Application of GIS to Identify Potential Areas for Aquaculture in Badulla District in Uva Province

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Introduction

Aquaculture is farming aquatic organisms including fish, mollusks, crustaceans and aquatic plants (FAO, 1990). The main intent of the present study is to highlight the role Geographic Information System (GIS) in identifying potential areas for aquaculture in Badulla district. The study was carried out in Badulla district in Sri Lanka by the geographical coordinates of longitude 80 .45 to 81 .15. Latitude 6 .34 to 7 .18. Data have been collected from secondary sources and used to generate maps to identify fresh water bodies in Badulla district. Map of seasonal tanks, reservoirs and tanks, stream network and rivers of Badulla district were developed. Water availability (proximity to rivers), soil texture, soil pH, rainfall, temperature and topography (slope, elevation) and land use factors were considered to identify potential areas for aquaculture (pond culture). Protected areas are considered as constraints. Water availability, soil texture, soil pH, slope, elevation, rainfall, temperature, land use/ land cover thematic layers were created using ArcGIS 10.1 software. All these thematic layers have been assigned the weights according to their relative influence on pond construction using Analytic Hierarchy Process (AHP) and GIS approach. Finally, all thematic layers have been integrated in a ArcGIS 10.1 environment to generate an aquaculture potential map. Thus, four aquaculture potential areas have been Identified, viz. “Most suitable”, “Suitable”, “Fairly suitable”, “Unsuitable”. The north part of the Badulla district is identified as most suitable and the southern part of the Badulla district is identified fairly and unsuitable for aquaculture in Badulla district.

Methodology

Data collection: Secondary data were collected from secondary sources.

GIS analysis: reservoirs and tanks, Rivers, Stream network of Badulla district were digitized using Arc View 3.1 software. GPS coordinates of seasonal tanks were stored & developed a map using ArcGIS 10.1 software to identify fresh water resources in Badulla district and all data were stored in ArcGIS 10.1 environment and factor thematic layers were generated to identify potential areas for aquaculture.

Analytic Hierarchy Process (AHP) - AHP is a multi-objective, multi criteria decision making approach that employs a pair wise comparison procedure to arrive at a scale of preference among a set of alternatives (Dai *et al*., 2001). Thematic layers were evaluated using scores and each weighted according to their relative importance on the aquaculture using Analytic Hierarchy Process (AHP) and GIS approach.

Map Generation -Each thematic layer was evaluated using the scores that were obtained according to the weighted linear combination in ArcGIS 10.1 environment. Vector format was converted to raster format. To reject the constraints the final result was multiplied by absolute constraints. The protected areas were allocated a zero score. Finally, the potential areas for aquaculture map was created and categorized into four levels: Most suitable, Suitable, Fairly suitable, Unsuitable based on the total scores obtained from the weighted linear combination.

Table 1. Site Suitability to identify potential areas for aquaculture.

Factor	Most Suitable(4)	Suitable(3)	Fairly Suitable(2)	Unsuitable(1)
Proximity to rivers(m)	500	500	>500	-
Soil texture	>40	35-40	35-20	<20
Soil pH	6-7	6-5.5	5.5-5.3	<5.3
Elevation	100	100-500	500-1200	>1220
slope	<5	5-15	15-25	>25
climate Rainfall (mm) Temperature (°C)	2000-2500 >27	>2500 24-26	2000-1600 22-24	<1600 <21
Land use	Paddy lands,	barren/unused lands, Scrub lands	Crop lands, Chena	Rocky, Tea plantations, Build up areas

Results and Discussion

Fresh water resources in Badulla district

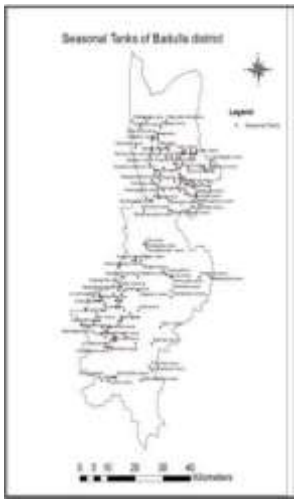


Figure 1. Seasonal tanks

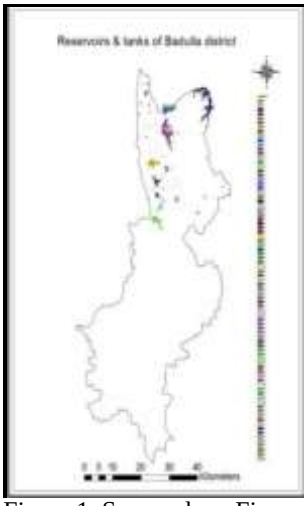
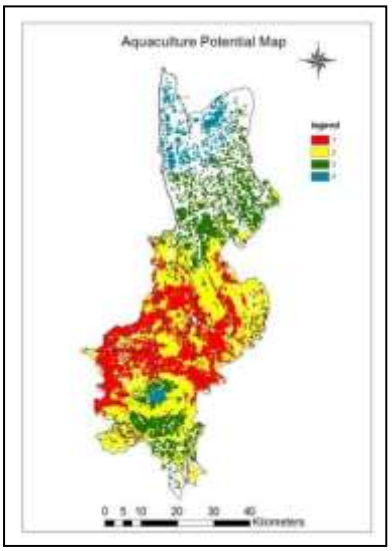


Figure 2. Reservoirs and tanks

Figure 3. Rivers and stream Network

Figure 4. Rivers of study area

Potential areas for Aquaculture – Figure 5 shows the potential areas for aquaculture in Badulla district. The northern part of study area fall under "most suitable" and large area of Mahiyanganaya DS division is the most suitable area for aquaculture and suitable areas are fallen to Ridimaliyadda DS division. The most of the southern part of the Badulla district fall in fairly suitable and unsuitable areas for aquaculture.



The soil texture & soil pH data was limited to 5 locations and the temperature data was limited to 4 locations and rainfall data was limited to 8 locations only because of interpolation techniques is used to generate data for other sites of the study area. The result of the study could be improved by increasing number of sampling locations, adding more specific criteria such as Physico-chemical properties of the water, socio-economic and market related factors, use of quality and up-to-date information and use of remote sensing data. The GIS database was very dependent on rating, weighting, and classifying suitability scores (Aguilar-Manjarrez and Ross, 1995). 1=Unsuitable, 2= Fairly suitable, 3=Suitable, 4=Most suitable

Figure 5. Potential areas for aquaculture in Badulla district.

Conclusion

Large area of Mahiyanganaya DS division is the most suitable for aquaculture and the most of suitable areas are fallen to Ridimaliyadda DS division. The results of this study can be applied in future with most updated and accurate data and can be used for development of other type of aquaculture (cage culture practices in perennial reservoirs).

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