 mm. Lithologically, the Trisik coast is covered by alluvium consisting of gravel, silt and clay. Sand deposits of reworked young volcanic material from Merapi volcano are transported by Progo River. Geomorphologically, the Trisik coast is located within the marine, eolian and fluvial units. Progo River transports sediments into the sea, sea water along the shore yellowish blue. During the wet season flooding may occur in the fluvial plain due to the high peak discharges of the Progo River. In the dry season, wind erosion seriously occurs in the sand dunes area and salt water encroaches up to the fluvial plain near the outlet of Progo River.

Soils are sandy, loamy, and clayey. The sandy soils are distributed along the sand dune areas and the loamy, clayey soils are found in the fluvial plain unit (Dames, 1955). Dry field is the dominant land use in the sand dune areas. Whilst wet rice fields cover the fluvial plains.



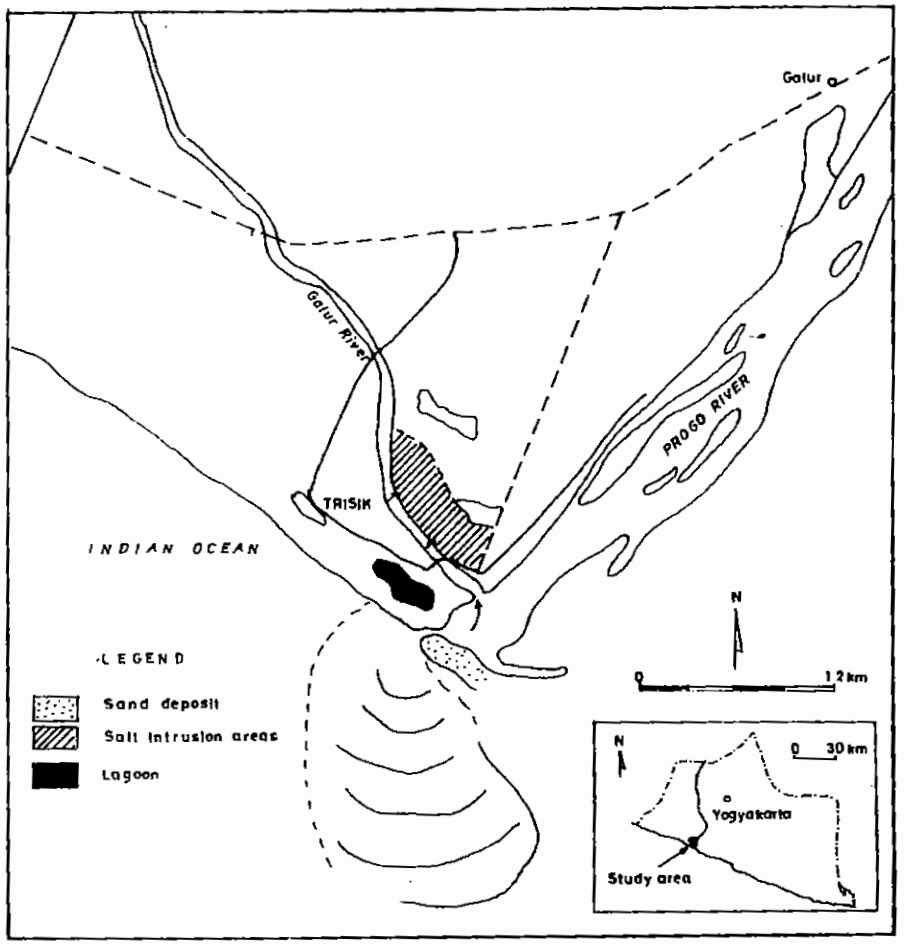



*Figure 1.* The Outlet of Progo River.

## GEOMORPHOLOGICAL ANALYSIS FOR COASTAL RECREATION

### Landforms Analysis

To produce a geomorphological map of the Trisik coast, interpretation of 1981 ortho-photos scaled 1 : 5,000 can be employed. The main geomorphological features to be presented on the maps are landforms and processes (Figure 2). Detailed geomorphological information such as slope, wind erosion, floods and tides, have been collected during the field compaigns.

By analysing the geomorphological map, the following landforms of the Trisik coastal area can be identified:

**a. Progo River, Galur Canal and Lagoon**

The outlet of Progo River is a nice object that shows the contact between fresh and sea water. In the wet season Progo River brings yellowish sediment into the sea and it causes the sea water along the shore to be yellowish blue. In the dry season, the outlet of Progo River is occasionally dammed up by sand deposits (see Figure 1). The Progo River outlet is dangerous for swimming because of the effects of swell and waves, especially during the high tide periods. It is less potential for water recreation due to the effect of sea water and the activities of the Progo River due to floods and river bank erosion. The Galur canal might be used for water recreation, such as swimming and other sports, because of the width and shallowness of its calm water, and the reduced effect of waves.

**b. Active Sand Dunes**

The sand dunes in the Trisik coastal area are irregular and of the longitudinal types. They are formed by eolian process. Field observations show that the agricultural activities are largely absent due to wind erosion and unfavourable factors, such as soil and water conditions. Therefore, sparse vegetation and bare land occur in sand dunes areas; these dunes are suitable for walking or passive recreation to enjoy the nice view of the sea.

**c. Less Active Sand Dunes**

This is partly used for agricultural activities such as growing secondary crops especially in the wet season. The larger part of the area is still in a natural condition with grass and bush cover. The wind action is less active. The land surface is mostly covered by natural vegetation. Therefore, the materials of the dunes are not easily transported by eolian processes. From field observations, it was found that the local people make wind barrier-breaks from local vegetation. These conservation practices should be considered in the development of this area as a coastal recreation site. Forest recreation and camping may be considered as suitable alternatives of recreational activities.

**d. Inactive Sand Dunes**

The wind action in this area is further reduced and depositional processes are less active. The material is mostly fine to medium-grained sands. The vegetation cover and landuse is different from the previous sand dunes. In this area, secondary



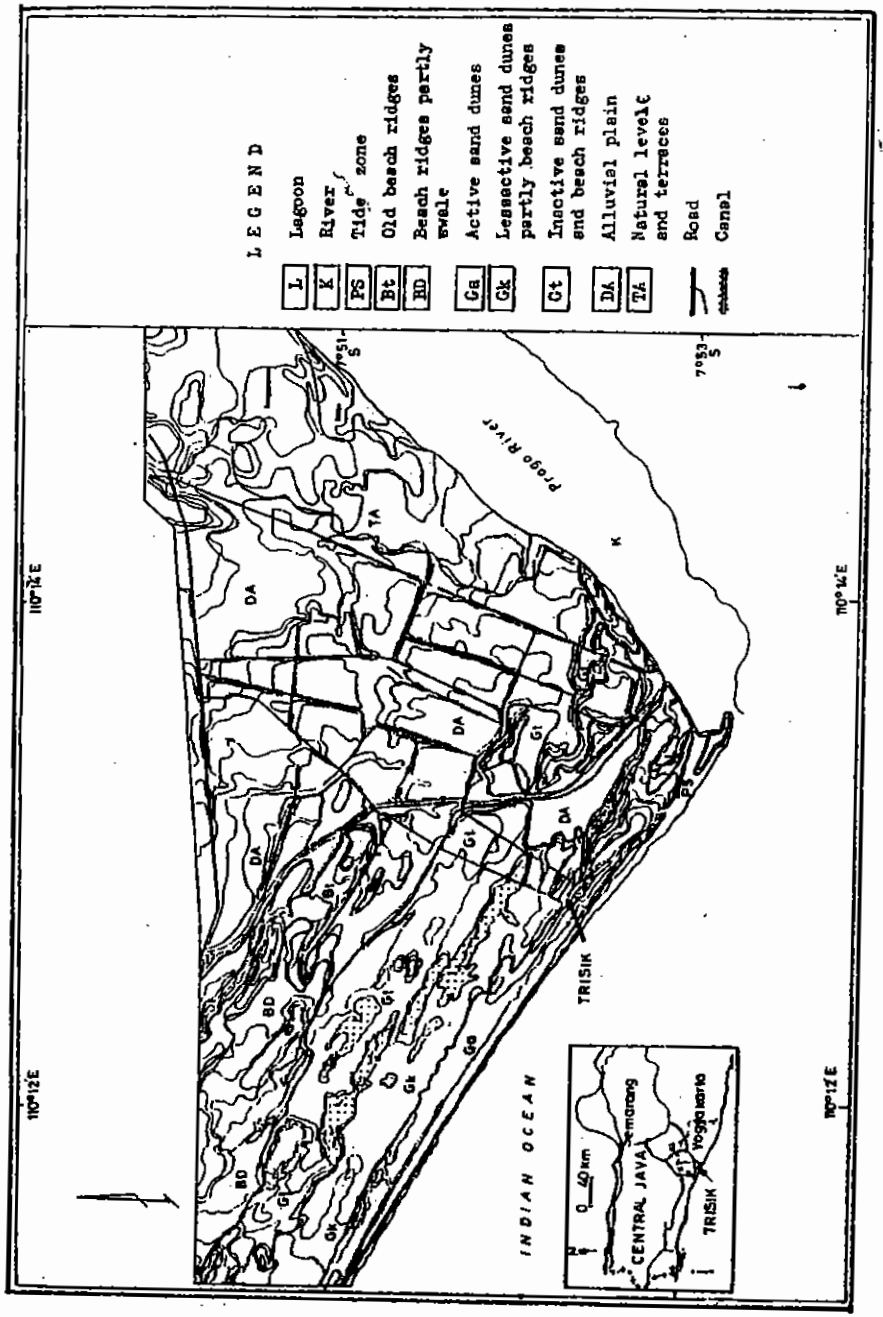



*Figure 2.* Geomorphological Map of The Trisik Coastal Area, Kulonprogo District, Yogyakarta Province.

crops such as groundnut or cassava are found. The sand dunes are less suitable for recreation, since it is rather far from the beach.

**e. Fluvial Plain and Backswamp areas**

It is characterized by a flat topography, poorly to moderately drained. And frequently flooded during the wet season. These conditions allow the farmers to grow such crops as dry field rice. This area is potentially used for agricultural activities. In the dry season, salt water may reach the alluvial plain through the Galur Canal. In the backswamps, the water conditions permit fishery, and therefore, this area is potential for fishing.

### Morphodynamics of the Beach

Morphodynamics is an aspect of studies on morphogenesis. The study of the dynamical effects of waves in the tidal zone is important for water recreation evaluation. The condition of the sea for swimming can be inferred from morphodynamical measurements. Three cross sections are measured in the field, the data are tabulated in Table 1, and presented in Figure 3.

By analysing the map, the sea is not suitable for swimming because of the strong waves. The effect of strong waves is reflected on the presence of the cliff in the tidal zone.

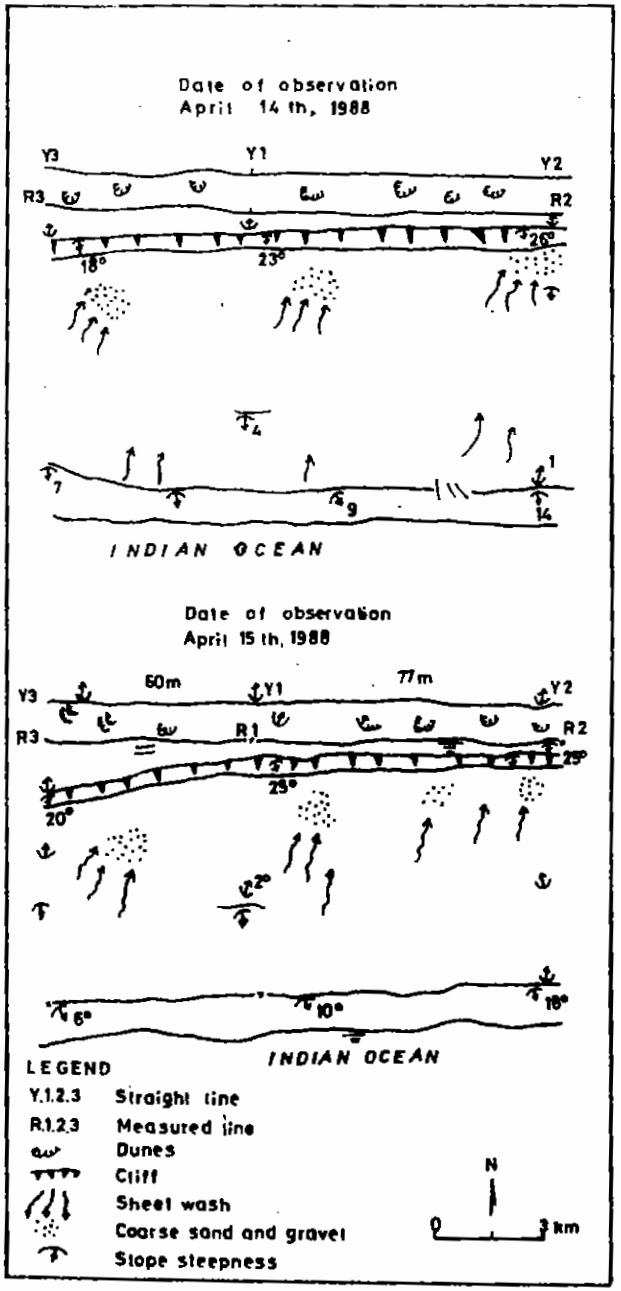
### Wind erosion

In the study area, wind erosion processes can be observed at the zones along the coast. A strip of low, undulating dunes occurs where the young Merapi products nearly reach the coast. The dunes consist of loose sands containing plagioclase, augite, magnetite, some hornblende, hypersthene, volcanic glass and small andesitic rock fragments.

The dominant factors of wind erosion in the study area can be estimated from soil erobility, climate, vegetation, and land use. Soils in the youngest outer dunes are characterized by dark grey colour (7.5 YR 5/0, dry) with wholly unweathered sands, whereas soils on the minor dunes are light brownish grey (2,5 Y 6/2, dry) slightly more silt and clay containing sands to sandy loams.

The greater part of the soils consists of particles of 0.1 - 0.5 millimetres in diameter, and have a weak clod size distribution. These soil characteristics are considered to indicated high erodibility.





**TABEL 1. DATA OF CROSS-SECTION MEASUREMENTS**

Date of observation
April 14th, 1988

Y2 R2 elevation 8 Cm point

| No. | Distance (cm) | angle (%) |
|---|---|---|
| 1. | 2,15 | + 1 |
| 2. | 4,00 | - 26 |
| 3. | 11,90 | - 1 |
| 4. | 22,00 | + 3 |
| 5. | 29,80 | - 1 |
| 6. | - | - 14 |

Y1 R1 elevation 20 Cm point

| | | |
|---|---|---|
| 1. | 5,75 | + 1 |
| 2. | 4,30 | - 23 |
| 3. | 15,90 | 0 |
| 4. | 18,40 | + 3 |
| 5. | 7,15 | - 4 |
| 6. | 20,40 | + 1 |
| 7. | - | - 9 |

Y3 R3 elevation 17,5 cm point

| | | |
|---|---|---|
| 1. | 8,90 | + 2 |
| 2. | 4,10 | - 18 |
| 3. | 24,00 | + 1 |
| 4. | 5,20 | - 1 |
| 5. | 21,20 | + 1 |
| 6. | - | - 7 |

Date of observation
April 15th, 1988

Y2 R2 elevation 7 Cm point

| No. | Distance (cm) | angle (%) |
|---|---|---|
| 1. | 2,10 | + 1 |
| 2. | 4,20 | - 25 |
| 3. | 14,20 | 0 |
| 4. | 19,60 | + 3 |
| 5. | 23,40 | + 2 |
| 6. | - | + 18 |

Y1 R1 elevation 19 Cm point

| | | |
|---|---|---|
| 1. | 6,10 | + 1 |
| 2. | 3,70 | - 25 |
| 3. | 10,00 | 0 |
| 4. | 24,60 | + 2 |
| 5. | 5,40 | - 2 |
| 6. | 6,10 | + 1 |
| 7. | - | - 10 |

Y3 R3 elevation 16,5 Cm point

| | | |
|---|---|---|
| 1. | 9,00 | + 2 |
| 2. | 3,30 | - 20 |
| 3. | 8,80 | - 2 |
| 4. | 15,00 | + 3 |
| 5. | 8,80 | - 2 |
| 6. | 18,80 | - 6 |

Note: Y R = tracing line

The climatic factor of temperature in the dry period, which lasts about four months (May up to August), ranging from 32-35$^0$C in the daytime, plays an important role in the local wind velocity, and desiccation of the land surface.

The low height and low density of vegetation along the coast has a strong influence on wind action. The scanty vegetation consists mainly of Pandanus, Calotropis Gigantea, Canavalid rosea on the dunes and of Ipomea Pes-caprae and [illegible] near the beach.



The inner dunes area can be used locally for agricultural activities, especially on silty soils and in water retaining areas.

## FLOOD HAZARD AND SALT WATER INTRUSION

A coastal alluvial plain is an area which may be subjected to damage by flooding and salt water intrusion. Altitudes of the coastal alluvial plain range from 3 to 8 metres above sea level. The flooding occur yearly, and vary from a half up to three months, i.e. December until January/February. The area is poorly drained with shallow watertables.

The parent materials have fine texture; alluvial river deposits are originating either from nearly limestone of Sentolo Hills or young Merapi Volcano. The soils are generally light grey, dark grey, olive grey or black heavy clays over bluish-grey or olive subsoils.

### Coastal-Recreation Zoning

Based on the geomorphological analysis, the coastal recreational area of the Trisik coast can be devided into seven zones. The zoning is based on landforms, morphodynamic aspects, wind erosion, flooding and saltwater intrusion. The coastal recreation zones of the Trisik coast are then described as follows (Figure 4 and 5).

1. **Water-recreation zone.** The zone extends along the tidal zone, the outlet of the Progo River, Galur canal and lagoon. The most important object for water recreation is the Galur canal because the condition of water of canal itself are stable. While the tidal zone and outlet of the Progo River are more dangerous because the effect of waves and swell.

2. **Passive coastal-recreation zone.** This zone lies within the active dunes areas. Within this zone, a view of the sea can be enjoyed at the day time. The problem of this zone is the relatively high, land surface therefore, this area is suitable for sun-bathing and sojourners under shelter.

3. **Active coastal-recreation zone.** This zone covers the leeward side of the active dune areas, because the wind action is less active here. The zone is more stable dunes, so that playground is available for active recreation in this zone.

4. **Coastal forest-recreation and camping zone.** The zone occupies the less active to inactive sand dune areas. The sand dunes are partly natural and therefore, they should be protected by growing a forest. The coastal forest is intended for conservation and recreation. The sand dune area has a undulating topography, which is considered suitable as a camping area.

5. **Cultural-recreation zone.** This zone is proposed for local cultural performances. The suitable area for cultural recreation is in the inactive sand dunes area. The main reason is that the wind action is very low, therefore the building facilities can be constructed in this zone.

6. **Recreation facilities centre zone.** This zone covers the less active sand dunes close to the main road and village. The recreation facilities to be

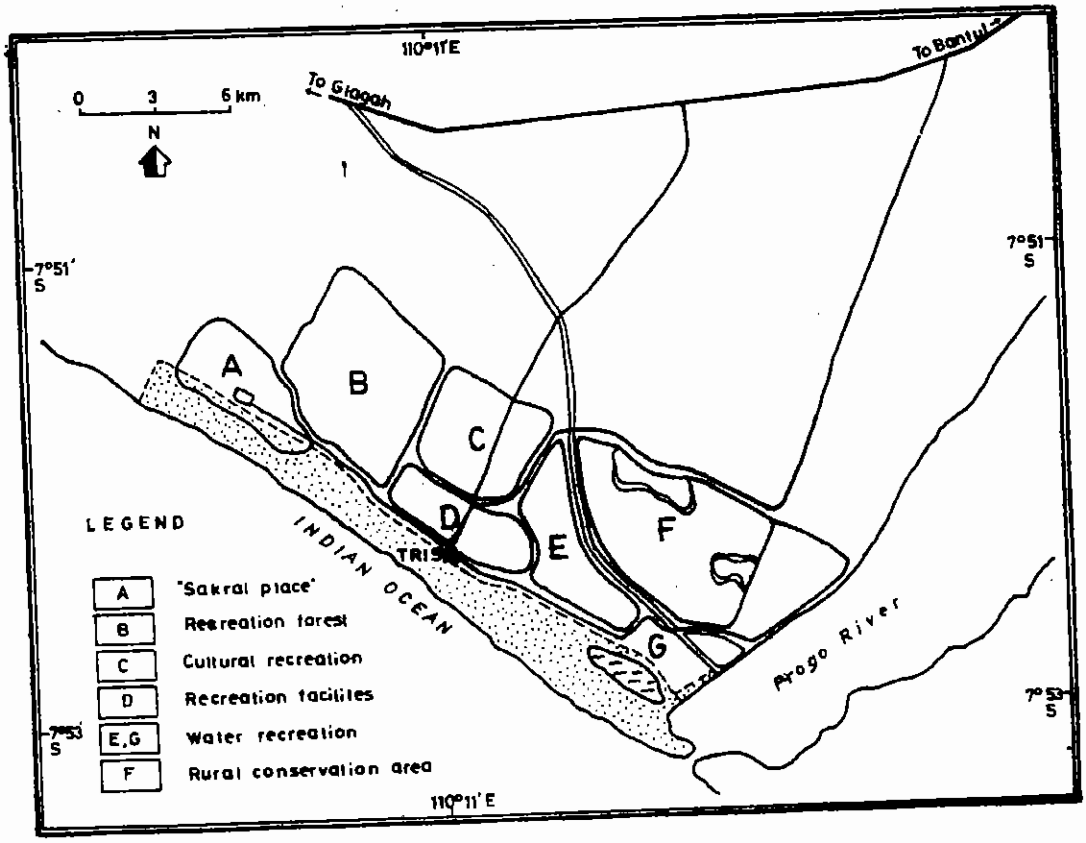
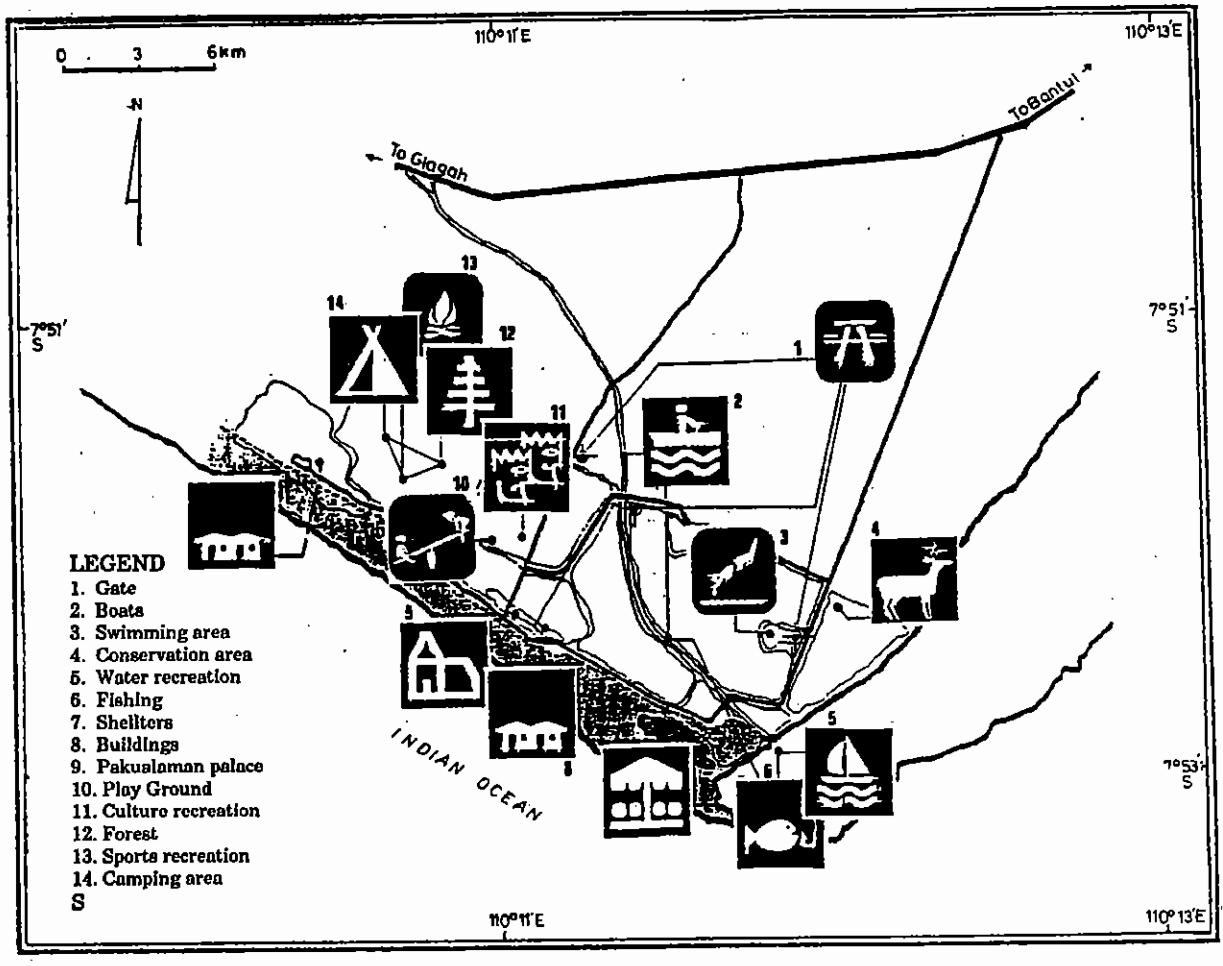



*Figure 4.* Zone Map of The Trisik Coastal Area, Kulonprogo District, Yogyakarta Province.





constructed in this zone are parking area, souvenir shops, restaurants, cottages, etc.

7. **Rural conservation recreation zone.** This zone extends over the alluvial plain and several old beach ridges. In the zone, Tanjungsari village is considered as a specific village for recreation.

## CONCLUSION

The principal conclusion which can be drawn from this study is that the utilization of aerial ortho-photo materials at scale 1:50,000 proved to be very succesfull in delineating the various geomorphological units, which froms the base for a further division into recreation zones.

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