Trans. Inst. Indian Geographers
Vol. 7, No. 2 July 1985

MORPHOLOGICAL CLASSIFICATION OF LAND AND ASSESSMENT OF ITS SUITABILITY FOR VARIOUS USES – A CASE STUDY ON BAVALIPUZHA – ARALAMPUZHA DRAINAGE BASIN

Srikumar Chattopadhyay and M. B. Salim, Trivandrum

ABSTRACT : Morphology forms the basic matrix to promote any kind of economic activity in a region. Due to increasing needs of the society there is a growing tendency to use almost all kinds of land for certain purposes, irrespective of their suitability.

This paper presents an outline of morphological classification of land and assessment of its suitability for various uses in the Bavalipuzha-Aralampuzha drainage basin. Based on the morphogenetic process, 16 environmental geomorphic units are identified under fluvial, land and man-made system. These units are further assessed for suitability of wet land agriculture, tree crops, irrigation, settlement, scientific and cultural interest and conservation. It is observed that a number of units like F_1, F_3, F_6, T_1 and T_2 are highly suitable for wet land agriculture, tree crop and settlement. There is naturally a certain amount of competition to promote these types of landuse in all these morphologic units. Again, the units of F_4, F_5, T_3, T_4 and T_5 need proper conservational measures in order to preserve the ecological balance. An attempt has been made in this paper to identify the morphologic units in terms of conservation as well as development of different functional uses.

INTRODUCTION

The continuous build up of social needs as a result of growing population exerts tremendous pressure on the existing land resources throughout the world, more particularly in the developing countries. Development of cultural landscape in almost all types of land irrespective of their environmental setting has not only caused land degradation but also tends to jeopardise the very foundation of the economy. It is now widely realised that a proper land classification along with suitability assessment for hosting different activities should precede landuse planning. This will help demarcating the most appropriate area for a particular use besides providing a clear idea about the poly-functional landscapes. The latter can be further investigated to formulate specific landuse type in order to obtain the optimum return without disturbing the eco-system.

The morphological system, a resultant of geology, climate, vegetation, hydrology and soil provide a base for land classification. It has a decisive role as far as differentiation and landscape system's properties are concerned (Majur, 1981). This type of study is yet to be taken up seriously in our country though the importance is well recognised. In the western countries, the contributions of Slovak Academy of Sciences (Majur 1981) and Environmental Analysis Group of Spain (1980) are noteworthy in this direction. The present work is an attempt to highlight the importance of this type of study in landuse planning.

STUDY AREA

The Aralampuzha–Bavalipuzha sub basin is located in the north-western flank of the Wynad plateau and covers about 400 sq. km. Morphologically the area is an interesting one having a strong structural control on the drainage pattern (Nair et al 1975). The plateau scarps characterised by steep slopes have been grossly subjected to human interference through deforestation and agricultural activities. Due to sheltering effect of the plateau scarps, this sub-basin is unique for some beautiful low level rain forests. Widespread deforestation, soil erosion and land slides are reported in the area. As a consequence, land has been considerably degraded. Moreover, the population is recorded to exceed 80,000 in 1981. It is thus felt that the area is highly suitable for the type and methodology of work discussed here.

MORPHOLOGICAL CLASSIFICATION

The study area has been classified into 16 morphological units based on morphogenetic systems like fluvial system, land system and man-made system (fig. 1). This classification provides varied information in environmental perspectives, which also help to understand the impact of a number of interacting physical landscape parameters. The identified units are listed in Table 1.

TABLE 1 : MORPHOLOGICAL UNITS

Fluvial System	
F_1	Flood plain/low level fluvial terraces
F_2	Moderate slope adjoining to the flood plain/river course
F_3	Alluvial flood plain away from the main channel
F_4	Fluvial Channel
F_5	Steep scrap plateau slope adjoining the major fluvial valley
F_6	High level flood plain
Land System	
T_1	Gently sloping terrain (around 5^o slope)
T_2	Undulated terrain
T_3	Highly dissected terrain
T_4	Hilly region
T_5	Prominent isolated hill
T_6	Hummocky undulated terrain
T_7	Mesa
Man-made System	
A_1	Major concentrated settlement
A_2	Terraced cultivable fields
A_3	Plantations

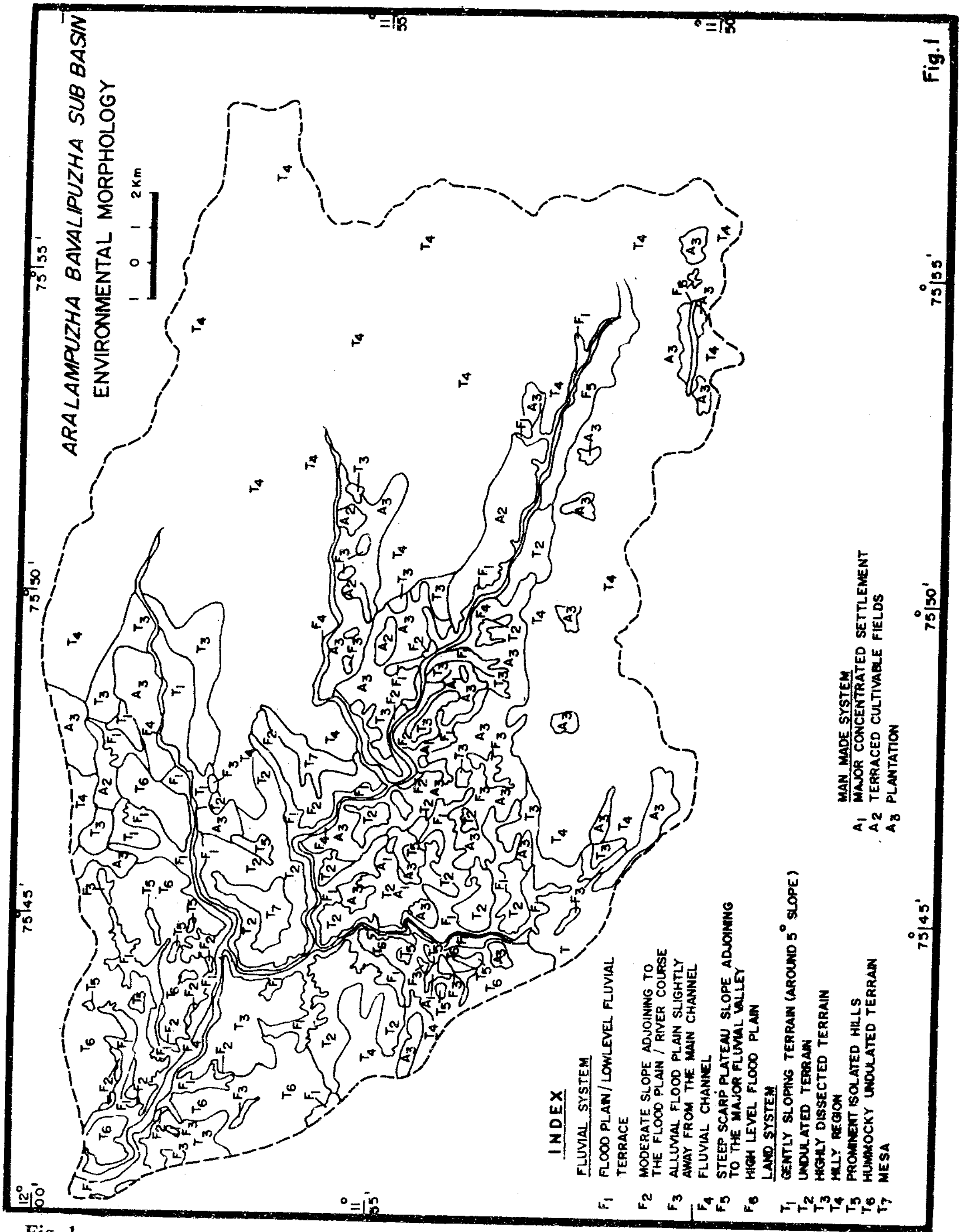
ARALAMPUZHA BAVALIPUZHA SUB BASIN
ENVIRONMENTAL MORPHOLOGY
1 0 1 2 Km
Fig. 1
INDEX
FLUVIAL SYSTEM
F1 FLOOD PLAIN/LOWLEVEL FLUVIAL TERRACE
F2 MODERATE SLOPE ADJOINING TO THE FLOOD PLAIN / RIVER COURSE
F3 ALLUVIAL FLOOD PLAIN SLIGHTLY AWAY FROM THE MAIN CHANNEL
F4 FLUVIAL CHANNEL
F5 STEEP SCARP PLATEAU SLOPE ADJOINING TO THE MAJOR FLUVIAL VALLEY
F6 HIGH LEVEL FLOOD PLAIN
LAND SYSTEM
T1 GENTLY SLOPING TERRAIN (AROUND 5° SLOPE)
T2 UNDULATED TERRAIN
T3 HIGHLY DISSECTED TERRAIN
T4 HILLY REGION
T5 PROMINENT ISOLATED HILLS
T6 HUMMOCKY UNDULATED TERRAIN
T7 MESA
MAN MADE SYSTEM
A1 MAJOR CONCENTRATED SETTLEMENT
A2 TERRACED CULTIVABLE FIELDS
A3 PLANTATION

Fig. 1

The units are arranged under different systems to indicate the dominant role of a particular process in carving them out. The units F_1 to F_6 are principally developed by fluvial processes. The unit F_3 (alluvial flood plain away from the main channel) indicates the older alluvium deposits along a pre-existing channel. The unit F_6 (high level flood plain) points out that the landscape is part of an extensive plateau surface, a product of peneplantation.

The seven units under land system broadly elucidate the present topographic character in terms of ruggedness. The three units under man-made system represent a totally modified landscape irrespective of their morphogenetic conditions.

SUITABILITY ASSESSMENT

Once the morphological classification is completed the next step is to assess those units for various uses or functions. For the present study six types of uses have been considered. The suitability of the units under these six landuse types are given in Table 2.

Analysing this table it is observed that upper two grades (Class 4 and 5) include the units of F_1, T_1, F_3, F_6, T_3, T_6, T_2, F_5, F_2, T_4, T_5, T_7 and F_4 for all these four functions. Excluding scientific and cultural interest group there are only 9 units (F_1, T_1, F_3, F_6, T_3, T_6, F_5, F_2 and T_2) which are suitable for wetland agriculture, tree crops and settlement development.

Gradation of the units for different uses is a subjective assessment supported by field work. For example the units of F_1 (Flood plain/low level fluvial terraces), T_1 (Gently rolling terrain), F_3 (Alluvial flood plain slightly away from the river) and F_6 (High level flood plain) are in upper two grades for wetland agriculture. From the morphological point of view these units are almost flat basin types having scope for simple irrigation and the soil is mostly alluviam. The units of F_3 and F_6 are marked at higher grades compared to F_1 and T_1 for wetland agriculture. The basis of this classification may be justified in view of the fact that crops at F_1 are partially threatened by occasional incidence of flood and the soil at T_1 lacks the productivity of flood plain deposits.

In the case of tree crops, the most suitable units are T_1, T_2, F_5 and F_2 followed by T_3 and T_6. The morphological characteristics of these units are highly suitable for tree crop culture. The units of F_1, F_3 and F_6 are not rated in the first two grades. This is mainly due to the limited extent of this type of land in the study area. This sub-basin with highly undulated topography in the flank of the Western Ghats has limited scope for wetland agriculture like paddy. Hence this type of lands should not be diverted for tree crops.

It is also noted that units like T_1, T_2 and T_6 figure in the upper two grades under the use of wetland agriculture, tree crops and settlement development (Fig.2). The study area or for that matter Kerala as a whole hosts very interesting cultural landscape, where all the settlements are completely surrounded by tree crops like coconut, arecanut and fruit trees. Gross bio-mass production is significantly higher in this state as compared to any other state of the country.

These units are further grouped according to their suitability of irrigation development (Table 3)

To develop agriculture, irrigation facilities have to be provided in the study region in spite of its favourable position in terms of two (south west and north east monsoon) rainy seasons in a year. Monsoo-

TABLE 2 : SUITABILITY OF THE MORPHOLOGICAL UNITS

2 (A) Wetland Agriculture

Class	Units
1	F_4, T_7, T_4
2	F_5, T_6, T_3, T_5
3	F_2, T_2
4	F_1, T_1
5	F_3, F_6

2 (B) Tree Crops

Class	Units
1	F_4
2	T_4, T_7
3	F_1, F_3, F_6, T_5
4	T_3, T_6
5	T_1, T_2, F_5, F_2

2 (C) Settlement

Class	Units
1	T_4, T_5, F_4
2	T_3, F_2, F_5
3	T_7, F_1, F_3, F_6
4	T_6
5	T_1, T_2

2 (D) Scientific and Cultural Interest

Class	Units
1	T_1, T_2
2	F_1, F_3
3	T_6, F_6, F_2
4	T_3, F_5
5	T_4, T_5, T_7, F_4

Class 1 represents least suitable
Class 5 represents most suitable

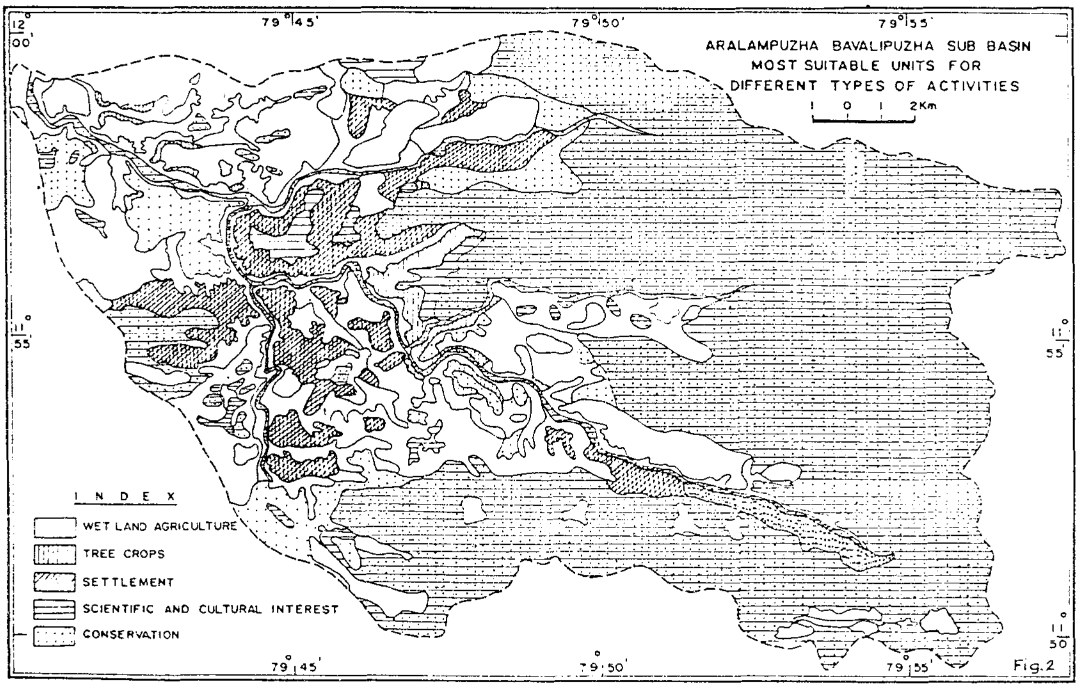

Fig. 2

TABLE 3 : SUITABILITY OF THE UNITS FOR IRRIGATION DEVELOPMENT

Type of Irrigation	Units
Canal Irrigation	T_1, T_2, F_1
Lift Irrigation	F_3, F_6, T_6, F_5, F_2
Well/Tube-well Irrigation	T_3, T_4, T_5, T_7

nal rainfall is erratic in distribution and sometimes north-east monsoon does not provide adequate rainfall to raise crops. Moreover due to undulated topography surface run off is considerably high leaving less moisture in the soil.

The units of T_1 and T_2 are less rugged and hence canal irrigation could be developed easily. But the other units are not suitable for canal irrigation either due to higher undulation or due to location at a higher altitude. The high level flood plain (F_6) and flood plain away from the main channel (F_3) are isolated from the low level flood plain (F_1) and are scatteredly distributed. Hence lift irrigation from the main channels is the only way to develop irrigation facilities. The units T_3 and T_7 can be provided irrigation only through tube wells/ bore wells. T_7 (Mesa), though represent a flat topography is under hard crust laterite. Sometimes the thickness of the crust goes more than a metre. Tube well/well irrigation is the only method to supply water there. The other 4 units are characterised by hills and valleys with high ruggedness index. These units have also to resort largely to tube well irrigation.

ASSESSMENT FOR CONSERVATION

Due to over use and/or misuse large areas have been qualitatively degraded, which need proper conservational measures to restore ecological balance. The land units are so interlinked with each other that degradation of any one of them will trigger a chain reaction, which will destabilise all other units. Hence, alongwith the exercise of identifying suitability for different uses, it is appropriate to separate out the units which need conservational measures. To assess the units for conservation three factors, namely quality (visual as well as potential), erosion proneness and fragility are selected and status of each unit has been ascertained. Erosion proneness of a unit has been worked out by studying the gully source and junction point density and slope. By fragility, it is indicated that the unit is vulnerable to any further interference either due to deteriorating potentials or due to its precarious condition in terms of utility. Table 4 shows status of the units under three factors and total value.

The units of conservation (F_4, F_5, T_3, T_4, T_5) marked in this table are identified by taking 6 (sum of three mediums) as the critical value. Comparing Table 4 with Table 2 (B) it can be observed that the units of F_5 and T_3 though suitable for tree crops, warrant conservation measures. The status of the units in terms of erosion proneness and fragility indicates that further utilisation of these units will be counter productive. Thus in spite of their suitability they should be preserved.

It can be mentioned here that the best possible way to conserve land units is to practice afforestation. Tree crops partly help in this direction but due to lack of under growth, the erodability could not be properly checked. Afforestation helps in

TABLE 4 : STATUS OF THE UNITS

Units	Quality	Erosion Proneness	Fragility	Total Value
F_1	3	1	1	5
F_2	2	2	1	5
F_3	2	1	1	4
F_4	3	1	3	7*
F_5	3	3	3	9*
F_6	3	1	2	6
T_1	3	1	1	5
T_2	1	2	1	4
T_3	2	3	3	8*
T_4	3	3	3	9*
T_5	2	2	3	7*
T_6	2	1	1	4
T_7	2	1	1	5

1 Low 2 Medium 3 High * Units for conservation

this direction. Incidentally it can be noted that F_5, T_3, T_4 and T_5 are mostly under forests with different degree of human interference in order to prevent land degradation.

CONCLUSION

This exercise as a part of an ongoing research project, reflects one methodological aspect of land classification. The morphological character, which forms the basic matrix of any developmental work on land surface, should be properly studied before recommending different landuse types. It is observed that most of the units are mutually exclusive to host different landuse types. But units with polyfunctional character i.e. suitable for hosting more than one landuse type are also marked in the study area. As a part of the Western Ghat region, with high topographical variations, this region warrants a meticulous landuse planning. This study provides an alternative approach in this direction. It also establishes the importance of studying morphological aspects as an aid to landuse planning.

ACKNOWLEDGEMENTS

This work is part of the ongoing research project entitled "A comparative study of landuse pattern in two selected river basins of Western Ghats of Kerala in relation to integrated drainage basin management planning", funded by the Department of Environment, Government of India. The authors are grateful to Dr. Harsh K. Gupta, Director, Centre for Earth Science Studies for various facilities. They are highly indebted to Dr. N. G. K. Nair, Head, RAD and Project In-charge for guidance and encouragement in the work. Thanks are also due to Shri Prasannakumar for drawing the maps and Smt. Sreekumari for typing the manuscript.

REFERENCES

Environmental Analysis Group (1980). Environmental Survey along the Santander-Unquera Coastal Strip, Northern Spain and Assessment of its Capacity for Development, *Landscape Planning,* 7, 23–55.

Majur, E. (1981). Functional Relief Delimitation for Economy Exploitation in the SSR, *Geographica,* 4, VII, 139–155.

Nair, K. K., Vidyadharan, K. T., Pawar, S. P., Sukumaran, P. V. and Murthy, Y. G. K. (1975). The Structural and Stratigraphic Relationship of the Schistose Rocks and Associated Igneous Rocks of Tellicherry – Mananthody Area, Cannanore District, Kerala, *The Indian Mineralogist,* 16, 85–100.

ADDRESS OF THE AUTHORS

Srikumar Chattopadhyay
M. B. Salim
Centre for Earth Science Studies
Trivandrum 10