INTEGRATED LAND RESOURCE MANAGEMENT AND SOCIO-ECONOMIC ANALYSIS FOR REHABILITATION OF PROJECT AFFECTED AREAS OF WESTERN MAHARASHTRA, A CASE STUDY OF TEMGHAR IRRIGATION PROJECT

A THESIS SUBMITTED TO TILAK MAHARASHTRA VIDYAPEETH
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DECLARATION

I hereby declare that, the thesis entitled "**Integrated land resource management and socio-economic analysis for rehabilitation of project affected areas of western Maharashtra – A case study of Temghar irrigation project"** submitted by me for the degree of Doctor of Philosophy is the record of work carried out by me under the guidance of Dr. Sunil. W. Gaikwad and has not formed the basis for the award of any degree, diploma, either in part or full to this or any other University or institution.

I further declare that, the material obtained from other sources has been duly acknowledged.

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CERTIFICATE

This is to certify that, the thesis entitled "**Integrated Land Resource Management and Socio-Economic Analysis for Rehabilitation of Project Affected Areas of Western Maharashtra – A Case Study of Temghar Irrigation Project"** submitted by **Mr. Vilas Bhiwaji Kamble** for Ph.D. degree in Geography in the faculty of Social Science, to the Tilak Maharashtra Vidyapeeth, is a original work which was carried out by him under my supervision and no part of the thesis has been submitted for any other degree or diploma of any other university. The materials obtained from other sources have been duly acknowledged.

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TILAK MAHARASHTRA VIDYAPEETH, PUNE

Synopsis of the Ph.D.Thesis

"Integrated land resource management and socio-economic analysis for rehabilitation of project affected areas of western Maharashtra – A case study of Temghar irrigation project"

Candidate: KAMBLE VILAS B. GUIDE: DR.SUNIL W.GAIKWAD

Introduction:

Integrated land resource management for economic development has been recognized as essential component of development planning .It has assumed much greater importance in India now with acceptance of multi level regional planning. In India various issues regarding depletion and deterioration of forest, water and soil resources are being discussed by various scholars, social thinkers and development planners. All the developments projects are essentially designed to serve the public interest in the best possible manner. The projects are the tools or the instrument through which or with which the developmental perspectives and the intention of the policy makers are carried out. However, such projects invariably need land for their normal operational activities; this implies either voluntary or involuntary rehabilitation of people owning that land since it is not always possible to get waste land devoid of any crop or habitation. Eventually this involuntary acquisition of assets for projects gives rise to the planning for rehabilitation and resettlement of the project affected people. The rehabilitation action plan outlines the rehabilitation and resettlement measures necessary to ensure compensation for assets acquired at replacement cost and mitigation of loss of livelihood for all PAPs so that their income is sustained and they are not made worse off due to project implementation.

Present work mainly intended to assess land resources to find a feasibility to rehabilitate these displaced people in their own environment and therefore mainly focus on the site suitability analysis for the project affected people be settled in the same piece of land.

Arrangement of text

The entire work has been arranged in eight chapters. **First chapter** deals with Introduction which high lights the problem of rehabilitation along with review of literature and major objectives of the study. **Second chapter** devoted to description of study area and methods of study. **Third chapter** outlines the relief and soil characteristics of the study area. **Forth chapter** portrays Land use land cover and site suitability analysis for rehabilitation of the project affected people. **Chapter fifth** focused on assessment of land degradation by water erosion using USLE equation as well as land evaluation by making land capability classification, land suitability classification and productivity assessment this is attempted to understand potential of land resources in

the study area. **Sixth chapter** devoted to understand the socio economic status of project affected people and views of rehabilitants along with their problems of rehabilitation. **Chapter seventh** has been devoted to integrated land resource management to upgrade and conservation of the resources in the study area. **Chapter Eightth** outlines the Discussion, Conclusions and suggestions.

2.2 Hypothesis:

Displacement of people due to infrastructural development has become a serious issue in India. No efforts have been made till recently, neither by government authorities nor by private / public sector to systematically restore these affected populations. There are serious instances took place, while implementing the rehabilitation policy within the legal framework, therefore it is hypothesized that, 'Development of rehabilitation model pertaining to minimization of the cost of rehabilitation and to retain peoples own socio-cultural dimensions within the framework of Integrated Land Resource Management (ILRM),' certainly will help in upgrading and maintaining the natural resources and will also be helpful in minimizing the degradation of environment as well as restoring the people to their native places'.

Major objectives of the study:-

The major objective of the present study is to evaluate the available land and soil resources in the catchments area of a Temghar lake so as to check the availability and status of natural resources in general and land resources in particular. Therefore following objectives have been outlined:-

1. To infer the potential of land resources in the catchments area and to evaluate land resources and its significance to meet the need of rehabilitation process in the same piece of land.
2. To analyze land use / land cover in the study area using remote sensing technique which will help in understanding the general trend of utilization of land resources in the study area and to identify suitable sites for rehabilitation within the catchments itself.
3. In order to assess the potential of a terrain in terms of land capabilities and suitability, soil productivity, soil physiographic relationship pertaining to soils-cape analysis forms the basis of the present study. This will help to identify and analyze land forms in terms of their potentials for optimum utilization of land resources and to identify suitable sites for rehabilitation.
4. To infer the nature and extent of degraded lands in terms of soil loss, which forms the basis of land evaluation studies therefore it is ascertained by computing empirical equation and visual interpretation of satellite images, this will help in delineation of priority sub basins for conservation planning.
5. To ascertain the present situation and status of rehabilitation process and to infer the socio-economic status of the project affected people and to understand general

perception of the villagers.

6. To prepare various thematic maps as a basis for further planning and management of land resource in general and regeneration of wasteland in particular for the rehabilitation of the project affected people.

Study area

The area selected for the present study is a catchments area of the Temghar Lake Catchments from western Maharashtra. The main purpose of the Temghar irrigation project is to supply water for Pune city as well as for irrigation in Haveli, Daund, Indapur and Baramati tahsils in Pune district. The dam is located near village Temghar across river Mutha, which located between at 18° 38' 00"N to 18° 47' 00" N. latitude and 73° 27'00" to 73° 32' 00" E longitude, and is about 50 Km. to the west of Pune city. The project was undertaken in May 1989 and completed in February 1993. The full reservoir levels have been fixed at 706.5m and an area of 499 ha. is thus under submergence. Temghar, Lavarde, Vegre and Vede are the affected villages due to this irrigation project. The geology of the entire study area is covered by basaltic lava flow known as "Deccan Trap". The climate is tropical monsoon type; the annual average temperature is 24.6 C and annual average rainfall is 1395.14 mm. physiographically the area exhibits extremely rough terrain and high variation in slopes. The area is well drained with perennial streams. There is a considerable variation in soil properties. The Temghar lake catchments have mixed deciduous type of vegetation.

Data base and methodology:

Data required for the present study has been acquired from various sources. Data pertaining to various aspects of the study mainly includes primary and secondary data. Main thrust has been given on collection of first hand information by visiting the project affected as well as rehabilitated places, which almost cover all the villages under consideration. Around 100% data has been thus, collected by conducting extensive house hold surveys. Around 82 households were interviewed at project affected place and 167 households are interviewed at rehabilitation places. This has resulted into determining very good extract of their problems regarding rehabilitation at rehabilitated places at the villages Shel-pimpalgaon, Kondhapuri, Vitthalwadi, and Apti. Detailed review of which has been taken in preceding lines.

Secondary data mainly obtained from talathi office at Temhgar, Paud panchayat samitee at Paud, Tahsil office at Paud, forest department government of Maharashtra, soil survey department government of Maharashtra, Maharashtra Engineering Research Institute (MERI) Nasik, Geological survey of India, Pune Irrigation department, Pune, Pune district project affected rehabilitation office, Pune, NGO like Gomukh, Kirloskar consultants, census hand books (Pune districts) 1991, 2001 etc.

Field components of present study mainly composed of observation based on soil sample collection according to change in the slope along with this field measurement of hydraulic conductivity and infiltration capacity has also been conducted in the field. Around 31soil samples has been collected and 167 field observations has

been carried out in the field.

Remote sensing data mainly used of very high resolution data of sensor SPOT a true colour image. The extension of features mainly vector in nature has been verified in the field through ground check on truthing.

Soil analysis of the collected soil samples has been performed in the soil laboratory around 31samples were analyzed and physical properties of the soil, like determination of soil texture, structure, bulk density % porosity, water holding capacity etc has been determined. Chemical properties have also been determined using digital pH meter, Digital conductivity meter, digital colourie meter etc. as well as titration method has also been performed to determine calcium carbonate, % organic carbon, % organic matter etc. Soil analysis kit has also been used to determine nitrogen, phosphorus, potassium (NPK).

Data analysis and computation of results:

Data generated through soil analysis has been processed for statistical operation. However these soil characteristics are also useful as basic input parameters in the soil erosion studies. Soil data in terms of their GPS location has proved to be very useful in determining spatial locations of soil sample as well as to infer the spatial distribution of various properties and preparation of various thematic maps. An attempt has also been made to estimate rates of denudation by digitizing Toposheets contours and aster DEM of 30m resolution.

Preparation of base map

Base map has been prepared using Toposheet no. 47F/11, 47F/15. Major operations involved in the preparation of base map are scanning of the toposheet and geo referencing the same in the GIS environment using toposheets no's, 47F/11, 47F/15 .After successful rectification of which high resolution SPOT image has been synchronized and rectified to the same projection and datum.

Preparation of Thematic maps using RS & GIS

Based on the data collection and data generation various thematic map of Temghar lake catchment has been prepared. It mainly includes digital elevation model, absolute relief map, relative relief map, percentage slope map, delineation of water shed.

Software's used

For the base map preparation and for preparation of various thematic maps, various GIS software's like Global Mapper version 12.01, Surfer version 9.01, Digem, Google earth BASIN-4', Diva-GIS, ILWIS (Integrated land and water information system) Adobe Photoshop has been used. Table No 2.8 Methods used for thematic map preparation.

Relief and soil characteristics

In order to understand relief and soil characteristics of the study area and to ascertain its usefulness as input parameter in soil loss estimation as well as resource

conservation and etc relief and soil characteristics have been studied in detail. The study area provides varied relief characteristics and resultant drainage system. The study area has been divided in to 63 sub basins ranging from single order to fifth order basin 0.05 km^2 to 7.45 km^2, respectively in terms of area coverage. Relief characteristics are analyzed with the considering various morphological units like height wise distribution, absolute relief, relative relief, percentage slopes, hypsometric analysis, terrain profiles, and various geomorphic units like escarpment, ridges, plateau summits, plateau fringe, pediment and plain surface are delineated from DEM and FCC image.

In the present analysis an attempt has been also made to correlate landforms and soils in terms of their distributions in the study area in general & soil status in particular. Distributions of percentage coarse sand, fine sand silt and clay have been shown in fig. 3.12, 3.13, 3.14 and 3.15. In all four major soil types are identified depending upon their texture. The most striking property is its colour. The data obtained from soil survey department have also been incorporated in the preparation of soil texture map. It was observed that, the variation in soil properties do show good co-relation with the geomorphic surfaces as well through out the area. The colour variation, textural class and depth variation in all soil types have an influence of geological structure on the overall formation and development of soils in the study area. The areas remarkably have thin soil cover which owes to excessive erosion and therefore their parts are exposed at places. The dynamics of these processes are triggered and operated by meteorological factors. The interpretation of soil properties variability in slope studies has also been performed along with geomorphic units.

Soil properties variability in slope studies:

Gentle slopes (Below 5 % slope) This is a low lying surface in the study area covers mainly the plain surfaces of valley floors of 4^{th} order channel basin (0.72 km^2.) and alluvium deposits (0.013 km^2.) spread along the water body. This slope unit covers 0.72 km^2 area (2.20 %) of the total land surface area. Moderate slope: (between 5-10%) This slope unit covers an area of 3.78 sq.km, (11.56 %) of the total land surface area. Steep slopes: (between 10-15%) slope unit covers an area of 3.85 sq.km. (11.77 %) of the total land surface area in the Temghar lake catchment area.

Moderately steep to steep slopes (15 to 35 %) This is the largest unit in terms of its areal extent in the study area. It covers 18.82 km^2 (57.55 %) of the total land surface area.

Very Steep slopes (above 35 % slope) this unit comprises about 5.54 km^2 (16.93 %) area of the total land surface area including the slopes above 35 %. This part confined to convex slope elements on a larger scale and therefore favors runoff of high magnitude with moderate to high condition of soil erosion

Land degradation and evaluation:

Soil loss of the Temghar lake catchments has been estimated using USLE (Universal Soil Loss Equation) to understand land degradation by water erosion. It is

observed that, soil loss in the Temghar lake catchments is very high and noticed to be range between 21.9876 kg/ m^2/year to0.1669 kg/ m^2/year.An attempts has also been made to categories sub basins according to rating. It is found that almost all sub basins in the study area contributes maximum soil loss. In an estimation of average soil loss of sub basins around 32 sub basins can be included in low soil loss category, 31 in medium category, 16 in high category05in severe category and 03 in category.

In land evaluation studies land capability, suitability and productivity assessment has been worked out. It is observed that in the land capability classification class I and II are totally absent, class III i.e. of moderate cultivation (7.59 km^2), class IV –limited cultivation, (23.60 km^2), class V- intensive grazing (0.50 km^2), class VI- moderate and grazing and forestry(1.02 km^2), class VII and VIII are totally absent. Class VII category indicates that soil have very severe limitations that make them unsuitable for cultivation and restrict their use mainly to grazing forest land or wildlife habitat, while Class VIII category indicates that soil and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed or esthetic purpose. This means good quality land for agriculture is not available in the catchments.

It is noticed in the land suitability classification according to FAO framework, S1 i.e. highly suitable land is absent, whereas, S2 i.e. moderately suitable land is 0.95 km^2 (0.36 %), S3 is a marginally suitable land accounts to2.71 km^2 (7.19 %) of the total land surface area. N1 and N2 classes are almost negligible in the study area.

Storie Index method of the soil productivity has been attempted to infer general productivity of the soil. It is observed that high productive land is almost absent and only mere % of productive land is present near to the backwater.

Land use/ Land cover analysis:

land use/ land cover analysis of the study area. Land use/ land cover inventories are assuming increasing importance in various resource sectors, agricultural planning, settlements, environmental studies and operational planning based on agro-climatic zones. Analysis based on SPOT image 2006 has been described with following aspects. Agricultural land 0.69 %, built up land category is negligible and it is only 0.48 %, water bodies and various streams acquired 13.24%, .where, forest area covers 24.88%, waste land and land with or without scrub is 54.38% covered.

Socio-economic status and views of project affected people and rehabilitants.

This part pertaining to socio-economic landscape and views of project affected people and rehabilitants. While explaining the facts, total demographic study has been considered. Total population, growth, density sex ratio, child ratio, religion, caste, and literacy and occupation structure all these aspects are helpful to describe the demographic profile of the study area. Views of project affected people has also been incorporated .Due toTemghar irrigation project around four villages are affected. Two villages are completely affected where as two villages are partially affected. Total geographical area (of four villages) affected due to Temghar irrigation project is 429 ha.and around 1834 population has been affected in which around 54 land less households are affected.

Around 3643.13 ha.agricultural land has been submerged. Rehabilitation of these people has been done.4.50 ha land has been submerged. Detailed interviews with these people clearly shows that, people are not at all satisfied with the rehabilitation, even they do not want to leave their native area. There are several problems raised due to this, are religion, social, psychological, cultural etc

Integrated land resource management

Effective planning and development of natural resources requires information in terms of current land use/land cover, drainage system, soil and terrain characteristic. It is realized fact that comprehensive integrated information on natural resources is an essential prerequisite for integrated land use planning of an area. Recently terrain evaluation has become a very important technique for the developmental planning purpose.

This chapter mainly deals with integrated land resource management of Temghar catchments area, in view of rehabilitating the project affected people due to this project. It becomes therefore very necessary to understand and examine natural resources in the area. Based on soil studies, particularly land capability, suitability and productivity assessment and soil erosion studies owing to terrain characteristic. Priority level of sub watersheds has been identified according to intensity of the problem i.e. soil erosion. In this study, 32 sub basins (37.70 km^2) subjected to low soil erosion, around 31 sub basins (17.0421 km^2) subjected to moderate erosion. Around 16 sub basins (15.3159 km^2) subjected to high erosion, around 07 sub basins (3.8599 km^2) severe erosion and around 03 sub basins (0.9563 km^2) very severe erosion. Therefore, Catchments area Treatment Plan (CAT) has been suggested which highlights the management techniques to control soil erosion and there by large volume of siltation in the backwater region. Integrated land resource management in view of rehabilitation of the project affected people becomes an essential component of the rehabilitation policies and methods. ILRM will certainly ensure the sustainable environment through participatory involvement of the people.

Findings and conclusions

The entire catchments area exhibits a hilly terrain characterized by vast proportions of waste lands in terms of scrub growth and gullied topography. This possibly contributes maximum sediments yield to backwater area of Temghar dam. Soil environment except in pediment and valley floor exhibit severe degradation therefore land capability as well as suitability and productivity of the land is not up to the expectation. It needs to be properly planned to minimize the degradation therefore Integrated land resource management plan is necessary to cope up with this problem. On the other hand, almost four villages have been displaced due to this project can eventually resettled in the same locality provided ILRM is undertaken. This will certainly help project affected people to maintain their religious, social and cultural needs in the same piece of land.

In depth examination of physical determinants (relief,soil,land capability, suitability and productivity), Land use/Land cover analysis, assessment of socio-

economic status of affected population due to Temghar irrigation project and the resultant implementation of rehabilitation of the same, various socio-economic, cultural dimensions and problems of the rehabilitants, present study arrives at following conclusions.

1. Relief analysis of Temghar lake catchments portrayed physical make up of the area which is very important and forms initial step in the assessment of natural resources and thereby resource management.

   a. Very low to moderate absolute relief category covers around 79% of total land surface area and extremely low relative relief covers around 65% of the total land surface area indicates this is a potential land surface unit and amenable for various kinds of uses. **b.** Extremely low dissection index also provides around 68.39% of total land surface area and altitudinal zone between 780 to 1000 m (73.197% of the total land surface area) as a zone for reclamation and can be practiced for various purposes especially for rehabilitation and agricultural practices. **c.** Area under moderate to steep sloping category covers around 79% of total land surface area and seems to be the most eroding sites and a potential surface area for horticulture and erecting some anti erosional structures provided management practices are initiated. **d.** It is also noticed in the hypsometric analysis that the entire catchments is in youthful stage of development (hypsometric Integral value 78.70%) and subjected to the process of denudation. **e.** Denudation of the surface area is also evident in the form of vast stretches of waste lands in the form of barren rocky surfaces and scrub land / without scrub lands (around 70% of the total land surface area) which are ultimately producing high surface runoff and thereby high sediments influx in the backwater of Temghar lake catchments. **f.** Soil environment in the study area has certainly reflected the effect of terrain characteristics and do show very poor quality and degrading in a nature. This has ascertained in the assessment of land capability, suitability and productivity.

2. In an attempt to simply identify the correlation among the fourteen different variables pertaining to physical determinant like elevation, absolute relief, relative relief, % dissection index, percentage slope, soil type, soil depth, infiltration rates, geomorphic units, soil capability, suitability, soil productivity, land use land cover and estimated soil loss etc. It can be observed that,

   a. Absolute relief, relative relief and dissection index and infiltration rate are moderately positive to highly positive correlated to each other. **b.** Elevation (height), absolute relief and relative relief shows moderately positive correlation with % dissection index and infiltration rate. **c.** Percentage dissection index have highly

positive correlation with infiltration rate and percentage slope shows very much sensitive to soil loss. **d.** Soil types have very strong correlation with suitability classification. **e.** Soil depth has strong positive correlation with geomorphic units, **f.** Soil capability however have strong correlations with soil productivity and land use/ land cover where as soil suitability does not show very good correlation to any other variable except soil loss (very low positive correlation) soil productivity have a very strong correlation with land use/ land cover.

3. Government authorities claim that, this is the only project where 100% rehabilitation plan has been implemented successfully is a false claim and real picture of which envisage that, these rehabilitants facing lots of socio cultural problems as mentioned in the earlier lines, therefore this claims remains on a paper only and facts are different and unfocused.
4. Acquisition of land in the affected area has remained a land of no practice because of legal constraints. Ratio between acquired land for project and allotted land is considerably unbalanced where almost in all affected villages, more than 75% of agricultural land is in balance but acquired land therefore no agricultural practices can be initiated. This seems to be the wastage of land resources and due to lack of maintenance it becomes permanent fallow lands.
5. Considering the soil quality as deduced and inferred from land capability, suitability and productivity assessment it is inferred that there is a degradation of soil environment due to lack of conservation structures and maintenance.
6. In land capability classification studies, class I (very intensive cultivation) and II (intensive cultivation) in nature are totally absent, in soil suitability classification studies, class S1 and S2 are of (highly and moderately suitable respectively) almost absent and remains only a class S3 (Marginally suitable) and N1 (currently not suitable), N2 (permanently not suitable) type of land. Productivity assessment of soil also indicates that entire area almost showing poor productivity. This seems to be great environmental threat to the area in terms of degradation of soil environment presently and as well as in the near future also.
7. Land use / land cover analysis also indicates that high proportions of waste lands which will happen to degrade the land surface area in the form of severe runoff and soil loss.
8. Project affected families (PAF's) forcefully rehabilitated at sites very far from their native place has to face day to day life conflict with host population due to non acceptance and involvement by them.

9. It is also inferred that government has almost spent Rs-70.51 Crores for this project .It can be certainly stated that, If only 60% of amount of this cost is spent for Integrated land Resource Management. It would be more worth, feasible and environmentally sustainable.
10. In EIA studies of this irrigation project it is also mentioned the Cost - Benefit – Ratio i.e. 1.17 indicates that this project is not that much beneficial.

Suggestions:

Since the present study intends to rehabilitate the people in the same piece of land. Land resources in the study area needs to be scientifically and systematically manage through the principles of Integrated Natural Resource Management (INRM) in general and Integrated Land Resource Management (ILMR) in particular. As an initial step in the management process it is certainly observed that, the area requires catchments treatment and can be achieved through engineering and biological measures to reclaim the land resources and to conserve them.

1. CAT (Catchments Area Treatment Plan) suggested though engineering measures and biological measures will certainly helpful in maintaining the natural environment of the area.
2. Site suitability analysis performed for rehabilitation of project affected families indicates that altitudinal zone between 780 to 1000 m is a suitable altitudinal zone for rehabilitation along with agricultural practices.
3. In ILRM, it also expected to have a participatory involvement of local people to make the management successful and fruitful that can be described as “participatory management done by the people for the people”.
4. In order to maintain social, religious and psychological attachment of the people to their native areas; it is wise to change rehabilitation policy by giving attention in management of local resources.
5. As initiation of ILRM, sub basins identified in the study of prioritization of them for conservation planning should be taken accordingly.
6. The models suggested for regeneration of waste lands, agriculture (including horticulture), forest and ecotourism should be initiated as a development of natural resources and as a basic step towards sustainable planning and management. However these models may be used as role model in such kind of situation and rehabilitation polices to be implemented in future.

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CHAPTER I

INTRODUCTION

1.0 Introduction:

India is the third largest country in dam building in the world and it now has over 3,600 large dams and over 700 more under construction. India's development policies and strategies have focused attention on indispensability of irrigation as important input for agriculture. Large-Scale Irrigation projects are important for higher agriculture growth, besides establishment of industries and power projects. India gave tremendous encouragement to the large river valley projects or large multipurpose dams. The dominant ethos was 'big is the best' and the conviction is that large multipurpose projects are the panacea to all the problems of poverty and under development.

Irrigation came to receive more importance after the independence. Between 1951 and 1980, 205 major and 910 medium irrigation projects were undertaken, among which 29 and 469 respectively were completed. During 1980-90 (Sixth and seventh Five Year Plans), 67 major and 156 medium projects were undertaken which are now in different stages of completion. Thus, the country is making headway in the irrigation front in terms of both numbers of dams constructed and area brought under irrigation.

Since 1950, five millions of people have been displaced by various development projects in India. Out of this, more than 40% are indigenous tribal population living in forest area. While they form only 8% of the total population, tribal communities had carried unfair share of the burden for so called national development. Most of these tribal were affected due to either construction of irrigation project or due to mining in forest areas. Though they are the rightful owners of forest resources, are pushed out of forest shattering their life and livelihood. Large parts of tribal population, who live in remotely forested settlements, do not have basic amenities such as clean drinking water, electricity and primary health care. Their life and livelihood depend more on forests than anything else. These tribes live in isolation with unique languages, culture, tradition and lifestyle.

Constructions of dams entail tremendous developmental challenges to policy makers and planners. If not, most important challenge a government faces for building a large-scale dam is the resettlement of the people displaced due to submergence of their land as a result of dam construction.

This requires evacuation and resettlement of the affected people of a large number of villages from the submerging area. They are called upon to give up their home and attachment to their ancestral property and a living among their kinsmen; their whole socio-cultural and economic life is thus disturbed.

There is a need for a comprehensive policy or a model, which can deal with resettlement as a developmental effort and not as an obstacle in the face of a dam project, as it is generally perceived. Although, circumstances are sometimes project specific, there are, however, major policy guidelines, which can be universally adopted, especially in the context of developing countries.

All the projects are essentially designed to serve the public good or interest in the best possible manner. The projects are the tools or the instrument through which or with which the developmental perspectives and the intention of the policy makers are carried out. However, such projects invariably need land for their normal operational activities; this implies either voluntary or involuntary rehabilitation of people owning that land since it is not always possible to get wasteland devoid of any crop or habitation. Eventually this involuntary acquisition of assets for projects gives rise to the planning for rehabilitation and resettlement of the project affected people. The rehabilitation action plan outlines the rehabilitation and resettlement measures necessary to ensure compensation for assets acquired at replacement cost and mitigation of loss of livelihood for all PAPs so that their income is sustained and they are not made worse off due to project implementation.

A burning lamp delights its surroundings, but leaves its shadow just below it. Similarly, dams generate social and economic benefits in their command areas, but impose social costs in their catchment or reservoir areas. The benefits in the command areas include provision of assured water supply to vast area of land, creation of employment opportunities to thousands of skilled and unskilled workers, development of fisheries and so on. Particularly, the problem of submergence is unique and very acute as compared to other social cost. For, it involves displacement of people from their traditional settlements to new surroundings, which affect all aspects of their life.

They have to leave their settlements, where they lived for generations and where they had developed 'multiplex relations.

Economic development tends to create new infrastructure in order to satisfy the increasing needs of growing population. It often involves acquisition of land and other assets, which can adversely affect the socio-economic well being of the people as well as the communities they live in. The impacts of development projects include physical relocation, disruption of livelihood and potential breakdown of communities.

As per the India Social Institute estimates, there are currently 21.3 million persons displaced because of development projects of which 16.4 million account for due to the irrigation projects. According to the Central Water Commission, 3,300 dams have been built since 1947 with another 1,000 under construction. The Indian Institute of Public Administration estimates that the average number of persons displaced by a large dam is 44,182.73. Among the best-known and most controversial cases of development-induced displacement in India is that of the Narmada Valley Project (Sardar Sarovar) in Gujarat, alone would displace more than ten lakhs of people, most of them small farmers and tribals. Project wise displacement shows that the Hirakud Dam, one of the largest in India, built in the 1950s, displaced more than 20,000 people, across 249 villages. The Srisailam project, completed in 1983, displaced a population of over one lakh. Another major irrigation project, Tungabhadra, undertaken in Karnataka, affected 90 villages, displacing 55,000 people belonging to about 12,000 families.

In Maharashtra about 2,200 villages have been affected due to implementation of 233 minor, medium and major projects, displacing more than 1.25 lakh families (Lokrajya, 1986).

The ultimate irrigation potential of the state is 8.11m.ha to 6.16m.ha from major, medium and minor schemes and 1.95 m. ha from local sector schemes. A potential of 5.85 m.ha has so far been created 4.49 m. ha from 71 major, 243 medium and 2940 minor irrigation State Sector Schemes and 1.36 ha from local sector schemes.

1.1 Initiatives taken up by Maharashtra government for irrigation potential

To increase the irrigation facilities in the state and to bring more and more area under irrigation the government established Irrigation Development Corporation in the Maharashtra.

1. Krishna Valley Development Corporation: - This was established in 1996. The 35 major, 53 medium and 418 minor projects.
2. Vidarbha Irrigation Development Corporation: -This was established in April, 1997.The 5 major, 26 medium and 55 minor projects.
3. Konkan Irrigation Development Corporation: - This was established in December 1997.The 1 major, 44 medium and 33 minor projects.
4. Tapi Irrigation Development Corporation: - This was established in 1997.The 6 major, 23 medium and 315 minor projects.
5. Godavari Marathwada Irrigation Corporation: - This was established in August 1998. The13 major, 22 medium and 303 minor projects.

A number of major, medium and minor irrigation projects have been taken up by the state government to tap the maximum water for various purposes.

1.2 Concept of Rehabilitation

Development-induced displacement can be defined as the "forcing of communities and individuals out of their homes, often also off their homelands, for the purposes of economic development". At the international level, it is viewed as a violation of human rights. The meaning of displacement has come to be more or less taken for granted, particularly in most academic literature. It is very important to understand that displacement is a multidimensional phenomenon and physical relocation is only one of the most significant outcomes. Rehabilitation can be envisioned as a process that would reverse the risks of resettlement. Rehabilitation is only possible where development takes place. Thus, resettlement must be planned as an integral part of the comprehensive development project. In this sense, rehabilitation is really an outcome of resettlement that is conceived not as a mere physical relocation or restoration of incomes but as development. One useful way of understanding development in the context of resettlement and rehabilitation of negatively affected people is in terms of the real freedoms that the citizens enjoy, to

pursue the objectives they have reason to value; and in this sense, the expansion of human capability can be broadly seen as the central feature of the process of development

Rehabilitation of irrigation project is the same concept, but following commitments should apply:--

i) Development, Conservation, Management and Utilization of land resources.
ii) Land information management and updating of land records, land registration, statistics, valuation, land survey and adoption of modern technology in these areas.
iii) Land use planning.
iv) Land markets, land distribution and relevant laws and regulations.

1.3 Need of Rehabilitation:

In providing the rehabilitation benefits to the displaced people no uniform procedure has been followed. Whenever the traditional habitations are destructed, the need for alternative accommodation instead of the old ones arises. But, responses and demands of the people for alternatives vary with the types of displacement. For example, many cases of irrigation project displacement, where people struggle for their very existence; any assistance that helps them to save their lives would be enough. Further, scope for proper planning and resource mobilization is very little, and only adhoc measures are initiated to tide-over the situation. If immediate measures are not taken in such cases, the end result will be more disastrous. .

Until 2009, there was broad policy that guides the rehabilitation efforts of state sponsored project in irrigation, power, mining etc. Different state governments implemented resettlement and rehabilitation in their own way and on a case-to-case basis. Past rehabilitation experiences in various projects reveal that they are far from satisfactory. The implementation of the policies has been locked in the govt.authorities. Controversial conditions are arises regarding the actual rehabilitation of project affected peoples, so that such problems are the great barrier in natural resource management and socio-economical development.

Preparation of the rehabilitation action plan and its implementation are integral part of the socio-economic and cultural process. The need for the RAP (Rehabilitation Action Plan) has been identified by the initial assessment and the analysis of expected

social impacts, which require appropriate mitigate measures for all PAPs who, on the basis of an established cut-off date, will be losing land or other assets or livelihood

The Narmada Valley Development Plan – which involves the construction of 30 large dams (including the Sardar Sarovar dam), 135 medium and 3,000 small dams in Western India is set to displace millions. Compensation, resettlement and rehabilitation mechanisms are non-existent, inadequate and/or unjust. The plan to submerge large areas of the states of Madhya Pradesh and Maharashtra by the Sardar Sarovar Dam has been controversial ever since it was proposed by the Narmada Valley Development Authority. In 1979 the Narmada Water Disputes Tribunal (NWDT) ruled on the compensation to be provided and stated that resettlement should be carried out at least six months before submergence of affected areas. Since the 1980s, the Narmada Bachao Andolan (NBA - Save the Narmada Movement) has been campaigning for proper resettlement and rehabilitation of the thousands of families displaced by the Sardar Sarovar Project (SSP). As India lacks legislation to deal with resettlement and rehabilitation, displaced persons lack rights to resettlement and rehabilitation. The Land Acquisition Act (1989) does have provisions for compensation for land acquired for developmental purposes but does not apply to people not holding legal titles to land.

1.4 Significance of land resource management in the process of rehabilitation

Study of land resources for economic development has been recognized as an essential component of development planning .It has assumed much greater importance in India now with acceptance of multi level regional planning.

Land resources management is the actual practice of the use of land by the local human population, which should be sustainable/appropriate techniques. In a broader sense it includes land-use planning, administrative and institutional execution, inspection and control of adherence to the decisions, solving of concession for plant and animal extraction. Improved land management that ensures better resource use and promotes long-term sustainability is basic to future food production and to the economic welfare of communities. Because of the dynamic aspect of land management, a flexible and adaptive process, approach for monitoring the quality and quantity of the land resources such as soil, water, and natural vegetation etc. and for determining how human activities affects their resources is essential.

Drainage basin or watershed forms a most convenient as well as most appropriate spatial unit for the study of natural resources like land, forest and water. Assessment of natural resources has become a vital issue in developmental planning and is a main focus area in conservation and management of natural resources.

In India various issues regarding depletion and deterioration of forest water and soil resources are being discussed by various scholars, social thinkers and development planners. Forest resources are being depleted due to unprecedented increase in population and vast stretches of the land surfaces are becoming barren and coherent which is of no use as far as productive land is concerned. Water resources are also deteriorating at a faster rate and most of the areas of India facing scarcity of water. Soil resources are also depleting at an alarming rate. Ultimate effects of depletion of all the resources are being seen in the transformation of arable and productive land in to barren and rocky unproductive lands.

Another striking problem arises in developmental planning especially in dam site areas is the submergence of land under water and resultant, rehabilitation problem of the villagers. The problem of this kind seems to be severe from point of view of the project affected people. Increasing population ultimately exert a pressure on natural resources, obviously, land resources are severely exploited due to increasing human interference in natural ecosystem therefore, there is an urgent need to asses such kind of resources and create awareness in the society. Degradation or depletion of such kind of resources may lead to adverse effect on naturally balanced ecosystem. Now it is realized fact that, the optimum utilization of any resource should be a pre-requisite goal of management of natural resources. Management of natural resources calls for delicate balance between competing demand and protection of fragile environment. Effective planning and development of natural resources requires information in terms of current land use / land cover system, soil and terrain characteristics.

During the last few decades the ecological systems in the western Maharashtra have undergone pronounced changes as a result of deforestation, industrialization, urbanization and changes in the agricultural patterns. This is more in the Western ghat region that has been affected by large-scale deforestation leading to soil erosion and other related problems. No efforts have been made till recent to undertake evaluation studies of the physical environment of this area to ascertain the impact of the various physical determinants on land use or economic development.

Studies have indicated that, the place of development of infrastructure is highly inadequate and needs to be thoroughly examined. Infrastructure projects are characterized by large financial out-lay, long gestation periods and involve considerable construction activity. These projects mostly require involuntary displacement of people from area where they live and work. Such a change cause socio-economic and cultural disruption to the affected people. What is more important is to develop and implement programmes, which are meaningful and workable in nature such that the affected population will not become worse off economically than before. Thus the sound rehabilitation action plan is warranted for project-affected persons on a productive basis to offset of losing land.

Temghar irrigation project under Krishna Valley Development Corporation (Krishna Khore Vikas Mahamandal) has been constructed in the year 2001.

Around four villages in Mulshi tahsil has been affected due to this project and subsequently rehabilitated in Khed and Shirur tahsils of Pune district. Rehabilitation authority claims that this is the only project where 100% rehabilitation of the affected people has been done. It is observed in the field survey that, there are several lacunas left by these authorities and rehabilitants are facing several kinds of problems.

It is therefore thought that, if the development of natural resources in the study area within the framework of "Integrated Land Resource Management" is undertaken to whether it will accommodate this affected population to avoid the problems of rehabilitation as discussed in earlier lines.

Present study therefore deals with various aspects of study area i.e. relief analysis, study of soil environment, land capability, suitability classification, productivity assessment, land use/land cover analysis, site suitability analysis, assessment of land degradation by estimating soil loss and inferring feasibility of ILRM to accommodate these affected population with their economic activities.

Present study also avails the use of RS, GIS, GPS survey, Soil survey, household surveys for affected as well as rehabilitants to infer their major constraints, difficulties and problems, as well as to find priority areas for conservation planning.

1.5 Review of Literature

Planners and researchers throughout the world have realized the significance of integrated land resource management. Main theme of which forwards a sustainable

development of resources. Following review of the worldwide literature has been taken into consideration for the present study.

Rehabilitation

The millions of displaced people do not exist anymore. When history is written they would not be in it, not even as statistics. Some of them have subsequently been displaced three and four times.... True, they are not being annihilated or taken to gas chambers, but I can warrant that the quality of their accommodation is worse than in any concentration camp of the Third Reich. They are not captive, but they re-define the meaning of liberty and still the nightmare does not end. They continue to be uprooted even from their hellish hovels by government bulldozers. The millions of displaced people in India are nothing but refugees of an unacknowledged war, Arundhati Roy.

Displacement or the involuntary and forced relocation of people has come to be acknowledged as among the most significant negative impacts of large water resources development projects such as dams. It is estimated that nearly 60 million people have been displaced worldwide due to the reservoirs created by large dams (McCully 1996).

A World Bank review of 192 projects worldwide for the period 1986 and 1993 estimated that, 4 million people were displaced annually by the 300 large dams (on an average) that entered into construction every year. In China alone by the late 1980s some 10.2 million people were officially recognized as "reservoir resettlers" (China Report 1999). According to same report the actual number would be much higher when these figures are officially updated. In India too the estimates of people displaced due to large dams vary, from 21 million to 33 million people (India Report, 1999). All these figures are at best. Only careful estimations and certainly do not include the hundreds of thousands and millions who may have been displaced due to several others aspects of the projects such as canals, powerhouses, associated compensatory measures such as bio-reserves etc. The Bank wide review referred to earlier found that the 192 projects displaced 625,000 more people than was originally estimated. In fact it is well established now that underestimation of figures is the norm rather than the exception (China Report 1999, Scudder 1997, McCully 1996). There is without doubt sufficient ground to consider it a "painful irony, and possible design, in

the fact that there are no reliable official statistics of the numbers of people displaced…"(India Report 1999:4).

. The most widespread effect of involuntary displacement is the impoverishment of considerable numbers of people. In India, for instance, researchers found that the country's development programs have caused an aggregate displacement of more than 20 million people during roughly four decades, but 75 percent of these people have not been "rehabilitated" (Fernandes 1991; Fernandes, Das, and Rao 1989). Their livelihoods have not been restored; in fact, the vast majority of development resettlers in India have become impoverished (Mahapatra 1999).

If impoverishment is the looming risk in displacement, the challenge is to organize risk prevention and provide safeguards. This can increase the benefits of development by eliminating some of its avoidable pathologies. It may not be feasible to prevent every single adverse effect. But it is certainly possible to put in place sets of procedures, backed up by financial resources that would increase equity in bearing the burden of loss and in the distribution of benefits. It is certainly possible, under enlightened policies, to protect much more effectively then current practices do the civil rights, human dignity, and economic entitlements of those subject to involuntary relocation.

The conventional planning approach that causes many to be displaced and allow only a few to be "rehabilitated" do not adequately protect against risks and loss of entitlements and rights. Without social safety measures, they have led to recurrent failures. In most cases, they have been incapable of preventing the victimization, de-capitalization, and impoverishment of those affected. But the repeated instances of resettlement without rehabilitation point sharply also to congenital defects in the current domestic policies of many countries, not just in the planning procedures. It is argued that such "development" policies, and the resulting planning methodologies, must be corrected or changed.

There are practical ways to fully avoid specific instances of involuntary displacement, or at least to decrease their magnitude. Although, historically speaking, relocations (as a class of processes) are unavoidable, not every individual case of displacement proposed by planners is either inevitable or justified. Further, even when displacement is planned, mass impoverishment itself is not a necessary outcome and

therefore should not be tolerated as inexorable. There are many ways to reduce displacement's hazards and adverse socioeconomic effects.

Redressing the inequities caused by displacement and enabling affected people to share in the benefits of growth is not just possible but imperative, on both economic and moral grounds. Socially responsible resettlement that is, resettlement genuinely guided by an equity compass-can counteract lasting impoverishment and generate benefits for both the national and local economy. Yet, much too often, those who approve and design projects causing displacement are deprived of an "equity compass" that can guide them in allocating project resources and preventing (or mitigating) the risks of impoverishment (Cernea 1986, 1988, 1996b; Mahapatra 1991; Scudder 1981).

An investigation by a German NGO Urgewald in 1999 revealed that, the private developer's cost-benefit analysis was based on erroneous data (poor villages, unirrigated lands, and little infrastructure). Besides questioning the economic viability of the project, the report also documents the underestimation in the extent of submergence and displacement and the lack of resources for adequate compensation and resettlement (Urgewald 1999). The case of the Maheshwar project also throws up the painful reality of the failure of public institutions and mechanisms to consistently safeguard citizens' rights. In the absence of strong public institutions and effective mechanisms to protect the rights and interests particularly of the poor, privatization and a free-play of markets could serve the interests of profits rather than public interest. The conflicts between private capital and public interest are well illustrated in the case of the Maheshwar Hydroelectric Project, the first large hydropower project in India. In this case the private developer has refused to accept full responsibility for resettlement on the grounds that it is the responsibility of the State government (SOC 025, 157).

The hostility from the host inhabitants is almost a universal phenomenon. Kottack states that, socio-cultural compatibility of settler-host relationship does not pay off in economic terms among others. Socio-cultural engineering is not simply desirable for economic development, but rather essential and cost-effective (Kottack, 1985).

Planners tend to underestimate the risks of conflicts between “Host” population and the settlers and also the disillusionment, which tends to follow resettlements (Barrow, 1987)

Development planners and policy makers more often than not, overlook this aspect. They tend to perceive the people as mere beneficiaries or target groups or a collection of people rather than as a structured group of active participants with their own culture, beliefs and organizations, with their needs and desire to make some security for future generations. Algaraa highlighted the role of traditional values in Gezirea scheme in Sudan. Traditional kinship system is still in existence despite the change in the techniques of production and development of social services (Algaraa, 1987).

Attempts to solve such complexities by the government should be very indigenous and situational. It must be stressed here that no single development strategy to improve the living standards of nomads can succeed universally. In each country solution must respond to the particular needs of the population involved and be compatible with their particular circumstance and habits (Ebrahim, 1984).

Social integration of the new settlers into the community life with the hosts should be regarded as an important and basic objective of the resettlement as no two groups with conflicting interests and values can hope to realize desired standard of living or healthy social life. Collective resettlement of the whole village is most appropriate as it can reduce the effects of hostility from host population (Dhagamwar, 1989).

Collective resettlement also maintains to an extent oustees former community life. Bahuguna cited the example of Tehri Dam oustees in India, whose community life is disturbed due to the fact that those who are so far resettled live in different disintegrated settlements (Bahuguna, 1990). Similarly, two major dam projects in Africa, namely Volta in Ghana and Kainji in Nigeria, which had affected 80,000 and 40,000 respectively, resulted in transformation of 700 villages into 52 rural townships and 239 villages into 140 new settlements respectively (Ralph Mills, 1989).

Newly emerge countries in the developing world were to depend on western technology western experts for rapid development. Even the policy makers and bureaucrats in these countries were western influence, due to their western education. So it was but natural to them to adopt a western style of development. The ideology of development adopted by developing countries derived its driving force from the linear theory of progress, on the basis of the pattern adopted in the west in the eighteenth and nineteenth century. This theory according to Shiva and Bandhyopadaya, equates

with economic growth, modernity with consumerism and non-market economy with backwardness (Shiva and Bandhyopadaya 1989).

Dr. Prakash Patankar who deliberately worked on 'Western Ghat Bachav Andolan' with the help this activity, he always trying concentrating the aim/view of government on negative impact of project affected villages. They are struggled to implements the rehabilitation policies in proper manner. According to them, while the preparing the plan to construct any type of irrigation project, perceptions of rehabilitants should be taking into consideration for successful rehabilitation of project-affected villages.

Mr. Vishwas Patil has written a novel named "*Zadazadati* ". He explains the problems created by the irrigation project affected peoples, their emotions, and tragedies and struggle situation for motherland.

In the Narmada project, which has the largest resettlement component till date, a large proportion of the displaced populations are tribals. They have been traditionally cultivating forestland but do not have any legal document of land ownership. They are declared as landless (Alvarese and Billorey, 1988).

In Itaipu and Tucurui dam resettlement in Brazil, the compensation offered to the displaced was insufficient to purchase new land and many were not offered compensation at all, because they had only customary, but no formal title of their land (Cernea, 1991).

The resettlement of those affected is never done in most desired manner. According to Barnabas, of 16,000 families affected by the Rajasthan Canal, only 900 families were given land and even that was cancelled later (Barnabas, 1985).

Integrated land resource management

IWM has come to be recognized internationally as an important holistic approach to natural resources management, which seeks to promote the concept of sustainable development (FAO, 1998). Such an integrated approach has been recommended in Agenda 21 of the Earth Summit of 1992 for all sectors dealing with the development and management of water resources (UNCED, 1992). It not only deals with the management of natural resources but also involves community development and economic activities (UNCED, 1992; JICA/HMG (N), 1998).

Decision maker, planner and scientist also agreed that integration was a process and a means rather than an end in itself: the nature of the process would vary depending on the desired end. At the same time, there was little discussion about whether integration is usually a part of sound NRM or an additional element. When examining the meaning and application of adaptive management: it is easy for discussion to lose focus and embrace all aspects of INRM.

There seemed to be a consensus that INRM involves the management of the impact of people on natural resources in a way that is:

1. Holistic in that it includes all elements of rural landscapes
2. Systematic in that it considers the interactions between these elements
3. Comprehensive in that it embraces the range of values attached to rural landscapes.

"The evaluation of integrated Natural Resource Management contributes to learning-oriented approach to enhancing agricultural productivity, sustainability and alleviating property.

A proper evaluation helps to judge merit or worth, improve programs and generate knowledge. One indicator of a constructive evaluation is that, if promotes learning and that the results are used to guide change. They point out that, the contribution of four factors to a reflective learning process that is necessary in integrated NRM. They are stakeholder participation, systems approach to evaluation, timing of the evaluation and an iterative approach to investigation. (Steve Twomlow and Nina Lilja. Australia, 1st, oct.2004)

Past reports indicated that, the status of much of the natural resources in the mountains of South Asia has been deteriorating. A steady flow of information regarding the unhealthy state of the world environment became available from the 1970s prompting actions first in the advanced countries, followed by greater international awareness and subsequently local level action in the developing nations (Ives and Messerli, 1989; Carson, 1992; Meadows, 2003; Sitaula et al., 2004). The 'Theory of Himalayan Environmental Degradation' (THED) (Eckholm, 1975) referring that the degradation of forest resources, improper land use and cultivation of crops on fragile steep land due to population pressure are the main causes of accelerated soil erosion and land degradation across the Himalayan region impacting the plains. It implies that a few million Himalayan hill farmers are responsible for the massive landscape changes that affect the lives and property of several hundred

million people living in Gangatic plain in India and Bangladesh (World Resource Institute, 1985; Rasul and Karki, 2007).

Development of a Soil Quality Index

Soil quality for agricultural production can be defined by measuring specific soil indicators spatially over landscapes. Several soil indicators have been proposed to monitor soil quality, however, indicators may change depending upon the soil quality-monitoring objective. Because soil quality is comprised of many variables an integration procedure is needed to establish a soil quality index. We have developed an integrative procedure [multiple variable indicator kriging (MVIK)] that provides a means of integrating soil quality parameters into an index to produce soil quality maps on a landscape basis. These maps indicate areas with a high probability of having good soil quality according to predetermined criteria. This procedure and the resultant maps can be produced at various time intervals to monitor changes in soil quality due to management practices or treatments. Moreover, by evaluating individual indicators over time, it is possible to identify specific soil properties that are affected by management practices. The probability maps produced from MVIK are more useful than rating soil quality on a scale of 1 to 10, and provide more flexibility to incorporate management decisions and environmental constraints into the soil quality profile.

(J.L. Smith, R.1. Papendick and J.J. Halvorson, Washington State University, Pullman, Washington, USA)

Soil Quality for Sustainable Productivity

Today, soil erosion by wind and water, the associated decline in soil productivity, and the adverse effects on water quality continue to be our most serious agricultural and environmental problems (Larson *et al*., 1990). Brown and Wolf (1984) reported that worldwide the mean annual loss of topsoil is estimated at 0.7 percent. This is of great concern because the loss of productivity may not easily be restored, even with application of chemical fertilizers. Studies have shown that when the topsoil is removed, or where it has been severely eroded, crop yields are from 20 to 65 percent lower compared with non-eroded soils (Massee, 1990).

Recently, Haberem (1992) introduced the idea of a "Soil Health Index" to characterize a soil's capability for sustainable production of healthy and nutritious crops. He likened this to a "report card" that would document the gains and losses in soil quality as affected by management practices.

They were focused more on soil conservation activities applying technical measures such as terracing, contour-bunding, landslide and gully control and plantation on degraded land (Rhoades, 1998; Pretty and Shah, 2000; Johnson et al., 2001). The emphasis was on building physical structures to control soil erosion and to rehabilitate degraded lands, and massive efforts were undertaken in this regard (Dejene, 2003). The Mahaveli scheme in Srilanka, and *The Journal of Agriculture and Environment Vol:.9, Jun.2008 Review PaperT* The Tarbela dam in Pakistan are examples of the largest sectoral approach irrigation projects in the world during the 1970s (ESCAP, 1997).

Land evaluation

Quantitative land evaluation procedures, namely USDA Land Capability Classification (LCC) and FAO Land Evaluation Procedure for Soil Site Suitability for various land utilization types have been used to assess the land suitability for different crops and for generating cropping pattern for kharif (summer) and rabbi (winter) seasons in a watershed. The database on soil, land use/land cover rainfall, and temperature was generated from data derived from Land sat TM remote sensing satellite and soil survey to perform an integrated analysis in the geographic information system environment. Arable and non-arable lands were delineated in the watershed using the USDA LCC and non-arable areas were masked for removal from future analysis. Different land quality parameters, viz. soil texture, depth, erosion, slope, flooding and course fragments under various land units were evaluated for a number of crops. Subsequently all of them were integrated using a sequence of logical operations to generate the land suitability maps for various crops. Kharif and rabbi season cropping patterns were developed by integrating crop suitability maps for the winter and summer seasons separately. Finally, cropping system maps for the watershed were obtained by integrating the two season cropping sequences within the crop calendar. Results indicated that the present agricultural area of 47% could be increased to 71% by adopting scientific land evaluation methods for watershed

development. It was also found that better land use options could be implemented in different land units as the conventional land evaluation methods suffer from limitation of spatial analysis for the suitability of various crops (D. Martin and S. K. Saha)

Irrigation Management

Despite remarkable expansion of irrigation in India during the last several decades and the large production and employment gains that it has made possible, most of India's irrigation systems are known for their underperformance. In addition it also leads to widening inequality in access to irrigation water between the users as well as across the regions. It was noted in a study that an increase of as much as 20 per cent in total production can be achieved nearly by improving the performance of irrigation system through management reforms (Bottral, 1981).

Problems related to Major and Medium Irrigation Systems

It is better to distinguish the set of problems that arise in the construction phase from the set of problems that arise in the operation and maintenance phase. The problems that arise in the construction phase are (i) cost and time overruns (may be due to. inadequate project finance), (ii) faulty design, (iii) rehabilitation of the project affected people and (iv) environmental degradation. The problem that arise in the operation and maintenance phase and which accounts for most of the ills of Indian irrigation are (i) underutilization of irrigation capacity (potential), (iil anequity in irrigation, (iii) lack of dependendability of irrigation, indifferent quality of irrigation, (v) wastage of irrJgatioia water, (vi) water logging, soil salinity and alkalinity of irrigated farming and (viii) financial losses and pricing of water. These are all interlinked problems and a number of problems that occur in operation and maintenance phase are a fall out of the problems faced in the construction phase, for example, the crucial problem of underutilization/misutilisation of irrigation potential. It is well known that an irrigation scheme is declared to have been completed for commissioning even when the net-work of field channels and land leveling work to receive water in the entire canal command, especially at the tail reaches, have not been completed. This inevitably leads to concentration of use of -storage water when released at the head reaches of the distribution system which leads to adoption of crops like paddy, sugarcane, banana etc., which require large quantity of water. Even

when most of the canal command is ready to receive the water after completing the works of land leveling and construction of field channels, the users in the head reaches are not ready to give up their claims on intensive use of irrigation water for their crops. This leads to underutilization/mis-utilisation of irrigation potential and inequitable distribution of water in the operation - maintenance phase (Dhawan, 1989).

Agricultural productivity

Agricultural productivity depends largely on the topsoil, the uppermost layer, which is about 15 to 20 cm deep for most soils. Topsoil serves many functions. It provides a rooting zone for plants, supplies a balance of plant nutrients, and retains stores and releases moisture for plant use. It also enhances seed germination and root penetration, and supports a complex community of beneficial microorganisms which decompose organic wastes, recycle plant nutrients, and protect plants from pests. All these functions are essential for maintaining the fertility and productivity of agricultural soils. Soils with these capabilities are considered by many to be "healthy soils".

This agricultural intensification with use of high yielding modern varieties and agrochemicals has many negative implications particularly for the unique landscape of the mountains where farmers are dependent on the local resources through locally developed technology (Sen et al., 2002). The degradation will have direct negative impacts on lives of 150 million people living in the HKH region and indirectly affect about 450 million more living downstream (Rasul and Karki, 2007),

Approaches to watershed management in developing countries of South Asia

A few notable approaches have been employed in watershed and resource management in southern Asia over the past half-century or so. These evolved in a more or less sequential manner as listed below:

Sectoral vs. integrated approach Sectoral approach can be understood as activities targeted for particular sectors such as natural resource management. During the early period (70s-80s) in developing countries, both non-government and government agencies had sectoral narrow approach. The objective was to implement

watershed management projects with the aim of land improvement, soil and water conservation, and forest management in mountain areas (Pretty and Shah, 2000).

The importance of watersheds as ecological units in the context of natural resource management and conservation cannot be overstated. They are hydrologic units that are often used as biophysical and socio-economic or political units for the planning and management of natural resources (Brooks et al., 1991). A watershed is a topographically delineated area that is drained by a stream system i.e. all of the land draining its rain, snowmelt and ground water into a stream or river (Corn, 1993; Swallow et al., 2001). Watershed management can be regarded as both a science and an art (Swallow et al., 2001). Broadly, it is "the process of guiding and organizing land and other resources use in a watershed to provide desired goods and services without adversely affecting land resources. It integrates various aspects of hydrology, ecology, soils, physical climatology and other sciences to provide guidelines for choosing acceptable management alternatives within the socio-economic context taking into consideration the interactions and implications among land resources and the linkages between uplands and downstream areas" (Brooks et al., 1991; Sen et al., 1997).

During the last few decades, degraded watersheds have posed serious problems to environment and people, both upstream and downstream (Mountain, 2002). The people of developing countries came to the realization that land degradation was a serious threat to the environment and to the well being of millions of people (Ives and Messerli, 1989; Oldeman, 1994; Jodha, 1995; Lal, 1998). As it is often the result of human activities, it can therefore, be prevented or controlled by human efforts. Degradation of land resources is a global phenomenon and worldwide soil degradation affects over two billion ha of land, putting at risk the livelihoods of more than 1 billion people (ESC, 2001). Perera and Fernado (2004) reported that 43 percent of the agricultural lands in 8 South Asian countries were affected by some form of degradation. It was also estimated in the GLASOD study that 25 percent of the regions' cultivated land had been degraded by water erosion, 18 percent by wind erosion, 13 percent by soil fertility decline, 2 percent by water logging, 9 percent by salinization and 6 percent by lowering of the water table (Young, 1994). Erosion by water is the most serious degradation problem in South Asia (Narwal et al., 2003). Past studies have indicated that water erosion is detrimental to soils globally both by the volume of soil removed and area of land influenced. It is reported that 1094

million ha is degraded globally due to water erosion of which 751 million ha is severely affected (Lal, 2002) while in Asia, 15 percent of the total land is seriously eroded (Scheer, 1999). Partap and Watson (1994) reported that about 42 million ha of land has been degraded in mountain regions of South Asia.

The concept of watershed management should, by default, be integrated and interdisciplinary (Montgomery et al., 1995; UNEP, 2004), many of the developing countries followed a sectoral approach implemented by different governmental agencies. They generally followed their national level targets based on their policy and plans. Paudel (2002) reported that sectoral integration often takes place at higher levels where decisions are made on allocation of resources. At the implementation level there is little integration among the line agencies. At the field level most line agencies implemented their programs separately according to their own targets and priorities (Paudel, 2002). For example in India, departments are highly sectoral. Staffs have a strong allegiance to their particular professional cadre and are not accustomed to working collaborately (Kumar and Bakshi, 2002). The holistic nature of an ecosystem requires holistic management since one sector's activity will affect another's responsibilities. Sectoral approach is unsuitable for the environment, especially at the field level resource management. Conflicts between government agencies with different priorities (e.g. regarding the use of national parks and mangrove forests) will arise (ESCAP, 1997). In such cases there is problem of duplication, coordination and integration of the program. Even within a single ministry, different departments exhibit lack of integration and coordination. The sectoral approach is no longer appropriate (Shah and Schreier, 1995) in watershed management programs, because each sector constitute independent entities within the administrative and bureaucratic system whereas watershed components such as land, water, vegetation, livestock and human activities are all interlinked each other. Townsely (1996) pointed out that sectoral division are meaningless at the local level particularly the poor watershed communities. Thus, the classic definition of watershed management has been modified by introducing the concept of integration and better sustainability of land, water and socio-economic resources to enhance environment quality and human welfare (Ozyuvaci et al., 1997). Most natural environments in developing countries are not so easily conceived or modeled, and people are not closely integrated with their environments (Swallow et al., 2001).

Integrated Watershed Management (IWM) which emerged in the 1980s can be defined as a comprehensive multi-resource management planning process, involving all stakeholders within the watershed, who together as a group, cooperatively work toward identifying the watershed's resource issues and concerns, as well as developing and implementing a watershed plan with solutions that are environmentally, socially and economically sustainable (Botero, 1986; UNEP, 2004). The holistic approach allows organizations and stakeholders to consider "a system in the context of the higher levels in which it is embedded, and provide insight into the significance of phenomena at lower levels" (Thurow and Juo, 1995; Archer and Smeins, 1991).

IWM has come to be recognized internationally as an important holistic approach to natural resources management, which seeks to promote the concept of sustainable development (FAO, 1998). Such an integrated approach has been recommended in Agenda 21 of the Earth Summit of 1992 for all sectors dealing with the development and management of water resources (UNCED, 1992). It not only deals with the management of natural resources but also involves community development and economic activities (UNCED, 1992; JICA/HMG (N), 1998).

Promoting integrated watershed development programs through the effective participation of local people is intended to prevent further ecological imbalance. Such an approach is needed for conserving, upgrading and using land, water, plant, animal and human resources (Mountain, 2002). Experience has shown that a sectoral approach to natural resource development must be replaced by an integrated management approach with multiple stakeholders' participation to address the environment issues and livelihoods of the rural communities.

Watershed development in India (especially after the 1994 National Watersheds Guidelines) represents a 'dynamic and evolutionary processes' with several guidelines, with several projects, and its enormous coverage in reaching the enriched (Reddy, 2006). This reveals the willingness of the government to interact and involve people in the planning and development of watersheds in India. Equally important is the ability of the government (thanks to non-government organizations and international agencies) to transpose international development discourses, such as watershed management, participatory development and integrated resources management to show their commitment to environmental management and to alleviate poverty. The Parthasarathy Committee Report (PCR) and subsequent

formulation of the Common Guidelines for Watershed Development Projects (hereafter CG) (GoI, 2008) has drawn a series of discussions in the Economic and Political Weekly (see Editorial June 3 2006; EPW issue Volume 41, Nos 26-27; Reddy, 2006; Shah, 2008; Deshpande, 2008; Joy et al., 2008). Some of these discussions endorsed (see the EPW issue dated July 8; Joy et al., 2008)

Rehabilitation of the degraded land through the sustainable management of soil and vegetation would minimize siltation and enhance the water yield in the catchments. Multispecies approach with native species in afforestation would be more advantageous from the point of resistance to pest and diseases, meeting the local demand, perennial water source and more efficient utilization of environmental resource. This serves as a better cover to the soil and aids in regeneration of soil.

Wastelands

The problem of declining land: man ratio gets exasperated through the increasing incidence of wastelands. Both nature and man-induced factors are at work in pushing more and more of cultivable area out of use for agricultural production, food supply and rural well-being. Inadequate property rights (most crucially access to land), poverty, population pressure and declining land-man ratio, inappropriate government policies, and lack of access to markets, credit, and technologies appropriate for sustainable agricultural development, etc., are the more glaring among such factors. These are usually put under the rubric man-made factors**.** There is a natural tendency with the rural poor to "over exploit' land resources. This generally takes the form of overgrazing or deforestation or "unhealthy" cultivation practices. For example, inappropriate cultivation practices can expose soil to water and wind erosion, water-logging, salinization or alkalinization, repeated tillage under economic stress can weaken soil structure, inadequate or imbalanced use of chemical fertilizers can remove soil nutrients and damage yield-raising capability of land, forest clearing for cultivation or reckless grazing on hill slopes can throw land out-of-use as time passes and so on (Miglani 1988, pp. 4-9; Lutz-Pagiola-Reiche, 1994, p.273). Agricultural and pasture lands are affected the most, and the process of 'over-exploiting land' has the latent tendency of perpetuating itself as population pressure continues to grow and cultivable land per head of rural population in general and of poor households in particular, continues to shrink (IFPRI, 1995, p.16).

Nature also contributes size ably to the ring wind erosion takes away the top soil and impairs the texture of soil; water erosion also takes away the top soil and leads to gulley and ravine formation. Floods lead to sand deposition which affects fertility status of the soil and in certain cases, renders land unfit for cultivation (Singh, *et al.,* 1988). Desert formation because of long spells of scanty rainfall (grossly inadequate to meet the minimum survival plant water requirement), snow covered areas during winter and glacial areas characterized by unsorted sediments, impeded natural drainage and poor soils, barren and rocky surface and steep sloping areas controlled by geological processes, landslides and snow avalanches, etc., are all manifestation of nature's handiwork in restricting man's access to cultivable land.

It is natural, therefore, to see that concerns are growing about the extent and rate of land degradation in the world and its effects on agricultural productivity and preservation of natural resources. In the past half-century, about 2 billion of the 8.7 billion hectares of agricultural land, permanent pastures, and forest and woodlands have been degraded. Two-thirds of the world's degraded lands are found in Asia and Africa, but human induced degradation is most severe in Africa, where 30 per cent of the agricultural land, pastures, forests and woodlands are degraded, followed by Asia (27 per cent) and Latin America (18 per cent). Of the total degraded lands in the world, about 40 per cent are mildly degraded which could be restored through good land husbandry measures, while another 45 per cent of moderately degraded land could be restored through significant on-farm investments. Restoring the remaining 15 per cent of severely degraded lands will be much more costly, involving major engineering investments. Worldwide, about 5 to 10 million hectares of land annually becomes unusable due to severe degradation (IFPRI, 1995, p. 16).

The process of deforestation has been another area of deep concern. Petty farming and other poor households clear forest land, usually unauthorized, to meet immediate food needs. Such clearings accounted for roughly two-thirds of the deforestation in the 1980s. There is no reason to believe that such forest conversions will slow down unless very stringent measures are resorted to *(Ibid,* p. 17). In recent years, while Latin America had the largest area of forests cleared and converted to other uses, other areas with smaller forest endowments had higher rates of forest conversion and carry heavier risks of completely losing their forest assets. Rates of forest conversion are most rapid, inter-alia, in continental Southeast Asia, averaging about 1.5 per cent a year. Deforestation has serious consequences, ranging from

increased soil and water degradation to greater food insecurity. The food insecurity effects apply all the more to the local poor people who depend on forest products for food, fiber, medicine and income (Ibid, 1995, P. 17).

It is widely believed that land degradation has catastrophic effects on agricultural productivity. Concrete evidence on the magnitude of these effects is, however, hard to find. Nonetheless, crop productivity losses are reported to be far more significant and widespread in hilly areas, dry land cropping areas and irrigated areas under the spell of excess and unregulated use of water and so on *{Ibid,* p. 16).

Wastelands are the degraded and unutilized lands except current fallows due to different constraints (CSIR, 1990). Poor land practices have led to malnutrition and decline in production capacity of the soil. It is estimated that in wastelands the biomass production is less than 20% of its overall potential. It includes areas affected by water logging, ravine, sheet and gully erosion, riverine lands, shifting cultivation, salinity and alkalinity, shifting and sand dunes, wind erosion, extreme moisture deficiency, coastal sand dunes etc. These degraded lands are ecologically unstable with almost complete loss of top soil and are unsuitable for cultivation due to decline in their quality and productivity.

Plantation

Local people should be involved and decentralized farmer's nursery should be promoted, thus generating employment to the locals in the afforestation programmes. (T.V. Ramachandra and Raushan Kumar-2003)

The plant species suggested for reforestation of open, fallow, degraded lands of low rainfall zones in the eastern part of the catchments are: *Acacia catechu, Acacia concinna, Butea monosperma, Pongamia pinnata, Schleichera oleasa, Madhuca latifolia, Emblica officinalis, Cassia fistula, Strychnos nux-vomica, Odina wodier, Dillenia pentagyrra; ltylia xylocarpa Buchanania lanzan, Careya arborea, Terminalia chebula, Pterocarpus marsupium, Phoenix sylvestris, Mangifera indica, Dendrocalamus strictus, Bambusa arundinacea, Azadirachta indica, Cordia myxa, Aegle marmelos, Sapindus laurifolius, Spondias mangifera.*

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CHAPTER II

STUDY AREA AND METHODS OF STUDY

2.1. Study area

The area selected for the present study is a catchment area of Temghar lake catchment from western Maharashtra. This is one of the minor irrigation projects under *Krishna Khore Vikas Mahamandal*. (Krishna Basin Development Corporation).The Temghar dam commenced in the year 2000. The dam has been constructed keeping in view the increasing population of Pune city and thus linked to Khadakwasla irrigation project. The main purpose of these minor/medium projects is to supply water for Pune city as well as for irrigation in Haveli, Daund, Indapur, and Baramati tahsils. There is growing consensus regarding rehabilitation problems all over the country. Lots of procedures involved in terms of rehabilitation of affected areas and areas where these people has to be rehabilitated.

The present study has been initiated to assess available natural resources in general and land resource management in particular in the lake catchment area itself and to ascertain the potential of it to hold these populations in the same catchment.

2.1.1 Geographical setup

2.1.1.1 Location

The dam is located near village Temghar across the river Mutha. The study area is a catchment of Temghar dam and located between 18° 47' 00"N to 18° 38' 00" latitude and 73° 27 to 73° 32' 00" E longitude. The study area is located about 50 Km. to the west of Pune city. It is accessible by road only from Pune via Khadakwasala-Bahuli or via Pirangut - Mutha (S.H-57). The nearest railway station and Airport is at Pune. The Mutha river is a right bank tributary of the Bhima River in main Krishna basin. The Mutha river originates in the main Sahyadri ranges in taluka Mulshi, District Pune and flows through Mulshi and Haveli tahsils before meeting Mula river in Pune. The dam is located at about 13 km. from the origin of the river Mutha. The catchment area is 37.7 km^2 up to the dam site including water body and area under

water body is 4.99 km^2. The average gradient of the river at the dam wall location is 35 m/km. the average width of the valley is 4km. (Fig 2.1a, b and photo plates 1 to 7)

2.1.1.2 Temghar irrigation project technical details

The survey and investigation for the storage dam was undertaken in May 1989 and completed in February 1993.Information collected from district rehabilitation center Pune reveals that, a project plan was prepared in 1994. However, project was not undertaken at that time. The project report including costing was subsequently revised and the revised report was prepared in 1999.The full reservoir level has been fixed at RL 706.5 m.(Table no.2.1) An area of 499 ha (4.99 km^2) is coming under submergence including 4.50 ha. (0.045 km^2) of forest land.(about 0.9% of submergence land) In principle, forest clearance has already been obtained from relevant authorities and Ministry of Environment and forest, western regional office, Bhopal, (wide letter 8B-14/98, FW/C/899 Dated 15/5/98).Technical details of TheTemghar irrigation project has been given in table 2.1.Land from four villages acquired for the project has been displayed in table no. 2.2 also depicts the land acquired from government which is 58.26 ha(0.5826 km^2)and forest land being 4.50 ha(0.0450 km^2).

2.1.1.3 The details of affected villages and their rehabilitation sites

Total area under submergence is noted to be 499 ha. (4.99km^2) and the land has been acquired from four villages namely Temghar, Lavharde, Wegre and Vedhe. Out of these four villages, Lavharde and Vedhe are partially affected and Temghar, Wegre are fully affected villages. Table 2.3 depicts the details of affected villages and their respective rehabilitation sites with distance.

Temghar irrigation project affected villages has been rehabilitated in five villages mainly in Khed and Shirur tahsils of Pune district, i.e.Shel-Pimpalgaon (Khed tahsil), Kondapuri, Rautwadi, Vitthalwadi and Apti (Shirur tahsil).

2.1.1.4 Geology:

The geology of the entire study area consists of dark coloured volcanic lava flows. Lava flow mostly of the cretaceous time. The major portion of the area is covered by basaltic lava flows known as “Deccan-Trap “of upper cretaceous to lower

Diagram 1

Diagram 2

Diagram 3

Diagram 4

Diagram 5

Diagram 6

Diagram 7

Diagram 8

Diagram 9

Diagram 10

Diagram 11

Diagram 12

Diagram 13

Eocene age. The lava were poured out of the long and narrow fissures in the earth's crust and are spread in the form of horizontal sheets constituting numerous spurs, hills and hill ranges; bold, flat topped plateaus with terraces. The landforms generated out of basalt are dominantly the flat topped elongated and round shaped hills, plateaus/ table lands, pediments, domes, undulating plains, gently sloping plains and 'v' shaped valleys.

The rocks are more or less uniform in composition and texture. The rock is dominantly basic in composition, very dark and grayish to gray in colour, hard, compact and tough (Gaikwad L.D.1976).

Most of the bedrock is overlain by overburden with few rocky outcrops visible. As the region falls in upper reaches of the river, there is absence of older alluvium commonly found in lower reaches of river. Basalt of two main types is found to occur viz. the compact or non-vesicular basalts (without gas cavities,) and the amygdaloidal basalt with gas cavities filled with secondary minerals. The compact basalt is found to occur as a thick flow up to 25m in thickness.

Amygdaloidal basalt with green or white spots produced by secondary mineralization also occurs. The white spots signify zeolite while green or black spots are produced by chlorophaetic mineralization. Fine grained red as well as black Tachylytic basalts are found as small flows or vein –like intrusions in the compact basalt.

Volcanic breccias, either with explosion fragments held together by zeolite or embedded in lava matrix also occurs. The lava matrix may be normal basalt. The compact basalts are found to be well jointed though there is some variation in pattern of jointing. The amygdaloidal basalts on the other hand are found to be splited and hence considered very suitable for foundation. The basaltic flows are of the two types

1. 'Pahoehoe' flow 2. 'Aa' flow

The 'Pahohoe flows' weathered easily and give rise to mature type of the topography with smooth hill slope and conical peaks. Broad valleys are common. The product of the weathering includes small-sub rounded fragments. 'Aa' flows main section comprise of dark grey, fresh basalt over this is found a section of flow braccia which also consist of angular block of vesicular trap cemented by glass or zeolitic or very fine grained altered basalt. (Fig. 2.2)

Diagram 14

2.1.1.5 Climate

Climate is tropical monsoonal type characterized by the well defined seasons like summer, rainy, October heat, and winter season.

Temperature:-

The months of the summers are March, April and May which are having variation in range of temperature. The mean annual temperature is 24.6°C while, mean summer temperature is 27.4°C. There is a significant variation in temperature conditions in western Maharashtra throughout the year. Seasons mainly summer, rainy and winters persist more or less four months duration, temperature recorded to be highest in the month of May which exceeds 38°C where as winter is a season where temperature is recorded to be minimum generally less than 15°C. Average condition of temperature variations are displayed in (Fig. 2.3)

In the Temghar catchment, the temperature distribution varies from east to west. It decreases towards west from 25.9°C to 23.9°C due to the physiographic variation i.e. undulating nature of the surface.

Rainfall:-

Monsoon starts in the month of June & receives up to the end of September. Average annual rainfall is 2740 mm. (Fig 2.4). The rainfall variations in the region show considerable increase towards west. Rest of the months are without spells and the months April and May sometimes gives torrential rainfall due to local climatic conditions.

2.1.1.6 Physiography

The area exhibits extremely rough terrain especially in the upper reaches of area, in fact these valley sides are characterized by numerous terraces on both the flanks. The region shows rugged topography which can be noticed by the high variation in the slopes (0^0 to above 30^0). General slope of the watershed is from south to north–east south of the main river and north to south-west at the northern reaches of the basin. The altitude varies between a minimum of around 648 meters ASL near the dam wall and a maximum of above 1100 meters ASL on the ridges of the basin

Diagram 15

Diagram 16

boundary mostly at the southern and northern water divide. Hilly undulated area and hillocks are present particularly in the northern and southern part of watershed. (Fig.2.5 a, b, c, d, e, f.)

2.1.1.7 Drainage patterns

The area is a well-drained with mostly perennial streams that get their rain water during the monsoon period (June to August). Most of the streams originate in the southern part of watershed and flow in a north east direction. These streams originating from a number of small valleys collect the excess rain water from the hills and plain areas and finally reach to Mutha river. The drainage network shows dendritic type of drainage pattern. The details of the stream number and orders are given in the table no.2.4 and (Fig.2.6).

2.1.1.8 Soil environment

As mentioned earlier, the study area is characterized by various slope segments. There is a considerable variation in soil properties. Sandy material is generally confined to higher slopes, whereas agriculture land shows silty, clayey and loamy and loamy sand in abundance.The general colour of soil along hill slope area is dark reddish and it is dark brown to yellowish brown in the Mutha valley floor. It seems the soils in the valley floor are rich in the amount of organic matter and humus content. Most of the valley floors are presently submerged. Along most of the hill slopes are barren, devoid of vegetation and thus exhibits very high potential land surfaces for surface runoff and soil loss, therefore top soil layer is very thin and almost lost at same places. Higher hill slopes have thin film of soil and it is also less compact compared to the agricultural soil on the hill slopes wherever forest cover exists, soils are enriched in organic matter, whereas in plain regions, due to the mixing of the soil with the other ingredients such as stones, grass, gravel has resulted in the modification of the soil properties.

2.1.1.9 Natural vegetation

The watershed has mixed deciduous type of vegetation thin shrubs predominant on hills and hill slopes. Some of the important species are enlisted below in Table No.2.5.

Diagram 17

Diagram 18

Diagram 19

Diagram 20

Diagram 21

Diagram 22

Diagram 23

Diagram 24

Diagram 25

The present study area is hilly and patches of reserved forest are observed along the hill slopes. Within the forest area itself, there may be occasionally cultivated patches or grazing land.

2.1.1.10 Total land acquisition

Temghar Lake has been displayed in table 2.2. The study area covers about an area of 3770 ha. (37.70sq.km) land has been acquired from the four villages for this project. The village wise break up of geographical area is given below: Table No. 2.2 total land acquisition

2.1.2 Socio-economic aspects:

Out of the four villages, Temghar and Vegre are fully affected, where as Lavarde and Vedhe are partially affected villages. Settlements are clustered at the lower basin of Mutha valley where alluvium deposits are quite extensive thus encouraging villagers to settle in the vicinity indulging in agricultural practices. Settlement forms a very minor portion of the whole study area and the villages are poorly linked with mostly unsealed roads. As one moves nearer to the river source, settlements tend to shrink in size and get dispersed in trend. Moreover the more rugged topography as one goes higher is inhospitable both for living and agricultural practices. The erection of two dams in the study area within the past decade has had a major impact on the lives of people around that area. Many families have been displaced because of the dam construction and most of the fertile lands in the Mutha valley got submerged forcing the inhabitants of the area to find other alternative places to settle down.

The Maharashtra Industrial Development Corporation (MIDC) has recently developed an industrial area at Kurkumbh in Daund Taluka,as a major centre and with sub centre's like Jejuri,Pirangut and Ranjangaon. Many private industries have come up at Pirangut in Mulshi tahsil. But these industries are having the speciality in the Information Technology; hence the opportunities of employment for this project affected people are strictly restricted as their education level is not up to the required one.

There are no mineral deposits or any other source in the study area for the employment potentials. The main source of livelihood in this area is agriculture. Other

occupations are, to collect fish and crab from the surrounding water sources and to sale it in nearest market places. Roads- Pune-Pirangut- Mutha—Vegre tar road is available in the study area. Major railway junction is at Pune, which is near about 50 km. away from the dam site. Major weekly market places are Pirangut and Khadakwasla. These places are linked with good motorable roads.

In the present study, an overview of socio-economic and cultural aspects has been taken in to consideration to infer the socio-economic and cultural dimensions of project affected as well as rehabilitated villages. It is observed that, people still remained at their native place and are practicing subsistence type of farming and very much backward in terms of their socio-economic status and standard of living. Most of them are from Hindu religion and very few are from other religion like, Budhist.They have still maintained their customs and are in communication with the people who have been rehabilitated else were. Even today they used to come for marriage, festivals and annual fairs etc.The relatives of project affected people are still manages and builds the relationships from the same area. People from rehabilitated area prefer to build such kind of relationships through marriages from their native places.

Worshipping a God in festivals and annual fairs is a remarkable cultural activity being practiced and maintained from both the sides i.e. from affected as well as rehabilitated sites. Project affected people are facing so many social and cultural problems in terms of different activities pertaining to annual fairs, festivals etc. They are not receiving proper education and has to go for long distance for higher education. An infrastructural development is almost stopped because of less population in these areas and still has to walk over a long distance to come to city area like Pune. Agriculture is being practiced and is mainly paddy cultivation and few millets on inferior soils, thus agriculture has become a restricted activity in this area.

Peoples from rehabilitated sites also facing socio-cultural problems and willing to go to their native area as their relatives are residing in affected areas. People where they have been rehabilitated, local ones have not yet accepted them as their own resident’s and citizens and have to face a problem of confrontation repeatedly.

2.2 Hypothesis:

Displacement of people due to infrastructural development has become a serious issue in India. No efforts have been made till recently, neither by government authorities nor by private / public sector to systematically restore these affected populations. There are serious instances took place, while implementing the rehabilitation policy within the legal framework, therefore it is hypothesized that, 'Development of rehabilitation model pertaining to minimization of the cost of rehabilitation and to retain peoples own socio-cultural dimensions within the framework of Integrated Land Resource Management (ILRM),' certainly will help in upgrading and maintaining the natural resources and will also be helpful in minimizing the degradation of environment as well as restoring the people to their native places'.

2.3 Major objectives of the study:

The major objective of the present study is to evaluate the available land and soil resources in the catchment area of a Temghar lake so as to check the availability of natural resources in general and land resources in particular. Therefore following objectives have been outlined:-

1. To infer the potential of land resources in the catchment area and to evaluate land resources and its significance to meet the need of rehabilitation process in the same piece of land.
2. To analyze land use / land cover in the study area using remote sensing technique which will help in understanding the general trend of utilization of land resources in the study area and to identify suitable sites for rehabilitation within the catchment itself.
3. In order to assess the potential of a terrain in terms of land capabilities and suitability, soil productivity, soil physiographic relationship pertaining to soils-cape analysis forms the basis of the present study. This will help to identify and analyze land forms in terms of their potentials for optimum utilization of land resources and to identify suitable sites for rehabilitation.
4. To infer the nature and extent of degraded lands in terms of soil loss, surface runoff and vegetation cover, forms the basis of land evaluation studies therefore it is ascertained by computing empirical equation and visual interpretation of

satellite images this will help in delineation of priority land facets for conservation planning.

5. To ascertain the present situation and status of rehabilitation process and to infer the socio-economic status of the project affected people and to understand general perception of the villagers.
6. To prepare various thematic maps as a basis for further planning and management of land resource in general and regeneration of wasteland in particular for the rehabilitation of the project affected people.

2.4 Database and Methodology

2 .4.1 Database:

Data required for the present study has been acquired from various sources. Data pertaining to various aspects of the study mainly includes primary and secondary data. Main thrust has been given on collection of first hand information by visiting the project affected as well as rehabilitated places, which almost cover all the villages under consideration. Around 100% data has been thus, collected by conducting extensive house hold surveys. Table 2.6

In addition to this, data from Talathi office, Tahasil office, forest department of Maharashtra, soil survey department, Maharashtra Engineering Research Institute (MERI), Nasik. Irrigation department, Pune, District rehabilitation centre, Pune, NGO etc. forms a major database for the present study. Details are outlined in the following lines.

2.4.1.1 Primary data collection

2.4.1.1.1 House hold socio-economic survey

In order to conduct a household survey, detailed questionnaire has been prepared and mainly questions pertaining to the people's perception of rehabilitation, has been incorporated. Around 82 families in the catchment and 167 families from the rehabilitated places were interviewed in detail considering each and every member of the family.

Diagram 26

Since the present study intended to synchronize the socio-eco information of project affected people, very comprehensive questionnaire for house hold survey has been prepared (Appendix-I)

Around 82 households were interviewed at project affected place and167 households are interviewed at rehabilitation places. This has resulted into determining very good extract of their problems regarding rehabilitation at rehabilitated places at the villages Shel-pimpalgaon, Kondhapuri, Vitthalwadi, and Apti. Detailed review of which has been taken in preceding lines.

2.4.1.1.2 Soil survey:

In order to infer characteristics of soil with respect to topography a detail soil survey plan has been prepared which involves mainly the soil survey at reconnaissance level. Soil survey thus conducted mainly includes, soil sample collection with soil anger, core tube, and infiltrometer. While collecting soil samples; effective rooting depth of plants has been considered, i.e.upto 25cms.It is also intended to collect the samples to represent almost all slope segments details are given in the preceding lines.

2.4.1.2. Secondary data:

Secondary data mainly obtained from talathi office at Temhgar, Paud panchayat samitee at Paud, Tahsil office at Paud, forest department government of Maharashtra, soil survey department government of Maharashtra, Maharashtra Engineering Research Institute (MERI) Nasik, Geological survey of India, Pune Irrigation department, Pune, Pune district project affected rehabilitation office, Pune, NGO like Gomukh, Kirloskar consultants, census hand books (Pune districts) 1991, 2001 etc.

2.4.2 Methodology:

2.4.2.1 Fieldwork component:

2.4.2.1.1 Collection of soil sample & field measurements.

Field components of present study mainly composed of observation based on soil sample collection according to change in the slope along with this field measurement of hydraulic conductivity and infiltration capacity has also been

conducted in the field. Around 31soil samples has been collected and 167 field observations has been carried out in the field.

2.4 2.1.2 Ground truthing

Remote sensing data mainly used of very high resolution data of sensor SPOT a true colour image. The extension of features mainly vector in nature has been verified in the field through ground check on truthing.

2.4.2.2 Laboratory components:

2.4.2.2.1 Preparation of base map:

Base map has been prepared using Toposheet no. 47F/11, 47F/15. Major operations involved in the preparation of base map are scanning of the toposheet and geo referencing the same in the GIS environment using toposheets no's, 47F/11, 47F/15 .After successful rectification of which high resolution SPOT image has been synchronized and rectified to the same projection and datum.

2.4.2.2.2 Soil analysis:

Soil analysis of the collected soil samples has been performed in the soil laboratory around 31samples were analyzed and physical properties of the soil, like determination of soil texture, structure, bulk density % porosity, water holding capacity etc has been determined. Chemical properties have also been determined using digital pH meter, Digital conductivity meter, digital colourie meter etc. as well as titration method has also been performed to determine calcium carbonate, % organic carbon, % organic matter etc. Soil analysis kit has also been used to determine nitrogen, phosphorus, potassium (NPK).

2.4.2.2.3 Data analysis and computation of results

Data generated through soil analysis has been processed for statistical operation. Major derivatives like mean standard deviation, mode, has been determined to infer the variation in the average characteristics of soil in the Temghar lake catchment. However these soil characteristics are also useful as basic input parameters in the soil erosion studies. Soil data in terms of their GPS location has proved to be

very useful in determining spatial locations of soil sample as well as to infer the spatial distribution of various properties and preparation of various thematic maps. An attempt has also been made to estimate rates of denudation by digitizing Toposheets contours and aster DEM of 30m resolution.

2.4.2.2.4 Preparation of Thematic maps using RS & GIS

Based on the data collection and data generation various thematic map of Temghar lake catchment has been prepared. It mainly includes digital elevation model, absolute relief map, relative relief map, percentage slope map, delineation of water shed. Table 2.7.

2.4.2.2.5 Software's used

For the base map preparation and for preparation of various thematic maps, various GIS software's like Global Mapper version 12.01, Surfer version 9.01, Digem, Google earth BASIN-4', Diva-GIS, ILWIS (Integrated land and water information system) Adobe Photoshop has been used. Table No 2.8 Methods used for thematic map preparation.

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Diagram 27

Table No. 2.7: Methods used for thematic map preparation

Sr. No	Map	Method	Source
1	Absolute Relief Map	By superimposing grid (1.5 cm *1.5m)	ASTER Data (30m Resolution)
2	Relative Relief Map	By superimposing grid (1.5 cm *1.5m)	ASTER Data (30m Resolution)
3	Dissection Index Map	By superimposing grid (1.5 cm *1.5m)	ASTER Data (30m Resolution)
4	Slope Map (%)	By superimposing grid (1.5 cm *1.5m)	ASTER Data float grid file format
5	Drainage Map	Digitization in global Mapper and process in Diva GIS software	Toposheet index no 47F/7 and 47F/11
6	Land use / land cover map	Digitization in global Mapper and process in Diva GIS software	Google image Dec-07
7	DEM model	Digitize the contour in Global Mapper and process in surfer software	Toposheet index no. 47F/7 and 47F/11
8	Sub watersheds	Basin 0.4 software	Arc Ascii file format Aster elevation data
9	Soil properties maps	Surfer software	Grid operations in surfer

Table no. 2.6

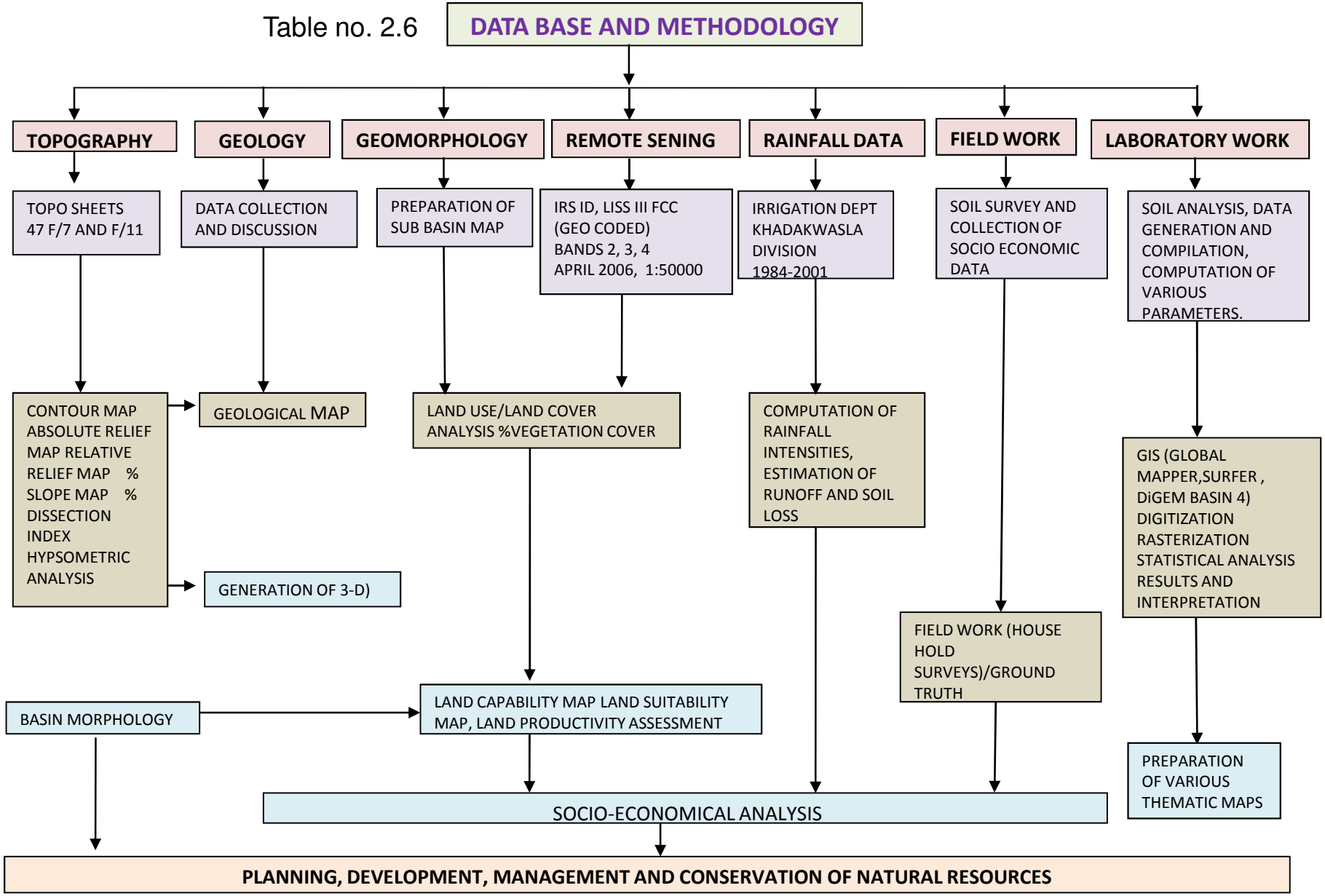

DATA BASE AND METHODOLOGY
TOPOGRAPHY
GEOLOGY
GEOMORPHOLOGY
REMOTE SENING
RAINFALL DATA
FIELD WORK
LABORATORY WORK
TOPO SHEETS 47 F/7 AND F/11
DATA COLLECTION AND DISCUSSION
PREPARATION OF SUB BASIN MAP
IRS ID, LISS III FCC (GEO CODED) BANDS 2, 3, 4 APRIL 2006, 1:50000
IRRIGATION DEPT KHADAKWASLA DIVISION 1984-2001
SOIL SURVEY AND COLLECTION OF SOCIO ECONOMIC DATA
SOIL ANALYSIS, DATA GENERATION AND COMPILATION, COMPUTATION OF VARIOUS PARAMETERS.
CONTOUR MAP ABSOLUTE RELIEF MAP RELATIVE RELIEF MAP % SLOPE MAP % DISSECTION INDEX HYPSOMETRIC ANALYSIS
GEOLOGICAL MAP
LAND USE/LAND COVER ANALYSIS %VEGETATION COVER
COMPUTATION OF RAINFALL INTENSITIES, ESTIMATION OF RUNOFF AND SOIL LOSS
GIS (GLOBAL MAPPER,SURFER , DiGEM BASIN 4) DIGITIZATION RASTERIZATION STATISTICAL ANALYSIS RESULTS AND INTERPRETATION
GENERATION OF 3-D)
FIELD WORK (HOUSE HOLD SURVEYS)/GROUND TRUTH
BASIN MORPHOLOGY
LAND CAPABILITY MAP LAND SUITABILITY MAP, LAND PRODUCTIVITY ASSESSMENT
PREPARATION OF VARIOUS THEMATIC MAPS
SOCIO-ECONOMICAL ANALYSIS
PLANNING, DEVELOPMENT, MANAGEMENT AND CONSERVATION OF NATURAL RESOURCES

Table No. 2.5: Species of natural vegetation and shrubs

Sr. No.	Local name	Botanical name
1	*Mango*	Magnifera Indica
2	*Khair*	Accacia Catheue
3	*Hirada*	Lerminala Chebula
4	*Behada*	Terminalia belerica
5	*Umber*	Ficus recemose
6	*Jambhul*	Enginia Jambulana
7	*Phanas*	Artocarpus ineisa
8	*Ain*	Terminatia formardasa
9	*Teak*	Tectona Grandis
10	*Bhabhul*	Accacia arabica
Shrubs		
1	*Ghaneri*	Latana Camera
2	*Ghypat*	Agave Sisolona
3	*Rui*	Calotropis gigntia

Table No. 2.4: Stream orders & numbers of Temghar lake catchment

Sr. No.	Stream Order	Stream Numbers	Total Stream Length (Km)
1	First	219	118.30
2	Second	46	84.40
3	Third	07	65.90
4	Fourth	02	104.54
5	Fifth	01	09.23

Table No. 2.3: The details of affected villages and their rehabilitation sites

Sr. No.	Name of the affected and to be rehabilitated village	Tahsil	Village where rehabilitation to be done	Tahsil	Distance from affected to rehabilitation Site (in Km)
1	Temghar	Mulshi	Shel-Pimpalgaon	Khed	80
2	Temghar and Lavarde	Mulshi	Kondhapuri	Shirur	103
3	Lavarde	Mulshi	Raut wadi	Shirur	96
4	Vegre	Mulshi	Vitthalwadi	Shirur	102
5	Vegre	Mulshi	Apti	Shirur	84

***Village Vedhe has not been rehabilitated due to partial land acquisition (i.e. 42.92 ha)**

Source: District rehabilitation center, Pune 2006.

Table 2.2 Land acquisition for Temghar irrigation project

Village	Area in ha	Area in Km^2
Temghar	137.28	1.3728
Wegre	219.44	2.1944
Lavharde	105.20	1.0520
Vedhe	42.92	0. 4292
Government land	58.26	0. 5826
Forest land	4.50	0.045
Total	**567.600**	**5.6760**

Source: District rehabilitation center, Pune

Table 2.1 Salient features and technical details of the Temghar irrigation project	
a) Source	Mutha River
b) Location	
i) State	Maharashtra.
ii) Region	Western Maharashtra
iii) District .	Pune
iv) Taluka	Mulshi
v) Coverage in Toposheet No's	47F/7, 47 F/11
vi) Latitude	18° 27' 0" (N)
vii) Longitude	73 °32' 0" (E)
Viii) No. of Project Affected Persons	2000 Persons
c) Yield and Utilization of the Project	
i) Catchment Area	37.70 sq.km. (3770 ha.)
ii) Rainfall	1400mm
iii) Proposed utilization	105.00 Scum (3.708 TMC)
iv) 50% Dependable yield	121.69 Mcum (4.297 TMC)
v) Percentage of Gross annual utilization to 50% Dependable yield.	86.29 %.
d) Dam and Reservoir	
i) Gross capacity of the Reservoir	107.96 Mcum (3.812 TMC)
ii) Capacity at Dead storage At MDDL (641.40 m)	2.95 Mcum (104Mcft)
iii) Capacity at live storage	105 Mcum (3.708 TMC)
iv) Maximum water level	710.12 m.
v) Evaporation losses	4.68 Mcum/0.165 TMC
vi) Type of Dam	Masonry dam with un-gated central spillway.
vii) Maximum height of Dam	86.680m (284.31ft).
viii) Length of Dam	1075 m
ix) Total quality of materials	

a) Masonry	1187.772 cum.
b) Concrete	44.9430 cum.
c) Excavation	8.34.173 cum.
x) Submergence of area	
a) Land under submergence at RL 707.25m and require for colony	499.034 ha.
b) Number of villages affected	4 villages (2 villages fully and 2 villages partially.)
xi) Controlling levels	
a) Riverbed = 641.56m.	
b) MDDL = 661.40m.	
c) FRL = 706.50 m.	
d) HFL = 710.12 m.	
e)TBL = 711.40.m.	
xii) Free board	1.26 m.
xiii) Spillway	
a) Type Un-gated central spillway with pier and a bridge to cross the River.	---
b) Maximum flood discharge	736 Cumecs (25996)
c) Estimated flood capacity	2092 Cumecs (73890 cusecs)
d) Height of Masonry section	86.68m (284.3ft)
e) Foundation level of Spillway.	72.00m.
f) Length of spillway.	624.720m (Average).
Xiv) Outlet	Irrigation cum power
a) Location RD 635.00m.	-
b) Type Conduit with screws type.	-
c) Foundation level	635.52m (at RD635.00m)
d) Full supply discharge.	9.91 Cumecs (350 cusecs).
xv) Canal	Canals are not proposed. Water will be let out through ICPO in Mutha river in the catchment of Khadakwasla dam.
Xvi) Command Area	

✓ Gross command area of KT weirs (Down steam of Khadakwasala Dam and up to back water of Khad akwasala project)	2000 ha. +18383ha. from Khadakwasala project
✓ Cultivable command area Khadakwasala project.	1600ha. +14398ha.from
✓ Irrigable Command Area from Khadakwasala Project	1000ha. from Mulshi +10830ha
✓ Intensity of Irrigation over Gross Command area.	58%
xviii) Total Cost of the project	Rs.323.53 Crores.

Source: Irrigation department, (Sinchan Bhavan) Pune



1. PANORAMIC VIEW OF TEMGHAR DAM AND SURROUNDING



2. VIEW OF THE CATCHMENT FROM TEMGHAR DAM WALL - BARE HILLSLOPES ON THE BACKGROUND

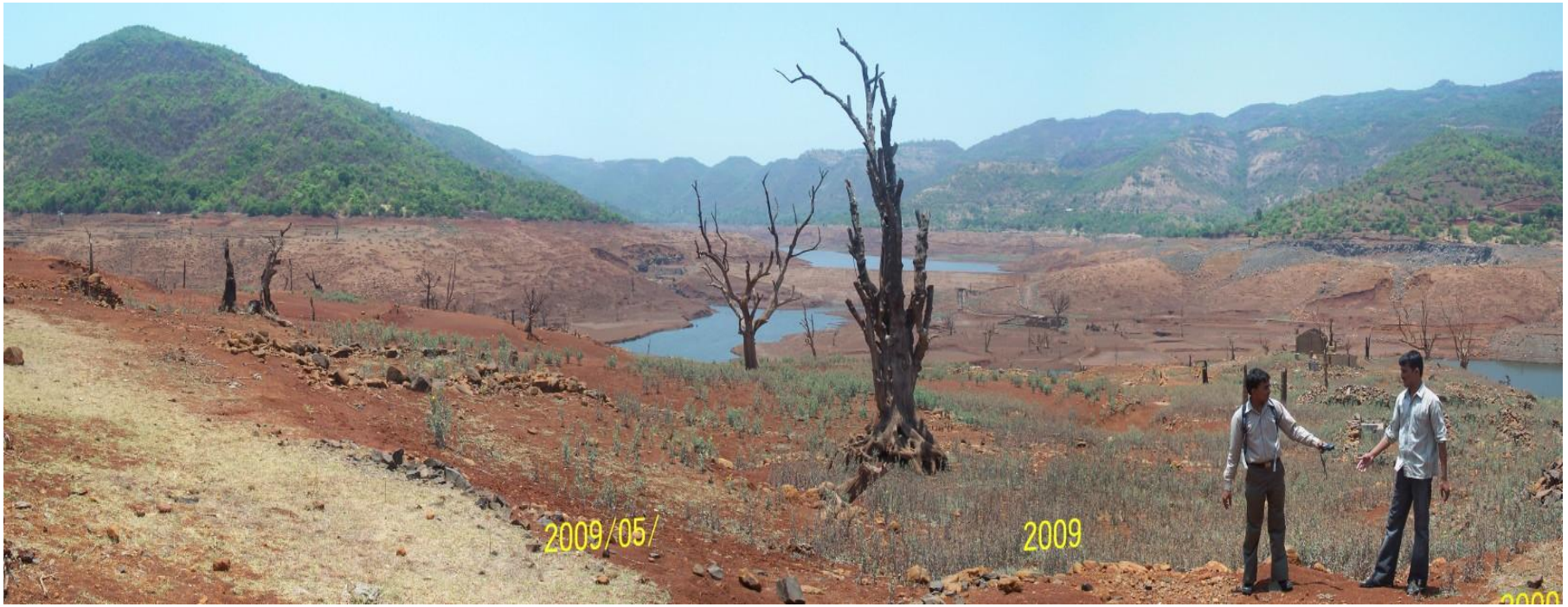


3. PANORAMIC VIEWS OF TEMGHAR DAM WALL AND BACKWATER AREA





4. VIEWS FROM MIDDLE OF THE BACKWATER AREA TOWARDS DAM WALL AND BACK



5. DISTANT VIEW OF TEMGHAR DAM WALL AND SUBMERGED HOUSES AND TREES ON THE FOREGROUND



6. DISTANT VIEW OF TEMGHAR DAM WALL AND CLOSE VIEW OF SUBMERGED HOUSES ON THE FOREGROUND

LOCATION MAP OF THE STUDY AREA

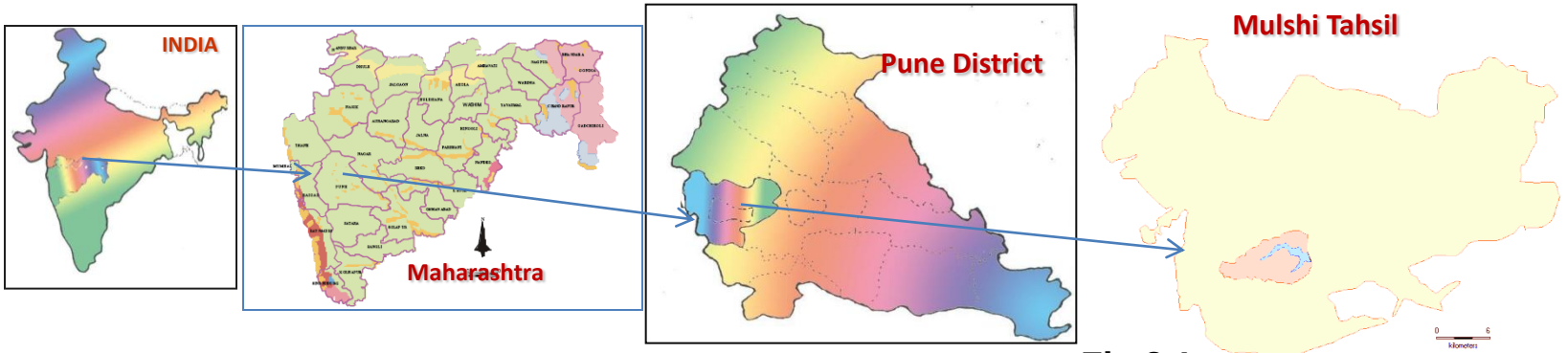
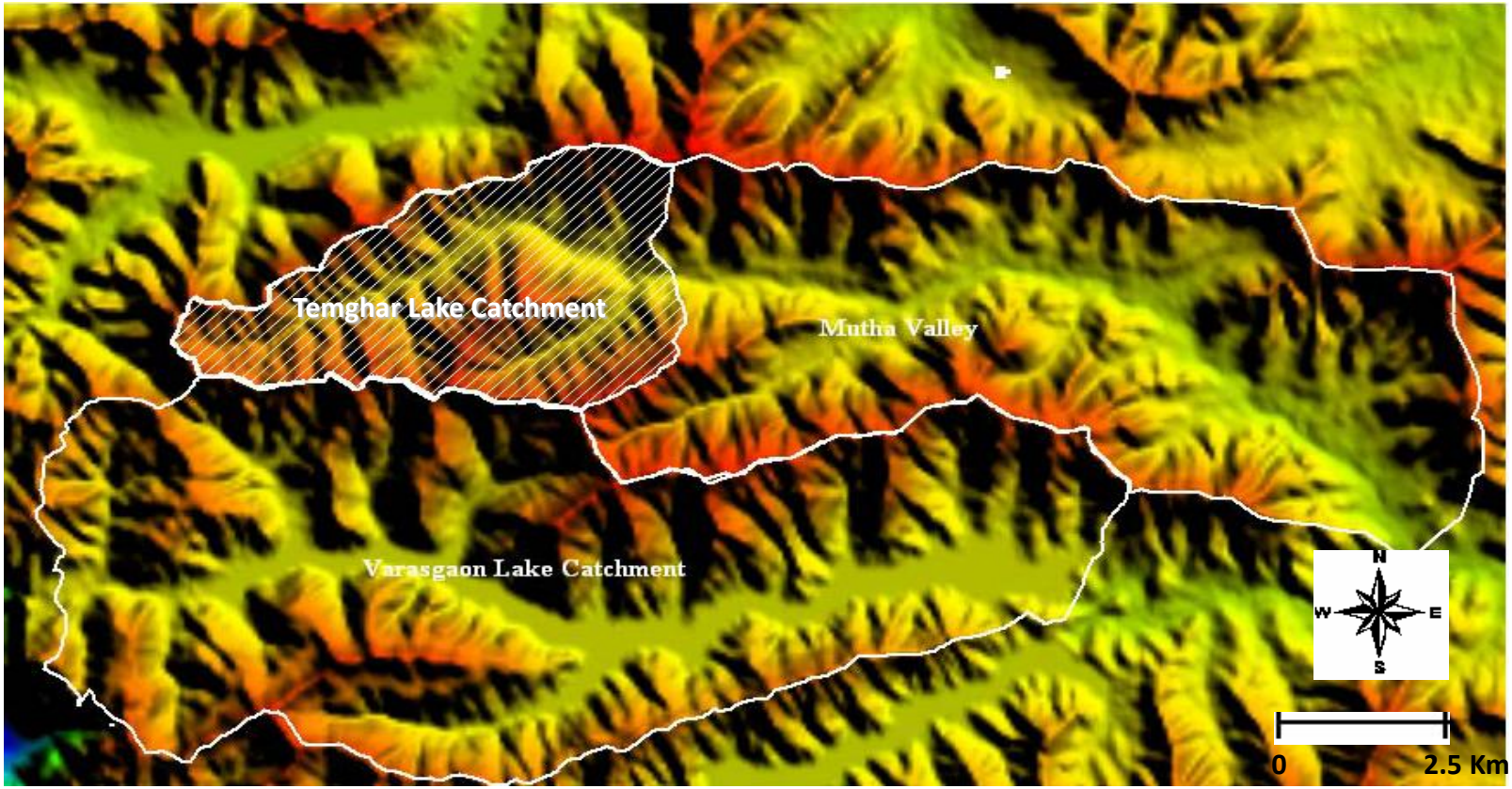


Fig 2.1a



Spatial location of Temghar lake catchment in Mulshi Tahsil (Village boundary overlay)

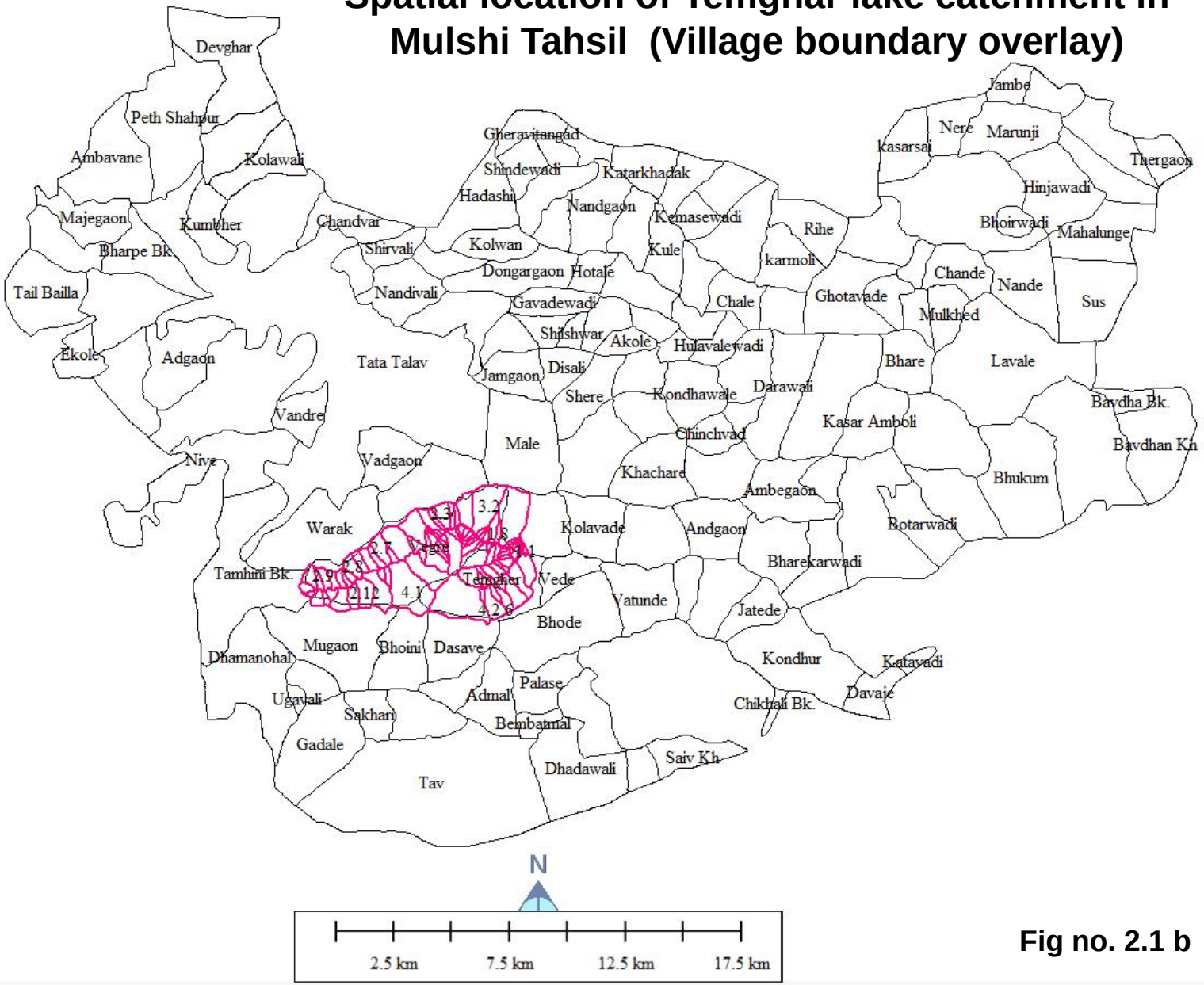


Fig no. 2.1 b

TEMGHAR LAKE CATCHMENT

GEOLOGY MAP

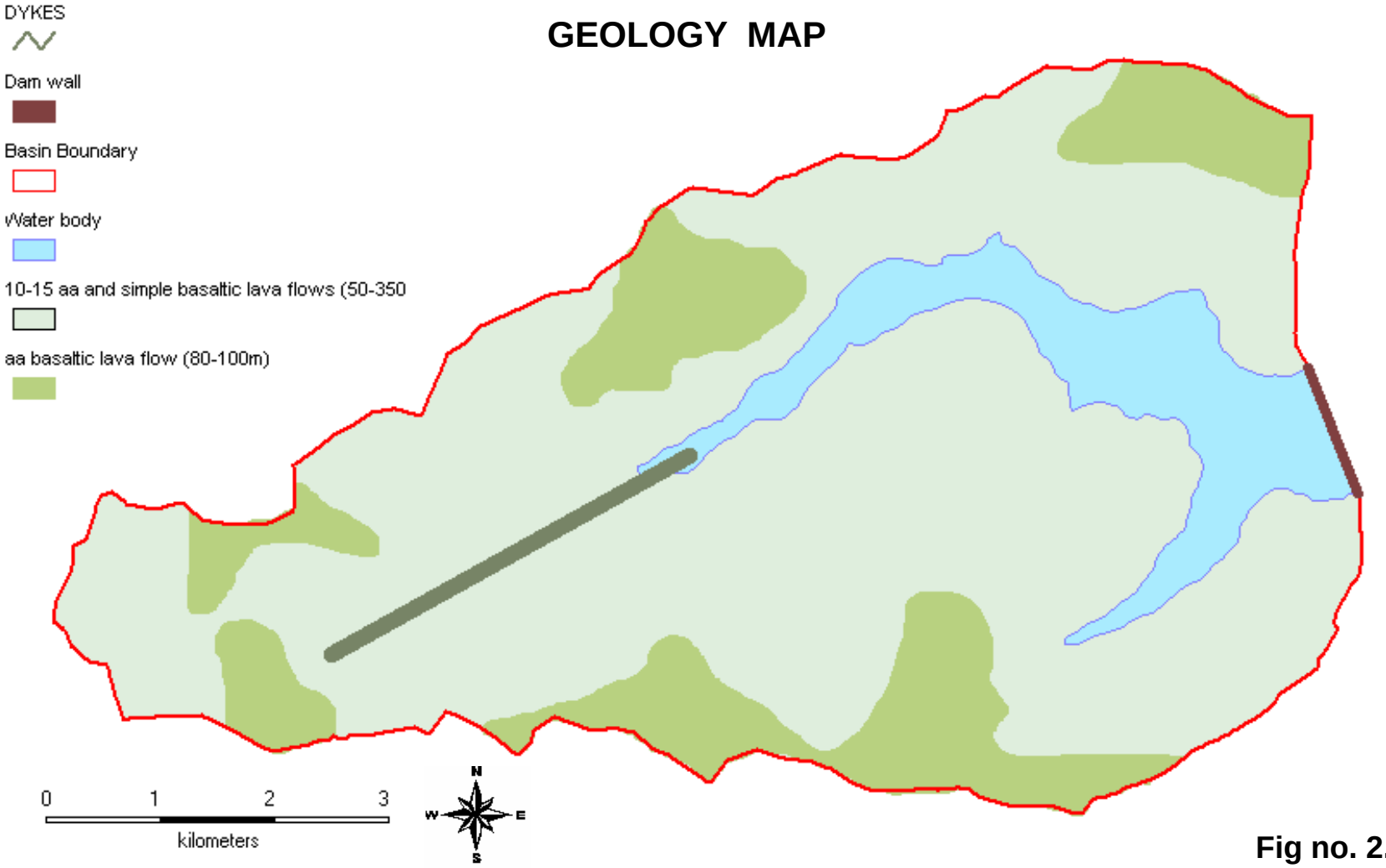
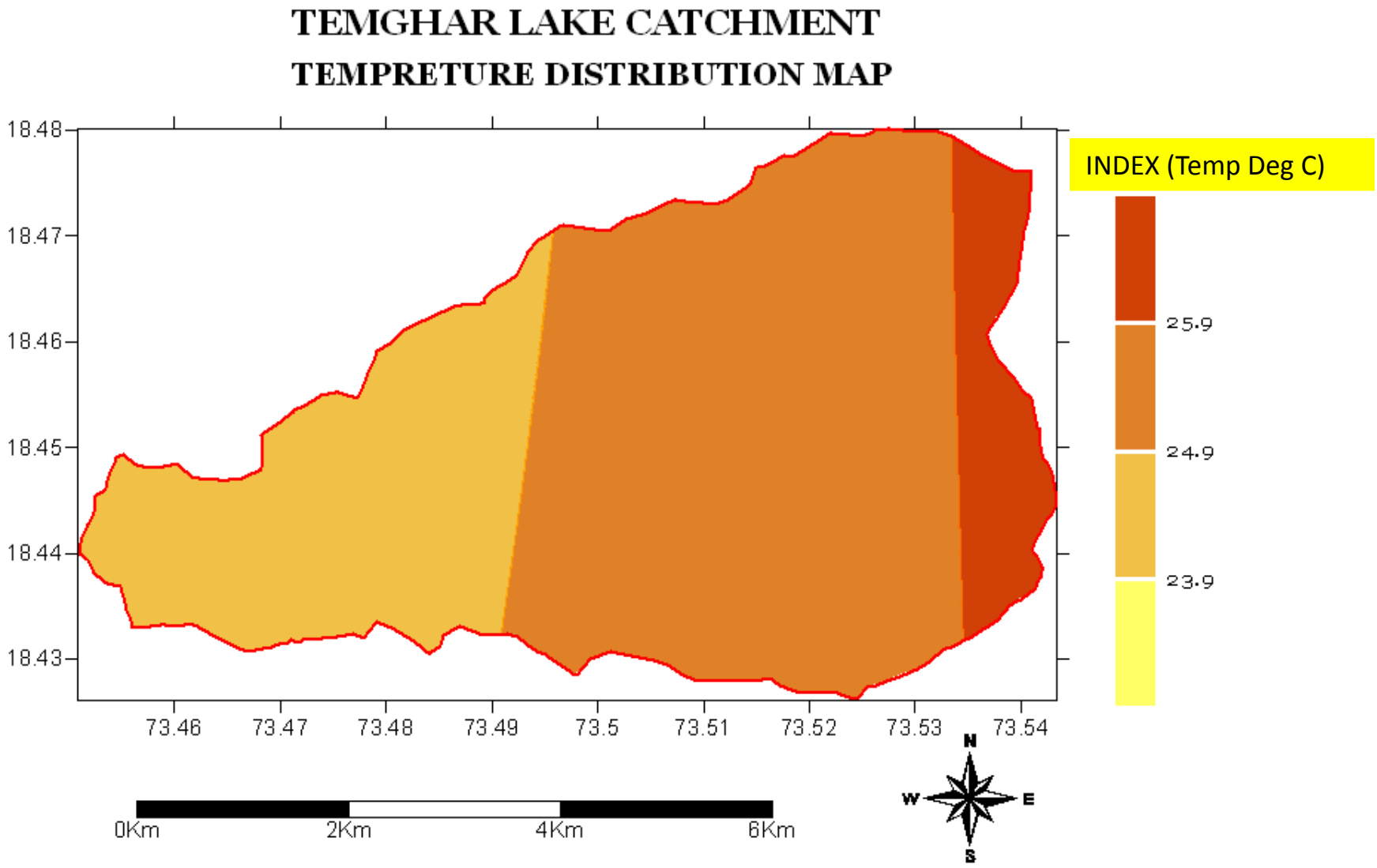
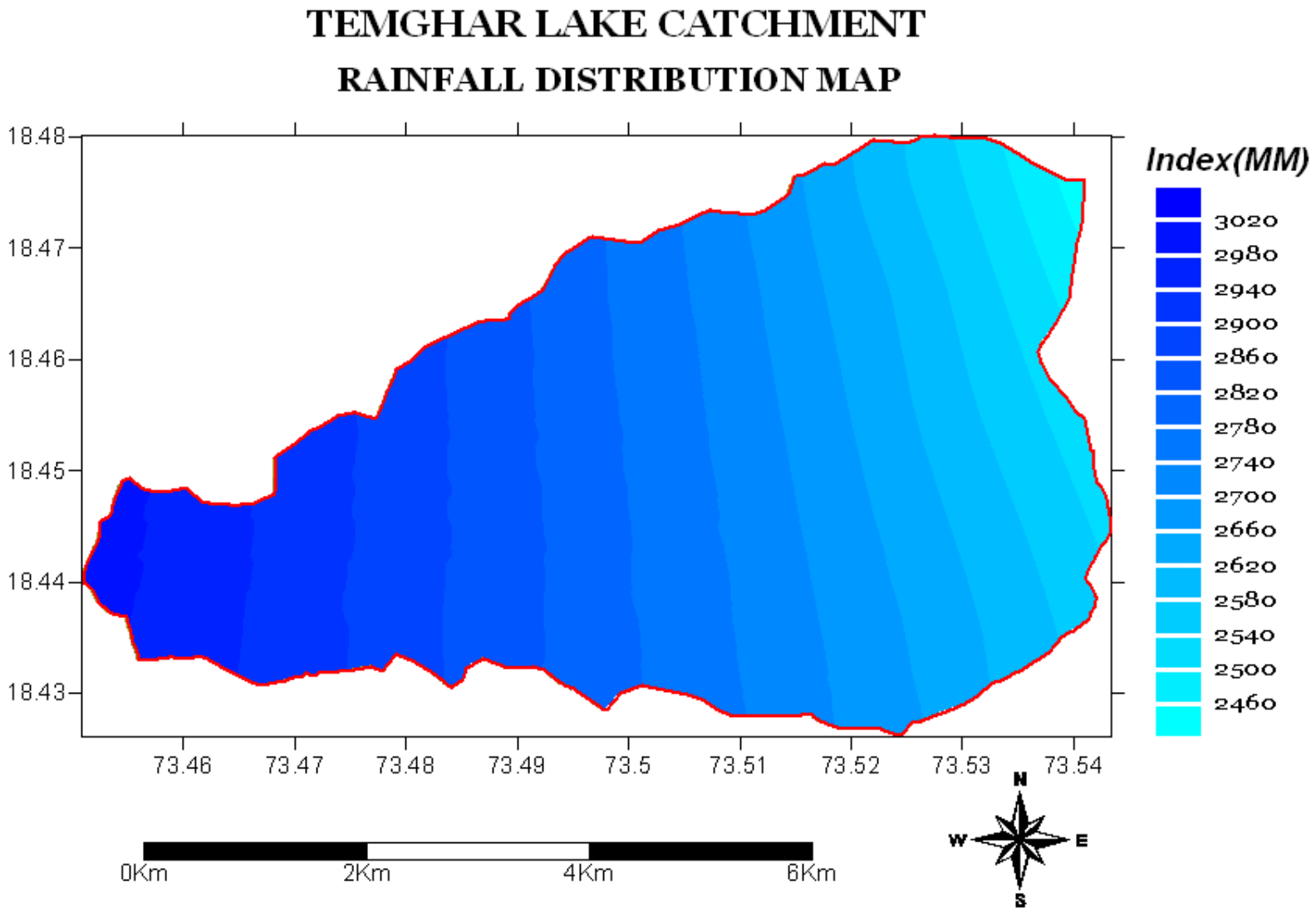


Fig no. 2.2



Source: FAO 2008

Fig no. 2.3



Source: FAO 2008

Fig no. 2.4

TEMGHAR LAKE CATCHMENT CONTOUR MAP

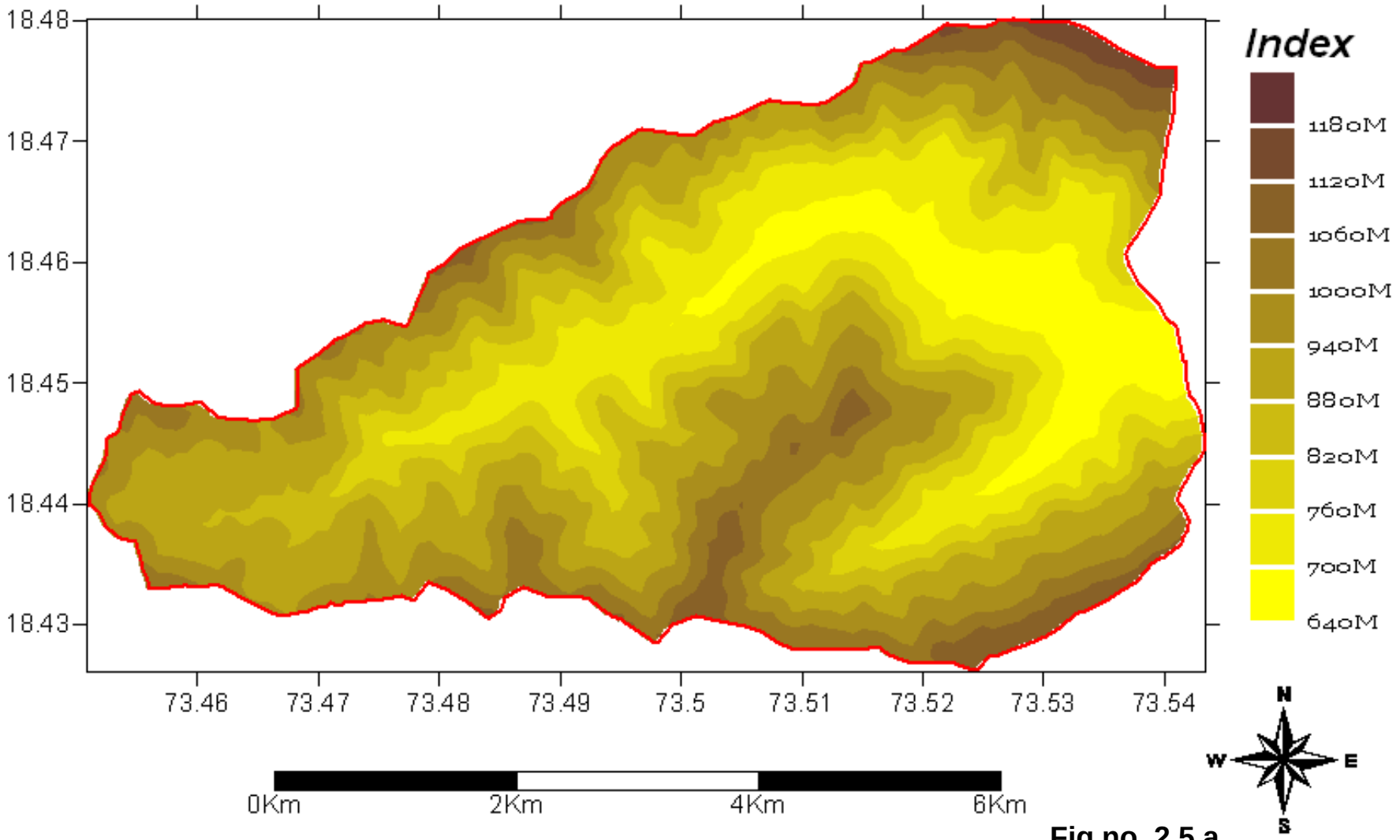


Fig no. 2.5 a

TEMGHAR LAKE CATCHMENT

DEGITAL ELEVATION MODEL

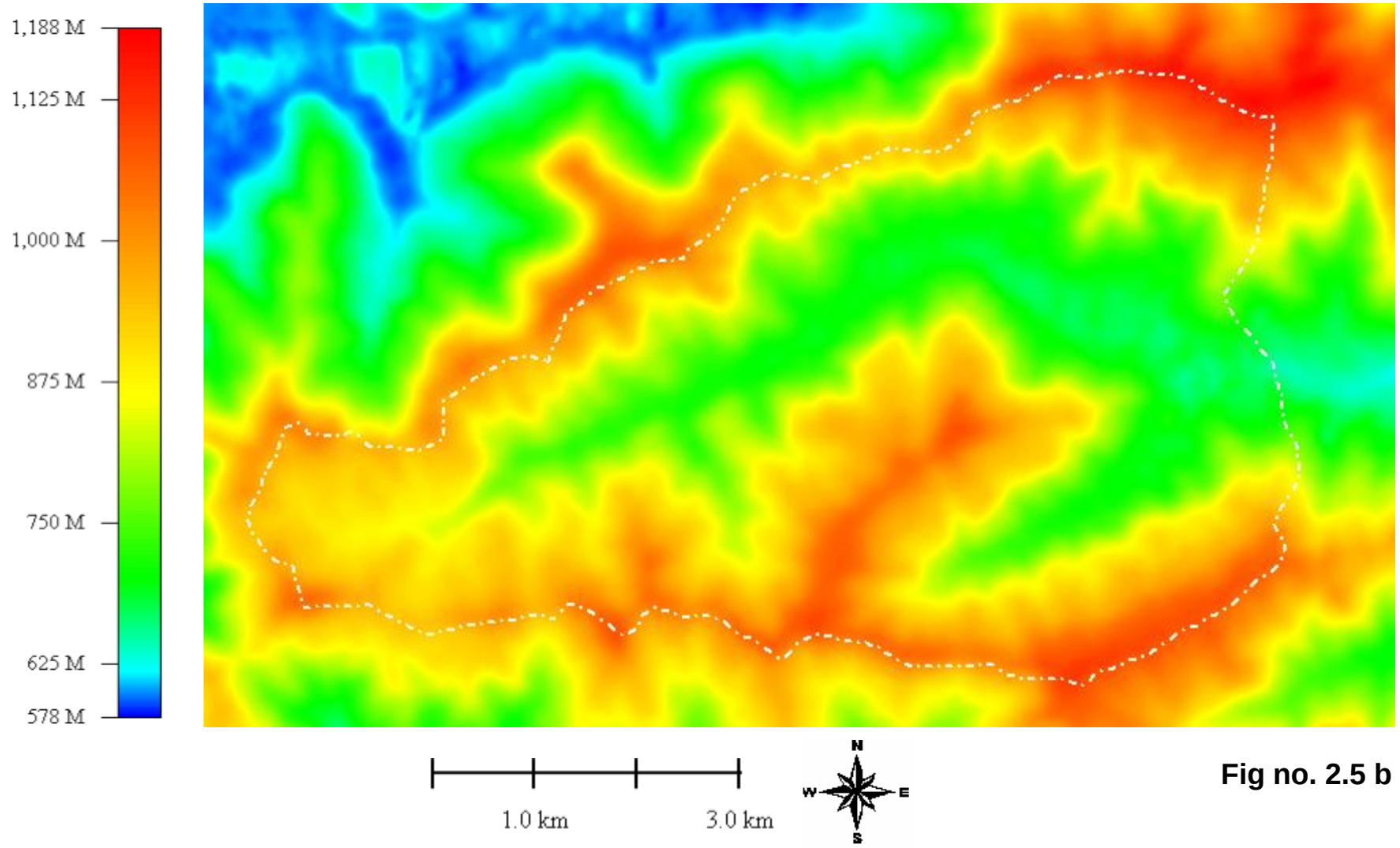


Fig no. 2.5 b

TEMGHAR LAKE CATCHMENT

SHADED RELIEF MAP

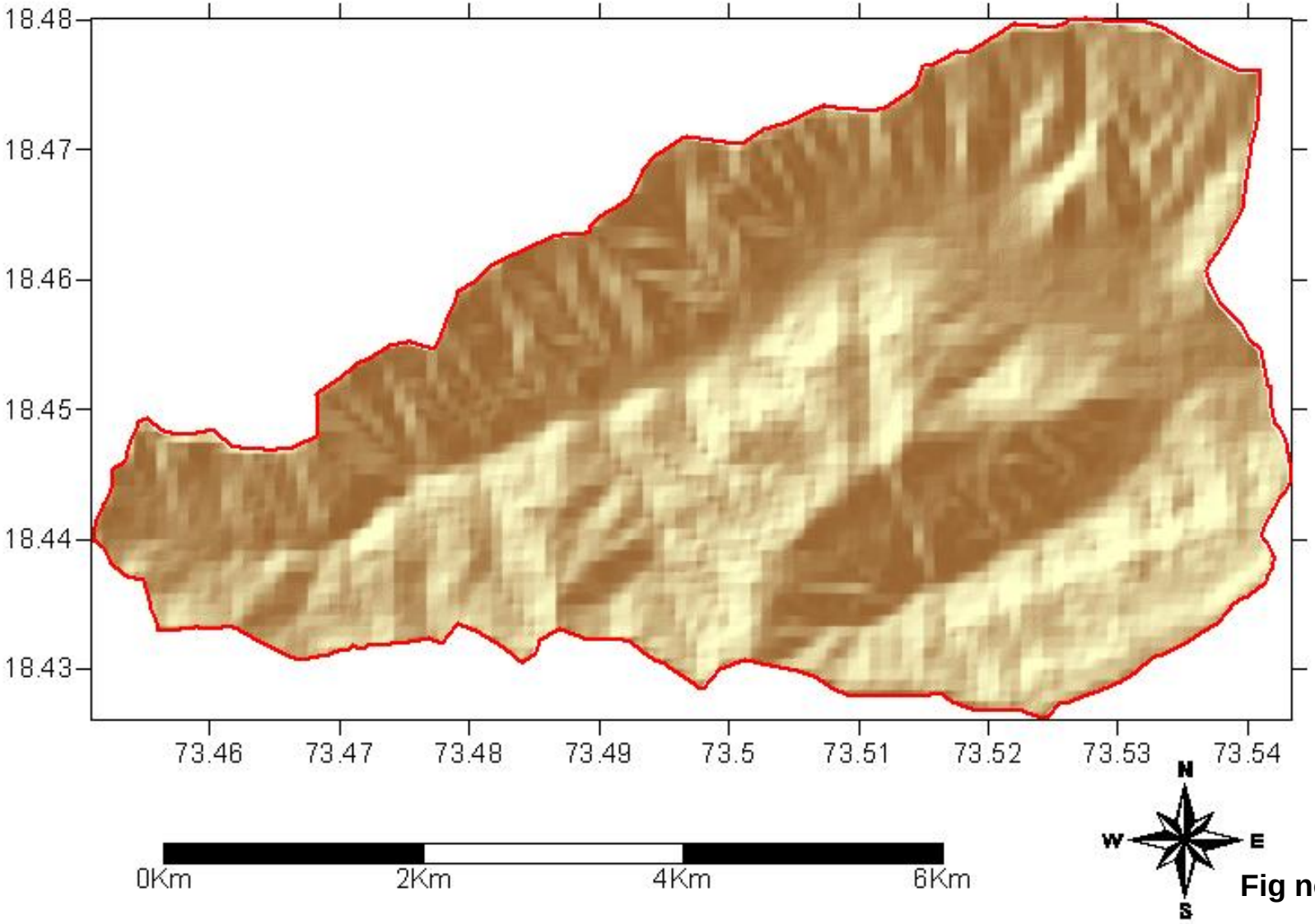


Fig no. 2.5c

TEMGHAR LAKE CATCHMENT

VECTOR MAP

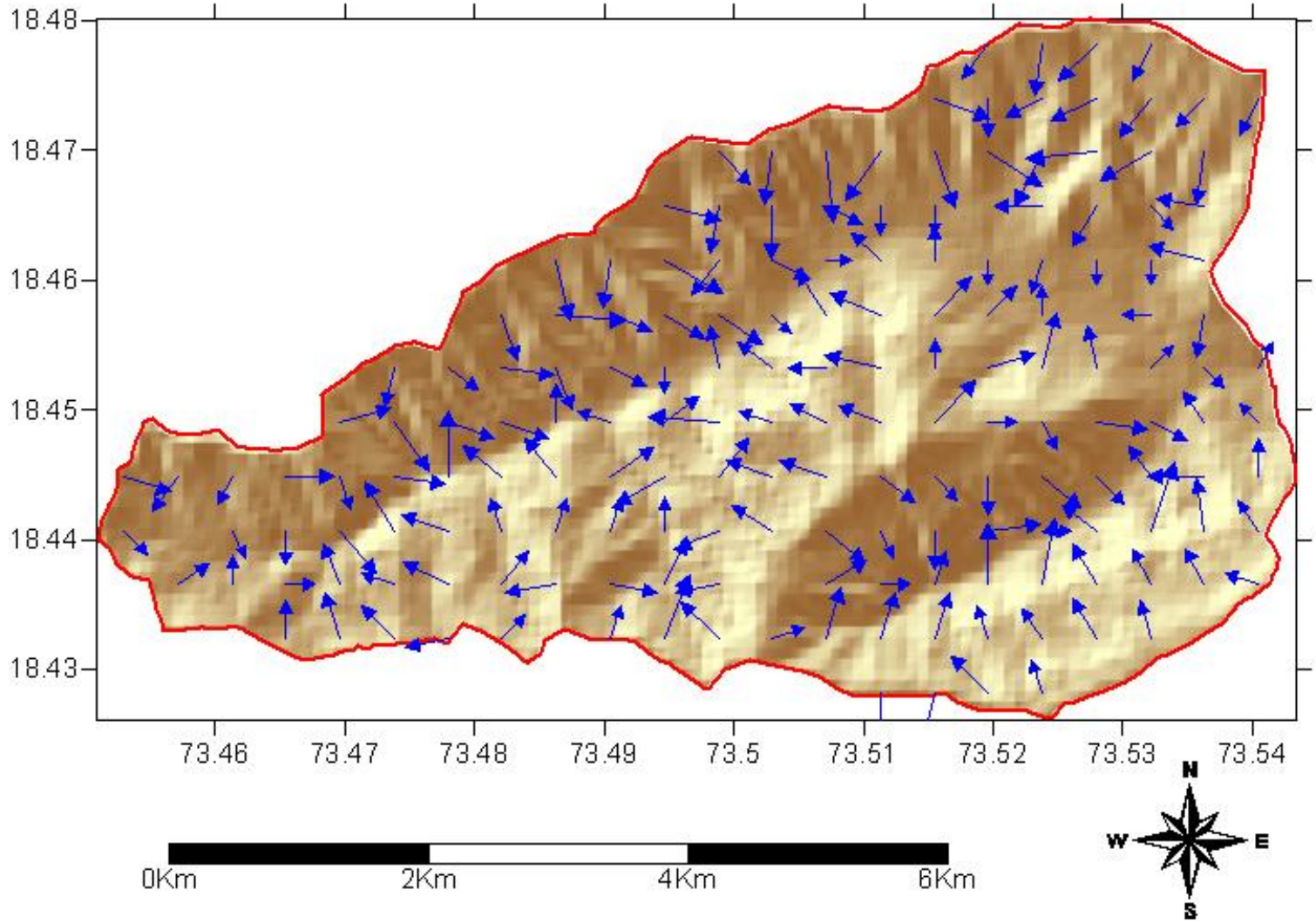


Fig no. 2.5 d

3D VIEW OF TEMGHAR LAKE CATCHMENT

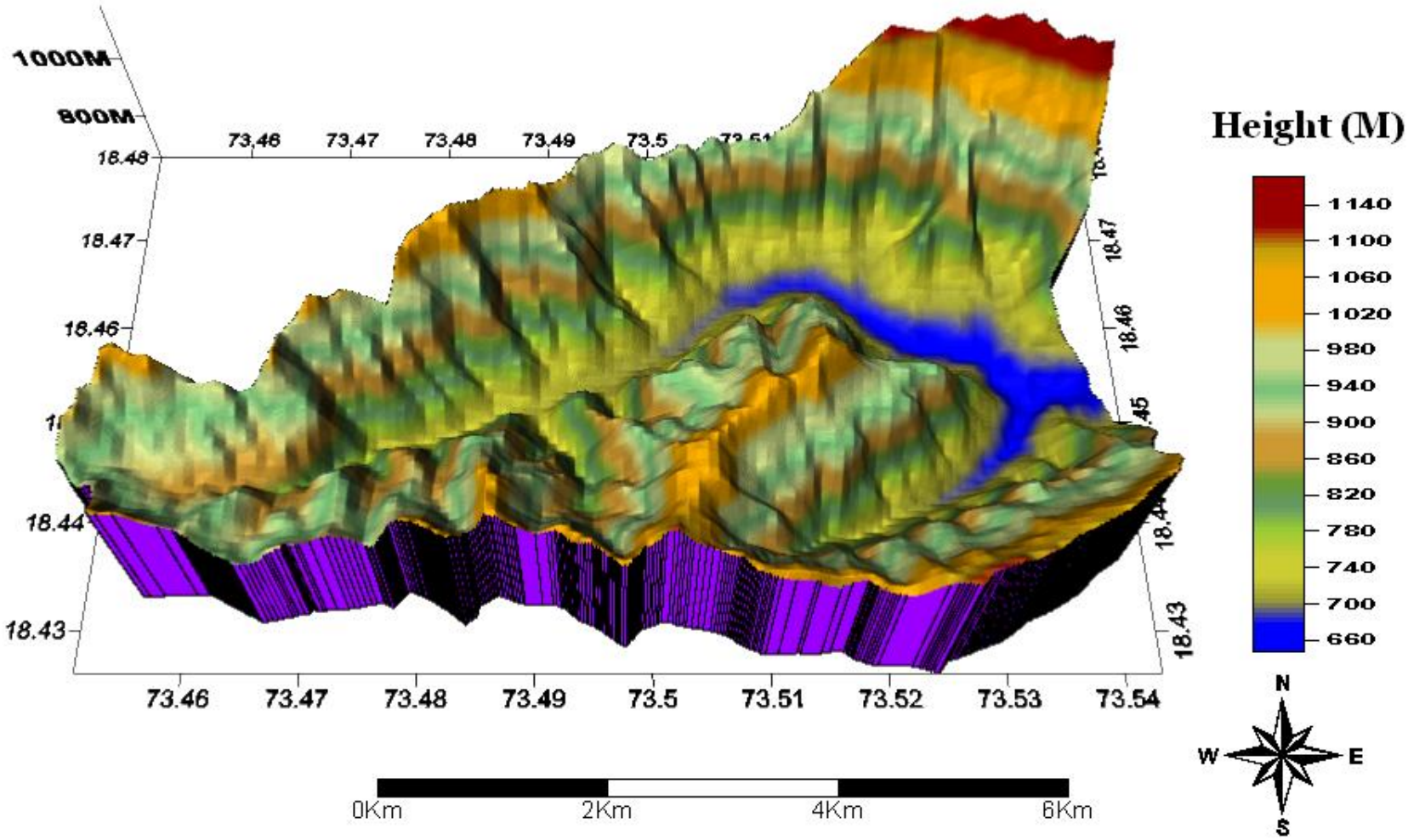


Fig no. 2.5 e

3D VIEW OF TEMGHAR LAKE CATCHMENT

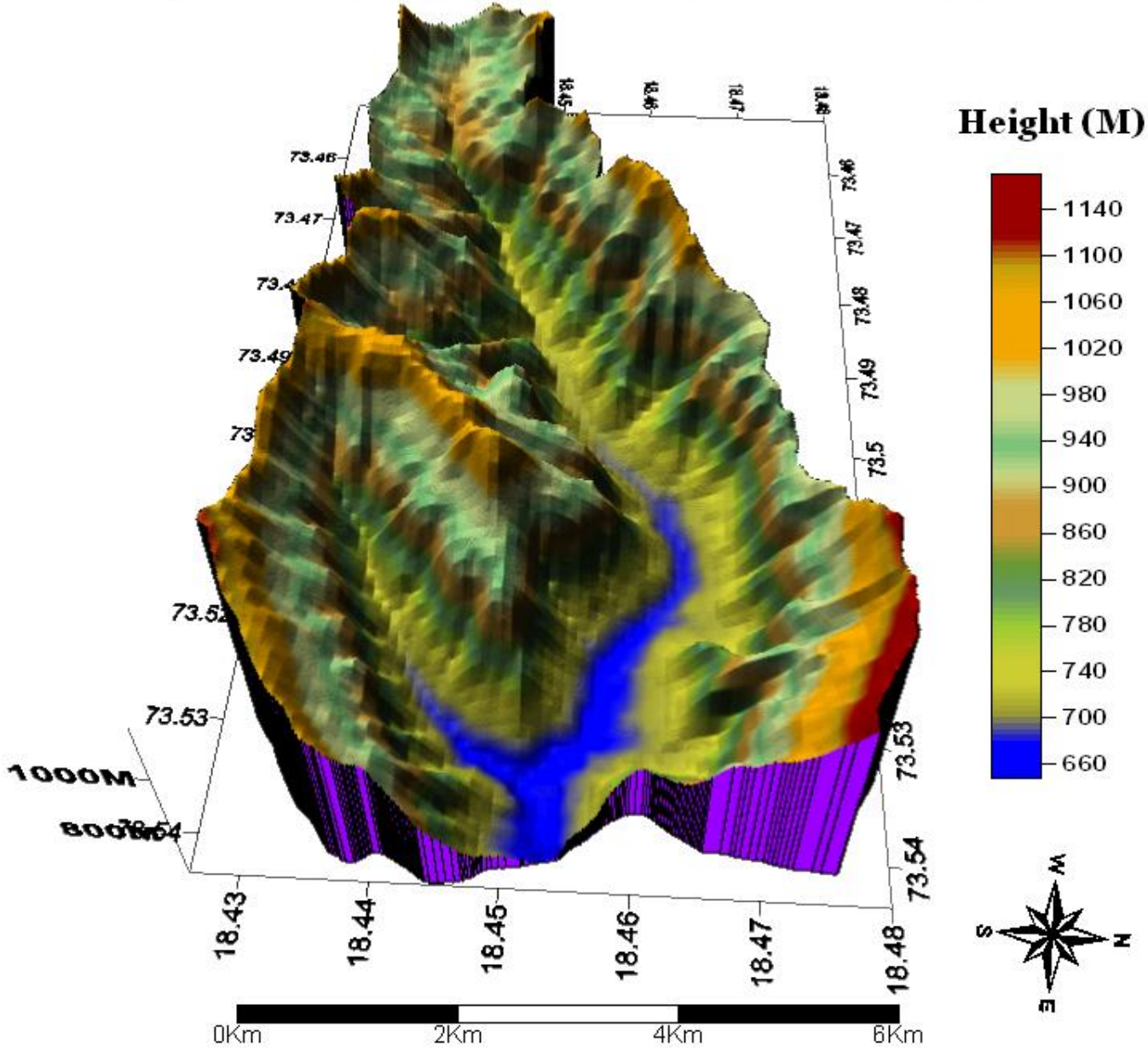


Fig no. 2.5 f

TEMGHAR LAKE CATCHMENT

STREAM ORDER MAP

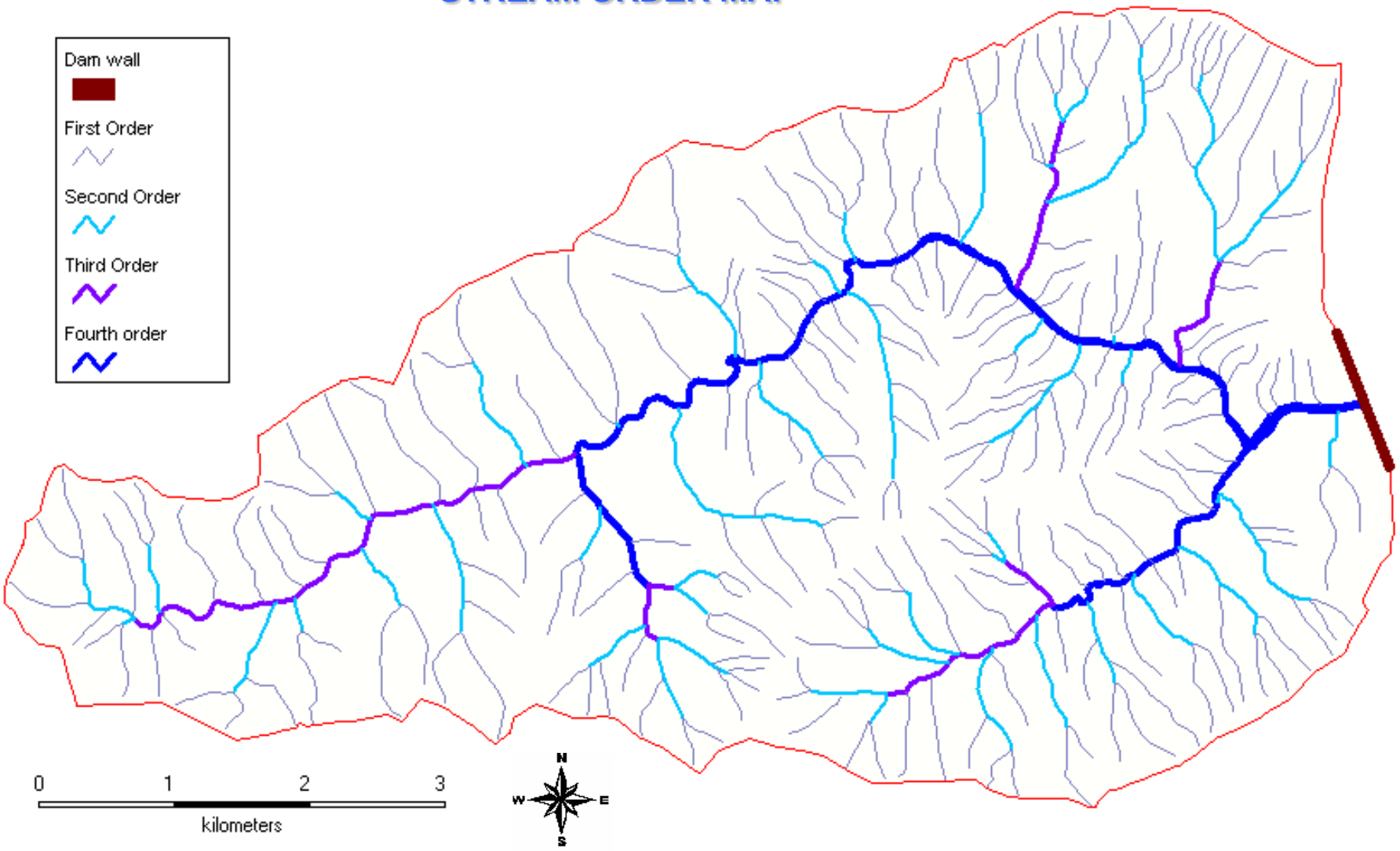


Fig no. 2.6

CHAPTER III

RELIEF AND SOIL CHARACTERISTICS

3.0 Introduction

The quantitative analysis of morphometric properties of a drainage basin has been useful in many application studies like estimation of surface runoff, flood discharge, ground water recharge, sediment yield soil loss as well as water conservation, environmental analysis and many others. The various morphometric properties depend on various aspects like geology, tectonics, vegetation & climate etc.

The study area provides varied relief characteristics and resultant drainage system. The entire area has been divided in to a number of sub basins & in all there are 63 sub basins ranging from single order basin to the 4^{th} order basin, covering about as low as (0.05 Km^2 to as maximum as 7.95 Km^2 areas, respectively). These sub basins have been further used for detail analysis. (Fig: 3.1 a and b)

3.1 Relief characteristics

The relief analysis is an initial step, to understand the terrain characteristics of an area. Relief is a function of geology, drainage, climate, soil & vegetation etc. Differences in elevation, resulting in variation of relief, other geomorphic attributes including absolute relief, relative relief, dissection index, drainage density, drainage frequency, slope etc. helps us in the classification of the terrain into morphological units.

3.1.1 Altitude wise distribution of area:

Altitude wise distribution of area has been computed Table no.3.1, fig 3.2 and 3.3 with the help of contour map shows, that about 32.04 % area to the total land surface area is under 800m contour, about 22.54 % area to the total land surface area is between 800m to 900m contours, about 31.76 % area to the total land surface area is between 900m to 1000m contours, and 13.65 % of the total land surface area is characterized by high relief (above 1000m contour).

D-1

D-2

D-3

D-4

D-5

3.1.2 Absolute Relief

It is a maximum elevation of a unit area. It provides an idea about the distribution of relief over the earth's surface. Generally, the absolute relief is used in the delineation of terrain morphology, which throws light on the structural & erosional characteristics of the region. In applied geomorphology, it has received much significance particularly in land use, vegetation & resource planning.

Absolute relief of the Temghar lake catchment has been obtained with the help of quantitative methods; the entire contour map of the study area has been divided into equal grids of the size of 77.452 m^2 each. The maximum elevation was noted with the help of contours. (Fig: 3.4)

The absolute relief in the study area varies from 670 m to 1150 m. The obtained values of the absolute relief of the study area have been classified into four categories.

Table 3.2.a, b & fig: 3.5 a & b shows the spatial distribution of absolute relief in the study area. High values of absolute relief are noted mainly in the marginal areas while lower values are restricted to pediment / plains of the hills. Very low absolute relief covers on area about 9.865 km^2 (26.167%) of the total land surface area. Their occurrences are in the foothill zones and are mainly characterized by pediment / plains just adjacent to the backwaters of the dam.

Low absolute relief covers 7.295 km^2 (22.302 %) of the total land surface area, which occurs in continuous patches along both the flanks of the backwater region. This is essentially a part of middle hill slopes merging into the valley regions. Moderate absolute relief covers 10.435 km^2 (31.902%) of the total land surface of the area and mainly covers the plateau fringe surface zones. It is more evident in the maximum coverage of hills and off shoots in the various directions, especially in the Temghar catchment area to the southern side of the study area. High to very high absolute relief covers an area of 5.115 km^2 (15.637 %).

The prolonged erosion has produced a larger area under less undulating & moderately undulating terrain, which is confined to the pediment & plain regions of the study area. This could be the potential land surface for horticulture and paddy cultivation.

D-6

D-7

D-8

3.1.3 Relative Relief

Relative relief is one of the most significant geomorphic variables. It is used for overall assessment of morphological characteristics of a terrain & for assessing the degree of dissection of a terrain. Relative relief is also termed as relative altitude, topographic relief, and amplitude of available relief, local relief. Lithology, structure, slope, climatic parameters, geomorphic process & vegetal cover etc influence variation in the values of relative relief. It helps in finding out the terrain characteristics & their significance with the controlling factor.

In the present study, Smith's (1935) method has been used to calculate relative relief, for the Temghar lake catchment. The area has been divided into equal grids of 77.452 m^2 each to prepare a relative relief map. (Fig: 3.6) more than 7000 grids are thus interpreted. The methodology involves the noting of maximum & minimum heights of each & every grid cell of the study area. Thereafter, the difference between maximum elevations have been found out which in fact, gives the relative relief values for grid cell. The table no. 3.3. a & b depicts the distribution of relative relief in Temghar lake catchment.

The study area represents numerous varied geomorphic expressions in terms of relative relief of the area. It ranges from 6 m to 58 m. The categories range from high to extremely low. (Table 3.3 a, b & Fig: 3.7 a & b).

Extremely low relative relief covers the longer & maximum portion of the study area & it is 21.28 km^2 (65.057 %) of the total land surface area. It occurs in continuous patches to both the side of the lake catchments & mainly covers the valley floors of major drainage system.

Moderate low-to-low relative relief covers 8.47 km^2 (25.894 %) area & is the second largest zone in terms of areal coverage Fig: 3.7 and b. This part is mainly characterized by undulating & rolling topography & devoid of vegetation. This could be a potential land facet which could be reclaimed for proper & optimum land utilization.

Moderate high-to-high category of relative relief covers an area about 1.98 km^2 (6.053%) of the total land surface area, is a third largest zone characterized by edges of plateau fringe surfaces.

D-9

D-10

D-11

Very high to extremely high relative relief covers about 0.98 km^2 (2.996 %) of the total land surface area. This is confined to highest part of the study area. It occurs in patchy form & represents the crests of the hill ranges in the study area.

3.1.4 Dissection Index

The dissection index, which is the ratio between relative relief & absolute relief, gives a better understanding of the landscape. The sharpness of terrain character of an area cannot be expressed adequately by interpreting the absolute relief and relative relief separately. The dissection index can be obtained by the following formula.

$$\% \text{ Dissection Index } = \frac{\text{Relative relief (Rr)}}{\text{Absolute relief (Ar)}} \times 100$$

It is the index of the degree to which dissection has advanced. In other words, it expresses the relation between the vertical distance of relief from the erosion level & relative relief i.e. the dynamic potential of the area.

To obtain the percentage dissection index for the Temghar lake catchment, the entire area is divided into 6697 grid cells of the size 77.452 m^2 & the values relating to relative relief and absolute relief have been calculated. Thus, the calculated dissection index for the study area varies from 0.5 % to 6.4 %. Grid wise calculation of percent dissection gives the perfect idea of the area where the topography has been highly dissected (Fig.3.8). With the help of these, four zones have been identified in the study area. These zones & the percentage area under each zone is tabulated, in the Table no.3.4 a, b and c.

The entire area falls under the category of extremely low dissection index ranging from 0.5 % to above 6.4 %. Extremely low dissection appears throughout the Temghar lake catchment region. The maximum area covers under the category of below 2 % which covers 22.37 km^2 (68.389 %) of the total land surface area.

Second largest zone covers under the category of 2 to 4% & covers an area about 6.52 km^2 (19.933%) of the total land surface area.

The category of 4 to 6 % covers about 3.28 Km^2 (10.028 %) of the total land surface area.

D-12

D-13

The dissection index category of > 6 % covers smallest part of the study area. The zone covers an area about 0.54 km^2 (1.651 %) of the total landscape area fig3.9 a and b.

3.1.5 Percentage slope

Slopes of any area directly give the geomorphic impression of the terrain slopes which are significant morphometric attributes in the study of landforms of a drainage basin (Savindra Singh & R. Srivastava 1975)

Slope defined as an angular inclination of terrain between hill tops & valley bottoms, resulting from the combination of many causative factors like geological structure, absolute & relative relief, climate, vegetation cover, drainage texture drainage frequency and percentage dissection index etc.

Slope map for the entire catchment has been prepared using GIS software i.e. global Mapper v 9.3 which reveals that, overall variation in the percentage slope range between 0 to even more than 70 %, fig 3.10 details of which has been discussed in the following lines.

Table 3.5 a, b and fig 3.11a and b gives the idea about distribution of percentage slope which depicts that, maximum areal coverage is under moderate steep to steep sloping category (15-35 % slope) & spreads over to cover 18.82 km^2 (57.55 %) of the total land surface area. Whereas minimum coverage appears under the nearly level category (percentage slopes below 1 %) which is 0.003 km^2 (0.01 %) & covers mainly valley floor region with low relative and absolute relief.

Very Gentle slopes mainly between 1-3 % slopes covers 0.264 km^2 (0.81 %) of the total land surface area & are confined to plain surfaces in the valley floors & along backwater site.

Gentle slopes mainly between 3-5 % slopes covers 0.452 km^2 (1.38 %) of the total land surface area & are confined to pediment surfaces along the backwater site.

Moderate slope unit covers 5-10 % slopes & spreads almost over plain, rolling & undulating pediment surfaces of the area. This slope unit covers about 3.78 km^2 (11.56 %) of the total land surface area.

Strong slopes covers about 10-15 % of slope unit and are highly characterized by rolling topography. It comprises the total area of about 3.85 km^2 (11.77 %) of the total land surface area.

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D-16

D-17

Moderate Steep to Steep slopes (15-35%) appear to be confined to the edges of summit surfaces & scarps. The areal coverage of this unit is very high about 18.82 km^2 (57.55 %) of the total land surface area. Very steep escarpment & edges of summit surfaces are confined to this unit of the slopes. This is a distinct & remarkable zone.

Very Steep slopes (>35%) appear to be confined to the edges of summit surfaces & scarps. The areal coverage of this unit is about 5.54 km^2 (16.93 %) of the total land surface area. Very steep escarpment & edges of summit surfaces are confined to this unit of the slopes. It is also a distinct & remarkable zone.

The varied slopes in the area restrict various land uses in the study area. Moderate slope unit between 5-10 % slopes seems to be the potential land for various purposes provided some remedial measures are undertaken.

3.1.6 Hypsometric analysis

Hypsometric Analysis is the study of the distribution of ground surface area, or horizontal cross-sectional area of landmass with respect to elevation (Strahler 1964). It has been employed in the identification of erosional surfaces & the resultant landforms. (Banling1933).

In the landscape analysis, it was first introduced by Langbe in 1947; he applied the hypsometric technique especially for obtaining the morphological evolutions of large drainage basins. Thereafter Strahler (1952), Miller (1953), Schumm (1956) & Coates (1958) also followed it for small drainage basin studies. Hypsometric Analysis not only presents the area height relationship but also discuss the landform in their static & dynamic aspects particularly, erosional characteristics, average height, stage of cycle of erosion, hydro morphological characteristics of terrain, can be well expressed with the use of this technique.

An attempt is made in the present analysis to compute hypsometric integral for the Temghar lake catchment and it can be revealed from the hypsometric analysis that area is in the young stage of development.

3.1.6.1 Hypsometric integral

Hypsometric Integral gives the quantitative expression of dynamics of the landform. It is generally used to show the proportion of area of the surface at various

elevations above or below a datum (F.J. Monkhouse & H.R. Wilkinson 1967) & thus the values of area are plotted as ratios of the total area of the basin against the corresponding heights of the contour & hence the area is represented by ratios of area & height

The form of hypsometric curve & the value of the integral are important element in the analysis of landscape & show marked variation differing with the stage of development & integral is large, but it decreases as the landscape is denuded towards a stage of maturity & old age (Strahler 1952).

From fig 3.12 and table 3.6 a and b, it reveals that, hypsometric Integral according to Strahler (1952) for the Temghar lake catchment is 78.70%. Here hypsometric Integral has been calculated for the entire drainage basin. The value of the hypsometric Integral & the form of the hypsometric curve taken together helps to identify the stage of basin development. The value of hypsometric integral show youthful stage of landform development. According to the spread of the river basin & the size of the valleys it may be inferred that the area is in youthful stage of development and subjected to the process of denudation.

3.1.7 Terrain profiles

Profiles, drawn from the contour map are of great assistance to the geomorphologists who are primarily concerned with the analysis of relief and surface of terrain because profiles provide a visual perception of the actual nature of terrain.

An attempt has been made in the present study to prepare a series of profiles at an interval of 0.5 cm East to West direction using DEM procured from Aster G DEM data. These profiles have been drawn with the vertical exaggeration of 6.75 times. Overall 17 profiles have been studied in the present analysis.

Terrain profiles drawn at a 632 m interval from dam wall to the extreme longest land section of Temghar Lake Catchment clearly depicts that, erosional surface in the area is confined to the altitude zone between 700 m to 980 m. In all, sixteen consecutive profiles from east to west direction have been prepared using GIS software. Slope studies of these profiles clearly indicate that these are the most possible potential sites for multiple uses of land surface area.

These profiles depict the variation in land facets in terms of its altitude (Fig 3.13). It can be better used to visualize the variation in topography and to identify the

D-18

D-19

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D-23

extent of various geomorphic surfaces. The profiles portray a complete relief of the terrain. Profiles exhibit sharp breaks in altitude focuses on geological control over the area. As mentioned earlier, the area is characterized by different lava flows, especially Pahoehoe and Aa flows. Pahoehoe flows weather easily. The alternate arrangement of these flows certainly affected on sharp blunt breaks in slopes. It also gives the idea about the topography and geomorphic surfaces. The pediments spread in the foothills showing extensive appearance. However the summit surfaces can be identifiable along marginal areas: whereas plateau fringe surface shows marked steep sided slopes.

3.1.8 Landforms

The regional geomorphology of the western ghat was first commented upon by Radhakrishanan (1967), using geological evidences like maximum thickness of the Deccan basalt flows, the outliers of Kaladgi meta sediments at the sea level in the konkan and presence of laterite at various levels on the flat Deccan plateau, he concluded that, the area has under gone differential settlements are not a true mountain range but represent the precipitous edge of an elevated plateau.

It can also be revealed from the geomorphic map of Pune districts prepared by NATMO (National Atlas and Thematic Mapping Organization) Department of Science and Technology, Government Of India Kolkata, based on exclusive use of aerial photographs and satellite images and field surveys (1995) that south west part of Pune district is characteristically a plateau surface and most of the landforms are erosional in origin due to its high relative relief. (Fig 3.6)

The detailed mapping of the study area as far as its geomorphology is concerned has been prepared using toposheet as a base map and visual interpretation of F. C.C. image on 1:50,000 scales.

3.1.8.1 Geomorphic map of Temghar lake catchment

Escarpments, ridges, plateau summits, plateau fringe, pediment and plain surfaces are delineated from the DE model and F.C.C. image and field checks are performed accordingly. Toposheet and Google earth image is used as a base map. (Fig: 3.14 and Table No. 3.7)

D-24

D-25

3.1.8.2 Plateau summit surface

It is a widespread geomorphic feature mainly covering marginal areas of watershed. The marginal convex slope segment part of this area is mainly characterized by plateau summit surface having 5.05km^2 (15.42%) of the total land surface area. This part mainly comprises the part of revenue village Wegre.

On the other hand to the southern part of Temghar lake catchment have marginal summit surfaces. This geomorphic unit mostly comprises almost entireTemghar village.

3.1.8.3 Plateau fringe surface

Sudden break in the slope delineated the boundary between plateau summit and fringe surfaces. It is also ascertained by spectral signature of the FCC image from yellowish to red in colour. Plateau fringe surfaces are characterized by steep slopes; in fact, this is a skirt zone of summit surfaces with blunt crests of the hill spurs. Steep valley sides and gullied/ ravenous topography is characteristic feature of plateau fringe surfaces.

About 72% of the study area comprises of plateau fringe surface. This includes large part of village Lavarde, Wegre and Temghar village. Plateau fringe surface exhibits steep valley side slope and upper part of rectilinear slopes. Surface wash seems to be the dominant process. Narrowing of gullies with considerable depth also indicates severe soil loss along the hill slopes.

Fringe zone seems to contribute maximum runoff, flood discharges and soil loss in the study area. This covers about 23.63 km^2 (72.25%) of the total land surface area of Temghar lake catchment. This means very large portion of the catchment is subjected to runoff and soil loss and is a major land segment contributing siltation in the back water of the dam area.

3.1.8.4 Pediment surface

Pediment Surface area measures about 2.71 km^2 (8.29 %) of the total land surface area. This surface zone is well marked by sudden drop in slope at the base of hill fringe zone. These are well identified by spreading of granular fragments; the surface is strewn with rock fields. The slope is irregular and showing undulations in

their appearance. This unit is under coarse material overlain by soils with weathered rocks. It constitutes a recharge zone wherever agriculture is practiced mainly along channels. The spreading of this surface can be well noticed along the 710.12 m contours and below to the left bank side of reservoir. The pediments are observed in the vicinity of villages Wegre and Temghar. The pediment surfaces follow the valley portion at the interface between plain surface and fringe surface zones.

3.1.8.5 Plain surface/ Valley floors

Thick alluviums brought about by streams get deposited in the valley floors is a characteristics of plain surface. The slope of the area can be perceived easily in the field as well as profiles also show the slope of the unit. The total area under this geomorphic unit measures about 1.32km^2 (4.04%) of the total land surface area.

The geomorphic map shows that the rolling plains are somewhat attached to valley floors, indeed shows limited scope to wide spread due to high relative relief

On F.C.C. the plain surfaces exhibits the different shades of colour ranging from faint yellow to red depending upon the density of vegetation cover, crops and grass cover. The boundary between pediments surface and plain surface is inferred from tonal differentiation on F. C. C. image.

3.1.8.6 Alluvium deposits

Very limited alluvium deposits appear to the end of the backwater. In monsoon due to higher level of water body, these deposits are submerged therefore this is an occasionally available land in the study area have not been taken in the estimation of total land surface area. However these deposits are considered in the following chapter of land use and land cover. This area admeasures about 0.01km^2 (1.30ha.) 0.03% to as inferred from F. C. C. There is net spatial change in this unit and shows increasing trend in its extent.

3.2 Soil characteristics:

Geomorphology or the science of landforms has something to contribute to the understanding of soils. Since, soils are the product of chemical, bio-chemical and physical processes acting upon the earth's materials under various topographic, climatic conditions they reflect as such to landforms, the climatic and geomorphic

history of the region in which they are evolved. The character of the soil is determined by the operation of process dependent on climate as modified by topography.

The association of dominant soils of specific landform in the terrain together called "Soilscape". It is to be taken into consideration that, the soils should not be studied independently because it is a natural body and have accentuating influence of geomorphology on the formation and development & overall makeup landforms. It always in amalgamation with landform, it does not develop independently nor can it be separated out from the landscapes.

In the present analysis an attempt has been also made to correlate landforms and soils in terms of their distributions in the study area in general & soil status in particular. Distributions of percentage coarse sand, fine sand silt and clay have been shown in fig. 3.16, 3.17, 3.18 and 3.19 In all four major soil types are identified depending upon their texture. The most striking property is its colour. The data obtained from soil survey department have also been incorporated in the preparation of soil texture map, table 3.9 and photo plate 7, 8 and 9.

It is important to mention that soils do vary in intricate manner and is a complex natural resource as far as their various components are concerned. It is attempted to co-relate the soil properties with relief properties.

It was observed that, the variation in soil properties do show good co-relation with the geomorphic surfaces as well throughout the area. The colour variation, textural class and depth variation (Table 3.10) in all soil types have an influence of geological structure on the overall formation and development of soils in the study area.(Fig: 3.15) The areas remarkably have thin soil cover which owes to excessive erosion and therefore their parts are exposed at places. The dynamics of these processes are triggered and operated by meteorological factors. The interpretation of soil properties variability in slope studies have also been performed along with geomorphic units as discussed below.

3.2.1 Soil properties variability in slope studies:

3.2.1.1 Gentle slopes (Below 5 % slope)

This is a low lying surface in the study area covers mainly the plain surfaces of valley floors of 4^{th} order channel basin (0.72 km^2.) and alluvium deposits (0.013

D-26

D-27

D-28

D-29

D-30

D-31

D-32

D-33

km^2.) spread along the water body. This slope unit covers 0.72 km^2 area (2.20 %) of the total land surface area. Although very less in extent, it is a distinct land portion in terms of its significance in land use.

Depth variation of soil environment shares the great influence of altitude and slope distribution in the area. Variations in depths of soils show the influence of relative relief, dissection of the topography and slope variation throughout the area. This slope category has maximum area with depth from 10 to 20 cm.

The physical properties of soils (Fig 3.16,3.17, 18, 19, 20, 21,) also show considerable variation. This slope category has maximum area with 10-30 % coarse sand, 30-40% fine sand, 10-20% silt and 30-40% clay. The dominant soil types in this category are clayey and sandy clayey.

Chemical properties of the soils (Fig 3.22, 3.23, 24, 25, 26, 27, 28, 29, and 30) provide favorable conditions with slightly alkaline to neutral conditions of soil pH. The percentage of Calcium carbonate in this slope category is mainly range between 2 to 3 %. Electrical conductivity (0.1 to 0.6 dSimen/ min), % Organic carbon, nitrogen, phosphorus do not exhibit high variations. The percentage of potassium is mainly range between 20 to 30%. The milli equivalent percentage of calcium is mainly between 10 to 20%. The percentage (Milli equivalent) of sodium and magnesium varies between 0.8 to 1.4 % and 4 to 21% respectively.

3.2.1.2 Moderate slopes (between 5-10%)

This slope unit covers an area of 3.78 sq.km. (11.56 %) of the total land surface area. This unit is mainly characterized by rolling pediment surface with blunt crest with rugged appearance of hill erosion. Sediments that are regularly carried out from subdue hill slopes are present at foothills the of plateau fringe surface. Depth variation ranges mostly between 10 to 20 cm.

Physical properties of soils in terms of their textural composition shows the coarse sand percentage varies between 10 to 30 %, % fine sand range between 20 to 40 %, % of silt range between 10 to 20 % and % of clay varies between 30 to 40 %, Soil type in this slope unit varies in great range of clay, sandy clay loam to sandy clay soils.

Chemical properties on the other hand show distinct variation in terms of pH range from 6 to 7, which indicate almost neutral soil condition and% $CaCO_3$ varies in

D-35

D-36

D-37

D-38

D-39

D-40

D-41

D-42

D-43

D-44

D-45

D-46

D-47

the range of 2 to 3 %. Electrical conductivity (0.1 to 0.6 dSimen/ min), % Organic carbon, nitrogen, phosphorus does not exhibit high variations. The variation is between 0.4 to 1.6 % of organic carbon, % nitrogen however shows poor levels of their presence in these soils ranging from 0.8 % to 1.4 %, and % phosphorus ranges between 0.3 to 1.8 % and milli equivalent percentage of potassium ranges mostly between 20 to 30 %.

The milli equivalent percentage of calcium is mainly between 10 to 30%. The milli equivalent percentage of sodium and magnesium varies between 0.8 to 1.4 % and 4 to 21% respectively. The milli equivalent % of Ca, Na and Mg are exchangeable cations and they are interrelated.

3.2.1.3 Moderately steep slopes (between 10-15%)

This slope unit covers an area of 3.85 sq.km. (11.77 %) of the total land surface area in the Temghar lake catchment area. Depth variation ranges mostly between 10 to 20 cm.

Physical properties of soils in terms of their textural variation in composition shows that % coarse sand varies between 10 to 30 %, % fine sand varies between below 10 to above 40 %, % of silt varies between 10 to 20 % and % of clay varies between 20 to 40 %,. Soil type in this slope unit mainly comprises clayey, sandy clay loam to sandy clayey soils.

Chemical properties on the other hand show distinct variation in terms of pH range from 6 to 7. % $CaCO_3$ shows a range of 2 to 4%. Electrical conductivity (0.1 to 0.6dSimen/min), % Organic carbon, nitrogen, phosphorus do not exhibit high variations. The variation is between 0.4 to 1.6 % of organic carbon, % nitrogen however shows poor levels of their presence in these soils ranging from 0.8 % to 1.4 %, % phosphorus ranges between 0.3 to 1.8 % and milliequivalent percentage of potassium ranges mostly between 4 to 54 %.

The milliequivalent percentage of calcium is mainly between 10 to 30%. The percentage of sodium and magnesium varies between 0.8 to 1.4 % and 4 to 21% respectively.

3.2.1.4 Steep slopes (15 to 35 %)

This is the largest slope unit in terms of its areal extent in the study area. It covers 18.82 km^2 (57.55 %) of the total land surface area. This also covers the uppermost margins of pediment surface and is a skirt zone of plateau summit surface. It also includes maximum part of plateau summit due to slope variation marked by sharp breaks in the slope. Depth variation ranges mostly between 10 to 30 cm.

Physical properties of soils in terms their textural composition shows the % coarse sand between below 10 to 20 %, % fine sand between below 10 to above 40 %, % of silt between below 10 to above 30 % and % of clay between 20 to 40 %, mainly. Soil type in this unit shows clay, sandy clay loam, sandy clay and clay. These soils are well drained and characterized by severe erosion zone. Physical properties of soils shows distinct variation as physical attributes change.

Chemical properties on the other hand show distinct variation in terms of pH range from below 6 to 7. % $CaCO_3$ shows some a range of 1.5 to 4.8 mainly. Electrical conductivity (0.1 to 0.6), % Organic carbon, nitrogen, phosphorus does not exhibit high variations. The variation is between 0.4 to 1.6 % organic carbon, % nitrogen however shows poor levels of their presence in these soils ranging from 0.8 % to 1.4 %, % phosphorus ranges between 0.3 to 1.8 % and mill equivalent % potassium ranges mostly between 4 to 54 %.

The mill equivalent percentage of calcium is mainly between below 10 to above 20 %. The percentage of sodium and magnesium varies between 0.8 to 1.4 % and 4 to 21% respectively.

Chemical properties of this slope unit show distinct variability in comparison with other slope units.

3.2.1.5 Very steep slopes (above 35 % slope)

This unit comprises about 5.54 km^2 (16.93 %) area of the total land surface area above 35% of slope. This part confined to convex slope elements on a larger scale and therefore favors runoff of high magnitude with moderate to high degree of soil erosion. Soli depth range between 15 to 20 cm.

The textural composition of soils also shows variation up to certain extent. % coarse sand varies between below 10 to 20 %, % fine sand varies between below 10 to

30 %, % silt variation is noticed to range between below 10 to above 30 %, and % clay is mostly above 40 %. The proportionate content of these soils of high altitudinal zone are confined to clay, sandy clay loam, sandy clay and clay types.

The specific gravity ranges between 1 to more than 2 gm/cc porosity range between 50 to 70%.

Chemical properties on the other hand do not show distinct variation in terms of pH range from below 6 to 7. % $CaCO_3$ shows some a range of 2 to 4%. Electrical conductivity (0.1 to 0.6 dSimen/min), % Organic carbon, nitrogen, phosphorus does not exhibit high variations. The variation is between 0.4 to 1.6 % organic carbons, % nitrogen however shows poor levels of their presence in these soils ranging from 0.8 % to 1.4 %, % phosphorus ranges between 0.3 to 1.8 % and milli equivalent % of potassium ranges mostly between 30 to 40 %.

The milli equivalent percentage of calcium is mainly range between 10 to 20%. The milli equivalent percentage of sodium and magnesium varies between 0.8 to 1.4 % and 4 to 21% respectively.

Thus the study of physical and chemical properties of soil in slope studies does not show any kind of serious problem in terms of environmental pollution but it seems certain that the soil environment in the study area is subjected to severe soil degradation.

3.2.2 Hydrological properties of soil

3.2.2.1 Measurement of infiltration rates

Infiltration capacity refers to the rate at which water can enter the soil, in other words it is vertical intake of water it depends upon numerous factors, but in particular it is affected by the physical characteristics of structure and texture. However, the antecedent rainfall conditions may also influence infiltration capacity and therefore, in order to standardize measurement, infiltration is normally assessed under defined moisture conditions- e.g. in a dry soil or in a fully saturated one.

It controls the rate at which rain water can be taken into the soil and thus influences the point at which overland flow occurs in soil. The effect of surface crusts, compaction and tillage are very important in the assessment of infiltration capacity.

Field measurements of infiltration rates are performed with the cylindrical tube (Photoplate 9) with constant water head and rates were measured every after 10, 20, 30, 40, 50 and 60 minutes interval. With the help of following formula, infiltration rates have been calculated and map has been prepared to show in its variation. (Fig: 3.31)

$$IC \quad (cm/min^{-1}) = \frac{\Delta Q \times A}{\Delta T}$$

In which ΔQ is the change in the volume of water in the bottle during time ΔT and A is the cross sectional area of a cylinder (II r^2). Based on the rating tables from Booker soil manual 2000 tables no.3.8 and 3.11 for the study area has been prepared and interpreted in the following lines

3.2.2.2 % Slope wise variation in infiltration rates.

3.2.2.2.1 Below 5% slope (Gentle slope)

Infiltration rate was measured in the field at various sites and at various slope units at 10 min interval. This is somewhat attributed to the surface material lying on pediment and plain surfaces of the area. The infiltration rate in this zone is mostly between 1 to 2 cm/hr.

3.2.2.2.2 Between 5% to 10% slope (Moderate slope)

This unit of slope mainly confined to plateau fringe surface with base hill slopes, high dissection and devoid of vegetation, contributes to greater overland flow and low infiltration. The susceptibility of erosion is high along these surfaces. The infiltration rate in this zone is mostly between 1 to 2 cm/hr.

3.2.2.2.3 Between 10% to 15% slope (Moderate steep slope)

This slope unit covers the blurnt crest zones of the topography of plateau fringe surfaces, mainly characterized by valley heads with very thin soil cover usually between 10-20 cm depth. The infiltration rate in this zone is mostly between 0.5 to 1.5 cm/hr.

D-49

3.2.2.2.4. Between 15% to 35% slope (Steep slope)

This also covers the uppermost margins of pediment surface and is a skirt zone of plateau summit surface. It also includes maximum part of plateau summit due to slope variation marked by sharp breaks in the slope. The infiltration rate in this zone is mostly between 0.5 to 1.0 cm/hr.

3.2.2.2.5. Above 35% slope (very steep slope)

As these slope unit mainly comprises convex slope elements with high degree of gradient with topped curved surfaces shows favorable conditions for infiltrations. The infiltration rate in this zone is mostly between 1 to 2 cm/hr.

❑❑❑

Table no. 3.11 : Area under infiltration class (Total land surface area)

Sr. No.	Infiltration rate class (Cm/hr)	Area (Km^2)	Area (%)
1	0 to 1	13	39.75
2	1 to 2	11.58	35.41
3	2 to 3	7.15	21.85
4	3 to 4	0.98	2.99
Total		**32.71**	**100**

Table no. 3.10 : Area under classes of soil depth (Total land surface area)

Sr. No.	Depth Class	Area (Km^2)	Area (%)
1	0-5	0	0
2	5 to 10	0.01	0.03
3	10 to 15	5.64	17.25
4	15 to 20	18.76	57.36
5	20 to 25	4.94	15.11
6	25 to 30	2.24	6.84
7	30 to 35	0.96	2.93
8	35 to 40	0.16	0.48
Total		**32.71**	**100**

Table no. 3.9 : Area under soil types (Total land surface area)

Sr. No.	Soil Type	Area (Km^2)	Area (%)
1	Clay	4.13	13.01
2	Clay loam	6.78	20.51
3	Sandy Clay	6.98	21.18
4	Sandy Clay Loam	14.82	45.3
Total		**32.71**	**100**

Table 3.8 : Rating of Infiltration capacity

Class	Infiltration category	Infiltration rate cm/hr
1	Very slow (non irrigable)	<0.1
2	Slow	0.1-0.5
3	Moderately slow	0.5-2.0
4	Moderate	2.0-6.0
5	Moderately rapid	6.0-12.5
6	Rapid	12.5-25
7	Very rapid	>25

(Source: Booker soil manual 2000)

Table no 3.7 Extent of area under Geomorphic units in the study area

(Total land surface area)

Sr. No	Geomorphic units	Area (km^2)	Area (%)
1	Plateau summit surface	5.05	15.42
2	Plateau fringe surface	23.63	72.25
3	Pediment surface	2.71	8.29
4	Valley floor / Plain area	1.32	4.04
Total area		**32.71**	**100.00**

Table 3.6 a : Hypsometric integral curve computation

Sr. No.	Altitude (m)	Total area (m)	Relative area (m)	Cumulative relative area (m)	Height (m)	Relative height (m)
1	>1100	0.33	0.88	0.88		
2	1080-1100	0.50	1.32	2.19	1100.00	100.00
3	1060-1080	0.76	2.00	4.20	1080.00	98.18
4	1040-1060	0.89	2.37	6.56	1060.00	96.36
5	1020-1040	1.55	4.10	10.67	1040.00	94.55
6	1000-1020	1.13	2.99	13.65	1020.00	92.73
7	980-1000	1.32	3.51	17.17	1000.00	90.91
8	960-980	1.85	4.91	22.08	980.00	89.09
9	940-960	2.82	7.47	29.55	960.00	87.27
10	920-940	3.16	8.38	37.94	940.00	85.45
11	900-920	2.82	7.48	45.41	920.00	83.64
12	880-900	2.26	6.01	51.42	900.00	81.82
13	860-880	1.63	4.33	55.75	880.00	80.00
14	840-860	1.52	4.03	59.78	860.00	78.18
15	820-840	1.53	4.06	63.85	840.00	76.36
16	800-820	1.55	4.11	67.96	820.00	74.55
17	780-800	1.57	4.17	72.13	800.00	72.73
18	760-780	1.55	4.12	76.25	780.00	70.91
19	740-760	1.67	4.42	80.67	760.00	69.09
20	720-740	1.80	4.78	85.45	740.00	67.27
21	700-720	2.18	5.79	91.24	720.00	65.45
22	<700	3.30	8.76	100.00	700.00	63.64
Total		**37.70**	**100.00**			

Table 3.6 b : Hypsometric integral curve computation results

Sr. No.	a/A*100	h/H*100
1.0	2.2	100.0
2.0	4.2	98.2
3.0	6.6	96.4
4.0	10.7	94.5
5.0	13.7	92.7
6.0	17.2	90.9
7.0	22.1	89.1
8.0	29.6	87.3
9.0	37.9	85.5
10.0	45.4	83.6
11.0	51.4	81.8
12.0	55.8	80.0
13.0	59.8	78.2
14.0	63.8	76.4
15.0	68.0	74.5
16.0	72.1	72.7
17.0	76.2	70.9
18.0	80.7	69.1
19.0	85.5	67.3
20.0	91.2	65.5
21.0	100.0	63.6

Table no. 3.5 a: Extent of percentage slope (Entire catchment area)

Sr. No.	Slope Categories	Slope (%)	Area (Km²)	Area (%)
1	Nearly level	<1%	0.003	0.01
2	Very gently sloping	1 to 3%	0.264	0.70
3	Gently sloping	3 o 5%	0.452	1.20
4	Moderate sloping	5 to 10%	3.780	**10.03**
5	Moderately steep sloping	10 to 15%	3.851	**10.21**
6	Steep sloping	15 to 35%	18.823	**49.93**
7	Very steep sloping	>35%	5.536	14.69
8	Water body		4.990	13.24
Percentage to total catchment area			**37.7**	**100**

Table no. 3.5 b: Extent of percentage slope (Total land surface area)

Sr. No.	Slope Categories	Slope (%)	Area (Km²)	Area (%)
1	Nearly level	<1%	0.003	0.01
2	Very gently sloping	1 to 3%	0.264	0.81
3	Gently sloping	3 o 5%	0.452	1.38
4	Moderate sloping	5 to 10%	3.780	**11.56**
5	Moderately steep sloping	10 to 15%	3.851	**11.77**
6	Steep sloping	15 to 35%	18.823	**57.55**
7	Very steep sloping	>35%	5.536	16.93
Percentage to total Land surface area			**32.7**	**100**

Table 3.4 a : Extent of Percentage dissection index

(Entire catchment area)

Classes	Area (Km^2)	Area (%)
Water body	4.99	13.236
Below 2%	22.37	59.337
2-4%	6.52	17.294
4-6%	3.28	8.700
Above 6%	0.54	1.432
Total	**37.7**	**100**

Table 3.4 b : Percentage dissection index

(Total land surface area)

Classes	Area (Km^2)	% Total land surface area
Below 2%	22.37	68.389
2-4%	6.52	19.933
4-6%	3.28	10.028
Above 6%	0.54	1.651
Total	**32.71**	**100**

Table 3.4 c : Rating of dissection index

Sr. No.	Particular	Category	Stages of erosion
1	Extremely Low	0-10	Old
2	Low	10-20	Mature
3	Moderate	20-30	Mature
4	High	30-40	Youth
5	Very High	>40	Youth

Table No. 3.3 a: Extent of relative relief

Entire catchment area		
Classes	**Area (Km^2)**	**Area (%)**
Water body	4.99	13.236
Below 20m	21.28	56.446
20 to 30m	8.47	22.467
30 to 40m	1.98	5.252
40m and above	0.98	2.599
Total	**37.7**	**100**

Table No. 3.3 b: Extent of relative relief

Total land surface area			
Classes	**Area (Km^2)**	**% Total land surface area**	**Categories**
Below 20m	21.28	65.057	Low
20 to 30m	8.47	25.894	Moderate low to Low
30 to 40m	1.98	6.053	Moderate high to High
Above 40m	0.98	2.996	Very high
Total	**32.71**	**100**	

Table No. 3.2 a: Extent of absolute relief

Entire catchment area		
Classes	**Area (Km^2)**	**Area (%)**
Water body	4.99	13.236
Below 800m	9.865	26.167
800-900m	7.295	19.350
900-1000m	10.435	27.679
Above 1000m	5.115	13.568
Total	**37.7**	**100**

Table No. 3.2 b: Extent of absolute relief

Total land surface area		
Class	**Area (Km^2)**	**% total land surface area**
Below 800m	9.865	30.159
800-900m	7.295	22.302
900-1000m	10.435	31.902
Above 1000m	5.115	15.637
Total	**32.71**	**100**

Table No. 3.1: Altitude wise extent of area

Sr. No.	Altitude (m)	Total Area (m)	Percentage area
1	<700	3.30	8.76
2	700-720	2.18	5.79
3	720-740	1.80	4.78
4	740-760	1.67	4.42
5	760-780	1.55	4.12
6	780-800	1.57	4.18
7	800-820	1.55	4.11
8	820-840	1.53	4.06
9	840-860	1.52	4.03
10	860-880	1.63	4.33
11	880-900	2.26	6.01
12	900-920	2.82	7.48
13	920-940	3.16	8.38
14	940-960	2.82	7.47
15	960-980	1.85	4.92
16	980-1000	1.32	3.51
17	1000-1020	1.13	2.99
18	1020-1040	1.55	4.10
19	1040-1060	0.89	2.37
20	1060-1080	0.76	2.00
21	1080-1100	0.50	1.32
22	>1100	0.33	0.88
Total		**37.70**	100.00



7. MEASUREMENT OF SOIL PROFILE IN THE STUDY AREA



8. MEASUREMENT OF SOIL PROFILE IN THE STUDY AREA





9. MEASUREMENT OF INFILTRATION RATE AND HYDRAULIC CONDUCTIVITY

TEMGHAR LAKE CATCHMENT

ORDERWISE SUB BASINS WITH DRAINAGE OVERLAY

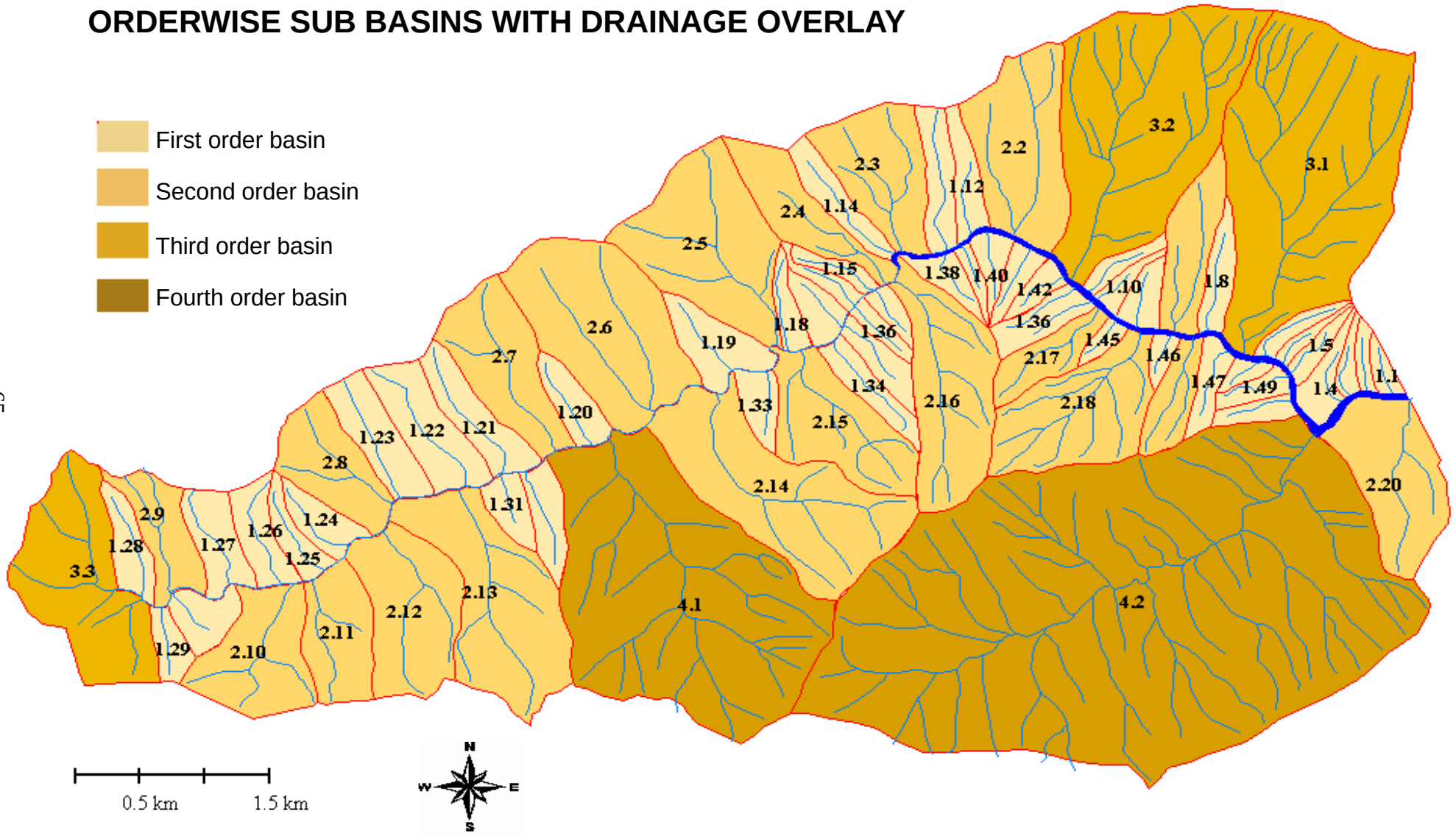


Fig. no. 3.1 a

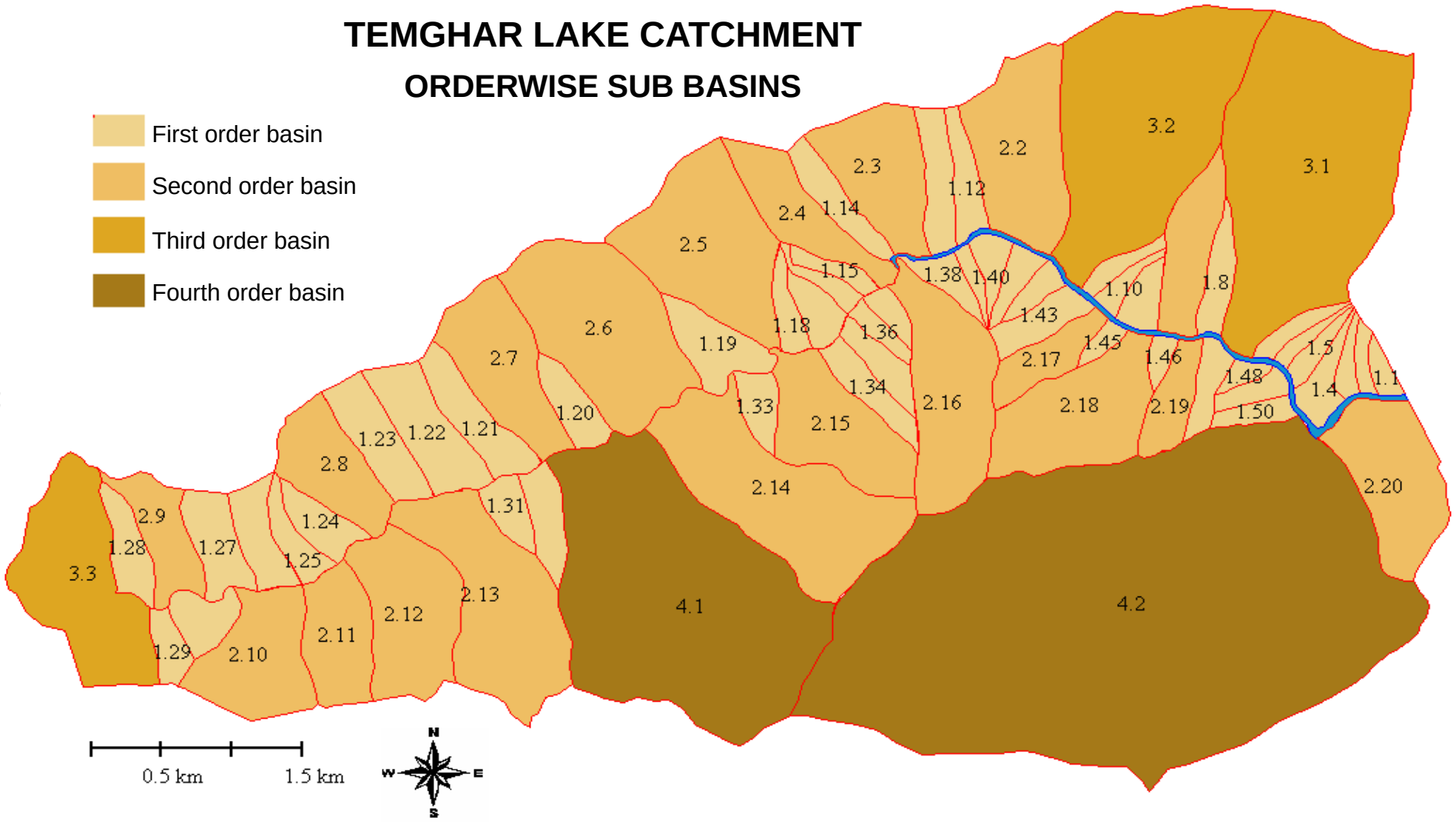

TEMGHAR LAKE CATCHMENT
ORDERWISE SUB BASINS
First order basin
Second order basin
Third order basin
Fourth order basin
3.2
3.1
2.3
2.2
1.12
2.4
1.14
2.5
1.15
1.38
1.40
1.10
1.8
2.6
1.18
1.36
1.43
1.19
1.45
1.5
2.7
2.17
1.46
1.48
1.4
1.1
1.34
1.20
1.33
2.16
2.18
2.19
1.50
2.15
1.23
1.22
1.21
2.8
2.14
2.20
1.31
2.9
1.24
1.28
1.27
1.25
3.3
2.13
4.1
4.2
2.12
2.11
1.29
2.10
0.5 km
1.5 km
N
W
E
S

Fig. no. 3.1 b

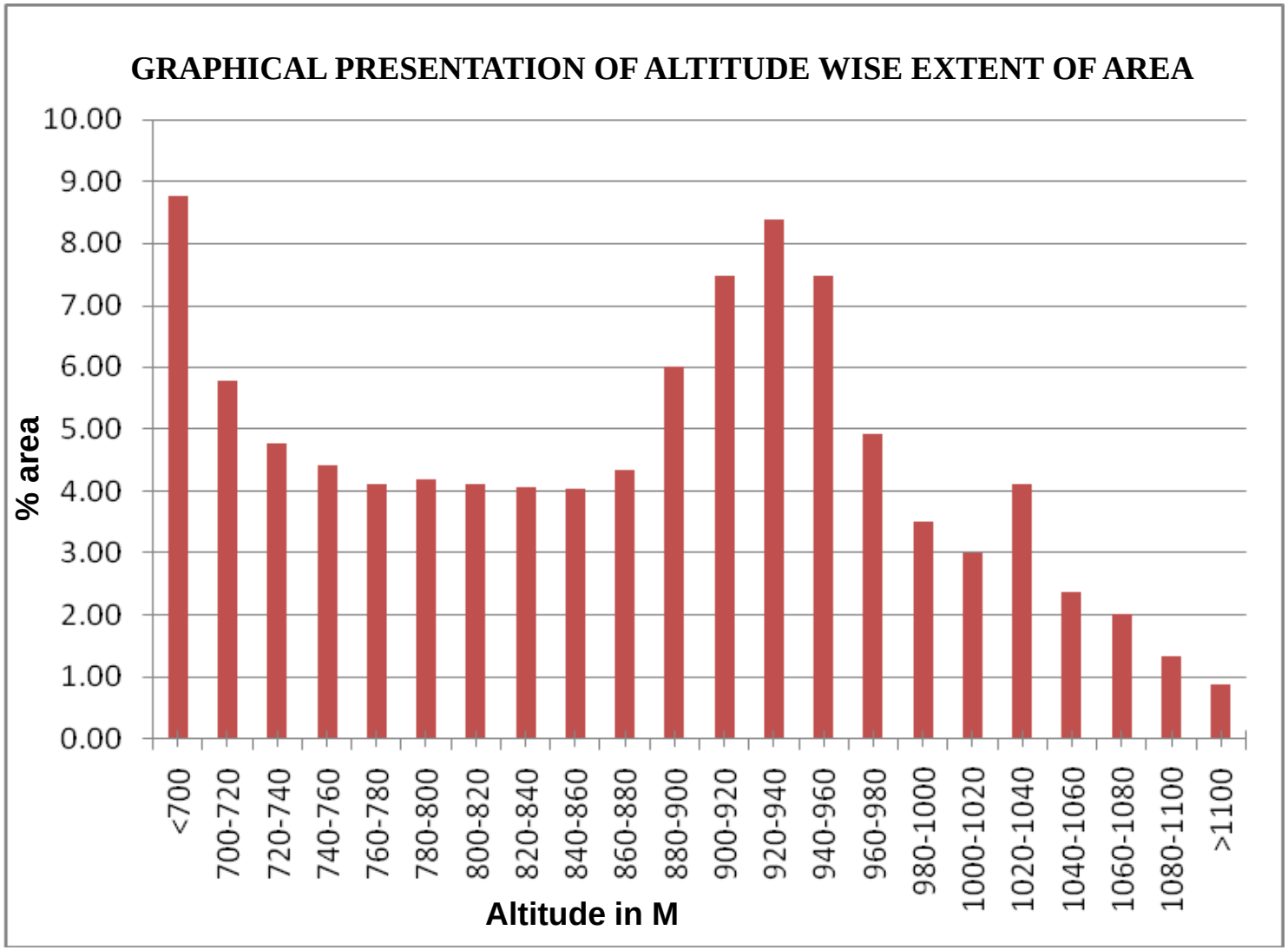

GRAPHICAL PRESENTATION OF ALTITUDE WISE EXTENT OF AREA
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
% area
<700
700-720
720-740
740-760
760-780
780-800
800-820
820-840
840-860
860-880
880-900
900-920
920-940
940-960
960-980
980-1000
1000-1020
1020-1040
1040-1060
1060-1080
1080-1100
>1100
Altitude in M

Fig. no. 3.2

TEMGHAR LAKE CATCHMENT
ALTITUDE WISE AREA COMPUTATION

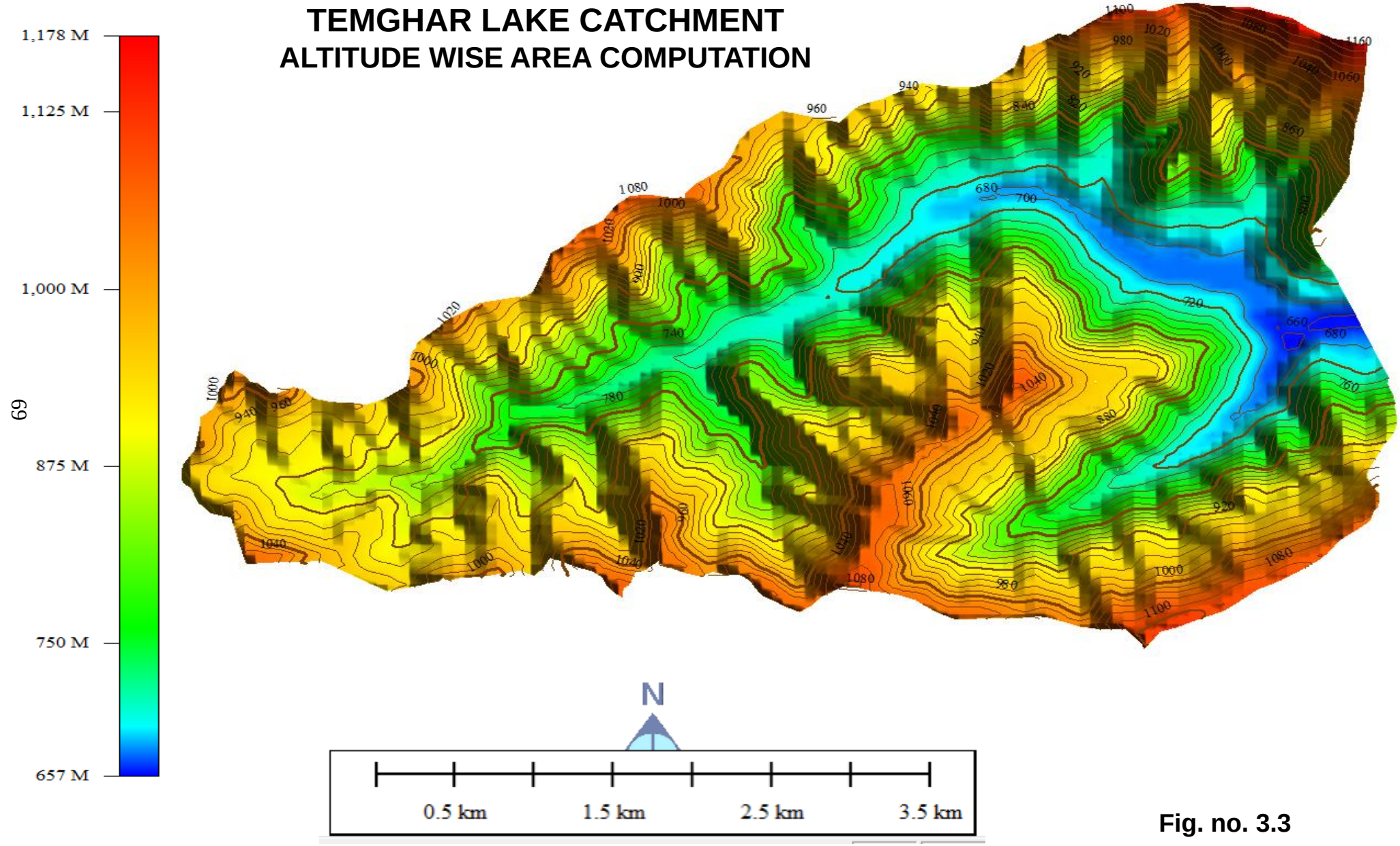
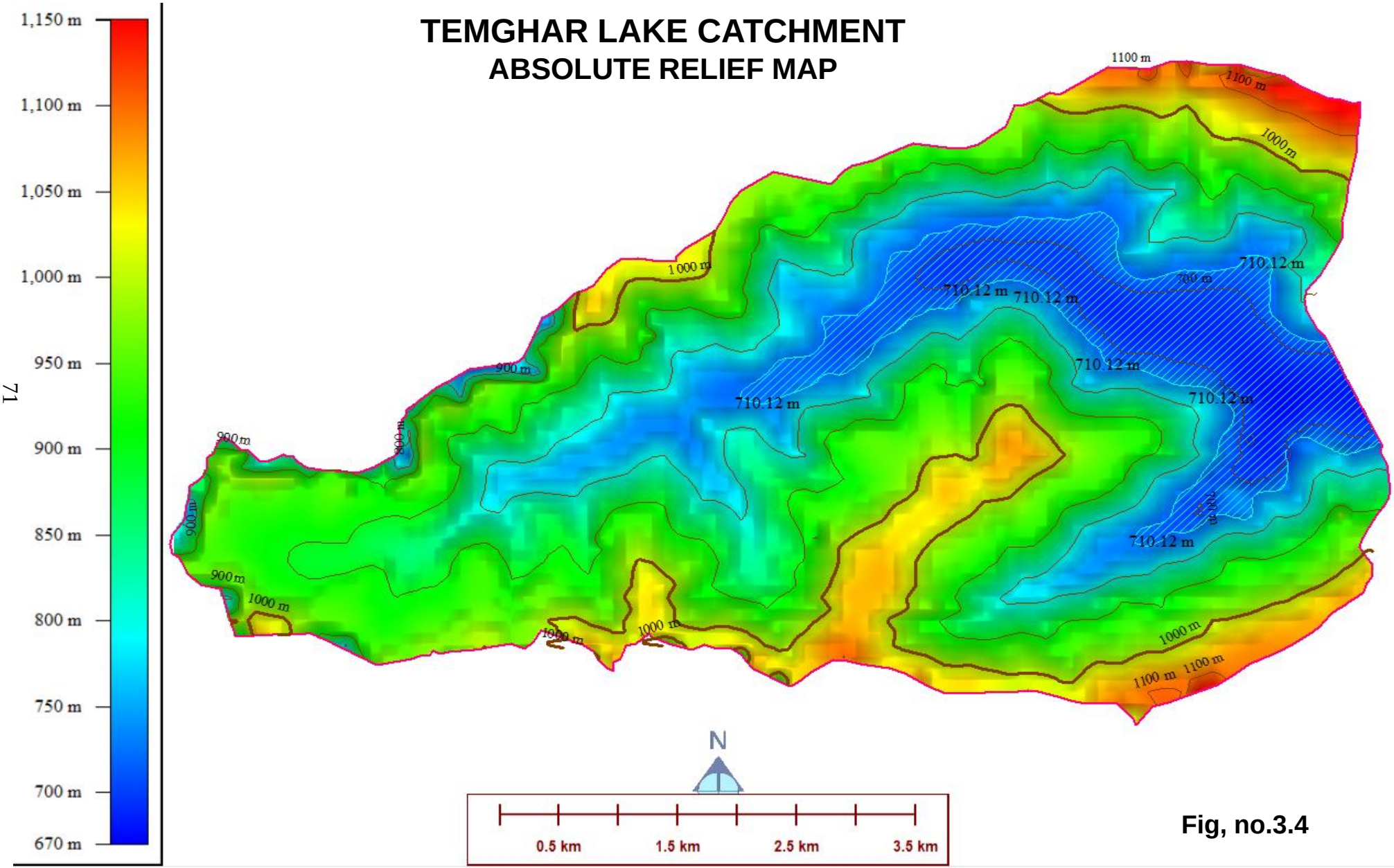


Fig. no. 3.3

TEMGHAR LAKE CATCHMENT
ABSOLUTE RELIEF MAP



Fig, no.3.4

PERCENTAGE AREA OF ABSOLUTE RELIEF

ENTIRE CATCHMENT

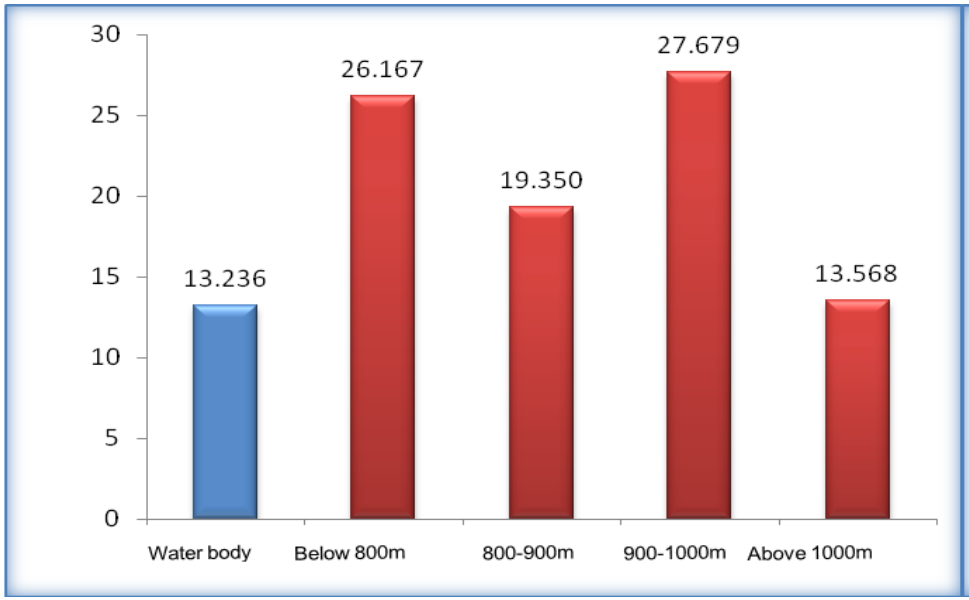


Fig. no. 3.5 a

TOTAL LAND SURFACE AREA

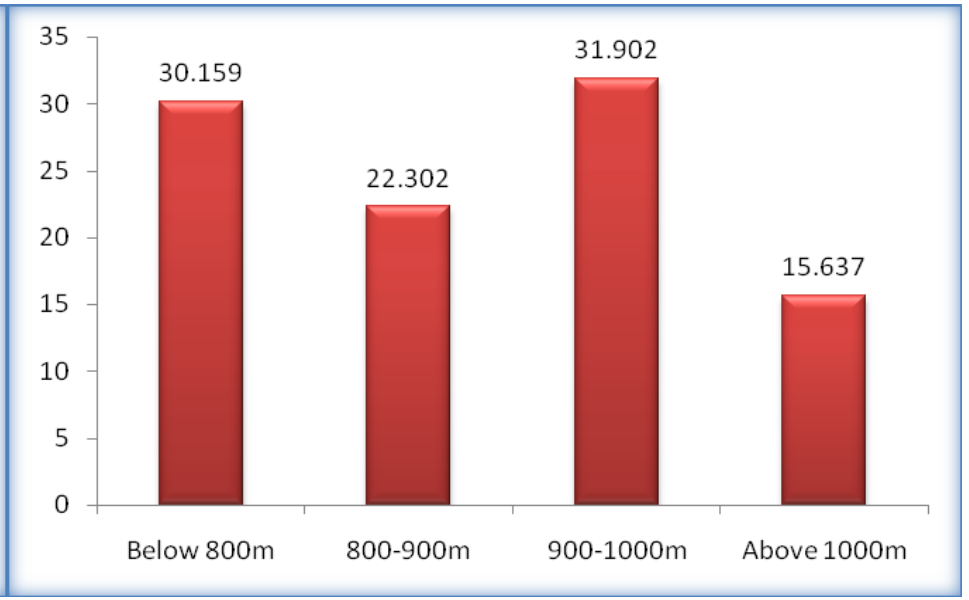


Fig. no. 3.5 b

TEMGHAR LAKE CATCHMENT
RELATIVE RELIEF MAP

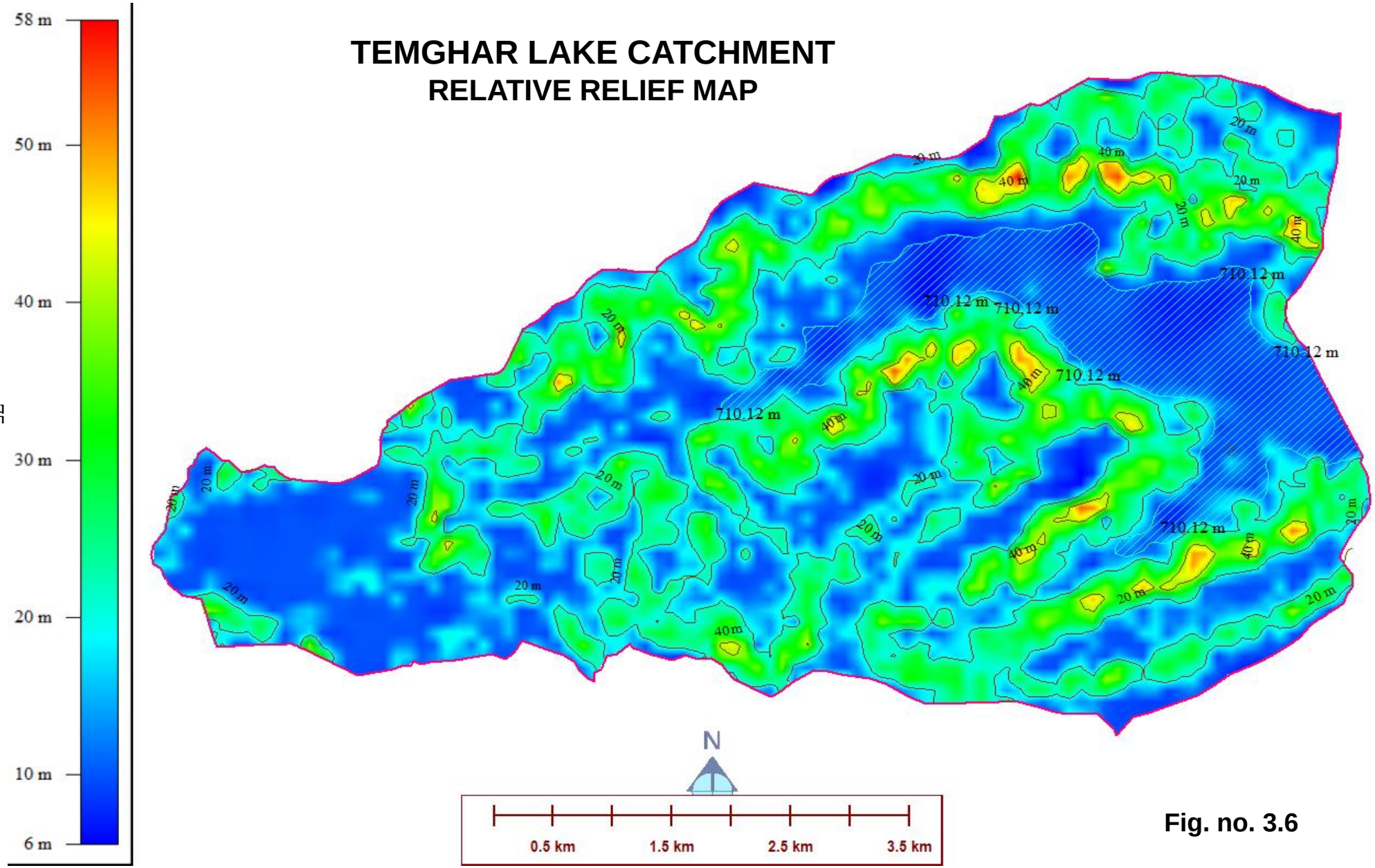


Fig. no. 3.6

PERCENTAGE AREA OF RELATIVE RELIEF

ENTIRE CATCHMENT

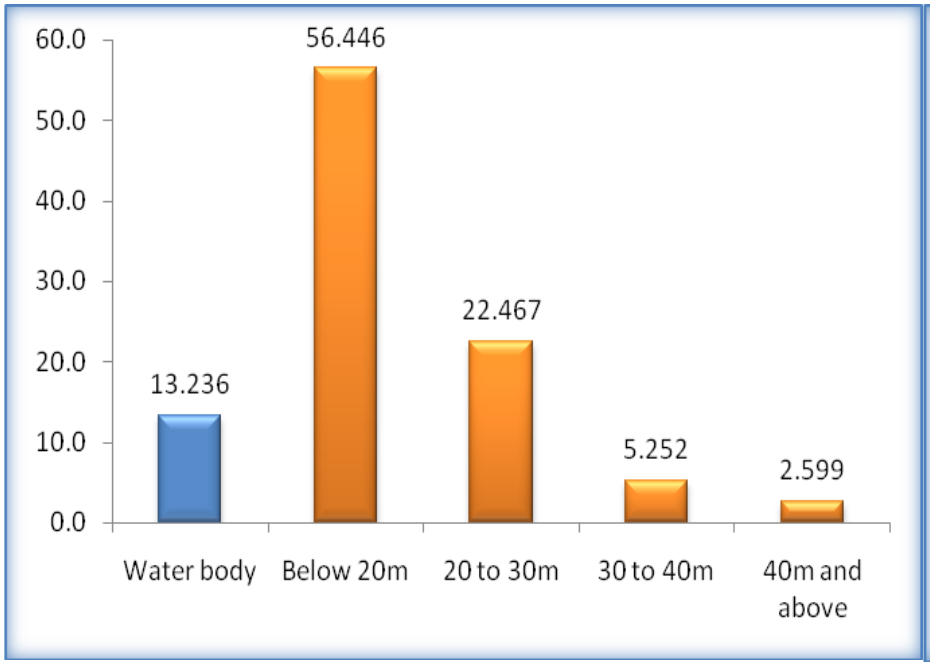


Fig. no. 3.7 a

TOTAL LAND SURFACE AREA

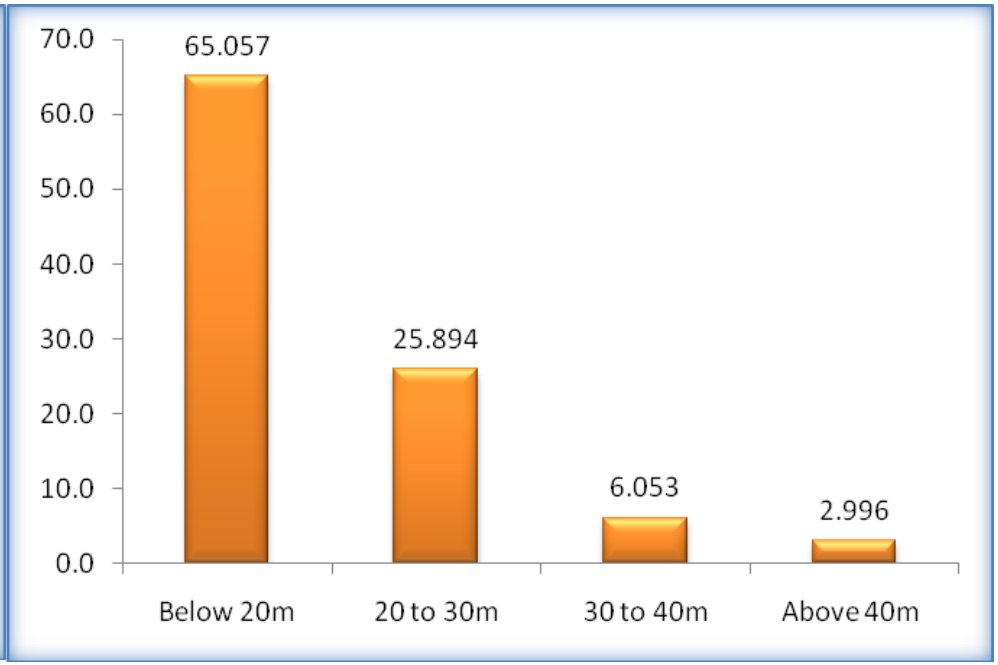


Fig. no. 3.7 b

TEMGHAR LAKE CATCHMENT
% DISSECTION INDEX MAP

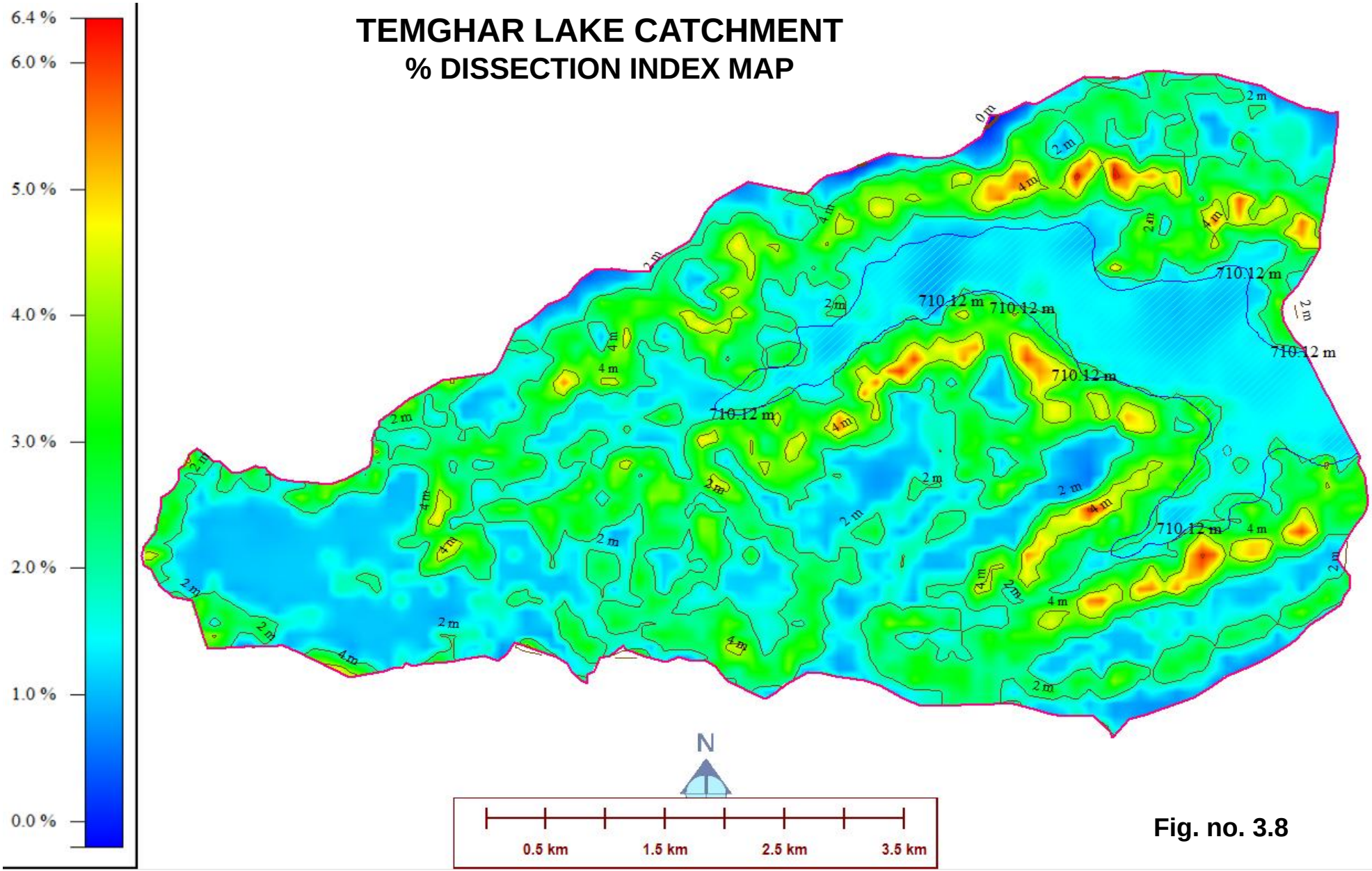
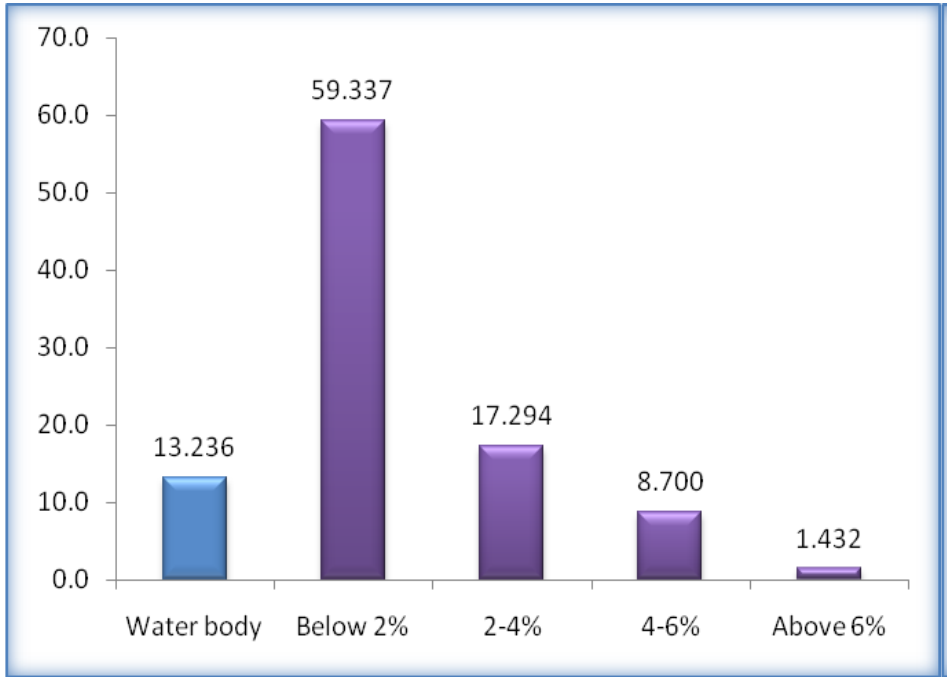


Fig. no. 3.8

PERCENTAGE AREA OF % DISSECTION INDEX

ENTIRE CATCHMENT



Fig, no. 3.9 a

TOTAL LAND SURFACE AREA

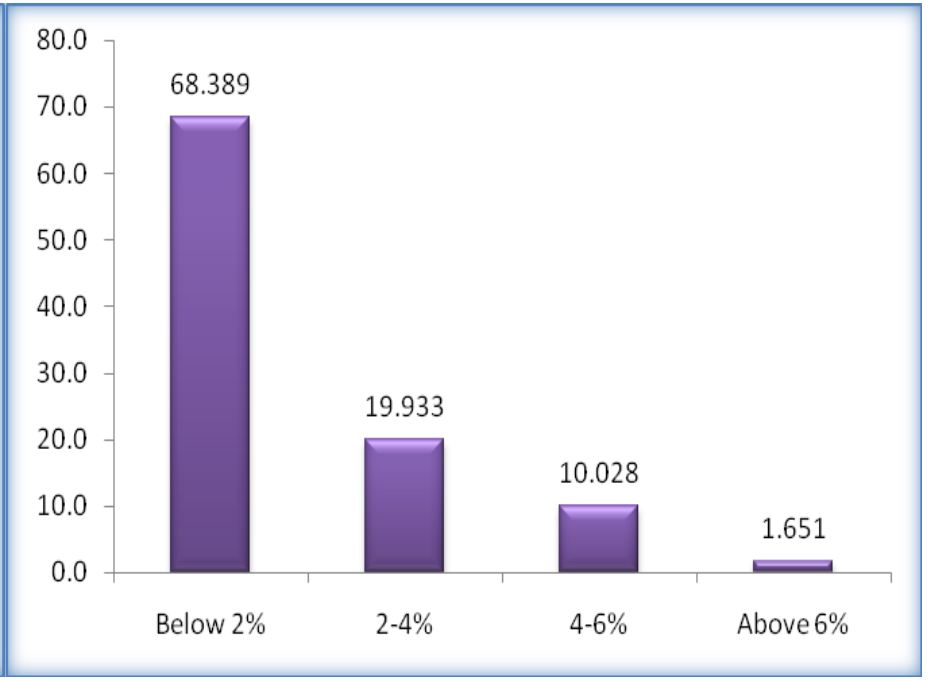


Fig. no. 3.9 b

TEMGHAR LAKE CATCHMENT
% SLOPE MAP

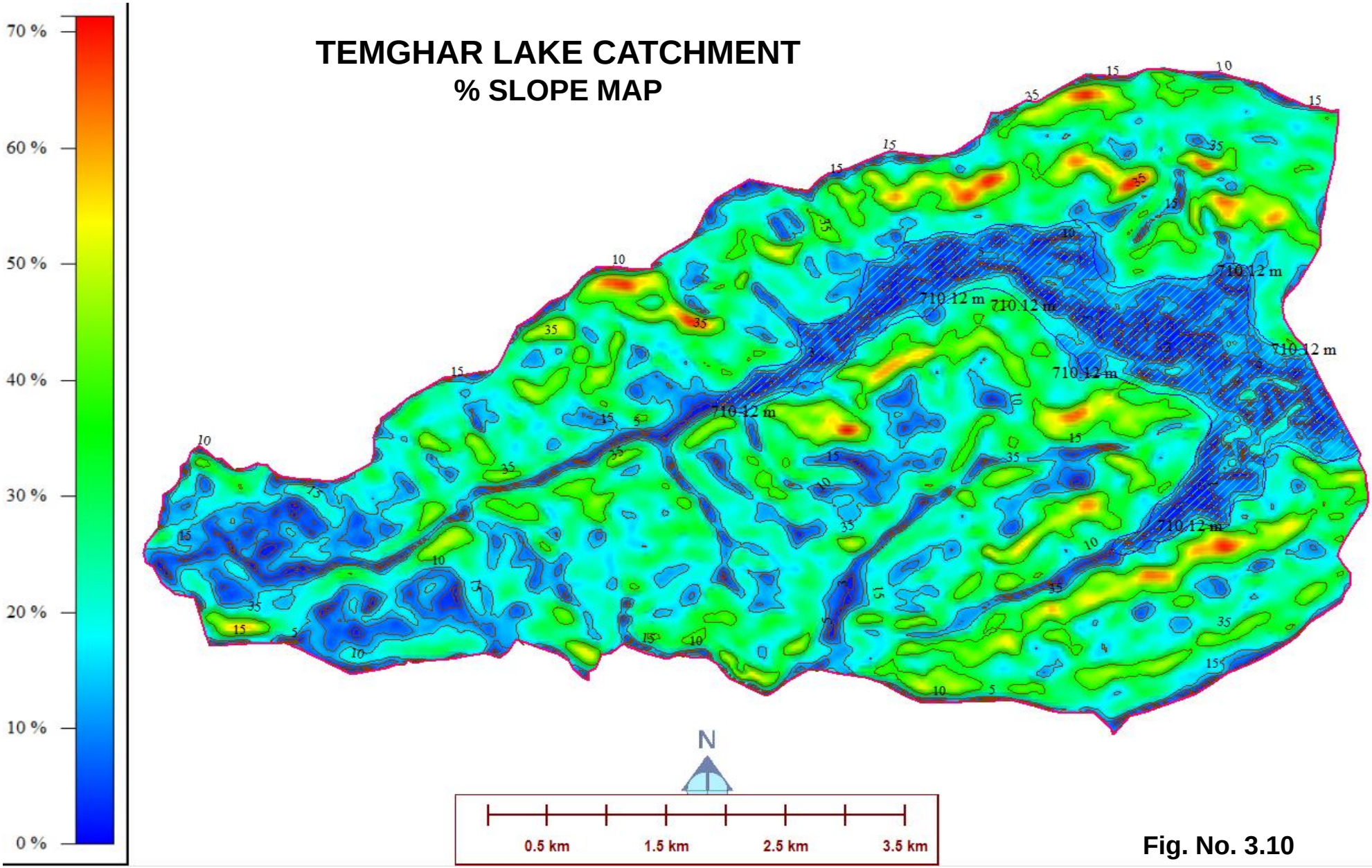


Fig. No. 3.10

PERCENTAGE AREA OF % SLOPE

ENTIRE CATCHMENT

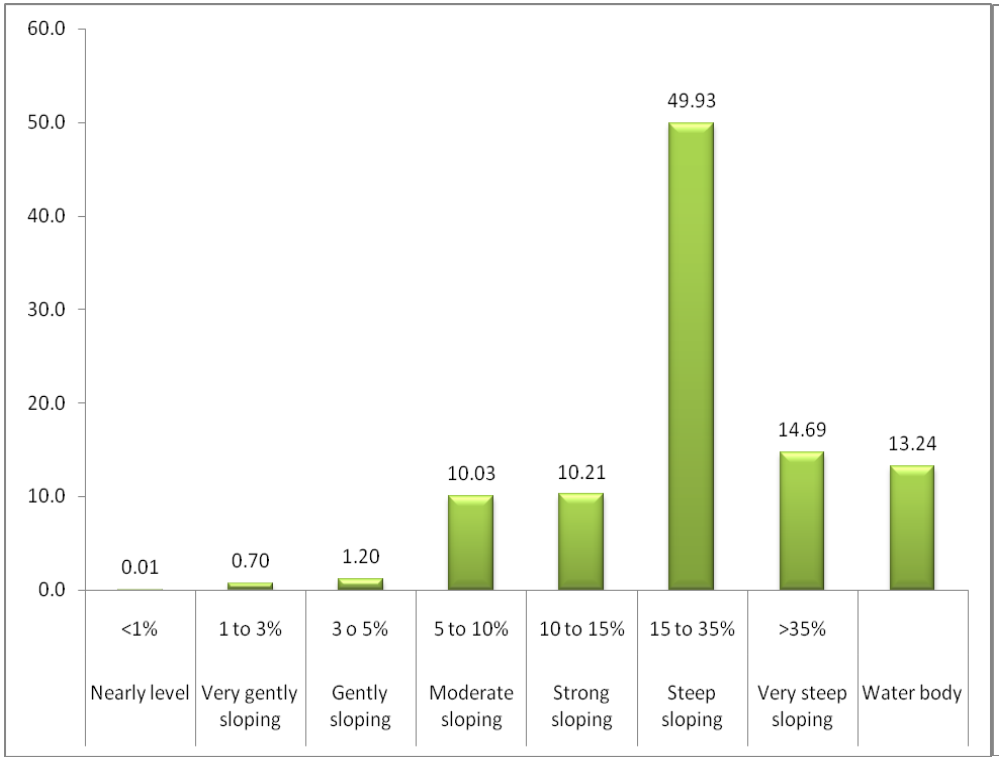


Fig. no. 3.11 a

TOTAL LAND SURFACE AREA

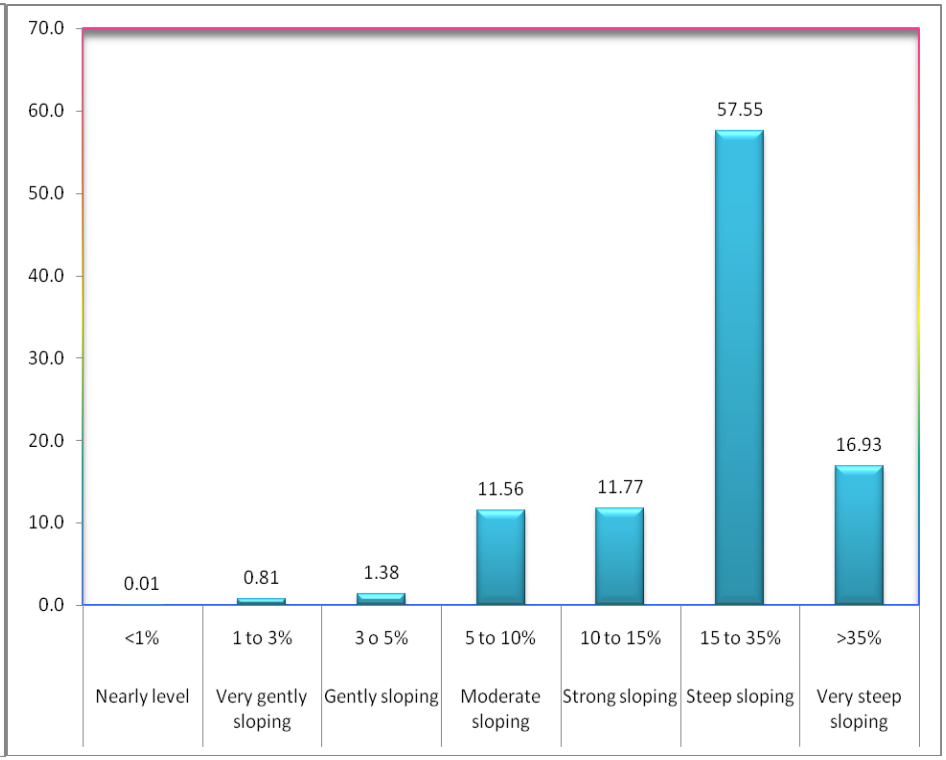


Fig. no. 3.11 b

TEMGHAR LAKE CATCHMENT

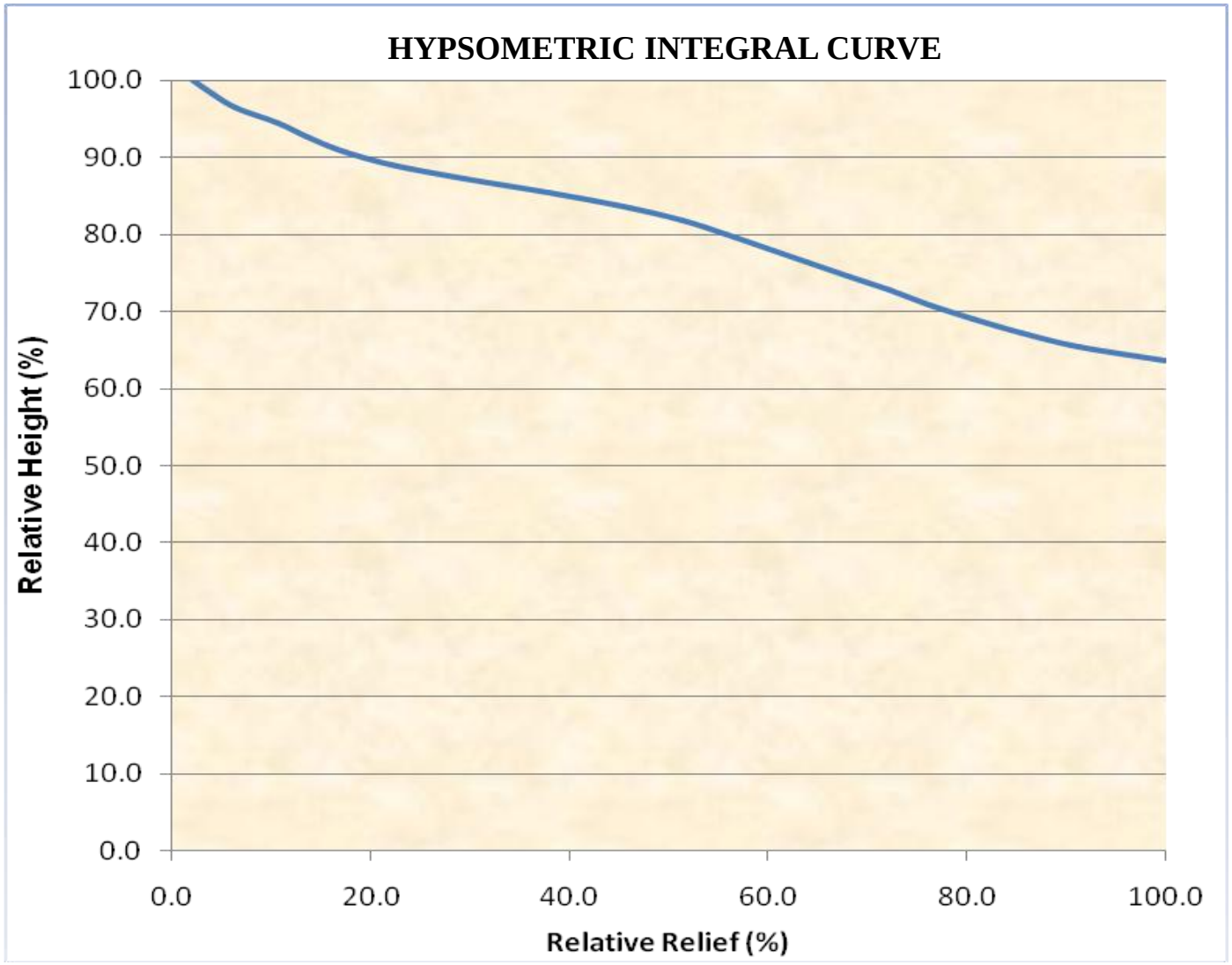
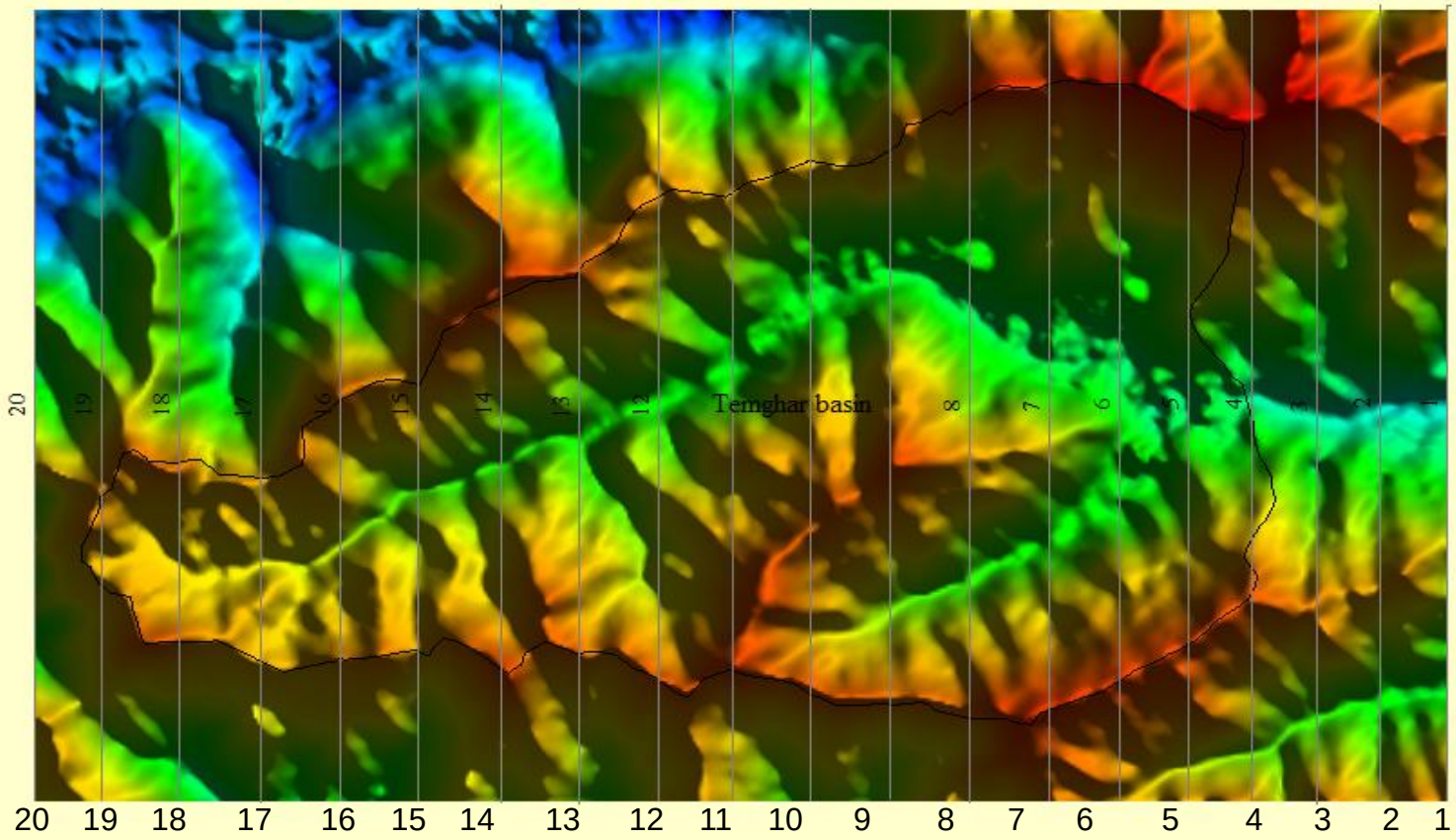


Fig. no. 3.12

TERRAIN PROFILES



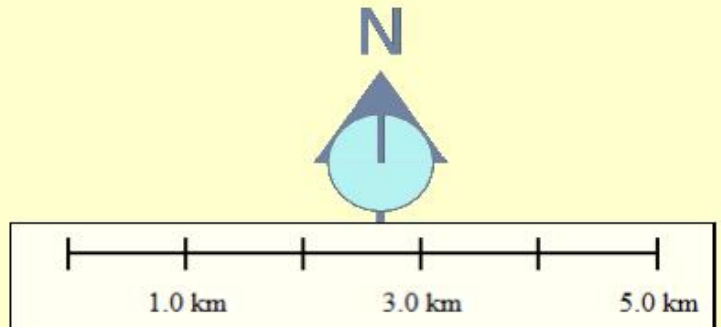
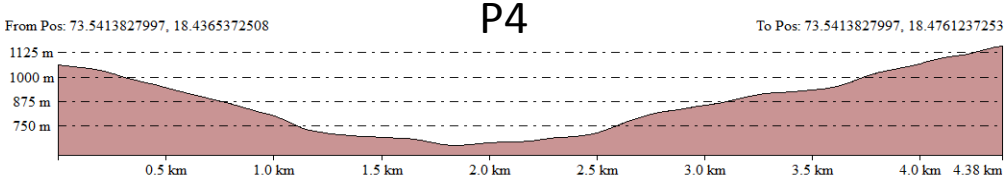


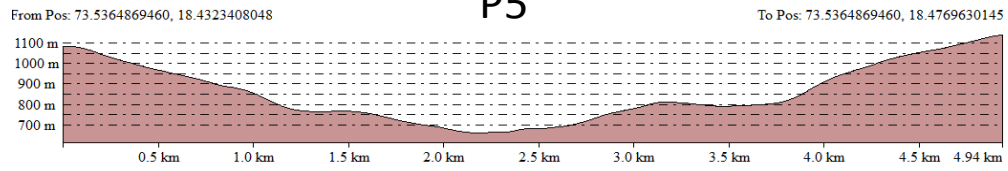
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TERRAIN PROFILES

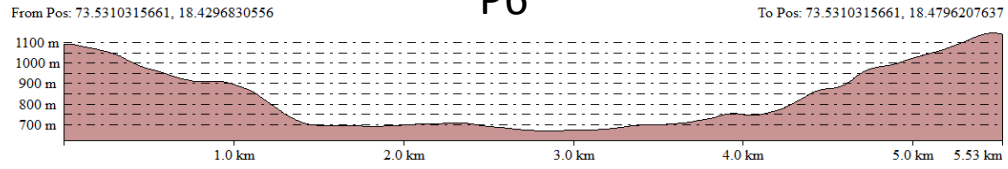
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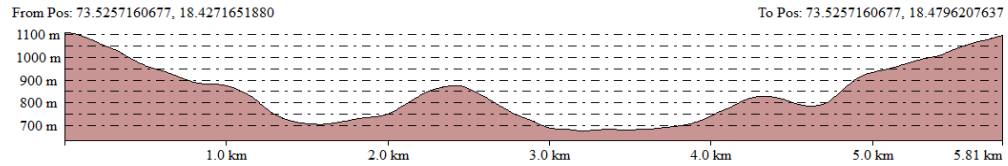
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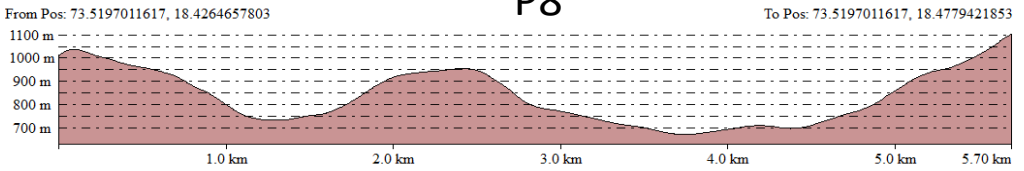
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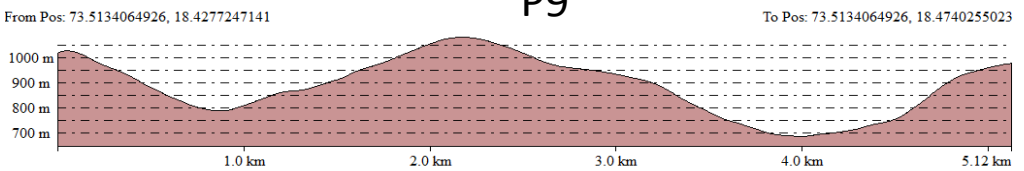
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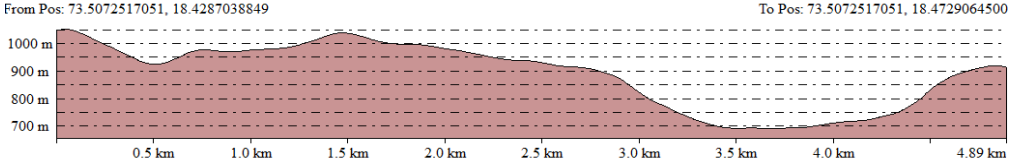
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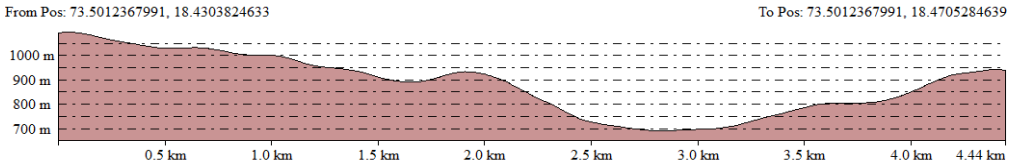
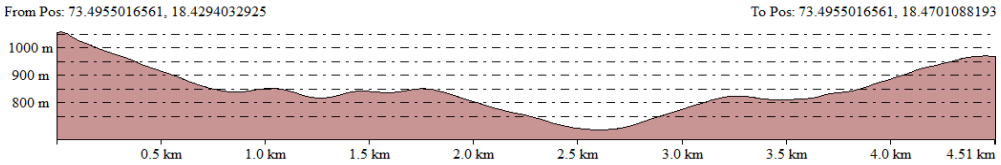


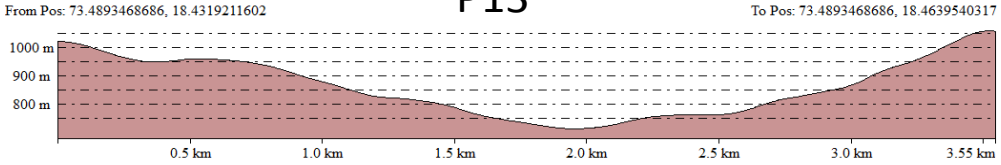
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TERRAIN PROFILES

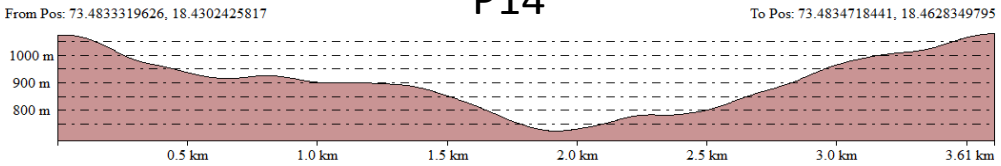
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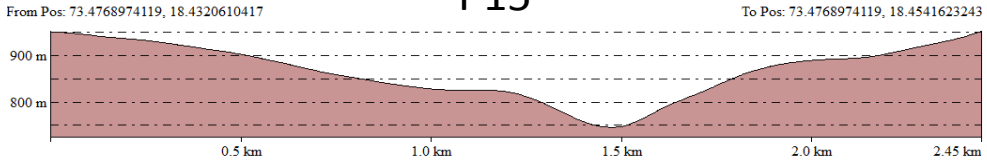
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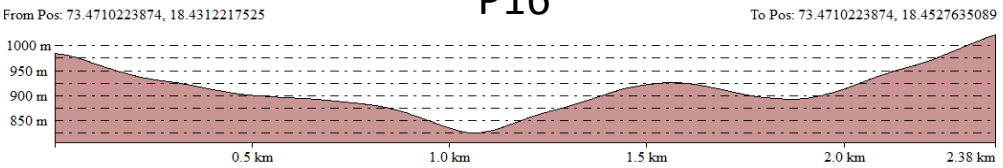
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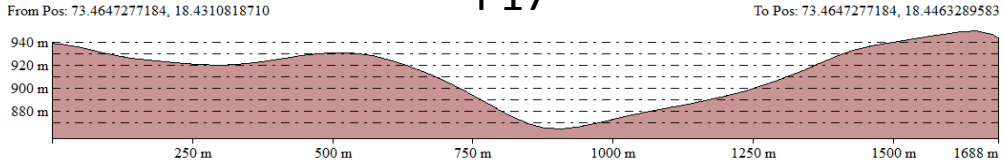
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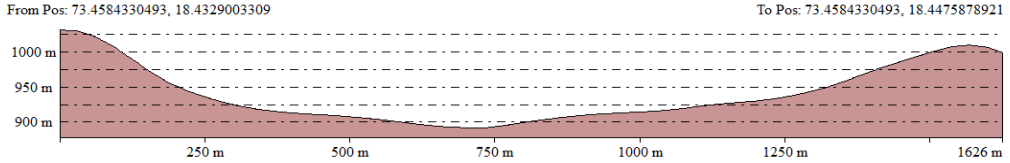
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P18



P19

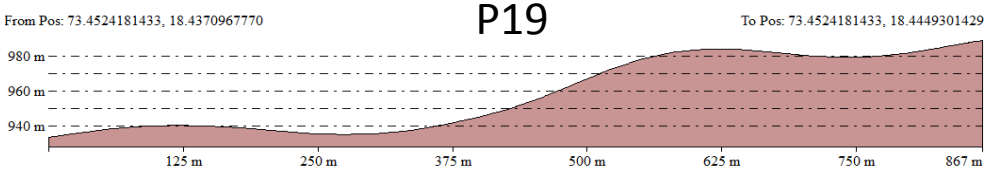


Fig. no. 3.13

TEMGHAR LAKE CATCHMENT

GEOMORPHIC MAP

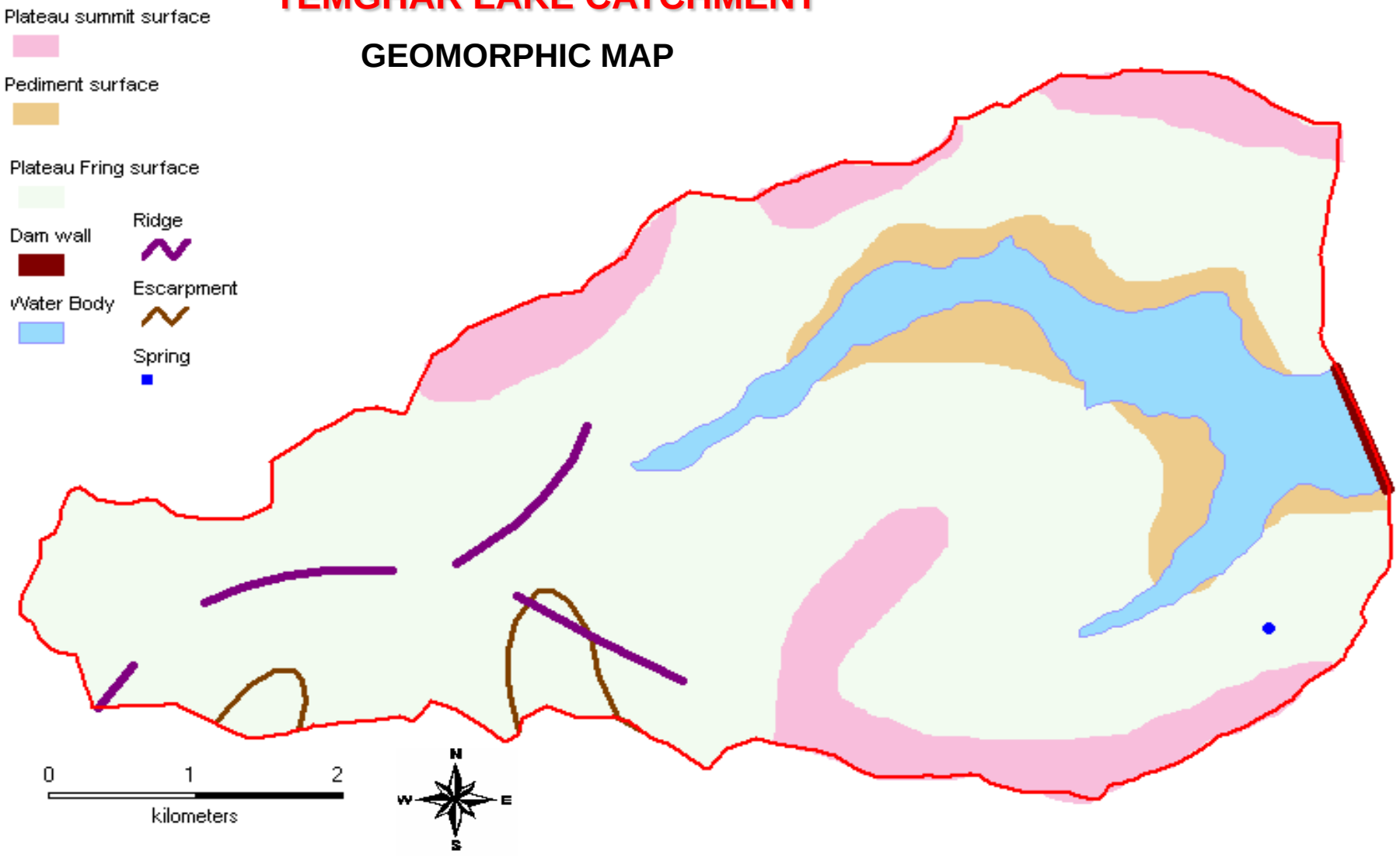


Fig. no. 3.14

TEMGHAR LAKE CATCHMENT

SOIL DEPTH VARIATION MAP

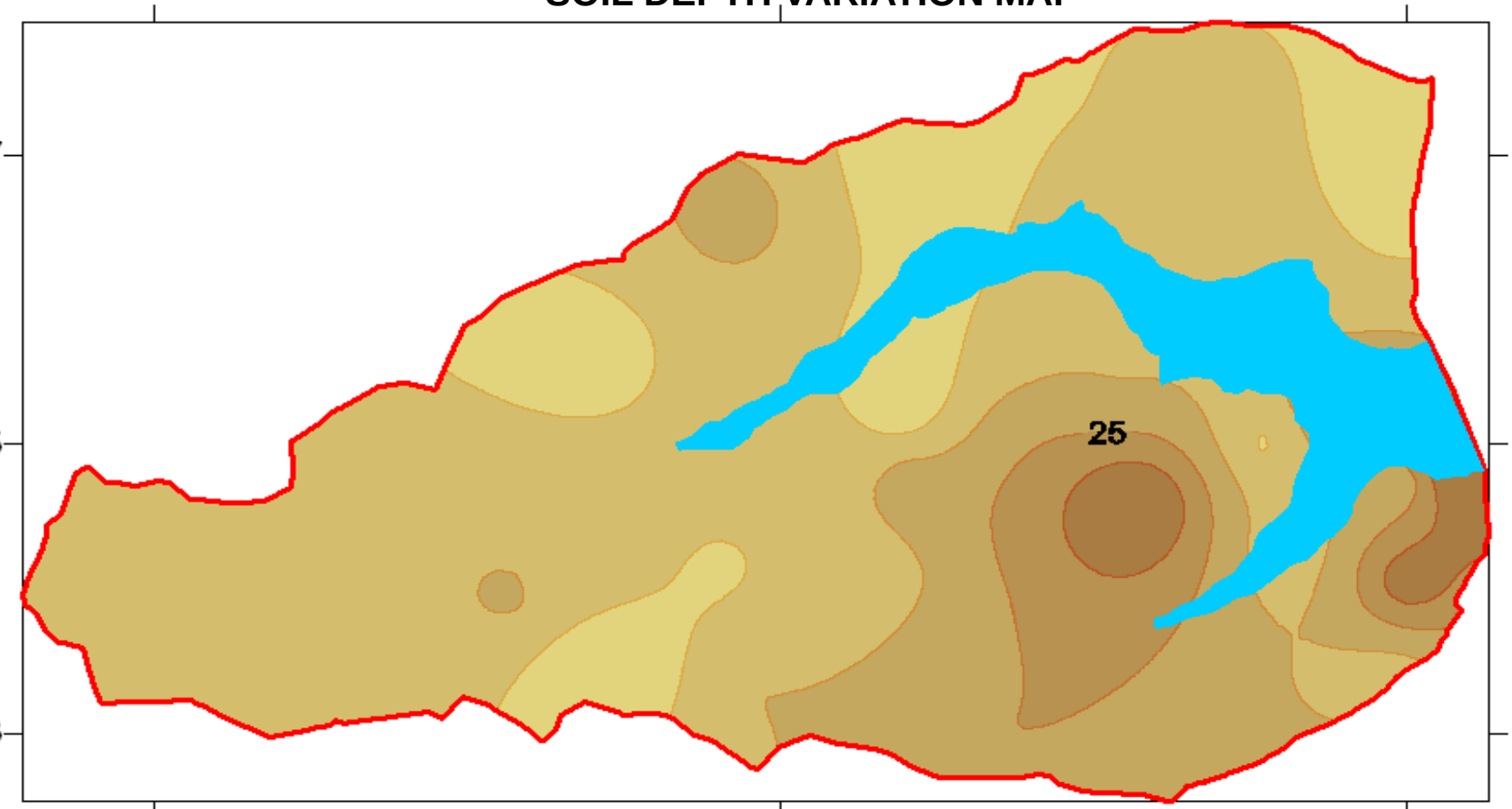


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TEMGHAR LAKE CATCHMENT

SOIL TYPES

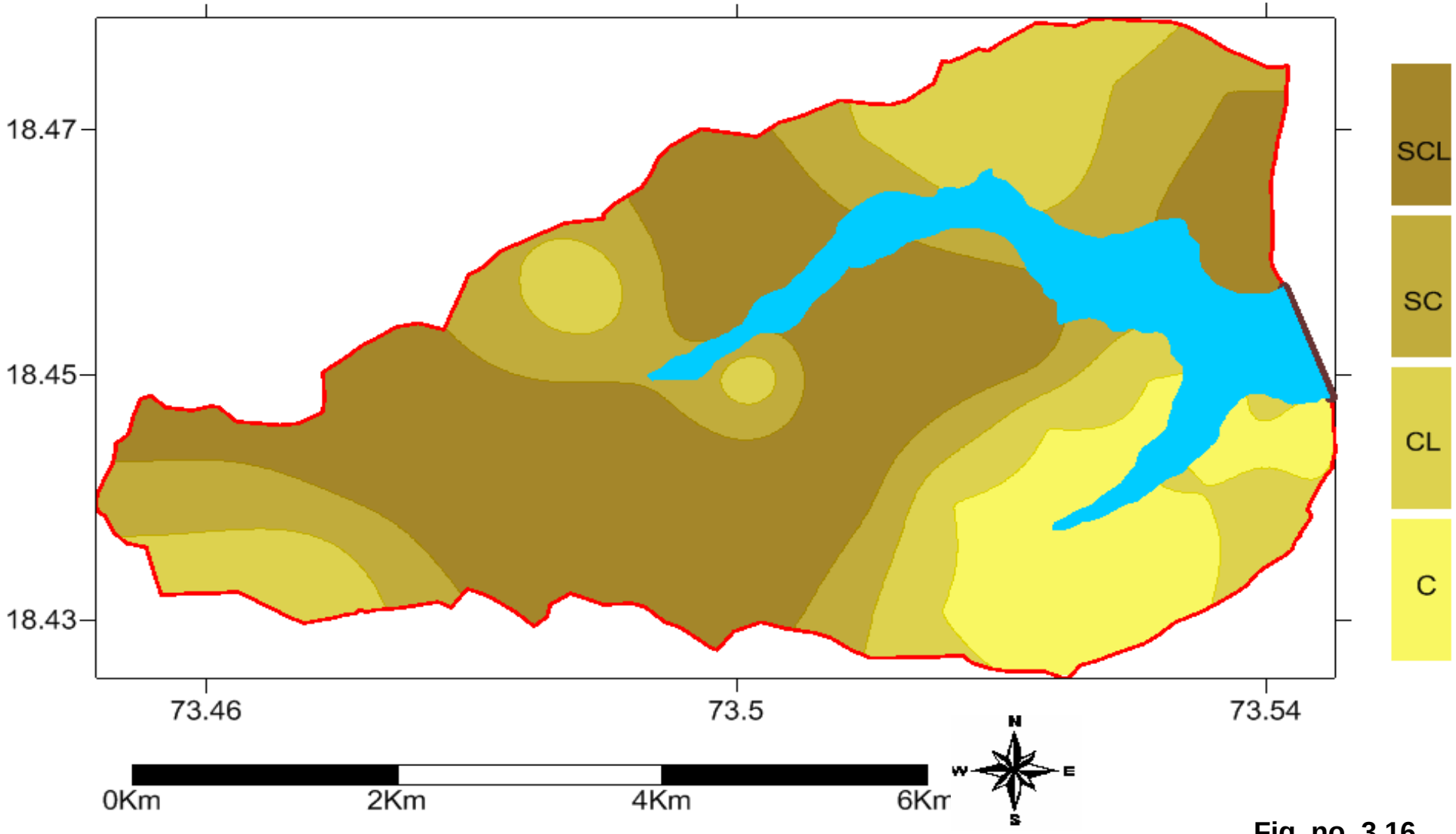


Fig. no. 3.16

TEMGHAR LAKE CATCHMENT
DISTRIBUTION OF COARSE SAND

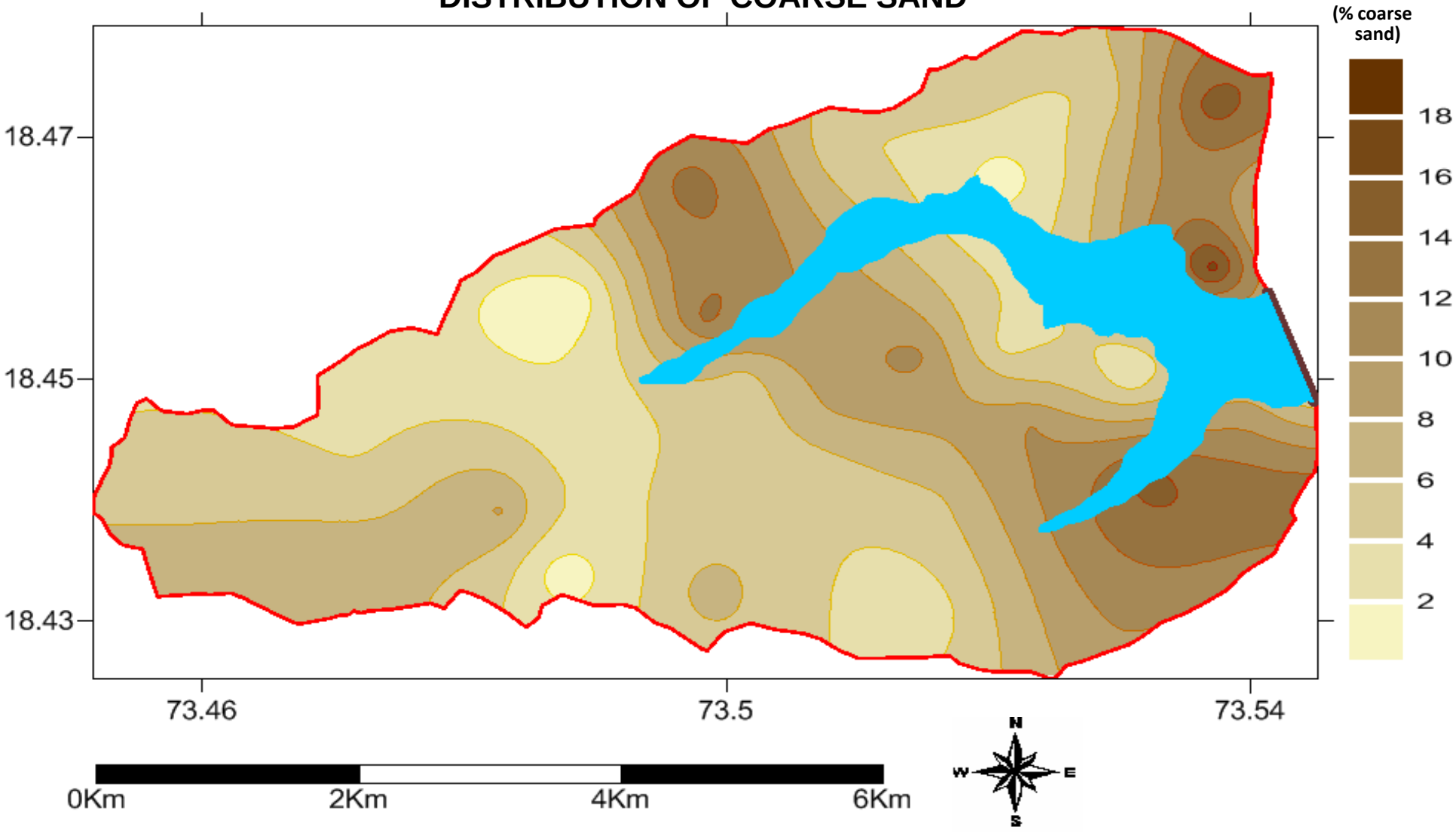


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TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF FINE SAND

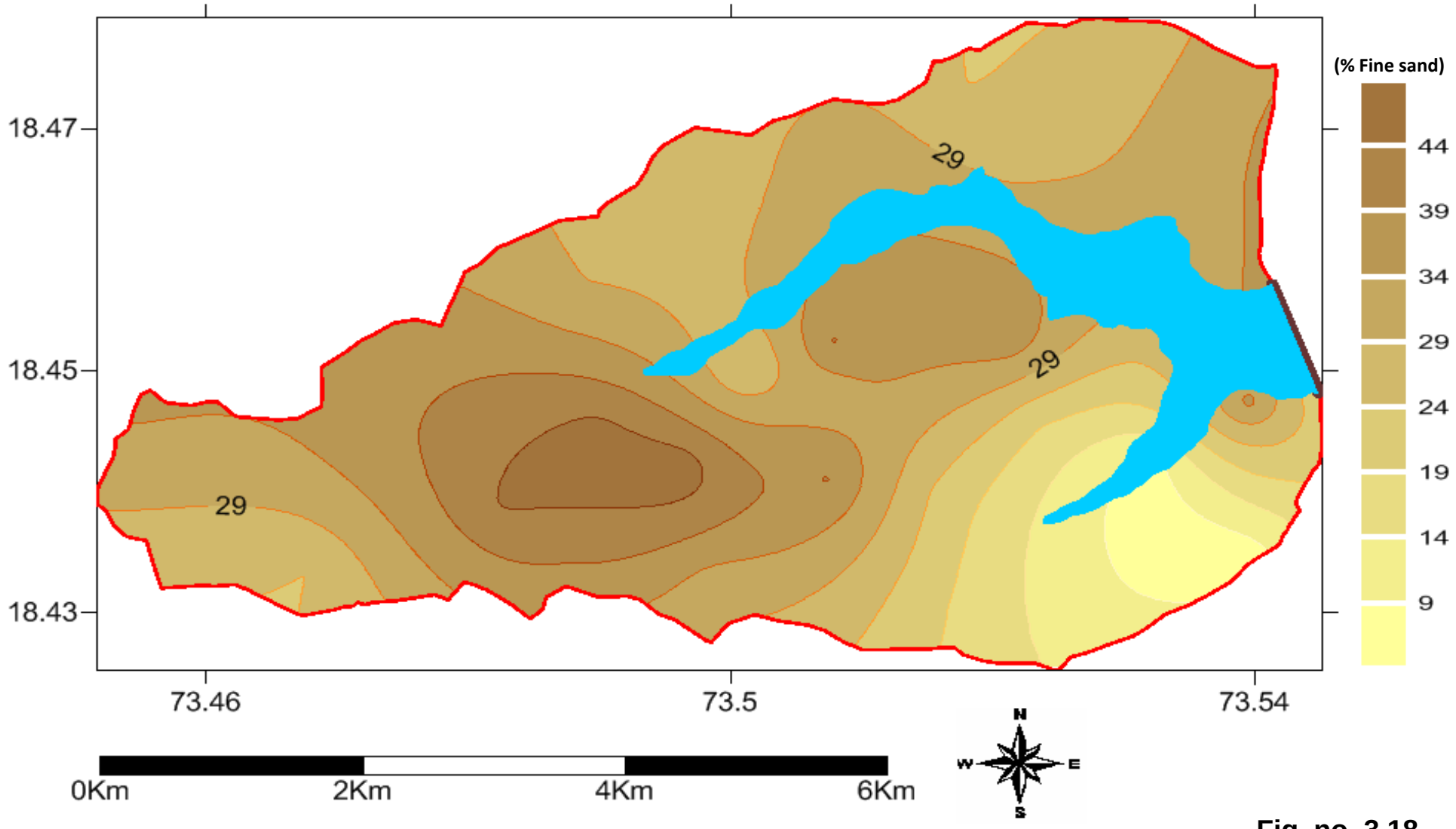


Fig. no. 3.18

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF PERCENTAGE SILT

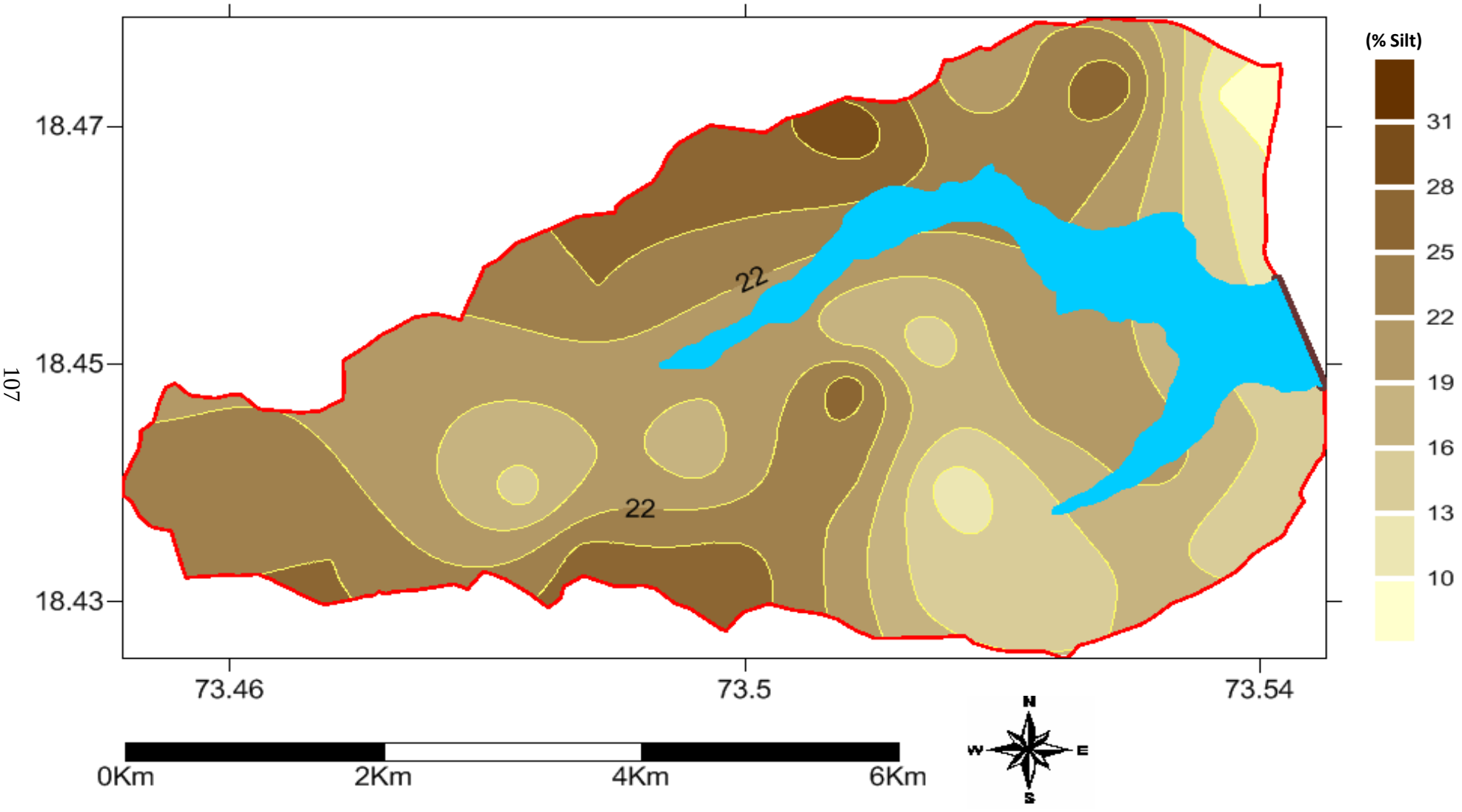


Fig. no. 3.19

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF PERCENTAGE CLAY

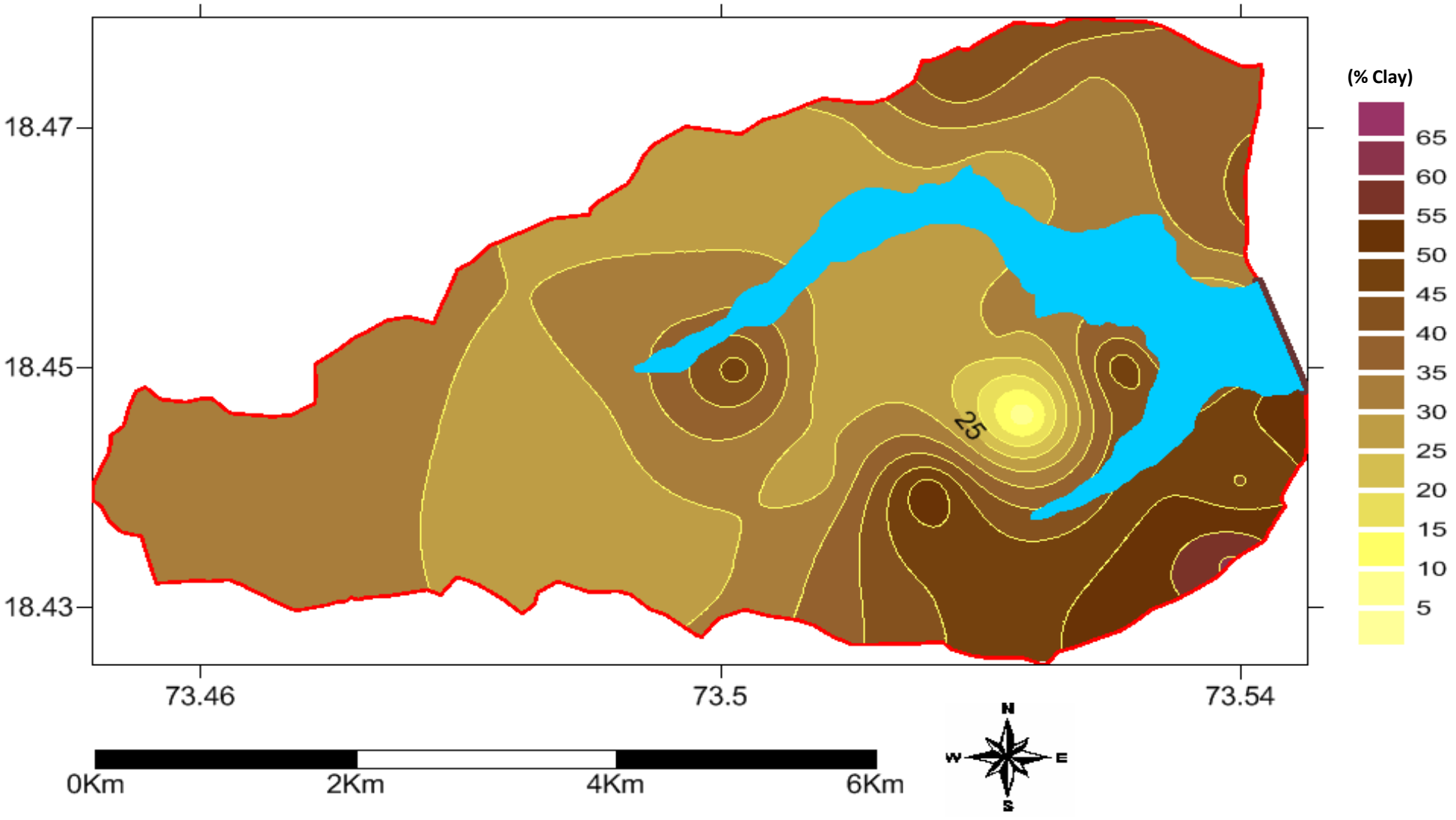


Fig. no. 3.20

TEMGHAR LAKE CATCHMENT
DISTRIBUTION OF PERCENTAGE POROSITY

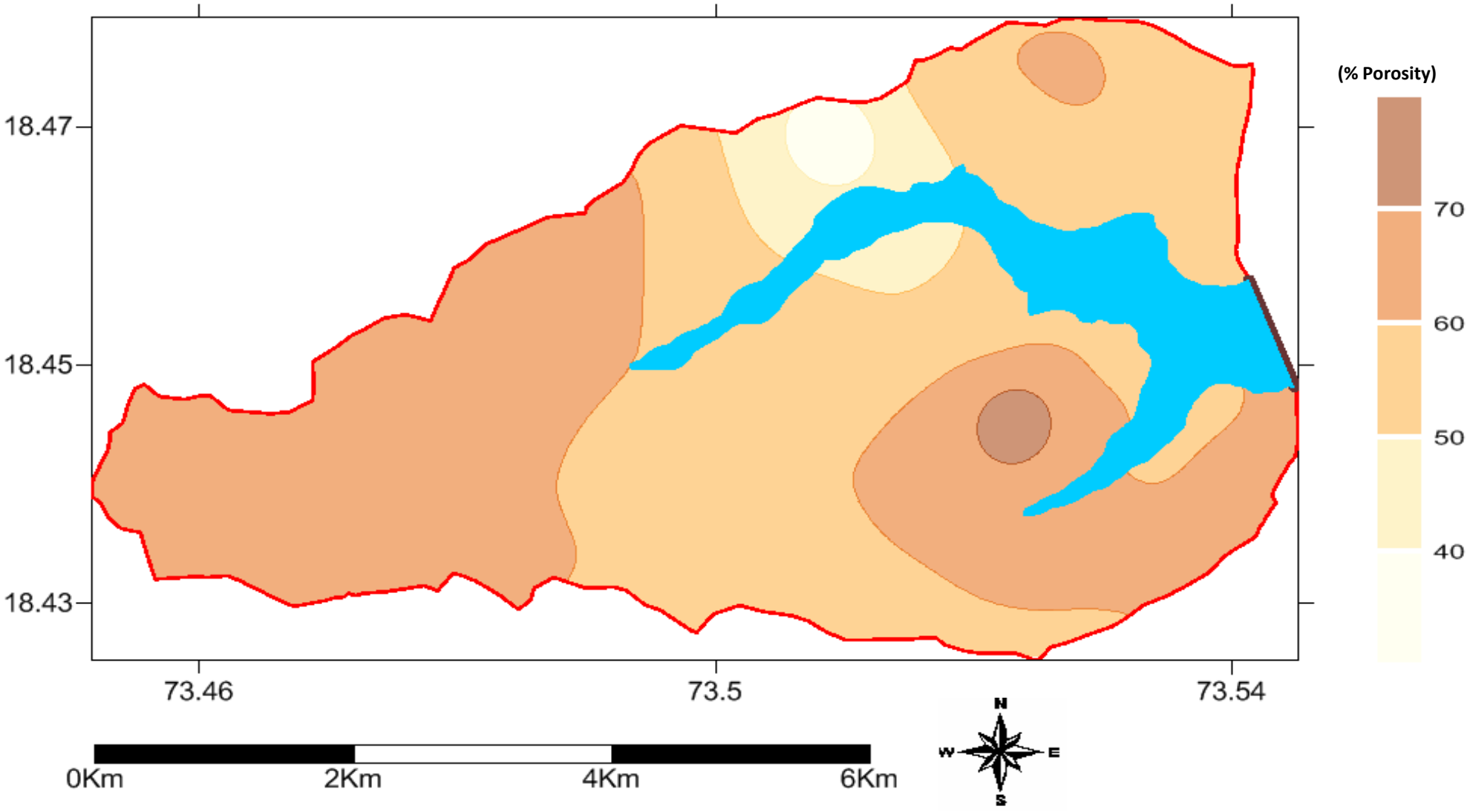


Fig. no. 3.21

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF SPECIFIC GRAVITY

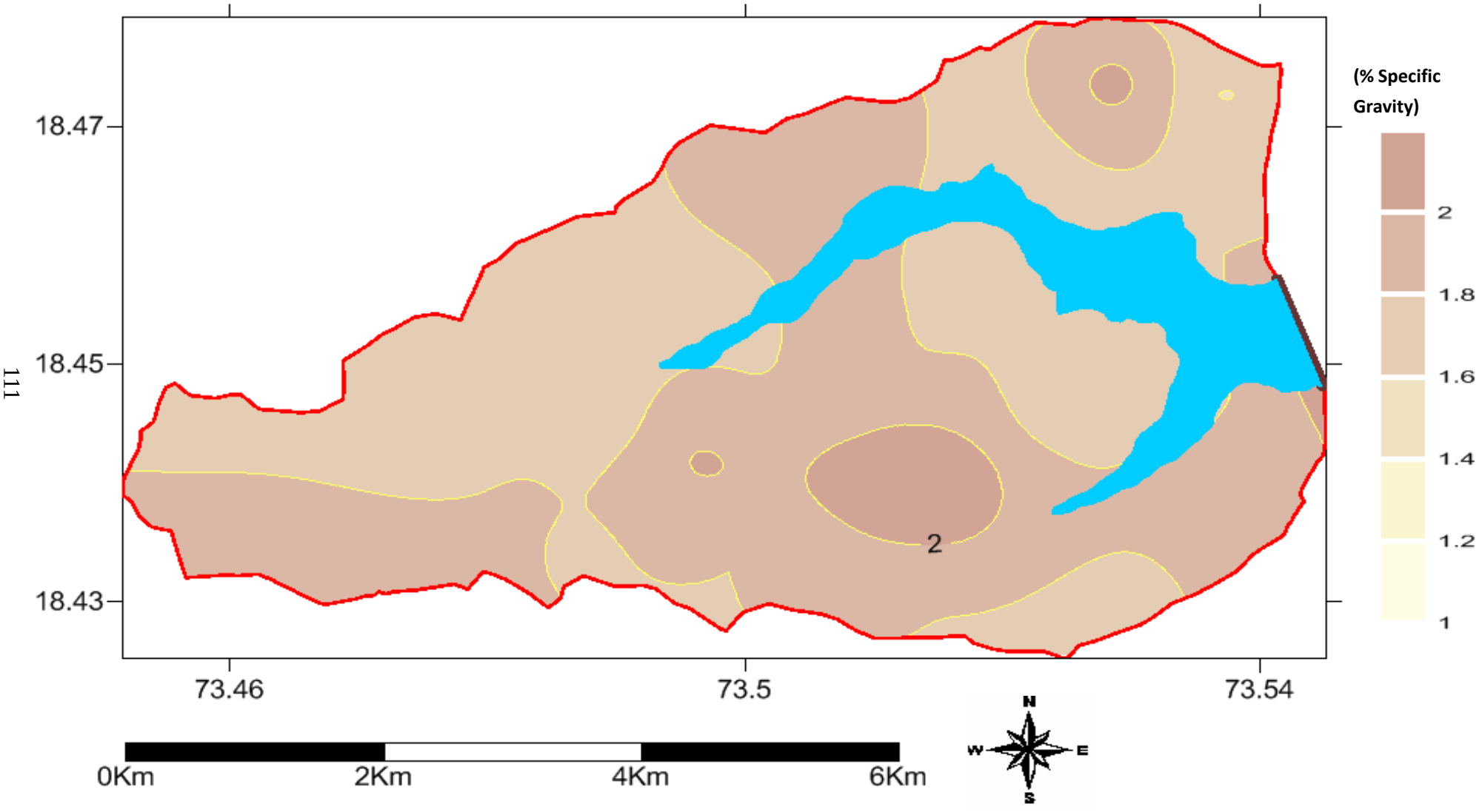


Fig. no. 3.22

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF SOIL pH

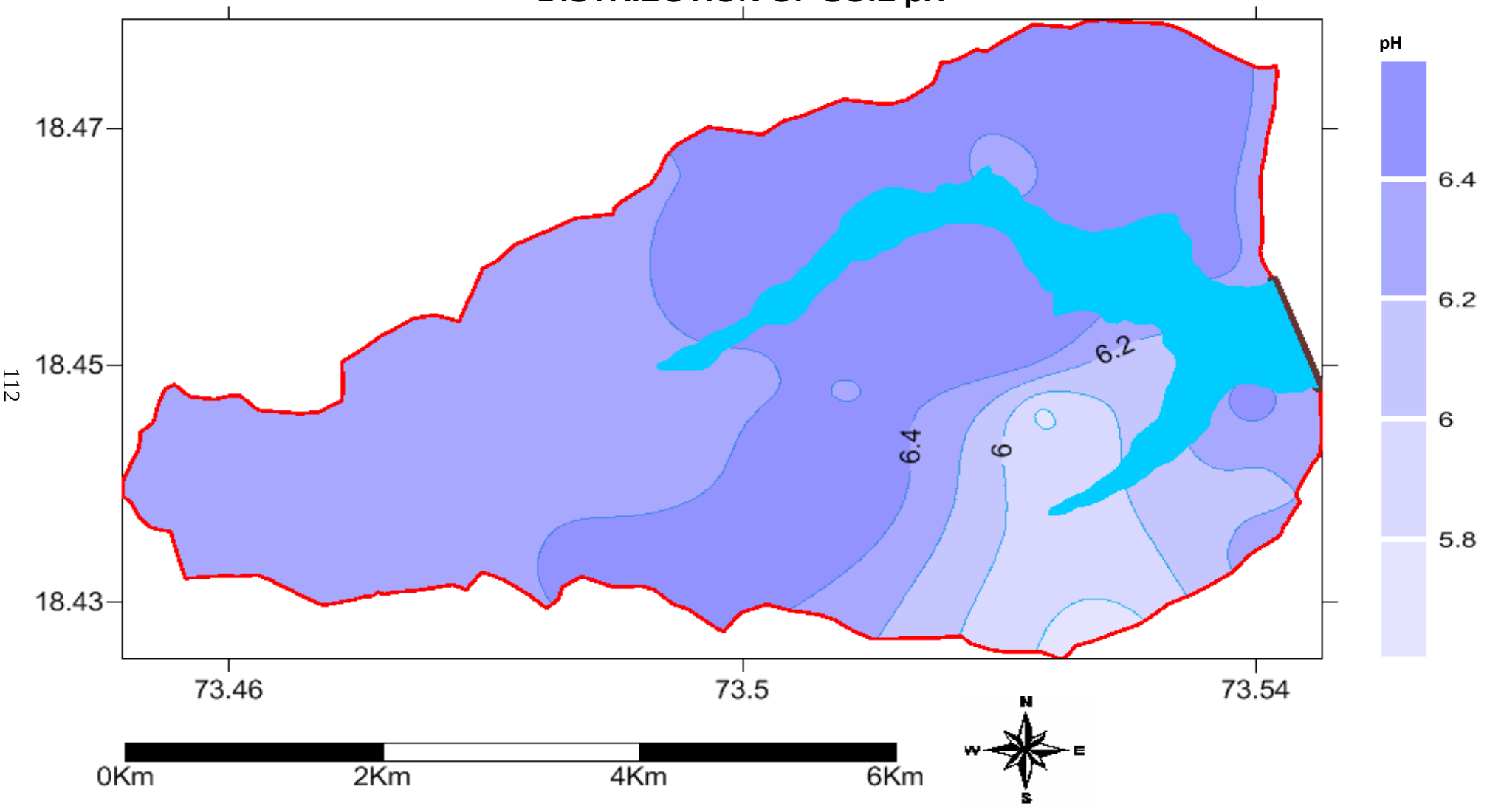


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TEMGHAR LAKE CATCHMENT
DISTRIBUTION OF ORGANIC CARBON

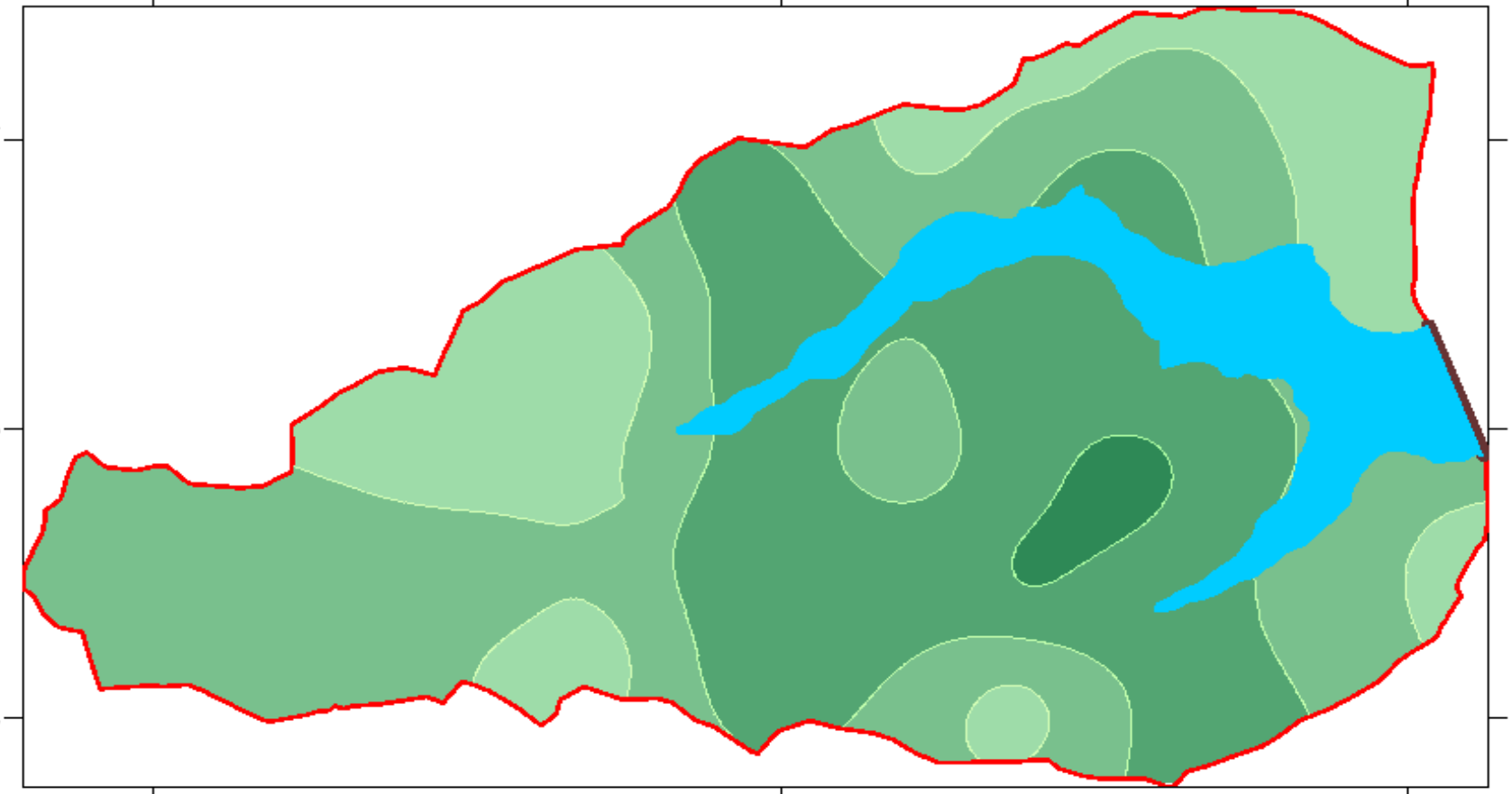


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DISTRIBUTION OF NITROGEN

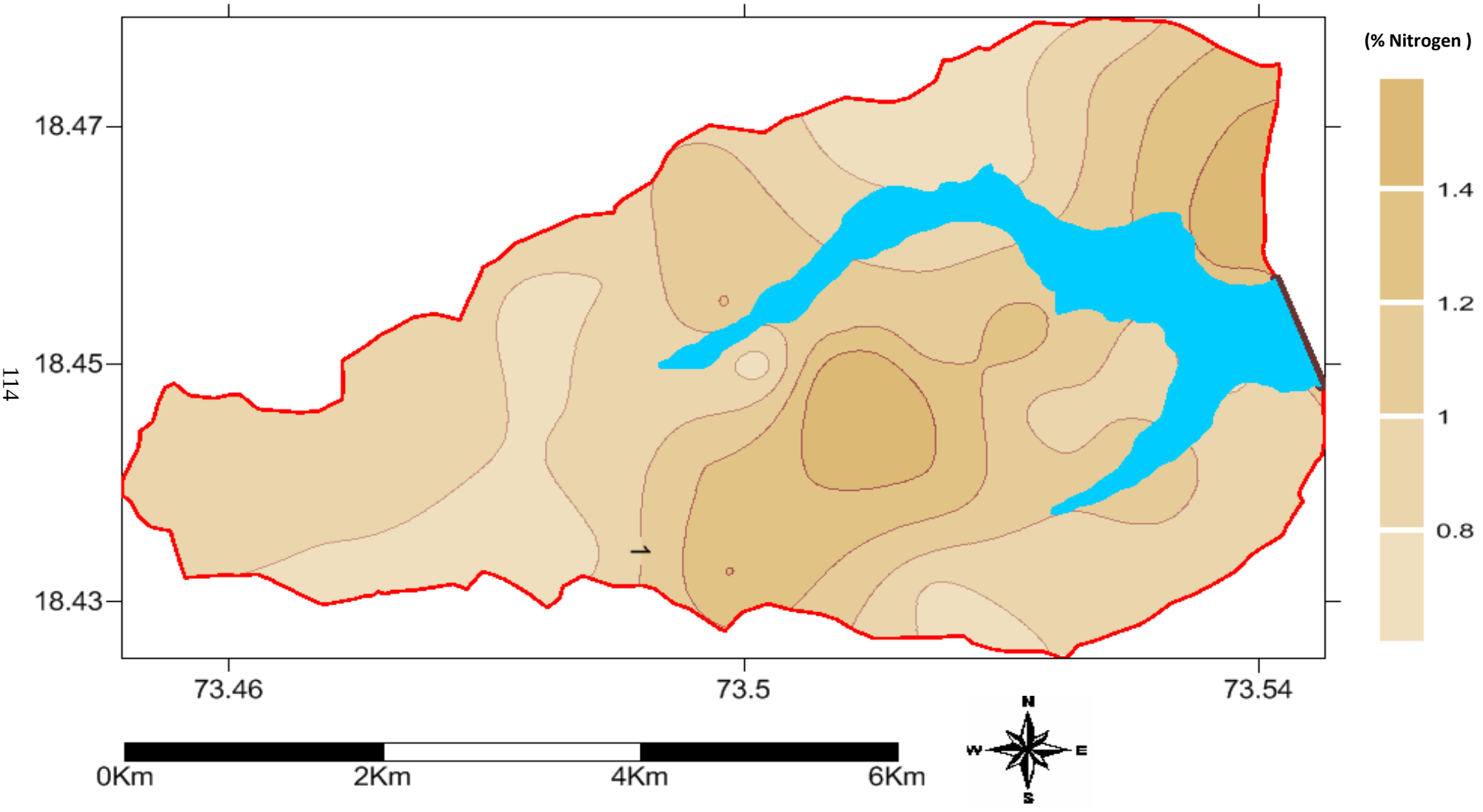


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TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF CALCIUM

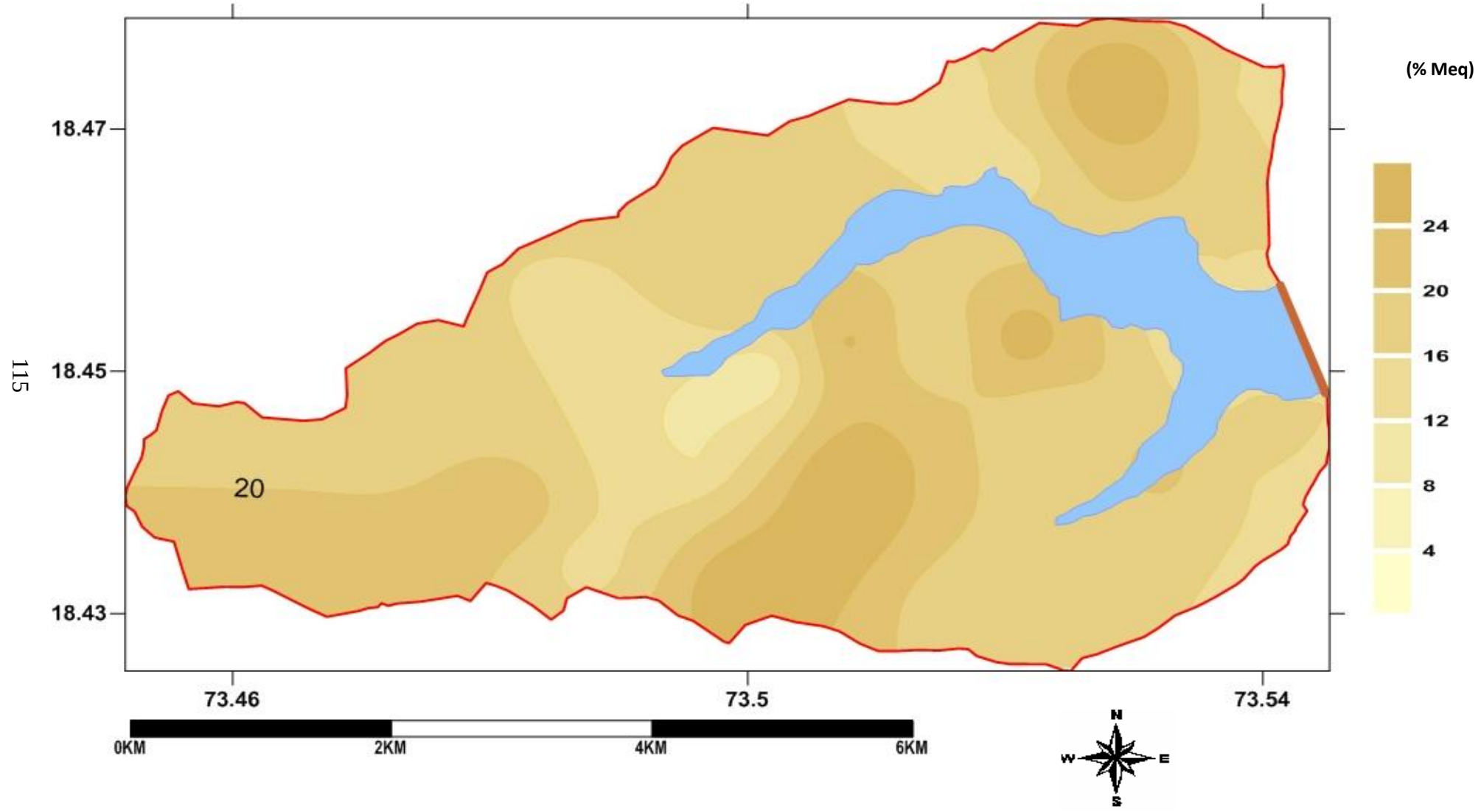


Fig. no. 3.26

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF MAGNESIUM

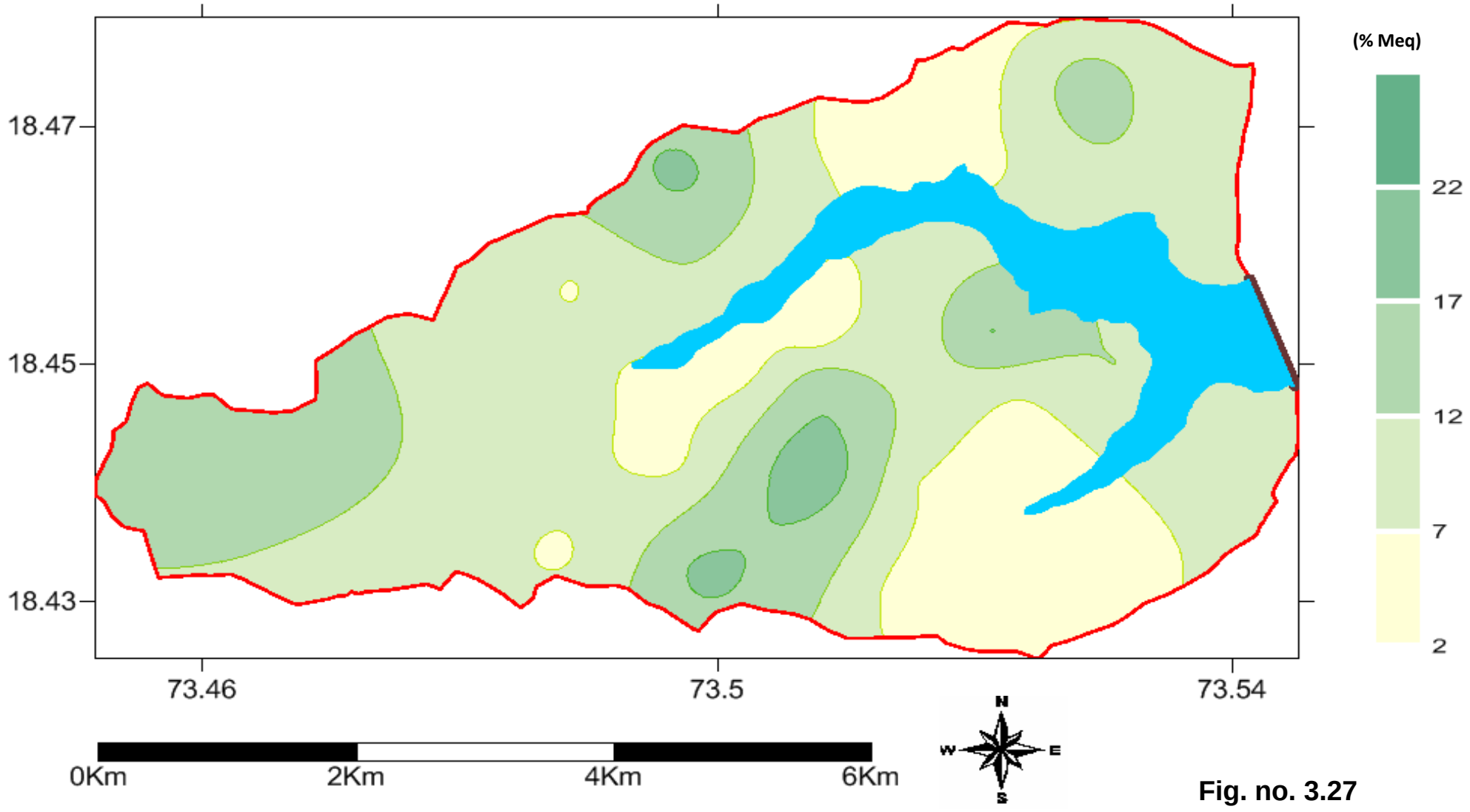


Fig. no. 3.27

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF PERCENTAGE $CaCO_3$

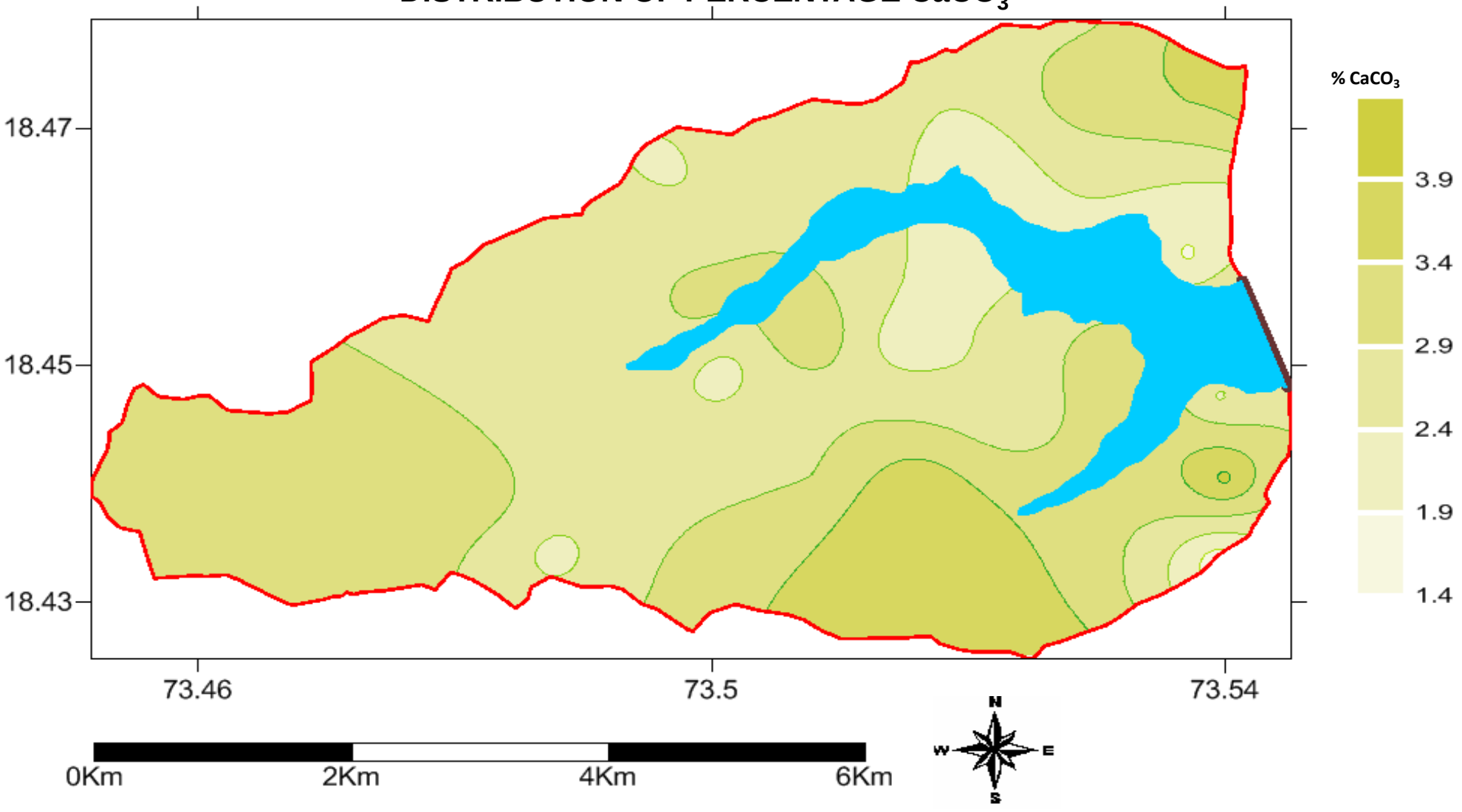


Fig. no. 3.28

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF PERCENTAGE PHOSPHORUS

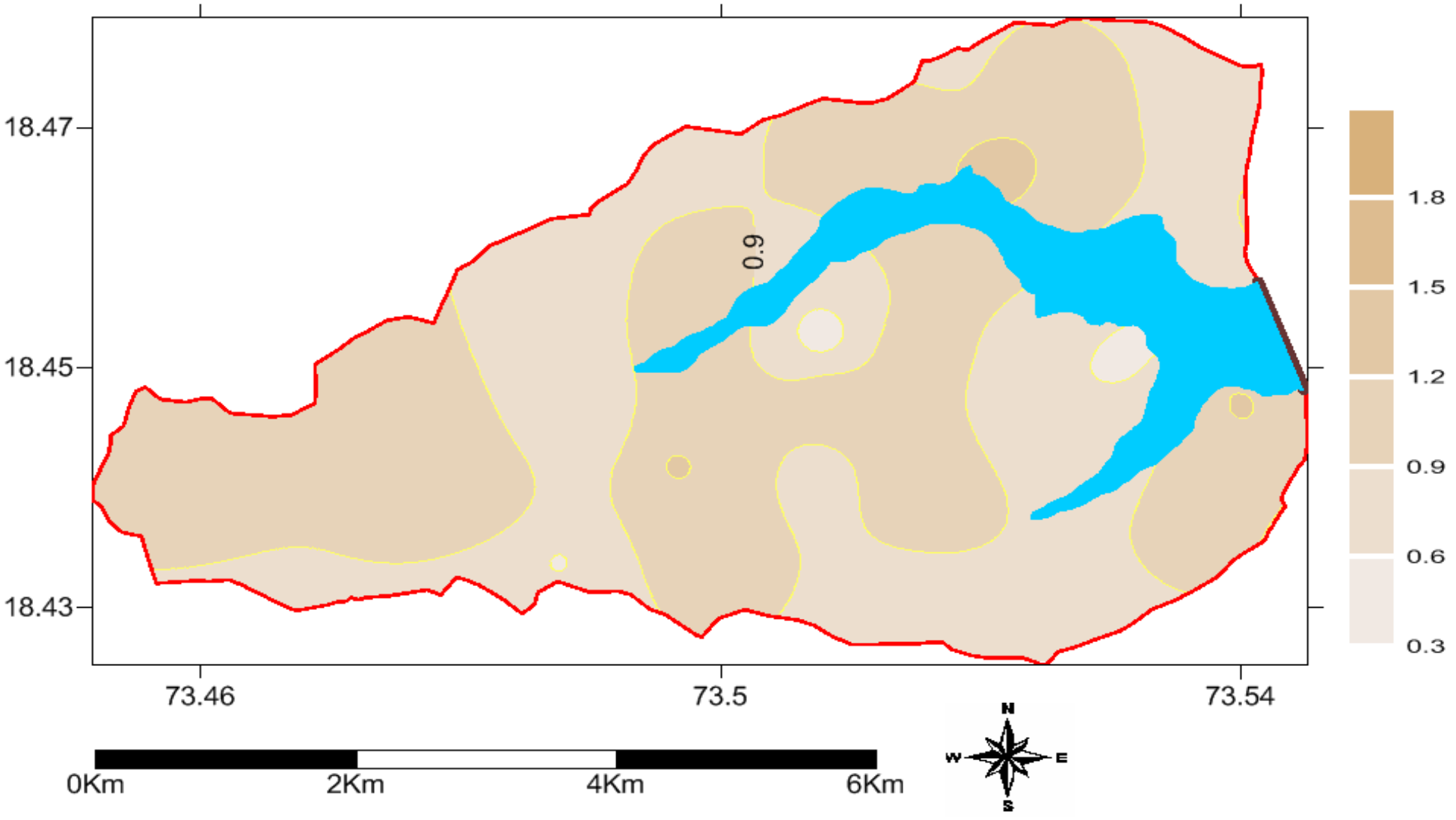


Fig. no. 3.29

TEMGHAR LAKE CATCHMENT

DISTRIBUTION OF ELECTRIC CONDUCTIVITY

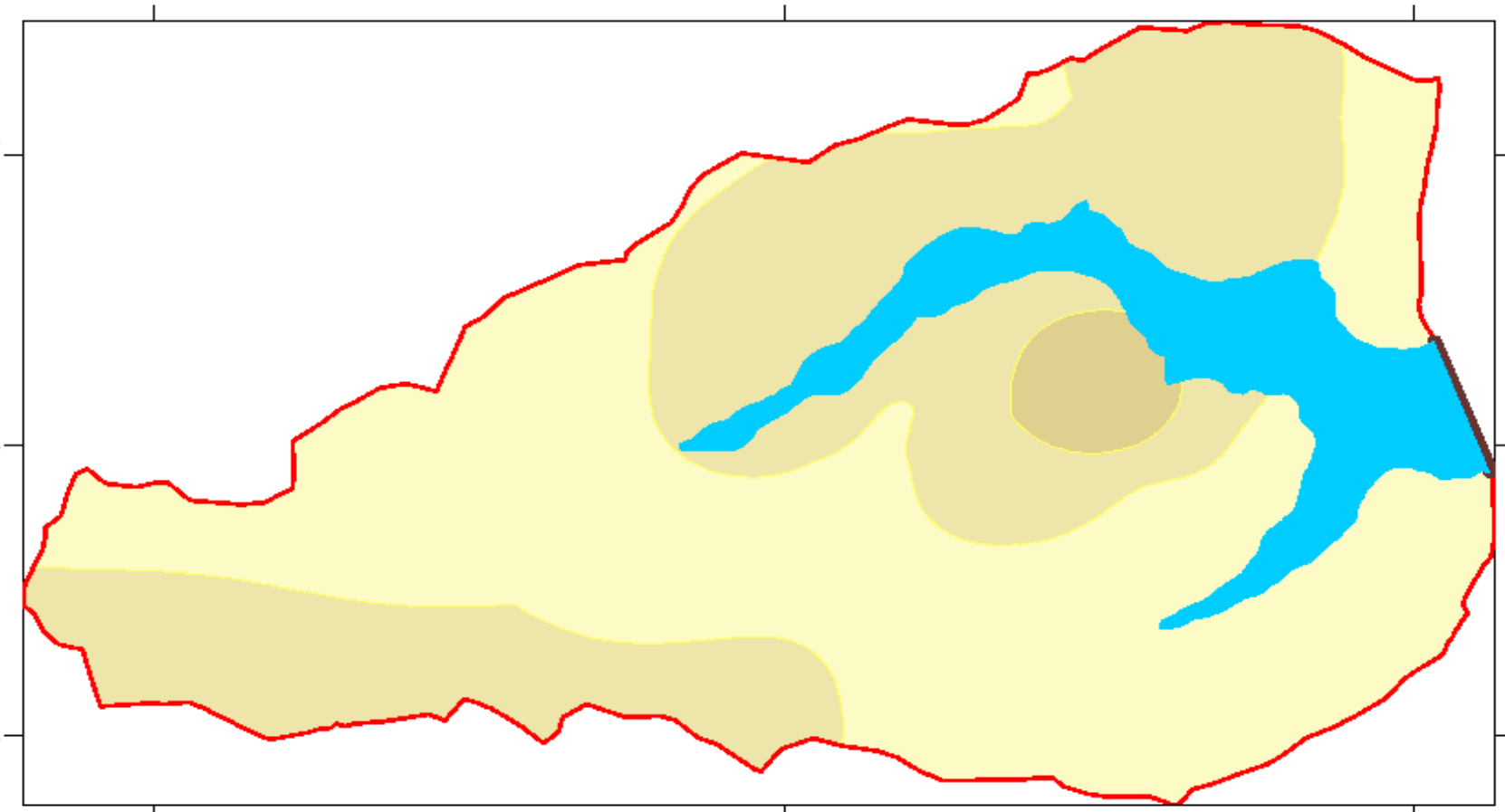


Fig. no. 3.30

TEMGHAR LAKE CATCHMENT

INFILTRATION RATE VARIATION MAP

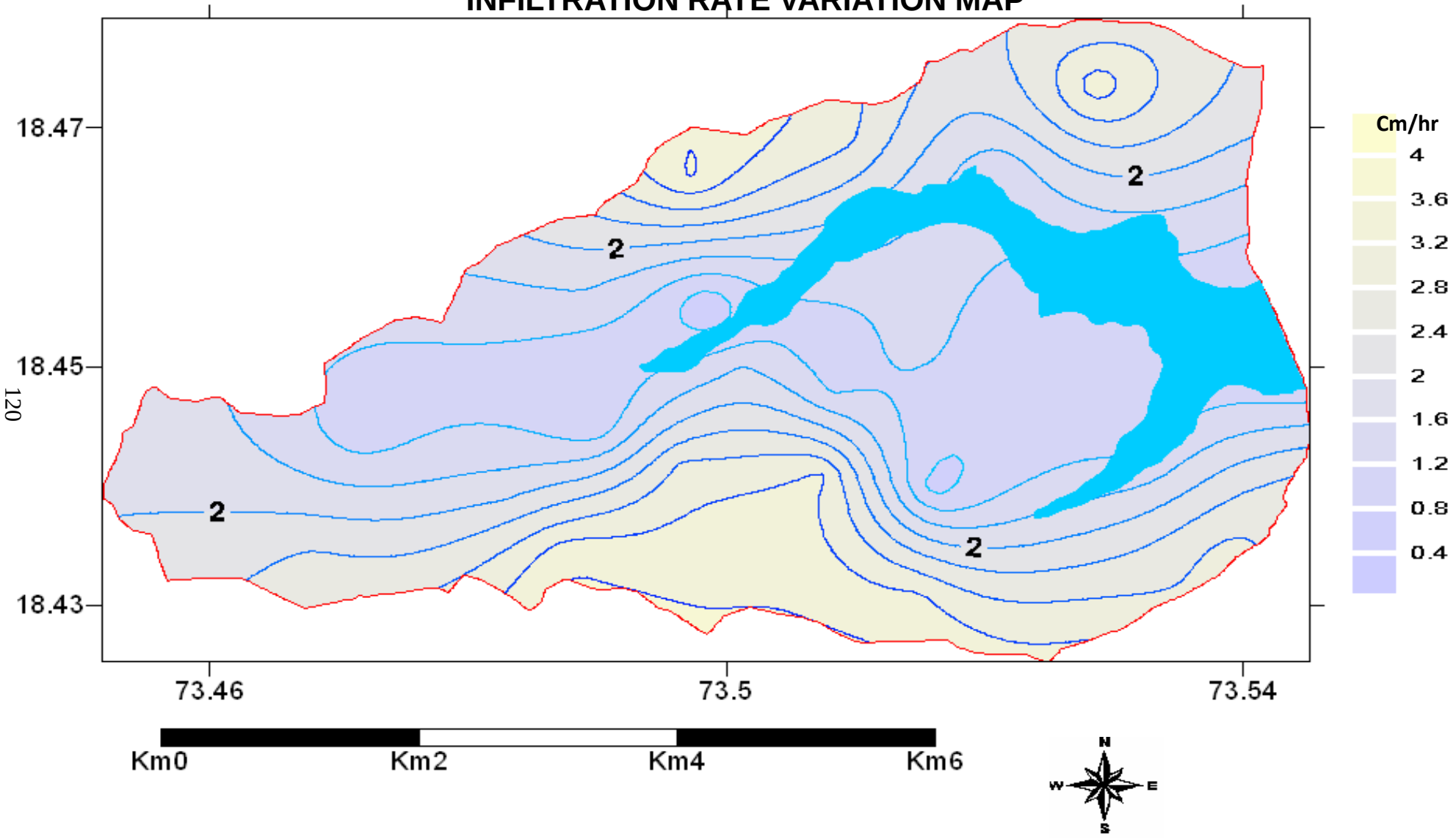


Fig. no. 3.31

CHAPTER IV

LAND DEGRADATION AND EVALUATION

4.0 Introduction

The present chapter deals with main two aspects of land resources assessment in the study area. First aspect being focused on land degradation due to soil loss which has been estimated using USLE, another aspect devoted to evaluation of land of land resources in the study area employing land capability, suitability and productivity assessment.

This exercise is thought to be very essential component of the present study which will form the basis for the soil suitability for rehabilitation of the people in the native area. As mentioned earlier, exploratory land resource field studies have been carried out, this gives a rapid general appraisal of an area. Normally this is either to determine what further studies are required or to locate suitable sites for specified development.

4.1 Land degradation

Land degradation in the study area has been assessed applying Universal Soil Loss Equation (USLE) which has been elaborated in length in the following lines.

4.1.1 Estimation of soil erosion using USLE

The universal soil loss equation (USLE) is a quantitative method of predicting soil erosion losses from rainfall, soil and other factors. The factors in the equation and its applicability to some situation in India have been used by Ram Babu et al (1970).

Since the present evaluates only the physical factor in order to arrive at the maximum potential loss, therefore the values of cropping management and erosion control practice factors have been taken as a unity.

The universal soil loss equation (USLE)

$$A = RKLSCP$$

Where,

A = Soil loss in short tons (2000lb)/acre/year (converted to $kg/m^2/yr$)

R = Rainfall erosivity factor,

K = Soil erodibility factor = Slope length factor

S = Slope gradient factor,

C = Crop management factor,

P = Conservation practice factor.

4.1.1.1 Computation of basic inputs parameters in USLE

a. Estimating R factor (Erosivity factor)

The rainfall erosivity factor 'R' in the USLE is the number of rainfall erosion index units (El_{30}) for a particular location. It is defined (Wischmeier 1959) as one hundredths of the product of the kinetic energy of the storm (KE) & the 30min intensity (I_{30}) as the most reliable single estimate of rainfall erosion potential & was termed as (El_{30})

The R factor has been computed applying three methods, Roose (1975 a) Morgan (19740 foster, Lane, Nowlin, Laflen & Young (1981)

The mean of these three methods have been given appropriate estimates of erosivity factor, (El_{30}) range from 300 to 800 mm.in the study area.

b. Estimating K factor (soil erodibility factor)

This factor relates the rate at which different soil erode due to inherent soil properties. Soil erodibility defines the resistance of soil to both detachment & transport depending upon the physical & the chemical properties of soil. The factor is defined as mean annual soil loss per unit of erosivity for a standard condition of bare soil.'K' factor i.e.erodibility factor varies in the study area to range from 0.20 to 0.29.

c. Estimating LS factor (slope length steepness factor)

The factor of slope length (L) & slope steepness (S) is combined in a single index. The high relative relief exhibits a significant variation in the LS factor in the study area ranges from 06 to 58 m. LS factor seems to be the dominant factor in accentuating soil loss in the area. The appropriate values are obtained from the equation.

$LS = L/22.13\ (0.065+0.0455+0.0065S^2)$

Where **'L'** is in m &**'S'** in percent

The high relative relief exhibits a significant variation in the LS factor in the study area ranges from 0.98 to 21.28 m.

According to Wischmeier the magnitude of the above values (0.01-0.9) is a function of soil characteristics, vegetal cover, crop residues & other factors.

d. Estimating C factor (Crop factor):

It represents the ratio of soil loss under a given crop to that from bare soil. In the present study this factor is taken as a unity & based on the % vegetation cover as estimated from FCC image for the Google image 2006.

e. Estimating P factor (conservation practice factor):

As like 'C' factor 'P' factor has also been considered as unity in the present study.

4.1.1.2 Results

4.1.1.2.1 Grid wise estimation of soil loss

In order to understand spatial patterns of variations in soil loss of the entire area. An attempt has also been made to classify the entire catchment into 9000 cells. It can be observed from the figure 4.1 that, middle portion of the Temghar lake catchment area is subjected to very high soil loss and estimated soil loss varies between 0.11 to 21.98 Kg./m^2/year. This part mainly consists of the areas of both the flanks of the reservoir. The middle part of the northern as well as southern flanks heavy soil loss is subjected to summital convexities of hill slopes and gullied ravenous topography of the area (Photo plates10, 11, 12, 13 and 14). Reduction in the soil loss is observed to the areas where dense forest cover patches are in existence. Plateau summits, plateau fringe slopes are subjected to severe soil loss and accounts to about 1.3871% of the land surface area.

The area comprised of four major geomorphic units viz; plateau summits surface, plateau fringe surface, rolling pediment & valley floor (plain) surface. The information thus generated & results obtained are discussed according to type of geomorphic units in the study area.

D-1

D-2

D-3

D-4

D-5

D-6

Plateau summit surface comprises about 5.05 area in km^2 (15.42%) of total land surface mostly cut as runoff zones along the marginal area of the study area. Mean soil loss estimated along this geomorphic unit is of varying magnitude and range between 5 to 10 $Kg/m^2/yr^{-1}$. Some pockets of the higher soil loss above 15 $Kg/m^2/yr^{-1}$ are noticed in southern part of this geomorphic units (Table 4.1)

Plateau fringe surface is a skirt zone of plateau summit surfaces marked by sharp to blunt crests with rugged appearance indicating that the surface runoff at the upper reaches of the surfaces has caused rill erosion, & characterized by gully heads & ravenous land. Higher mean soil loss is to the order of 13.89169 $Kg/m^2/yr^{-1}$, has been observed along this geomorphic units

Pediment surfaces have moderate mean soil loss ranges between below 5 to 10 $Kg/m^2/yr^{-1}$.Mean soil losses in the plain surface is below0.117587 $Kg/m^2/yr^{-1}$.

4.1.1.2.2 Prioritization of sub watersheds for conservation planning based on soil loss estimation studies

Natural resource development programmes are applied generally on watershed basis and thus prioritization is essential for proper planning and management for sustainable development**.** Watershed deterioration is a common phenomenon in most parts of the world. Amongst several causes, the major ones are improper utilization of watershed resources without any proper vision. Therefore, drainage basins, catchments and sub- catchments are the fundamental units of the management of land and water resources. The watershed management concept recognizes the inter-relationships among the linkages between uplands and low lands. Soil and water conservation is key issue in watershed management. While considering watershed conservation work, it is not feasible to take the whole area at once. Thus, the entire basin is divided into several units as a watershed and sub-basins. In the study area (Temghar lake catchment) prioritization of sub watersheds for conservation planning based on soil loss estimation studies has been planned in the following manners.

4.1.1.2.2.1 Sub basin wise estimation of soil loss

In all five priority levels for conservation planning has been determined (Fig 4.2).

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4.1.1.2.2.1.1 Priority level I: Very severe soil loss (Above 20 kg/m^2/year)

About three sub basins are noticed to be in this category. Three fourth order basins namely TEM 4.2.7, TEM 4.2.9, TEM 4.212 comes under this category. Percentage slope variation is between 20 to 35.5%. Soils are mainly of Sandy Loam and Sandy clay Loam soil in this area. Main characteristics of this area fall under wasteland category of Land use/ Land cover class. This category covers 0.45371 km^2 (1.38371% areas).

4.1.1.2.2.1.2 Priority level II: Severe soil loss (Between 15 to 20 kg/m^2/year)

This category between 15 to 20 kg/m^2/year covers about 3.30481 km ^{2} (10.103% area)of the total land surface area and covers first order basin, viz TEM - 1.33, TEM -2.5 TEM -2.6 TEM -2.7 TEM -2.17, total four are sub basins of second order basins whereas TEM -4.2.10 and TEM -4.2.13 are fourth order sub basins. Very steep valley side slopes with numerous formations of gullies and typical ravenous topography of these basins mainly noticed to fall under wasteland category of land use type.

4.1.1.2.2.1.3 Priority level III: High soil loss (Between 10 to 15 kg/m^2/year)

Around sixteen sub basins comprise this category and covering 05.83911km^2 (17.851% area) of the total land surface area. Hill slopes with devoid of vegetation, sandy loam dominant soil type with very less infiltration capacities contributes maximum soil loss along with high erodibility index. Slopes in this category range from 15% 30%. In this category in all sixteen sub basins have been noticed out of , i.e. seven are the first order sub basins, TEM - 1.14, TEM - 1.19, TEM - 1.24, TEM - 1.41 TEM - 1.42 TEM - 1.43 TEM - 1.44. Seven second order basins TEM - 2.2, TEM - 2.3, TEM - 2.8, TEM - 2.14, TEM - 2.16, TEM - 2.18, TEM - 2.19, Two are fourth order basins, TEM - 4.2.11, 4.2.14 covers this entire category.

4.1.1.2.2.1.4 Priority level IV: Medium soil loss (Between 05 to 10 kg/m^2/year)

Soil loss in this category range to vary between 05 to 10 kg/m^2/year comprises 31 sub basins out of which seventeen are first order basin, viz TEM- 1.12, TEM -

1.13, TEM - 1.20, TEM - 1.21, TEM - 1.22, TEM - 1.23, TEM - 1.25, TEM - 1.29, TEM - 1.32 TEM - 1.34 TEM - 1.35, TEM - 1.36, TEM - 1.39, TEM - 1.40, TEM - 1.45, TEM - 1.47, TEM - 1.50. Four second order basin, TEM - 2.1, TEM - 2.13, TEM - 2.15, TEM - 2.20.Three third order basin i.e. TEM -3.1, TEM -3.2, TEM - 3.3.and seven fourth order basins TEM -4.1, TEM -4.2.1 TEM -4.2.2, TEM -4.2.4, TEM -4.2.5, TEM -4.2.6,TEM -4.2.8.This category covers maximum area about 16.01381 km ^{2} (48.957% area) of the total land surface area. In this category it is noticed to be high seems to be due to the bare hill slopes of mainly scrubland, elongated depressions along hill slopes.

4.1.1.2.2.1.5 Priority level V: Low soil loss (Below 05 kg/m^2/year)

This category covers maximum area about 07.09856 km ^{2} (21.701% area) of the total land surface area and comprises 32 sub basins out of which 25 are first order basins viz,TEM-1 TEM-1.2,. TEM-1.3, TEM-1.4, TEM-1.5, TEM-1.6, TEM-1.7, TEM-1.8, TEM-1.9, TEM-1.10, TEM-1.11, TEM-1.15, TEM-1.16, TEM-1.17, TEM-1.18, TEM-1.26, TEM-1.28, TEM-1.30, TEM-1.31, TEM-1.37 TEM-1.38, TEM-1.46, TEM-1.48, TEM-1.49, 05 second order basins TEM-2.4 TEM-2.9, TEM-2.10,. TEM-2.11, TEM-2.12, and two are fourth order basins TEM-4.2.3, TEM-4.2.15.. The spread up of these basins mainly noticed along the pediment zone with sandy clay loam soil environment. This favours high infiltration and well marked with medium to dense vegetation cover. Slope is ranging between 5% to 10%.

In view of the site suitability for rehabilitation of the project affected people in the native area itself, a detailed study of land and soil resources is much essential therefore, land evaluation of the study area has been performed and land capability, suitability and productivity assessment has been worked out. The details of each component are outlined in the following lines.

4.2 Land capability classification

The concept of land capability was developed during the 1930s in the USA, but the wide spread adoption of land capability schemes only began after 1960s. The assessment of land capability involves an evaluation of the degree of limitation, imposed by permanent or semi permanent attributes of land to one or more land uses.

The land capability classification of Temghar lake catchment has been performed by adopting USDA classification system and the method developed by soil survey department of Maharashtra state. The system of soil survey department more or less is similar to that of USDA system of classification. USDA system is widely used in Indian environment.

The broadest categories of the system which have been worked out for the present study area indicating degree of their limitation on a broadest level. Various soil properties and village level soil survey data from soil survey department has been incorporated in the preparation of land capability map. In the present analysis, topographic aspect (slope rock outcrops), erosional aspect (signs of erosion), hydrological characteristic (soil drainage), physical soil condition (stoniness, depth, texture, soil stoniness, available water capacity, chemical properties of soil ($CaCO_3$, pH and organic carbon and organic matter).etc have been considered for each of the soil sample location along with soil profile characteristics.

4.2.1 Land capability classification of Temghar lake catchment

Land capability classification performed for the Temghar lake catchment following the USDA method, demonstrated very good results. As mentioned earlier the study area is characterized by hilly terrain with considerable higher slopes, have pronounced effect on the land capability classification of the study area. The village wise information of soil environment of the study area has been obtained from soil survey department and field observations in the study area led to prepare a rating table (table no 4.4) for the capability classification. According to this, when entire area has been classified, it is observed that, class I (very intensive cultivation) and II (intensive cultivation) are totally absent in the study area, and rest of the classes present are III, IV, V, VI have been described and displayed in table no 4.2 and Fig.4.3 and 4.4, and elaborated in the following lines.

Class III Moderate cultivation: This class measures about 20.13 % (7.59 km^2 (75.90 ha.) of the total land surface area and mainly confined to the pediment surfaces with insignificant gullied topography. The extent of this class is noticed to the southern part on a wider scale and covers maximum undulating, rolling pediments of Temghar and Vede villages. In the northern part it is noticeably delineated along pediments and follows the general shape of villages, and some north eastern part of the village Vegre.

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Class IV Limited cultivation: Almost entire catchment in the back water area of reservoir is delineated by this class. The area under this class admeasures about 62.60% (23.60 km ^{2} or 236.00 ha.) of the total land surface area. Degrees of limitations have been increased in this class. Exclusive part which occupied by these classes are III, V and VI along with water body of four villages mainly comprising Temghar, Vegre, Vede and Lavarde.

Class V Intensive grazing: Followed by the class IV, upper part of the water body mainly marginal portion of the catchment has occupied by this class. The area under this class is 1.33% (0.50 km ^{2} or 50 ha.) of the total land surface area. The extent of this class is noticed to the southern part of village Temghar, southern part of the village Lavarde and western part of the village Vegre.

Class VI Moderate grazing and forestry: This class mainly covers the portions of waste lands, forest lands and degraded forests in both sides of Temghar lake catchment confined mainly to plateau summit and fringe areas. The area under this class is about 2.71 %(1.02 km ^{2} or 10ha) of the total land surface area.

Land capability classification performed for Temghar lake catchment indicates that, terrain in the lake catchment is not suitable for intensive farming. Moreover moderate cultivation can be adopted only for 20% of the total land surface area. Very high extent accounted for class IV seems to be the potential land surface area for horticulture and is a significant part of land surface area. Area under class III and class IV covers around 82% of total land surface area which is a amenable portion of the terrain for various kind of uses.

4.3 Land suitability classification

4.3.1 Introduction

In the present study an attempt has also been made to identify land suitability classes on existing resource conditions. Broad level classification of land suitability is attempted using FAO framework. Land suitability classification promotes more specific about the fitness of the land for a given use, this being implied by the word ‘suitability’ rather than ’capability’. Thus, for instance, it is possible to map land suitability for specific use of land.

4.3.2 The FAO framework

The framework for land evaluation (FAO 1976 a) is a standard set of principles and concepts on which national or regional land evaluation systems can be constructed. It emphasizes in particular the importance of explicitly stating the intended land use and the level of management envisaged, and that land evaluation may be either on current suitability or, as for irrigation / drainage schemes, on potential suitability. It should be emphasized that, the system is only a framework, and for most projects it will need quantifying with detailed specifications as discussed in FAO (1979 a) and Smyth *et. al.* (1979).

The frameworks structure is compatible with other systems but allows with great flexibility. There are two orders, termed suitable (S) and not suitable (N), conditionally suitable land (Sc) is a 'phase' of the order suitable, and approximates to classes 4 and 5 of USBR, but its extent must be small with respect to the total study area; Definitions of FAO land classes are given in table 4.3The framework employs several terms to define or describe land features in particular 'land quality' and 'land characteristics'.

4.3.3 Land suitability classification of Temghar lake catchment

The soil survey being at exploratory and reconnaissance level owing to prefeasibility level. Land suitability of the study area has been attempted following FAO framework. (Table 4.3 and Fig.4.5 and 4.6)

S1 Highly suitable This class is absent in the Temghar lake catchment.

S2 Moderately suitable Low lying pediment surfaces and plain surfaces of the study area is a potential zone of moderately suitable land for cash crops as well as food grains, for both Rabbi and Kharif seasons. The area is exclusively suitable for paddy cultivation provided; dependable water supply is made available and even for rain fed conditions also. This category covers about 0.36% (0.95km^2) of the total land surface area.

The main villages comprising this area are Lavharde and Vede

S3 Marginally suitable This category covers the area to about 7.19% (2.71km^2) of the total area and mainly covers the extensive pediments up to the base of plateau fringe surface zone. The relative relief varies between 40 to 60 m with % dissection

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D-14

index which varies between to 4 to 6 %. This category may be amenable by erecting anti erosion structures in the area. The potential use of land may be attributed to growing of medicinal plants and horticulture. Horticulture practicing in this part no doubt be initiated by innovative technology of irrigation through sprinkler and drip irrigation. Lift irrigation schemes should be undertaken as there is a plenty of water supply in the form of water body of Temghar reservoir in this area.

Afforestation through horticulture and growing of native plant species may be certainly helpful in multipurpose conservation of the land resources in the study area. Moreover basin treatment should be given in the form of gully plugging and Gabion structures which will help to enrich the ground water resources in the study area.

N1 Currently not suitable This category covers about 18.75% (7.07km^2 area) of the total land surface area and rank second in terms of its extent in the area. The plateau fringe surface area is a characteristic of this category and appeared to be highly dissected with high range of relative relief from 80 m to 120 m. The soils are good enough to support native tree plantations in the study area.

Recently the trend of construction of farm houses and an afforestation of the lands by their owners at a elevation has been introduced in the area. This is a welcome trend of land utilization in these remote areas, may provide employment opportunities to the local people as well as restoration of scare species is possible, however this has led to unprecedented runoff and soil loss in the study area. The bare nature of hill slopes in this area may be covered by introduced plantation with limited inputs. Water supply may be made available through lift irrigation scheme from Temghar reservoir in the area.

N2 Permanently not suitable This category covers about 59.87% (22.57km^2) of the total land surface area and is characterized by summital convex parts of the plateau surfaces with thin soil cover and mainly having sandy to sandy clayey soils. The moisture conditions are optimum in this class area but are a good recharge zone to enrich the ground water storage.

Land suitability thus provides potentiality of the land resource development in the study area. This is ascertain through linked potential utilization from N 2 – recharging of ground water – N 2 – check to soil erosion by introduced plantation and based on dependable water supply, S 3 – horticulture and extensive afforestation – S 2 – grazing of cash crops and food grains – S 1 –which will certainly achieve the socio-economic upliftment – wildlife conservation – restoration of species through forest

conservation and enrichment of socio-economic status of the village poor accordingly. This exercise will certainly focus on sustainable development and potential land resource management in the study area.

4.4 Land productivity assessment of Temghar lake catchment

4.4.1 Storie index method of soil rating

This method of soil rating known as the Storie index is based on the soil characteristics that govern the lands potential utilization and productive capacity. It depends on other physical and economical factors that might determine the desirability of growing certain plants in a given location.

The percentage values are assigned to the characteristics of the soil itself, including the soil profile (Factor A), the texture of the surface soil (Factor B), the slope (Factor C) and the condition of the soil exclusive of profile, surface texture and slope, for example drainage , alkali content, nutrient level, erosion and micro relief (factor X). The most favorable or ideal conditions with respect to each factor are rated at 100%. The percentage values or ratings for the four factors are then multiplied, the result being the Storie index method of rating of soil. (Table 4.4)

The characteristics of soil profile (factor A) -are essentially the features of the surface layers. Soils that are deep and readily pervious to roots and water are rated at 100%. Profiles with dense clay sub soil are rated lower. Primary or residual soils are rated in accordance with the depth of bedrock.

Next, the soils are rated on the basis of the texture of the surface soils. Medium textured soils such as the loams and silt loams are rated highest.

Rating of the slope of the land is considered as factor C. nearly level or gently sloping land is rated at 100%. As the slope increases, the rating for this factor decreases. As shown in the soil rating chart, single letters are used to indicate simple slopes and double letter to indicate compound slopes. The percent slope expresses the number of feet rise or fall for 100 feet horizontal distance.

Conditions exclusive of profile, soil texture, and slope are considered in factor X on the soil rating chart these conditions consist of drainage, alkali, or salt content, general nutrient level, acidity, erosion and micro relief . if two or more condition

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exists that are listed under factor X, the rating for each are treated independently, that is, they are multiplied in order to secure the factor X rating.

4.4.2 Soil grading

For simplification six soil grades have been set up in by combining soils having ranges in index rating as follows;

Grade1 (excellent): soils that rate between80and100%and which are suitable for a wide range of crops. This grade is absent in the study area.

Grade 2 (good): soils that rate between 60-79% and which are suitable for most crops. Yields are generally good to excellent. This grade is absent in the study area.

Grade 3 (fair): soils that rate between 40-59% and which are generally of fair quality. With less wide range of suitability than grade 1 and 2. Soils in this grade may give good results with certain specialized crops. About 10.48%total land surface area of Temghar lake catchment fall under this grade i.e. 3.95 km^2

Grade 4 (poor): soils that rate between 20-39% and which have a narrow range in their agricultural possibilities. For example, a few soils in this grade may be good for rice, but not good for many other uses. 63.26% of total land surface area of the study area comes under this grade i.e. 23.85 km^2

Grade 5 (very poor): soils that are rated between 10-19% are of very limited use except for pasture, because of adverse condition such as shallowness, roughness and alkali content. About 11.72% of Temghar lake catchment fall under this grade i.e. 4.42 km^2

Grade 6 (nonagricultural): soils that rate less than 10 % include. For example, tidelands, river wash, soils of high alkali content and steep broken land. 1.30% of total land surface area of Temghar catchment comes under this grade i.e. 0.49 km^2

4.4.3 Soil productivity assessment of Temghar lake catchment

Soil productivity assessment exercised for Temghar lake catchment has produced very good results. Several parameters in each and every factors of Storie Index have been computed in GIS environment which almost covers soil as well as terrain parameters. Entire area divided into more than 7000 grid cells each covering

about 77. 2 m^2. The output map displayed in fig no 4.7 and 4.8 and productivity classes displayed in table no 4.4.

It can be observed from above fig no 4.7 and 4.8 and table no 4.4 that productivity classes of grade 1 and 2 are almost absent in the study area and productivity from fair to non agricultural land does exist in the study area. Grade 3 and 4 of fair and poor productivity almost comprises 73.74% of the entire catchment area and 84.99% of the total land surface area. Very poor of the grade of 5 accounts to 13.51% of the total land surface area. Thus the spread of the grade 3, 4, 5 almost comprises 98.50% of the total land surface area. It can be therefore said that, soil productivity in the study area is not at all good however some of the land facets are amenable and can be regenerated for optimum potential desired land use.

Land capability classes, suitability classes almost match with the productivity classes, indicating that, there is a high influence of physical determinants' in terms of relative relief, absolute relief, dissection index and percentage of slope on the soil environment.

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TEMGHAR LAKE CATCHMENT

SOIL LOSS ESTIMATION USING USLE

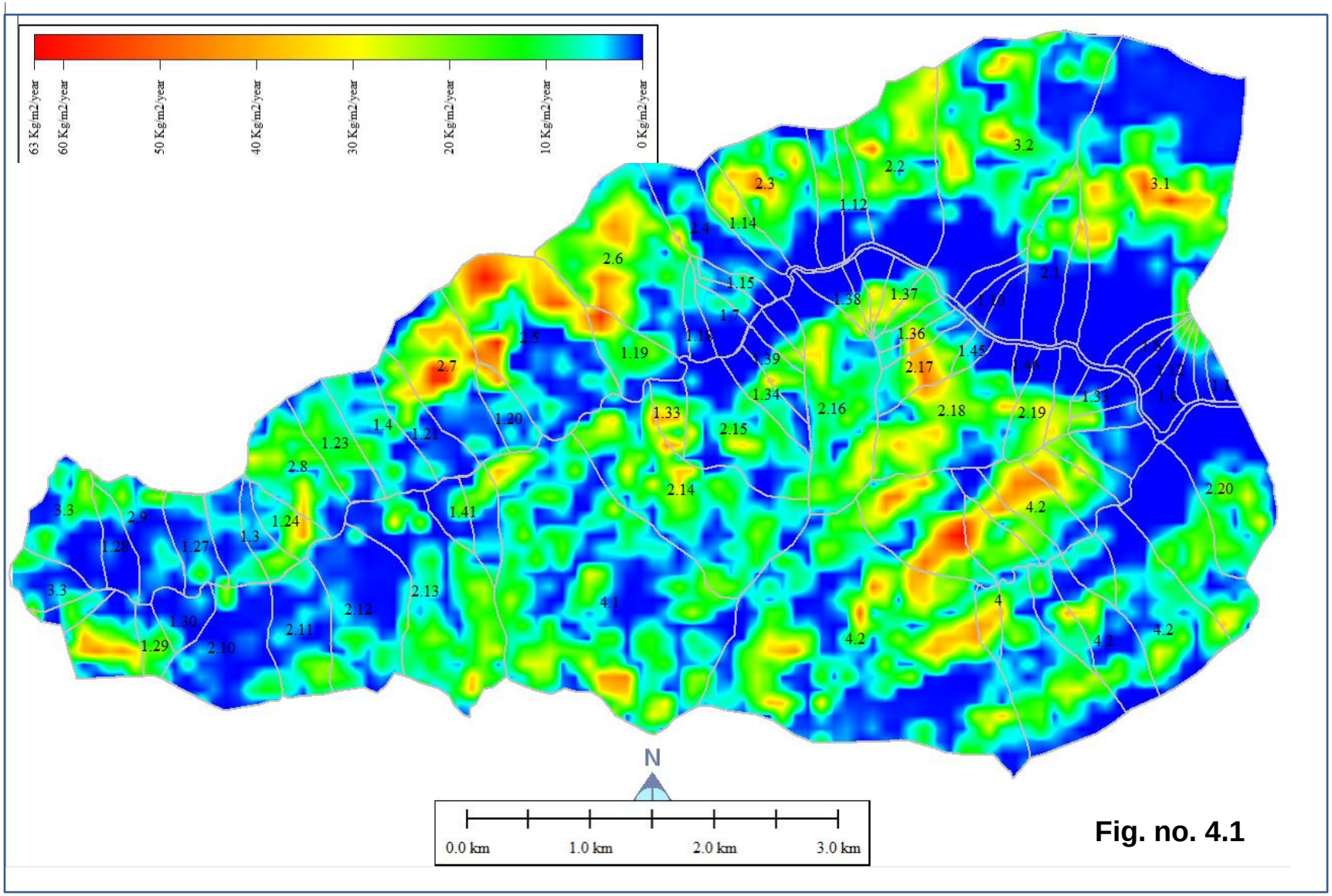


Fig. no. 4.1

TEMGHAR LAKE CATCHMENT

PRIORITIZATION OF SUB BASINS FOR CONSERVATION PLANNING

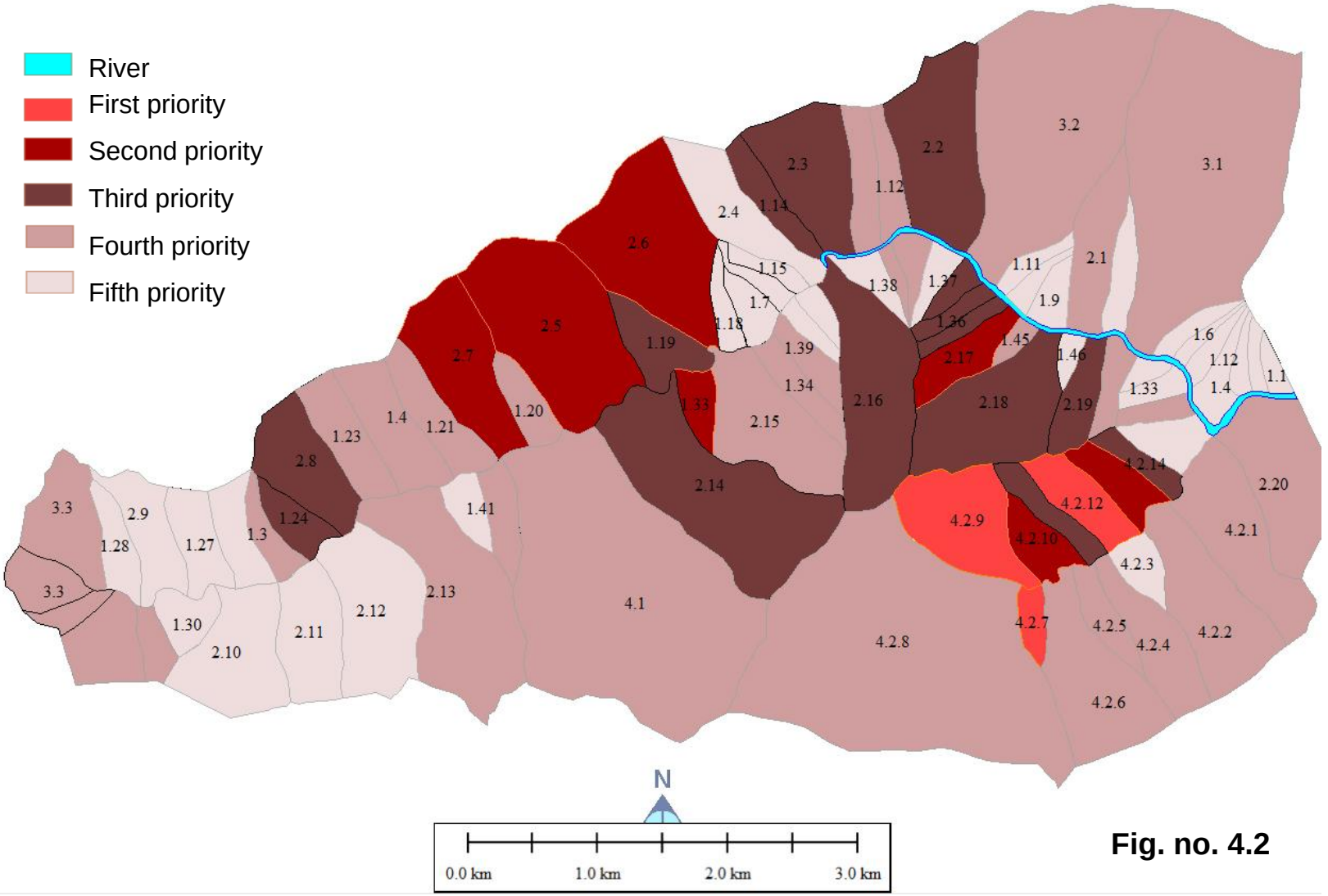


Fig. no. 4.2

TEMGHAR LAKE CATCHMENT
LAND CAPABILITY CLASSIFICATION MAP

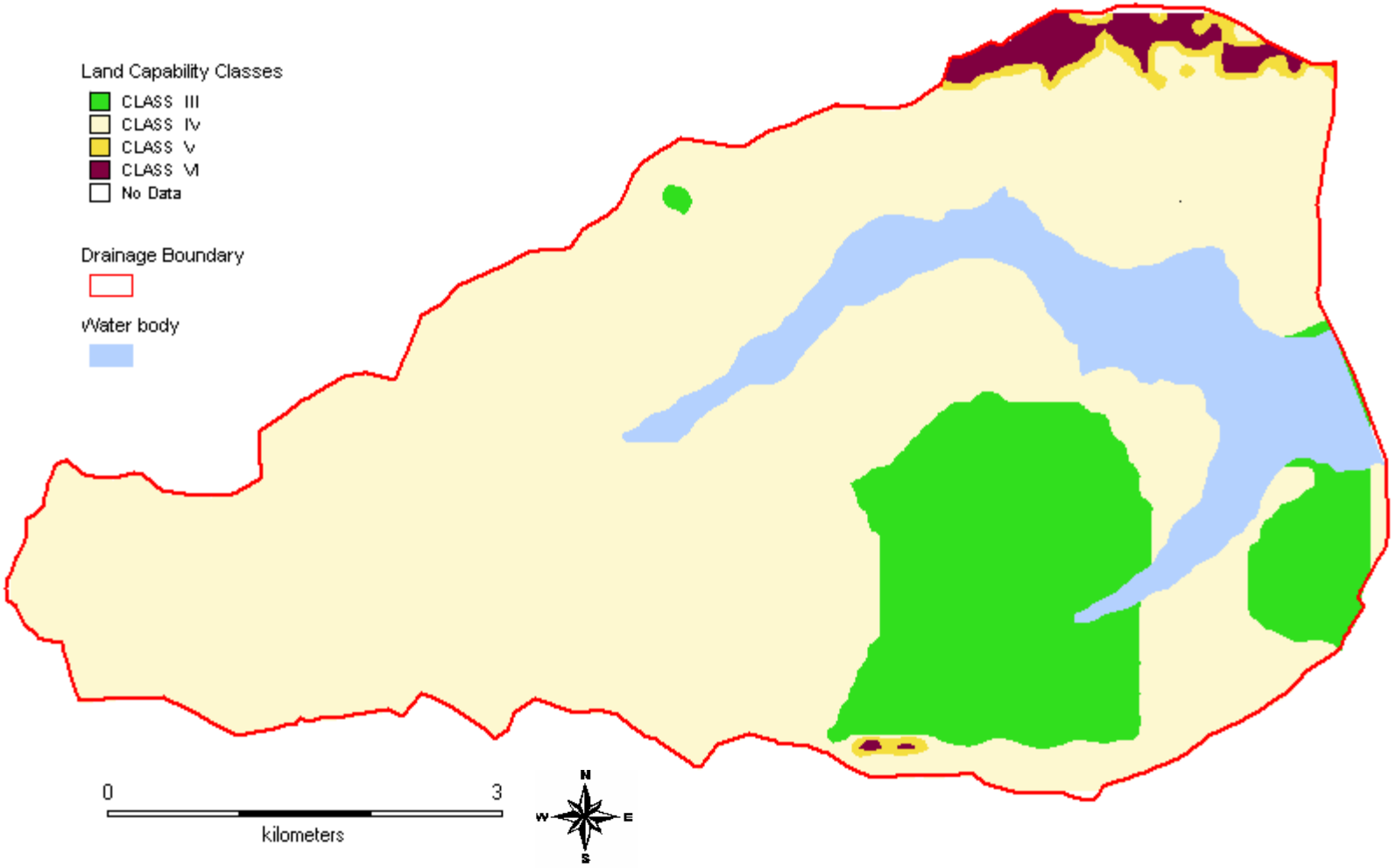


Fig. no. 4.3

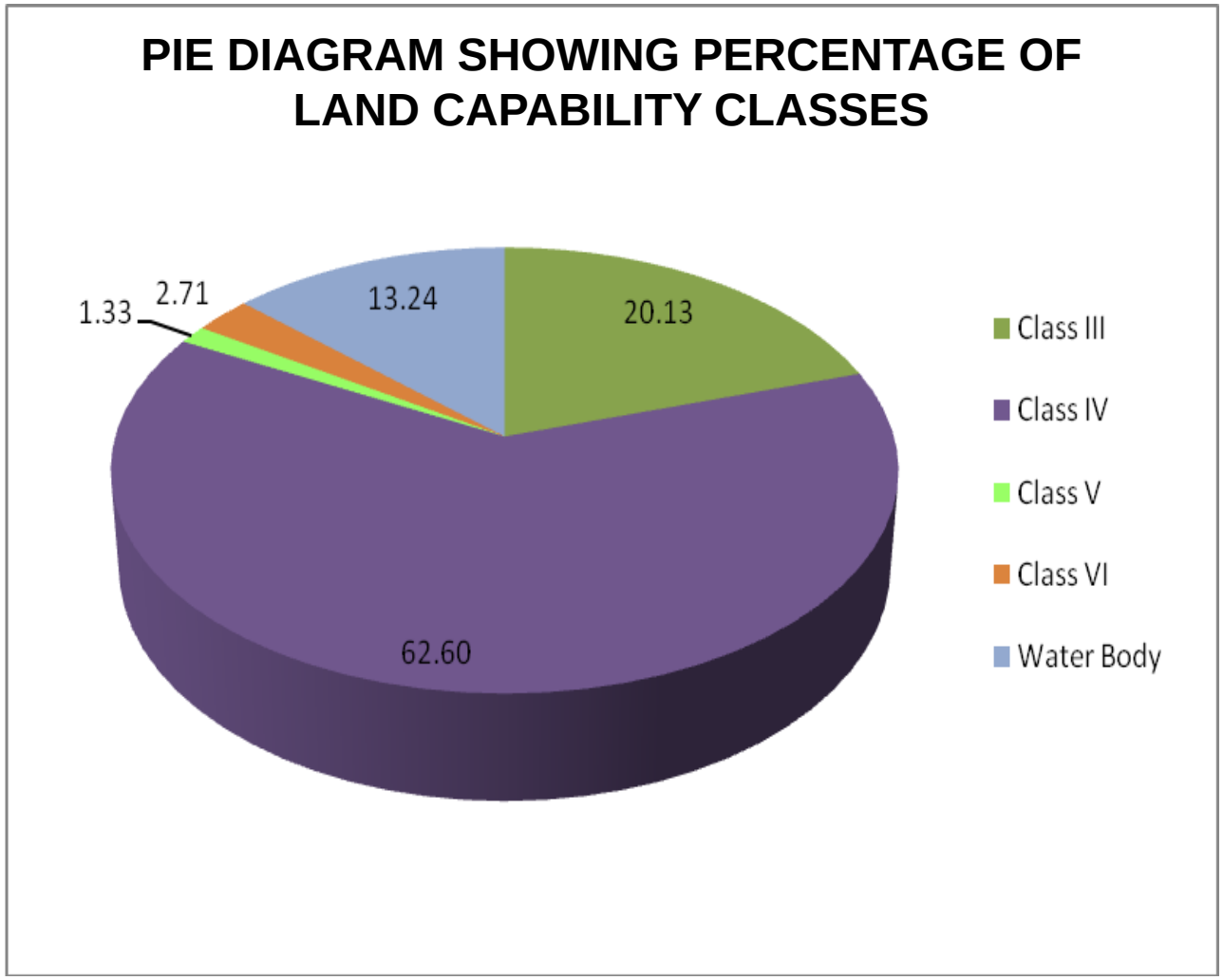

PIE DIAGRAM SHOWING PERCENTAGE OF LAND CAPABILITY CLASSES
1.33
2.71
13.24
20.13
62.60
Class III
Class IV
Class V
Class VI
Water Body

Fig. no. 4.4

TEMGHAR LAKE CATCHMENT

LAND SUITABILITY MAP

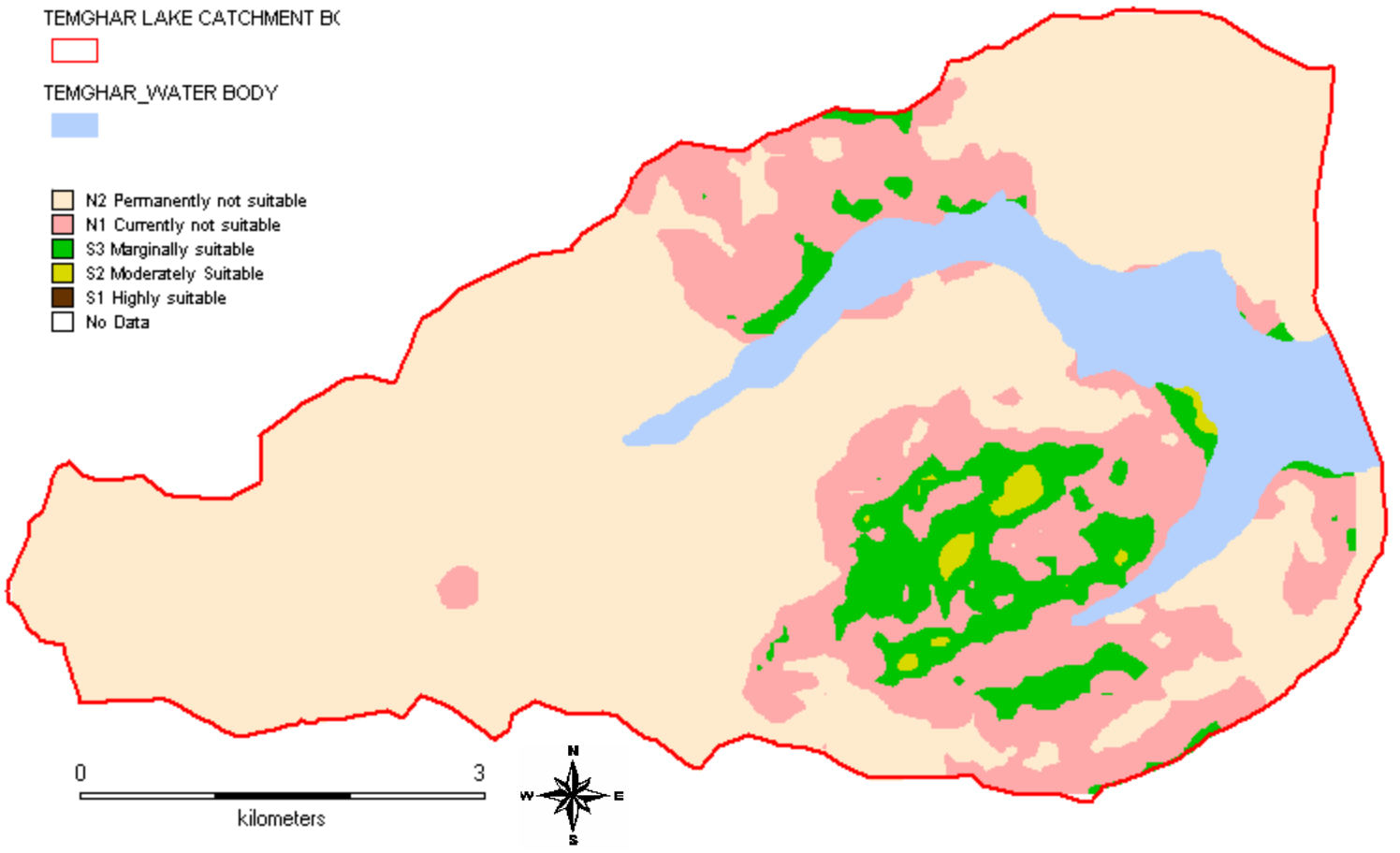


Fig. no. 4.5

GRAPH SHOWING PERCENTAGE OF AREA UNDER LAND SUITABILITY CLASSES

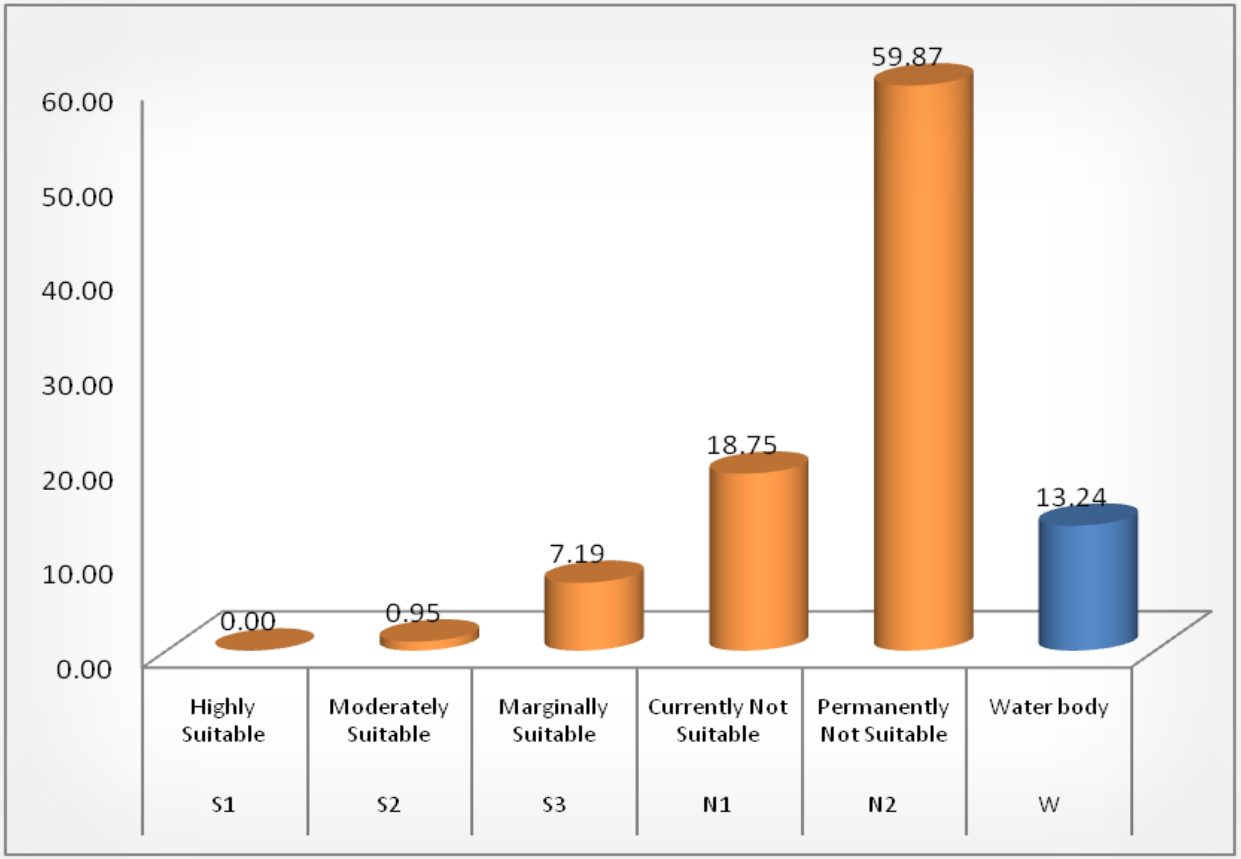
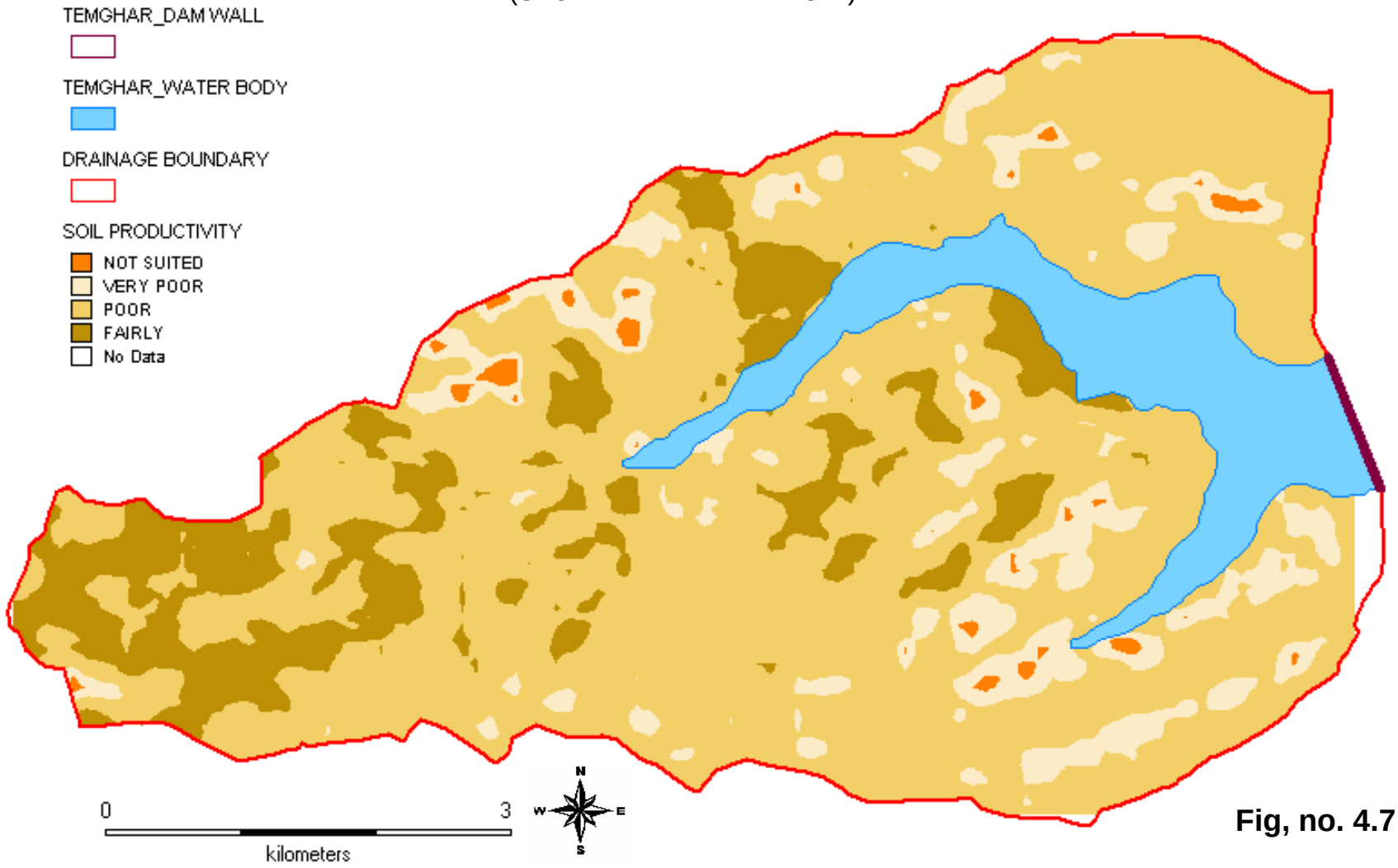


Fig. no. 4.6

TEMGHAR LAKE CATCHMENT

SOIL PRODUCTIVITY MAP

(STORIE INDEX METHOD)



Fig, no. 4.7

PIE DIAGRAM SHOWING PERCENTAGE OF LAND PRODUCTIVITY CLASSES

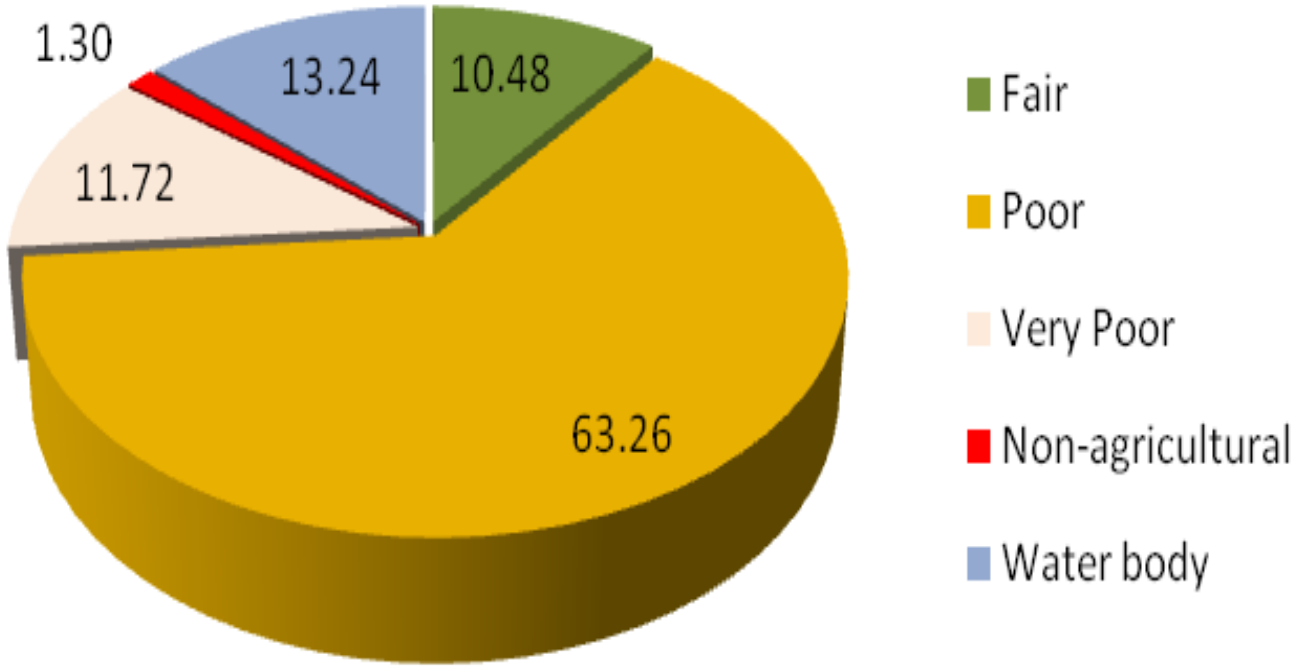


Fig. no. 4.8

Table 4.4: Extent of area under Soil productivity classes and its rating

(Storie Index)

Sr. No.	Grade	Productivity Class	Area (Km^2)	Area in %
1	Grade 1	Excellent	0	0.00
2	Grade 2	Good	0	0.00
3	Grade 3	Fair	3.95	10.48
4	Grade 4	Poor	23.85	63.26
5	Grade 5	Very Poor	4.42	11.72
6	Grade 6	Non-agricultural	0.49	1.30
7		Water body	4.99	13.24
Total			**37.7**	**100**

Table No. 4.3: Extent of the area under land suitability classes

Sr. No.	Code	Land suitability classes	Area (Km^2)	Area (%)
1	S1	Highly Suitable	0	0.00
2	S2	Moderately Suitable	0.36	0.95
3	S3	Marginally Suitable	2.71	7.19
4	N1	Currently Not Suitable	7.07	18.75
5	N2	Permanently Not Suitable	22.57	59.87
6	W	Water body	4.99	13.24
Total			**37.70**	**100**

Table No. 4.2: Extent of the area under land capability classes

Sr. No.	Land capability classes	Area (Km^2)	Area in %
1	Class I	0	0.00
2	Class II	0	0.00
3	Class III	7.59	20.13
4	Class IV	23.6	62.60
5	Class V	0.5	1.33
6	Class VI	1.02	2.71
7	Water Body	4.99	13.24
Total		**37.7**	**100**

Table 4.1: Extent of the area under soil loss - Universal Soil Loss Equation (Total land surface area)

Soil loss in $Kg/m^2/Y^{-1}$	Below 5	5 to 10	10 to15	15 to 20	Above 20	Total
Area in Km^2	07.09856	16.01381	05.83911	3.30481	00.45371	**32.71**
Area in %	21.701	48.957	17.851	10.103	1.3871	**100**



10. GRAVEL BED STREAMS INDICATE HIGH RUNOFF AND THEREBY SOILL LOSS



11. PERMANANT FALLOW LANDS –COVERED WITH GRASSES



12. HUMAN INDUCED EROSION –CUTTING OF HILL SLOPES FOR ROAD CONSTRUCTION



13. SCRUB LAND PRONE TO EROSION



14. STEEP SLOPES SUSCEPTIBLE TO HEAVY SOIL LOSS AND RUNOFF

CHAPTER V

LAND USE / LAND COVER AND SITE SUITABILITY ANALYSIS

5.0 Introduction

Land use refers to the human activities on land, which are directly related to the land. It encompasses a vide varieties in both the rural and urban environments such as agriculture, industries, commerce, transportation, constructions and recreation. (Clawson and Stewort 1965 and 1987)

Land cover refers to the vegetation (natural and planted), water, bare rock, sand and similar surface and also manmade construction occur on the earth surface. Another manner according to the Burley (1961) land cover implies the vegetation and artificial constructions covering the land surface. These include natural features such as vegetation, water and cultural features such as agricultural crops, buildings and roads.

Land use/ land cover inventories are assuming increasing importance in various resources sectors agricultural planning, settlements, environmental studies and operational planning based on agro climatic zones. Information on land use/ land covers permits to better understanding of the land utilization aspects on cropping patterns, fallow lands, forest grazing lands, wastelands and surface water bodies, which is vital for developmental planning.

The land use planning may be concerned with putting environmental resources to new kind of productive use. The need for land use planning is frequently brought about, however, by changing needs and pressures; involving competing use for the same land. The functions of land cover planning is to guide decisions on the land use in such a way that the resources of the environmental output to the most beneficial use for man, whilst at the same time consuming those resources for the future.(ILRI-international institute for land reclamation and improvement 1997).

5.1 Land use/ land cover analysis of the Temghar lake catchment

Pune city has experienced rapid growth due to its accessibility to Mumbai and remaining cities mainly in western Maharashtra like Nashik, Satara, Kolhapur etc.The conditions are favorable for comprehensive developments like education, information

technology, and industrialization. Over the last two decades considerable industrialization has took place around Pune city leading to rapid urbanization of the area. Hence, the growth of population and density of population has been rapidly increased. The growing population has created increasing demands for basic infrastructural amenities like water, electricity and sanitation etc. At the cost of this development, natural resources are at the verge of exploitation, therefore exploited. New ways of management of the natural resources has to be taken up urgently. Temghar lake catchment is one of the important dams to provide water supply to Pune city.

The main purpose to undertake land use and land cover analysis using remote sensing data is to ascertain site suitability for settlement and agriculture for rehabilitation of project affected persons as well as to suggest potential land use for different purposes keeping in view the norms of sustainable management and development of natural resources

5.1.1 Methodology

Methodology adopted in the present analysis can be summarized in the following steps. SPOT image procured from Google Pro. Programme, which is available on the internet. Around 36 pieces of the image having a resolution of 10m each downloaded successfully and rectified accordingly. Thus, the mosaicing of 36 pieces has been achieved in GIS environment maintaining the resolution. Since the image is true colour in nature; it has become very easy to undertake it for visual interpretation. Digitization of each and every category in the polygons gave area estimation very accurately. In all seven categories could have been identified and area statistics has been generated (Fig 5.1 and Table 5.1).

5.2 Land use/land cover analysis based on SPOT Image (Google pro) 2006

The land use /land cover study of the area has been attempted in order to identify and map the various types of land use/ land cover classes in the study area, interpreting of Google **SPOT** image 2006 ((Table 5.1,and 5.2 and Fig 5.1,5.2, 5.3a ,b,5.4 a and b,5.5) visually.

D-1

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D-3

D-4

D-5

D-6

D-7

Agricultural land

It is defined as the land primarily used for farming and for production of food, fiber, and other commercial and horticultural crops. It includes land under crops (irrigated and unirrigated). Fallow, plantations etc.

Crop land

It includes those lands with standing crop as on the date of the satellite imagery. The crops may be of either Kharif or Rabi or Kharif Rabi seasons.

Fallow land

It is described as agricultural land, which is taken up for cultivation but is temporarily allowed to rest, un-cropped for one or more seasons, but not less than one year.

Plantations

It is described as an area under agricultural tree crops, planted adopting certain agricultural management techniques. It includes tea, coffee, rubber, coconut, areca nut, citrus, orchards and other horticultural nurseries.

An attempt has been made in the present study to delineate the area under agriculture. It is observed that, agriculture is being practiced in patchy form and is mainly paddy fields this seems to be due to hilly terrain and very few plain lands in the marginal areas of the water body is available. Thus the agriculture is mainly practiced in kharif season. Fallow land is also present in the form of bunds of agricultural fields. As mention earlier a new trend of development of land for commercial purpose in the form of real estates and farm houses has been emerged in this area and therefore inclination of the people is towards selling of the land and thus practicing of agriculture is almost stopped. Introduced Plantation is being practiced by these owners but proportion is very less. So agricultural lands thus accounts to only 0.69 % of entire catchment and 0.79 % of total land surface area.

Built up land

It is defined as an area of human habitation developed due to non-agricultural use and that which has a cover of buildings, transport, and communication, utilities in association with water, vegetation and vacant lands.

In the study area, it is observed that, very scattered settlements are spread over hill slopes on either sides of catchment and therefore their percentage is negligible and accounts to only 0.6 % of the total catchment area, and 0.55% of total land surface area.

Area under roads measures about 0.42 % of the total catchment area and 0.49% of total land surface area and only runs for Lavasa city from southern marginal area of catchment.

Water body

It is an area of impounded water, areal in extent and often with a regulated flow of water. It includes man-made reservoirs/lakes/ tanks/canals, besides natural lakes, rivers/ streams and creeks.

River/Streams

It is a natural course of flowing water on the land along definite channels. It includes from a small stream to a big river and its branches. It may be perennial or non-perennial. In the study area major river Mutha flowing from west to east direction Temghar dam on which has been constructed. The upper reach of river mainly characterized by first and second order channels and very less area in percentage has been occupied by rivers.

Reservoir/Lakes/Tanks/Canal

It is a natural or man-made enclosed water body with a regulated flow of water. Reservoirs are larger than tanks/lakes and are used for generating electricity, irrigation and for flood control. Tanks are smaller in aerial extent with limited use than the former. Canals are inland waterways used for irrigation and sometimes for navigation.

Temghar lake catchment is a man-made enclosed water body the dam wall of the same has been constructed on river Mutha. It is around three TMC capacity dam and acquires about 13.24 % (4.99 Km²) of the total catchment area.

Vegetation cover

Forest

It is an area (within the notified forest boundary) bearing an association predominantly of trees and other vegetation types capable of producing timber and other forest produce. Total area under forest has been estimated to be 9.38 Km², (28.68 %) for the entire catchment.

Evergreen/Semi-evergreen forest

It is described as a forest, which comprises of thick and dense canopy of tall trees, which predominantly remain green throughout the year. It includes both coniferous and tropical broad-leafed evergreen trees. Semi-evergreen forest is a mixture of both deciduous and evergreen trees but the latter predominate.

Deciduous forest

It is described as a forest which predominantly comprises of deciduous species and where the trees shed their leaves once in a year. It is noticed, in the study area to cover about 24.88 % (9.38 Km²) of total catchment area and spreads over almost on all the slope segments. Forest resources in study area are being depleted at an alarming rate due to clearance of forest for commercial purposes. In the study area mainly species of evergreen, semi evergreen and deciduous forest are observed.

Degraded forest or scrub

It is described as a forest where the vegetative (crown) density is less than 20% of the canopy cover. It is the result of both biotic and abiotic influences. Scrub is a stunted tree or bush/ shrub. In the study area forest cover is being transformed to degraded forest or scrub area due to the activities mentioned earlier.

Forest blank

It is described as openings amidst forests without any tree cover. It includes openings of assorted size and shapes as seen on the imagery. In spite of degraded forest, evergreen semi evergreen and deciduous forest, forest blanks are also observed near paddy fields and in reserved forest area.

Forest plantations

It is described as an area of trees of species of forestry importance and raised on notified forest lands. It includes eucalyptus, casuarinas, bamboo etc. Forest plantations are observed to be introduced plantations in the form of bamboo and jackfruit trees near the settlements and agricultural fields. Basic aim seems to be the protection of agricultural fields as well as settlements.

Waste land

It is described as degraded land which can be brought under vegetative cover with reasonable effort, and which is currently underutilized land is deteriorating due to lack of appropriate water and soil management or on account of natural causes. Wastelands can result from inherent/imposed constraints such as, by location, environment, chemical and physical properties of the soil or financial or management constraints. (NWDB, 1987).

In the study area, three main categories of waste lands are prominently observed and are in the form of gullied/ravenous land, barren rocky/stony waste / sheet rock area and land with or without scrub.

Gullied/ravenous land and land with or without scrub

The gullies are formed as a result of localized surface runoff affecting the friable unconsolidated material In the formation of perceptible channels resulting in undulating terrain The word 'ravine' is usually associated not with an isolated gully but a network of deep gullies

They occupy (relatively) higher topography like uplands or high grounds with or without scrub. These lands are generally prone to degradation or erosion. These exclude hilly and mountainous terrain.

Hill slopes in the study area are mainly characterized by gullied and ravenous topography and shows high proportions of runoff in rainy season. On the other hand land with and without scrub area has also been noticed to its maximum and accounts to 54.38 % (20.50 Km²) of the total catchment area.

Barren rocky/Stony waste / Sheet rock area

It is defined as the rock exposures of varying lithology often barren and devoid of soil cover and vegetation. They occur amidst hill forests as openings or scattered as isolated exposures or loose fragments of boulders or as sheet rocks on plateau and plains.

Barren rocky surfaces are also observed along very steeper slopes and measured to be 6.31% (2.38 Km²) of the total catchment area (Photo plates 15, 16, 17, 18 and Fig 5.5).

5.3 Altitude wise variation in land use / land cover

Agricultural land

Slope ranges from 3% to more than 30% in this class. Agricultural lands in the form of paddy fields are noticed to in the elevation range of 720 m. to 800 m. Above MSL as well as 920 m. to 940 m and 960 m. to 1000 m. This covers only 0.69% (0.26 Km²) of the total catchment area. (Table No.5.3a, b and fig 5.6)

Alluvium deposits

Slope is below 3% in this class. This is an occasionally available land surface area and is the sedimentary deposits carried by the streams. A thick soil layer have been deposited in the extreme western end of the Temghar dam and are below the height of 720m above MSL and covers 0.01 Km² (0.03%).

Built up land

Slope ranges from 3 to more than 35% in this unit. Built up land in the form of roads and settlement is present in the study area and only covers 0.18 Km², which is less than 0.5% of the total catchment area. Approach road constructed for Lavasa city

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passes through the catchment and noticed to be cover elevation range between 740 to 1040 m. above MSL.

Settlements in the study area are noticed to be below 760 m. above MSL. Villages mainly Temghar and Wegre are covering their gaothans and measured to be only 0.06 % (0.02 Km²) of the total catchment area.

Water body

Slope ranges from below 1% to 15% in this unit. FRL has been fixed at 710.12 m.above MSL and covers 4.99 Km² area of the total catchment area. This covers around 13.24% of the total catchment area. .

Waste land (Barren land)

Slope ranges from 3% to more than 35% in this unit. Barren land covers around 6.31 % of the total catchment area and also spreads throughout the catchment. Surprisingly very high percentage of barren land found to be below 800 m contours above MSL.

The variation of barren land in this altitude zone is varying between 8% to more than 12% of the total barren land in the study area.

Land with / without scrub

Slope ranges from 3% to more than 35% in this unit. Land with / without scrub occupies almost 20.50 Km² area which accounts to more than 50 % of the entire catchment i.e. 54.38%. This is in fact a potential land surface area for optimum utilization provided management practices are done. It also spreads throughout the catchment and almost in all altitude zones. However, maximum percentage of the total land with / without scrubs area has been noticed to be in the altitude zone of 880 to 960 m above MSL and varying between more than 6% to more than 10% of the entire category.

Vegetation cover

Slope ranges from 3% to more than 30% in this unit. Vegetation spread throughout the catchment and covers 9.376 Km² area which accounts to 24.88 % of

the total catchment area. Percentage of the total vegetation cover noticed to be high and more than 7.47% to 8.511% area coincides with the 880 to 940 m. above MSL.of altitude range. Above 11% of the total vegetation cover noticed to be in the altitude zone of 700m to 720m above MSL.

5.4 Site suitability for rehabilitation

In an exercise of altitude wise estimation of different LU/LC categories, it is observed that, altitude range from 780m to 1000m found to be suitable for rehabilitation purpose. The above mentioned category of altitude has been decided on the following criteria's.

i) It should be at least 80m in relative height from water body.
ii) It should contain high proportion of wasteland category.
iii) It should contain both sloping land (Hill fringe) as well as pediment zone which could be used for horticulture, medicinal plantation and for afforestation programme which will arrest the erosion.
iv) Soil loss should be in severe to very severe category.
v) Land capability should range from category IV to VII.
vi) Productivity of land should be poor.
vii) Relative relief should be less and range between 0 m and 30m.
viii) There should not be forest cover within this rehabilitation zone. (Fig.5.7)

Estimation of area to the total land surface area reveals that, around 64.35% to the total land surface area can be made available for rehabilitation with ample choice of the area.

The above mentioned criteria has been decided keeping in view to utilize wasteland and degraded land to its maximum potential and can thus be appropriately utilized. The altitudinal zone with height range owing to wasteland categories with high proportion i.e. between 780m to 860m ASL can thus be utilized for agricultural practices and above 860m to 1000m for settlement of the population. It is to be also taken into consideration that, actual requirement of land for affected villages in 17.37 % of the total land surface area and thus can be made available for various purposes. Practices of integrated land resource management thus become inevitable and indispensible, which are discussed in length in the following chapter.

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TEMGHAR LAKE CATCHMENT

GOOGLE IMAGE 2006

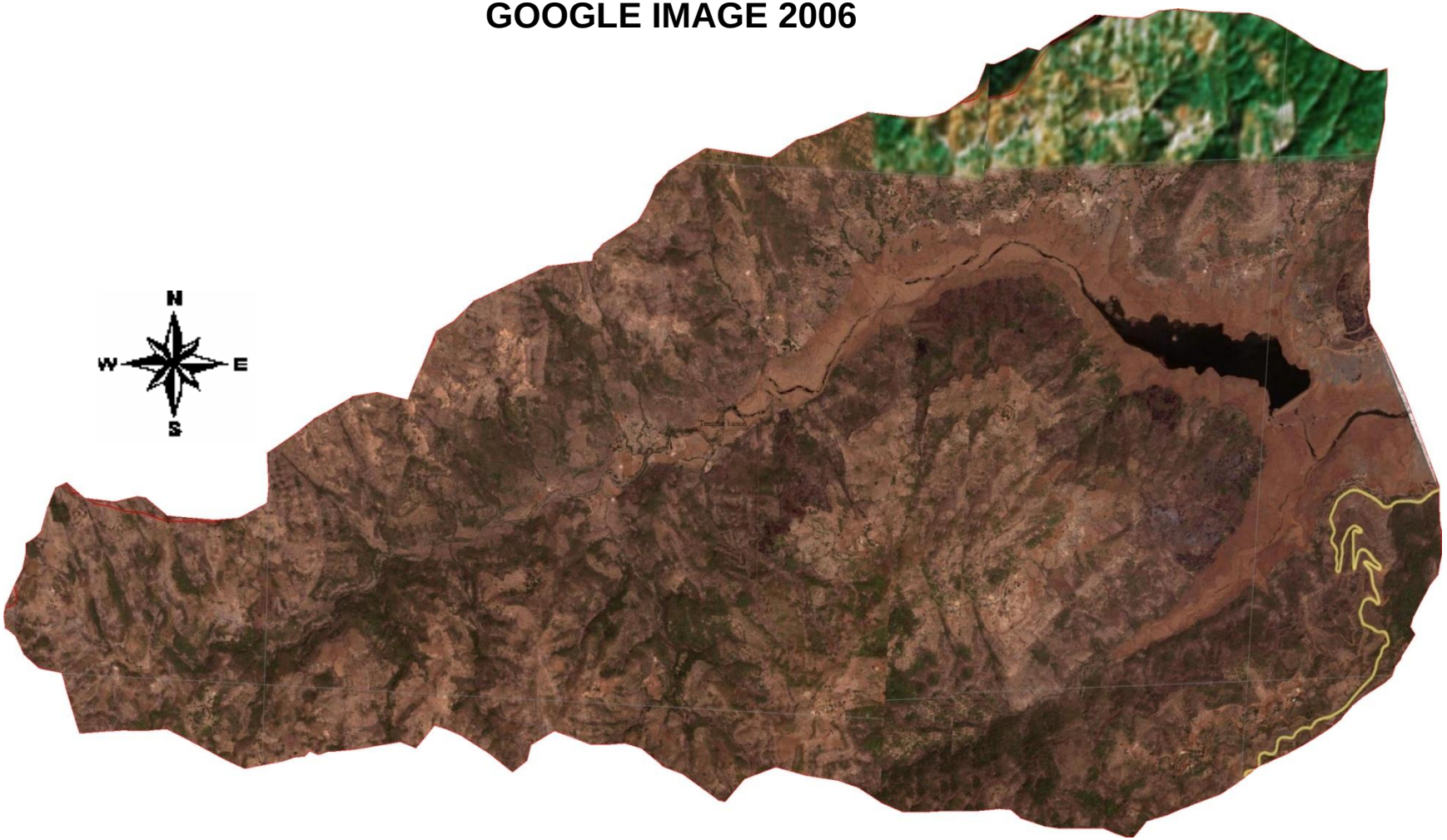


Fig. no. 5.1

TEMGHAR LAKE CATCHMENT

LAND USE / LAND COVER MAP BASED ON GOOGLE IMAGE 2006

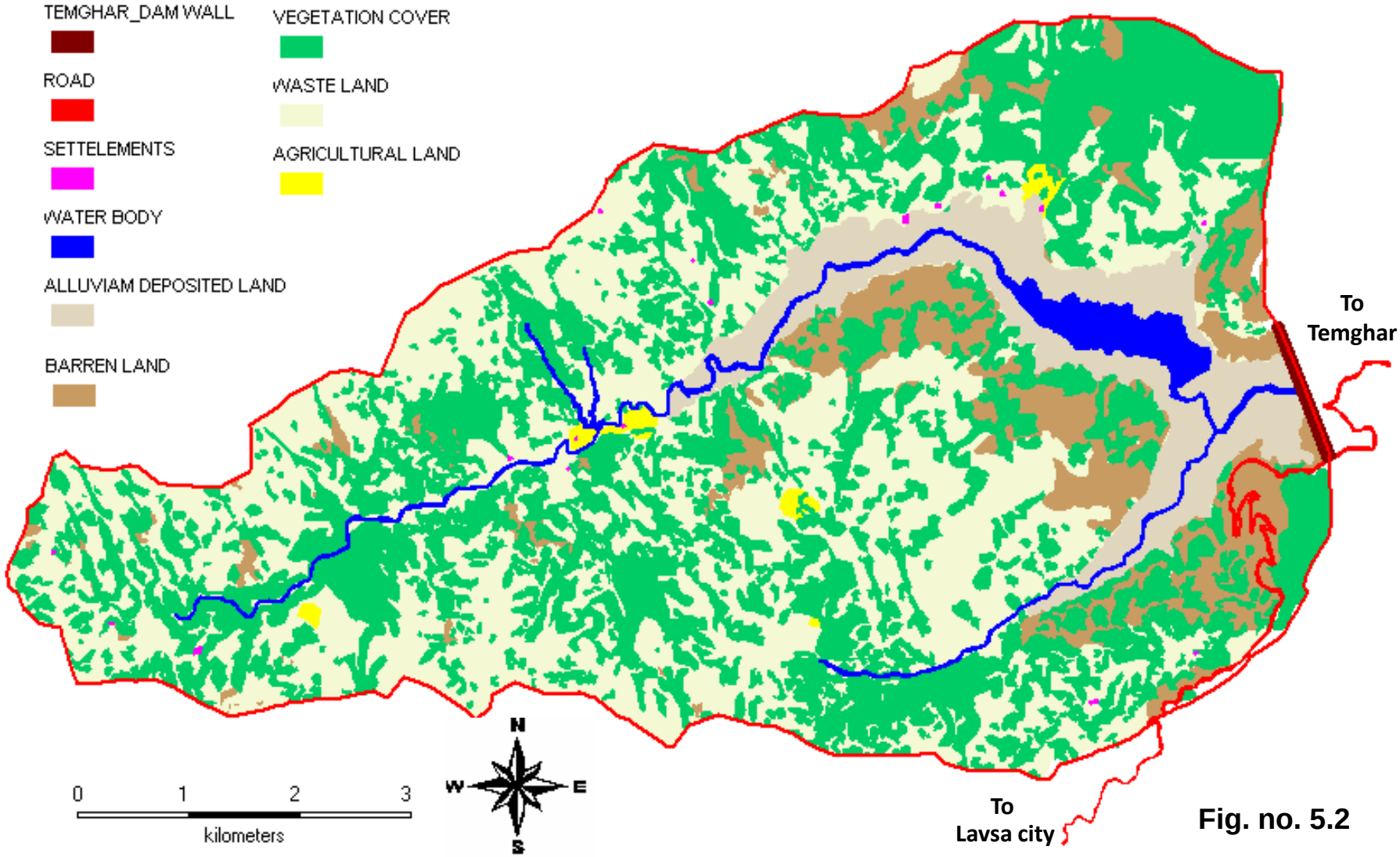


Fig. no. 5.2

GRAPHICAL PRESENTATIONS OF
LAND USE / LAND COVER FOR ENTIRE CATCHMENT

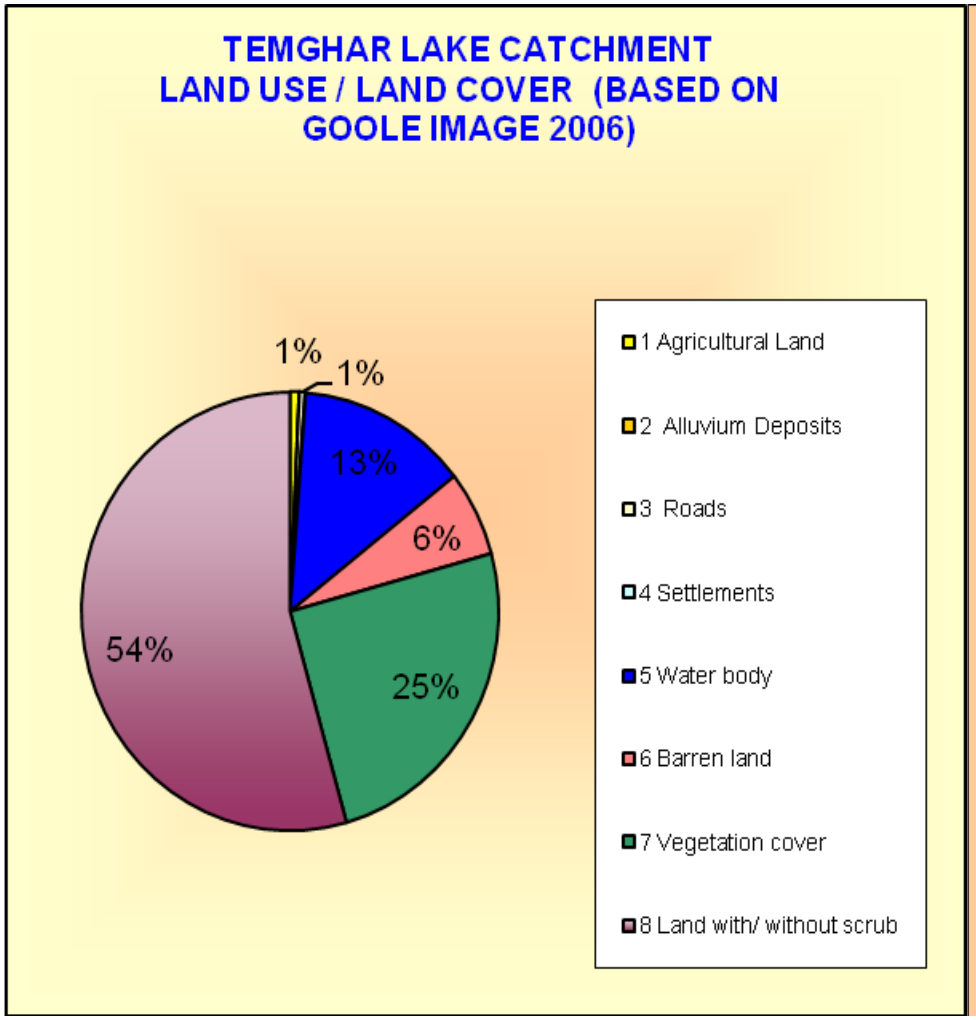


Fig 5.3 a

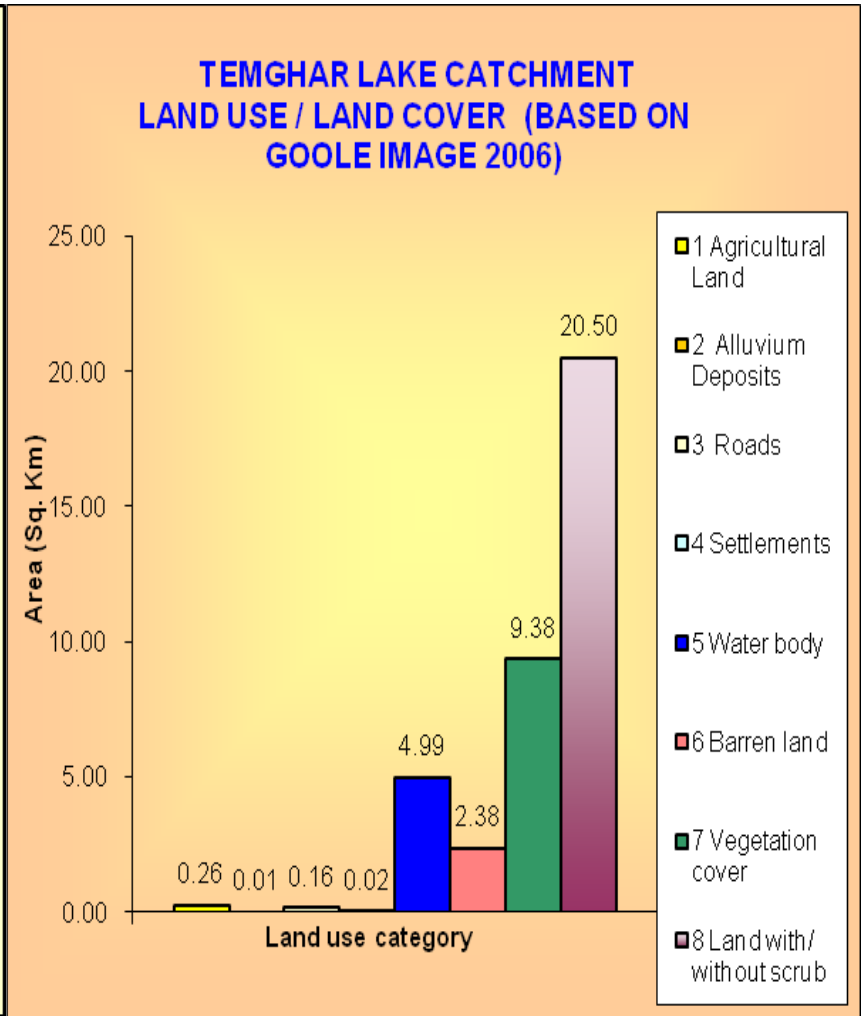


Fig 5.3 b

GRAPHICAL PRESENTATIONS OF LAND USE / LAND COVER OF TOTAL LAND SURFACE AREA

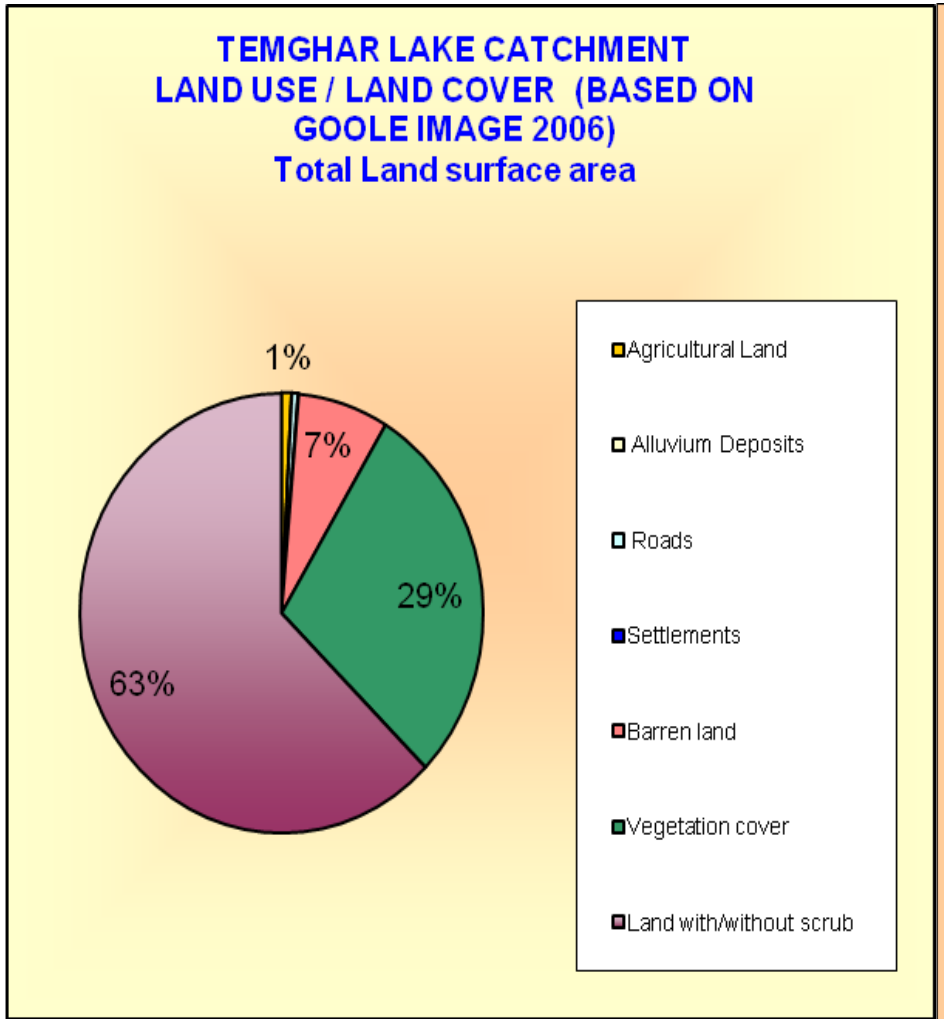


Fig .5.4 a

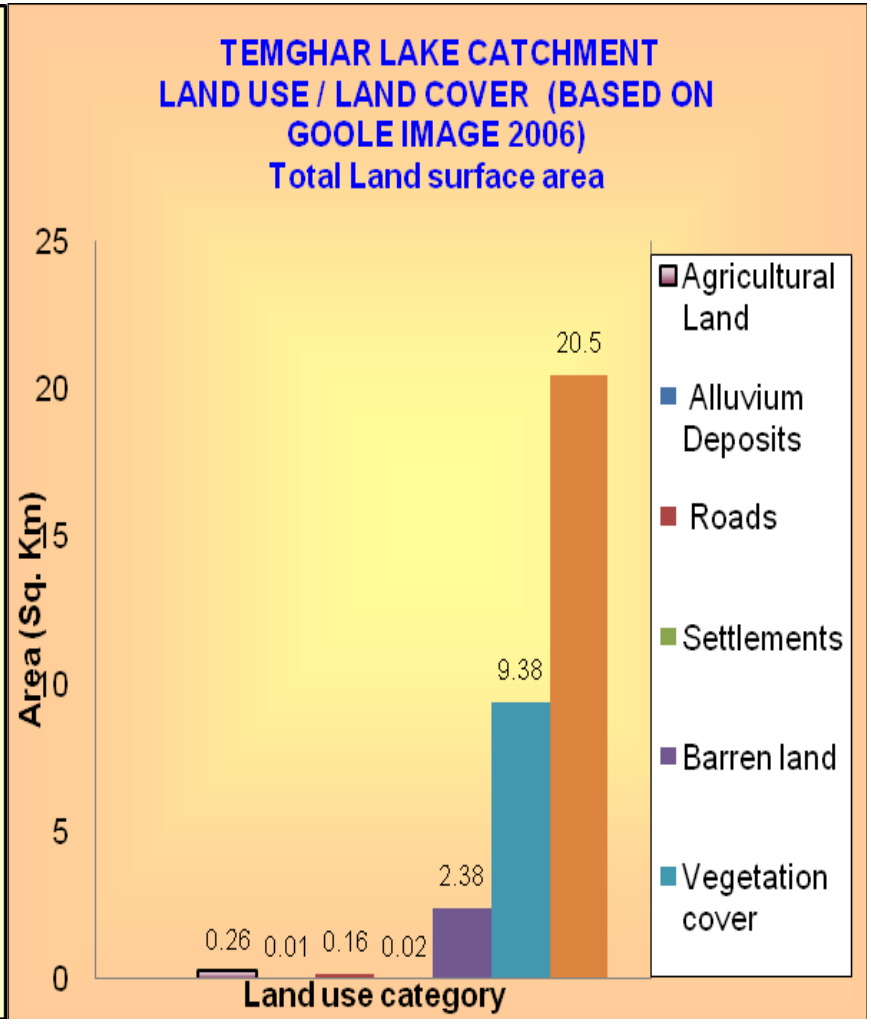


Fig .5.4 b

TEMGHAR LAKE CATCHMENT

3D VIEW OF LAND USE / LAND COVER MAP BASED ON GOOGLE IMAGE 2006

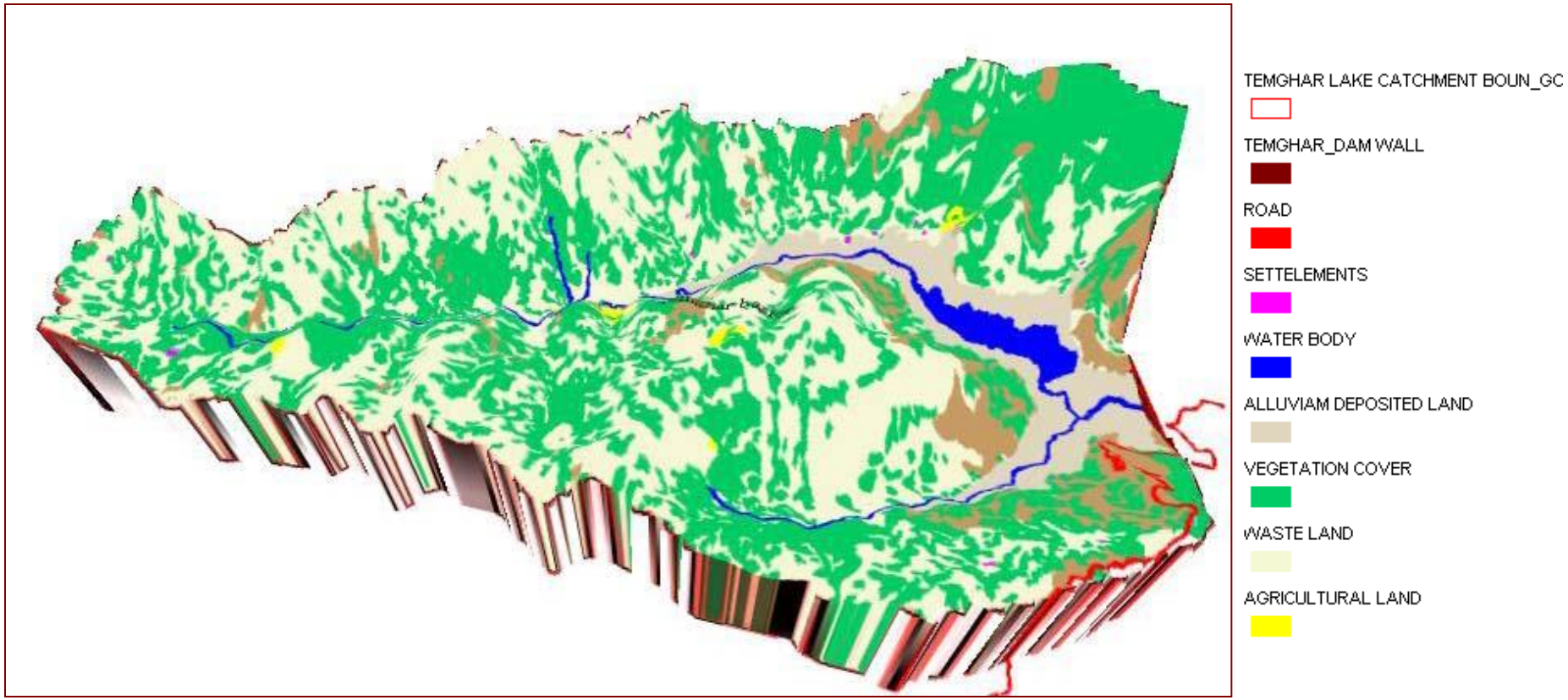


Fig. no.5.5

TEMGHAR LAKE CATCHMENT

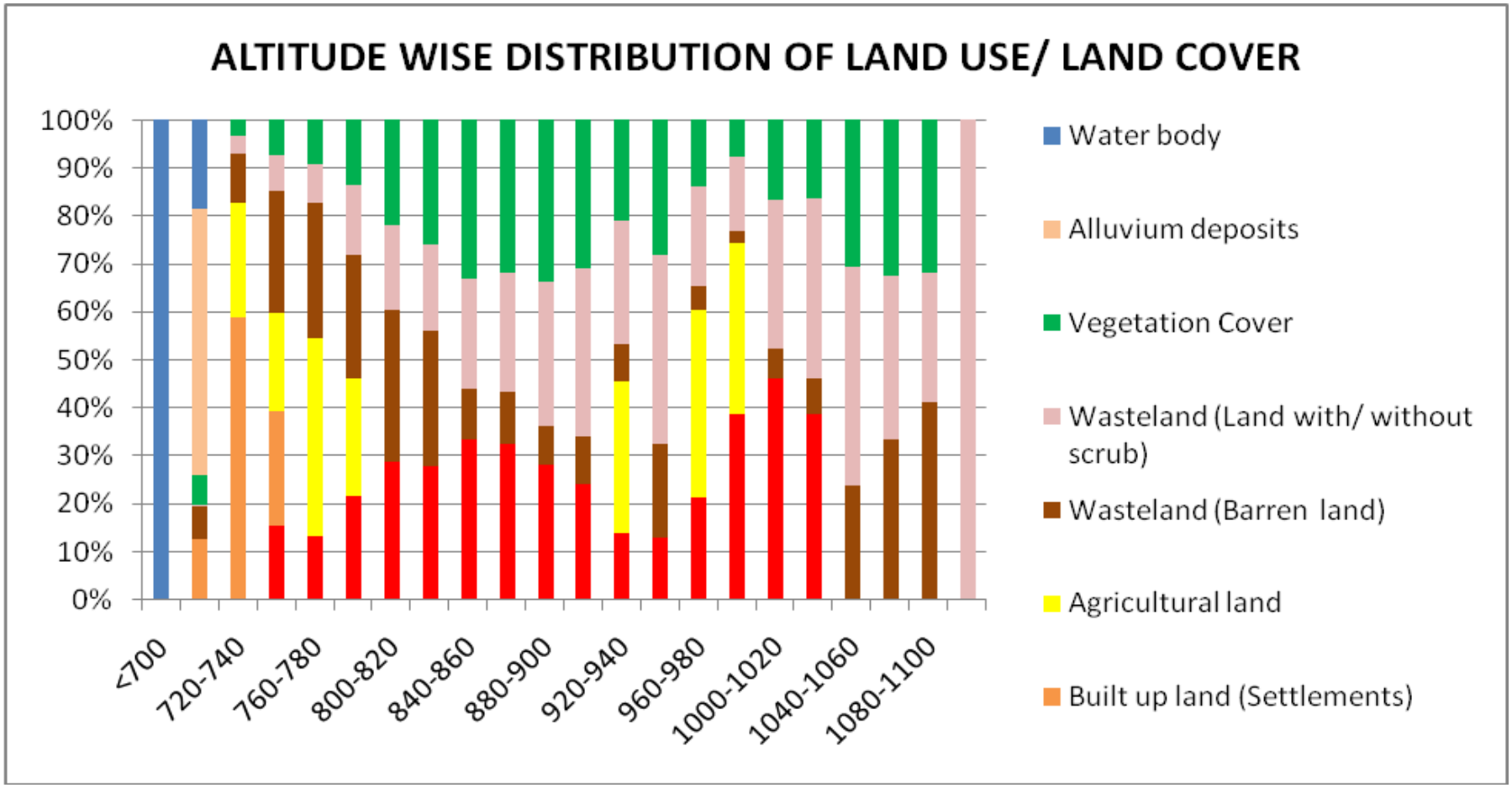
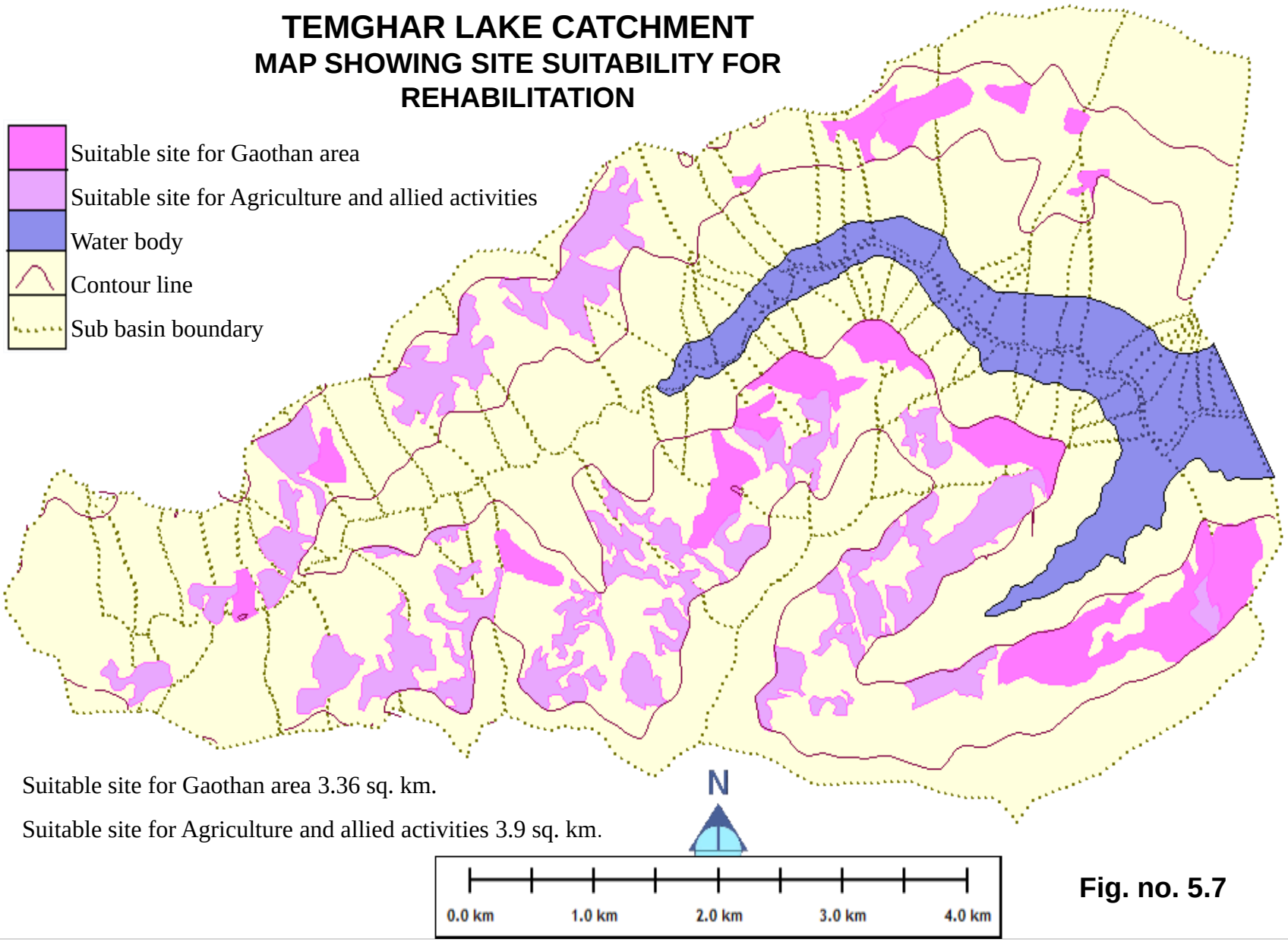


Fig. no. 5.6

TEMGHAR LAKE CATCHMENT

MAP SHOWING SITE SUITABILITY FOR REHABILITATION



Suitable site for Gaothan area 3.36 sq. km.

Suitable site for Agriculture and allied activities 3.9 sq. km.

Fig. no. 5.7

Table no.5.3 : Altitude wise distribution of land use / land cover (Entire catchment)

Sr. No.	Height (m)	Built up land (Road)	Built up land (Settlements)	Agricultural land	Wasteland (Barren land)	Wasteland (Land with/ without scrub)	Vegetation Cover	Alluvium deposits	Water body	Area (Km^2)
1	<700	0	0	0	0	0	0	0	3.31	**3.31**
2	700-720	0	0.005	0	0.3	0.107	1.078	0.013	1.68	**3.183**
3	720-740	0	0.014	0.067	0.26	0.86	0.33	0	0	**1.531**
4	740-760	0.014	0.003	0.03	0.346	0.865	0.397	0	0	**1.655**
5	760-780	0.01	0	0.05	0.31	0.77	0.411	0	0	**1.551**
6	780-800	0.011	0	0.02	0.195	0.93	0.408	0	0	**1.564**
7	800-820	0.011	0	0	0.18	0.87	0.496	0	0	**1.557**
8	820-840	0.01	0	0	0.15	0.83	0.548	0	0	**1.538**
9	840-860	0.01	0	0	0.047	0.88	0.583	0	0	**1.52**
10	860-880	0.01	0	0	0.05	0.98	0.578	0	0	**1.618**
11	880-900	0.01	0	0	0.042	1.371	0.701	0	0	**2.124**
12	900-920	0.01	0	0	0.061	1.86	0.754	0	0	**2.685**
13	920-940	0.009	0	0.033	0.075	2.112	0.798	0	0	**3.027**
14	940-960	0.005	0	0	0.112	1.93	0.636	0	0	**2.683**
15	960-980	0.01	0	0.03	0.035	1.25	0.385	0	0	**1.71**
16	980-1000	0.02	0	0.03	0.02	1.01	0.238	0	0	**1.318**
17	1000-1020	0.01	0	0	0.02	0.865	0.212	0	0	**1.107**
18	1020-1040	0.01	0	0	0.029	1.24	0.249	0	0	**1.528**
19	1040-1060	0	0	0	0.04	0.66	0.204	0	0	**0.904**
20	1060-1080	0	0	0	0.056	0.49	0.214	0	0	**0.76**
21	1080-1100	0	0	0	0.051	0.29	0.156	0	0	**0.497**
22	>1100	0	0	0	0	0.33	0	0	0	**0.33**
Total Area (Km^2)		**0.16**	**0.022**	**0.26**	**2.379**	**20.5**	**9.376**	**0.013**	**4.99**	**37.7**

Table 5.2: Temghar Lake Catchment

Land use / Land cover statistics based on SPOT image 2006

(Total land surface area)

Sr. No.	Land Use / Land cover class	Area		
		Km²	**Hectares**	**Percentage**
1	Agricultural land	0.26	25.97	0.79
2	Alluvium deposits	0.01	1.30	0.03
3	Roads	0.16	15.98	0.49
4	Settlements	0.02	2.20	0.06
5	Barren land	2.38	237.80	7.28
6	Vegetation cover	9.38	937.80	28.68
7	Land with/without scrub	20.50	2050.00	62.67
Total		**32.71**	**3271.00**	**100.00**

Table No. 5.1 : Temghar lake catchment

Land use / land cover based on SPOT image 2006

(Entire catchment)

Sr. No.	Land use / Land cover classes	Area		
		Km²	**Hectares**	**Percentage**
1	Agricultural land	0.26	25.97	0.69
2	Alluvium deposits	0.01	1.30	0.03
3	Roads	0.16	15.98	0.42
4	Settlements	0.02	2.20	0.06
5	Water body	4.99	499.00	13.24
6	Barren land	2.38	237.80	6.31
7	Vegetation cover	9.38	937.80	24.88
8	Land with/without scrub	20.50	2050.00	54.38
Total		**37.70**	**3770.00**	**100.00**





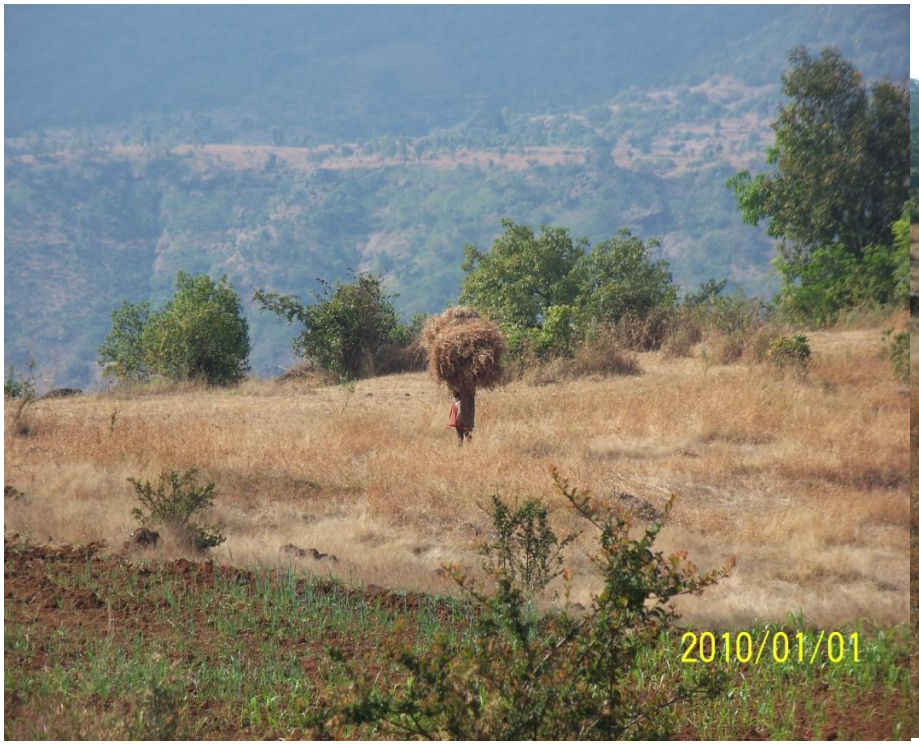
15. WASTE LANDS IN THE FORM OF ROCK OUT CROPS AND GULLIED TOPOGRAPHY



16. WASTE LANDS IN THE FORM OF ROCK OUT CROPS AND GULLIED TOPOGRAPHY



17. WASTE LANDS IN THE FORM OF BARREN -EXTENSIVE FOOT HILLS





18. WASTE LANDS IN THE FORM OF BARREN -EXTENSIVE FOOT HILLS

CHAPTER VI
SOCIO-ECONOMIC STATUS OF AFFECTED PEOPLE AND REAL FACTS OF REHABILITATION

6.0 Introduction:

The present chapter mainly intends to summaries' the socio economic landscape of the project affected families and to ascertain their major occupation and way of sustaining life as a whole. It is therefore thought to undertake intensive household survey of these four affected villages, as well as based on the data obtained from other sources has also been incorporated to discuss trends in population growth. It is also thought to look out in the present situation of the rehabilitation of these families reseated in other tahsils in order to understand their problems a questionnaires was designed and accordingly house hold survey has conducted to ascertain their overall views regarding rehabilitation.

This is an attempt to picturise the situations of affected as well as rehabilitated families.

6.1 Socio-economic status of the affected villages:

The socio-economic aspects of the Mulshi taluka in general and the project affected people in particular are studied in detail. These affected villages are namely: Temghar, Wegre, and Lavharde & Vede, of these villages, Temghar and Wegre are fully affected and villages Lavharde and Vedhe are partially affected. As per official records and information, this is the only project where almost 100% rehabilitation plan has been implemented.

6.1.1 Population and its growth

Population in the study area (project affected villages) has been reviewed from 1951 to 2001 and dynamics of population has been tabulated in table 6.1. The Temghar irrigation project commenced in the year 2000. Since then the implementation of rehabilitation started in the year 2001. An attempt has been made here to understand the factual situation of the families, whose rehabilitation has been done. It is observed that, most of the families still retained in their own villages even

after the implementation of the rehabilitation programme. Some of the families partially shifted and some of them have been completely shifted. This part of the chapter mainly focuses on socio-economic status of these populations who has still retained, at their native places. Review of population since 1951 has been done to highlight the changes in population over a period of 50 years (Table 6.1, fig 6.1). Major characteristics of population in terms of the growth, population density, average size of the households, sex ratio, dependent population, religion, caste, literacy, shelter and cultural needs have been enumerated below;

6.1.2 Population composition and characteristics

It is observed from the table 6.1; that, the villages under the study considerably show the changes in population dynamics. Village Temghar almost show around 185% growth in their population.

Very prominent change in population has been noticed since 1951 to 2009. Decreasing trend in the population observed since 1961 up to 1991. After 1991, sudden change in the population increase observed to be continuously increasing where village Lavharde shows around 243% growth in 1991- 2001 and after 2001 it is noticed to be 13.17% increase due to shifting of population. On the other hand village Vedhe shows drop in population which is around -21% in the decade 1991 to 2001 and it is noticed for the present decade to be 5.21% The possible reasons for this growth seems to be linked with good transport network with Pune city and availability of irrigation facilities in these villages, which have brought significant effect on population growth and development of infrastructural facilities. Wegre village being so interior and partially affected in the said project show remarkable decrease in the population. In case of village Vedhe, this is being a small village, since 1951 does not show remarkable growth in the population up to 2001 and 2009 respectively.

The past trends in the population of villages under study and the decennial growth observed is presented below (Table 6.1)

6.1.3 Population density

The average density of population in the villages under study is much lower as compared to tahsil and apparently shows that, adequate land is available per person for survival. Only Temghar and Lavharde have forest land. Thus availability of

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agricultural land also appears to be adequate. However, the village Temghar and Wegre are located on the steep slopes of the valley and good quality agricultural land is available only close to river. Soils on the slopes are of poor grade where only millets can be grown. (Table no. 6.2 and fig 6.2)

6.1.4 Average size of the households

Village wise number of households and population has been collected from census 2001 and socio-economic survey 2009 using the data, the average size of the households has been estimated. (Table no. 6.3).It is observed that, there is slight increase in household as well as in population in case of village Temghar, Lavharde Vedhe and Wegre.

6.1.5 Sex ratio

The ratio indicating the number of female's per 1000 males has been computed using the census data presented in Table no. 6.4.

The sex ratio appears to be well balanced. However, it should be noted that there is a regular out migration of young male population to cities like Pune and Mumbai, leaving limited population of male members in the villages. The utility of the female members for survival of the family could also be the reason for adequate female population. In the agriculture and animal husbandry, the male members carry out the task of preparing agricultural fields, sowing and in case of animal husbandry sales of milk. The rest of the work of maintenance of agriculture is mainly done by raring of animals and live stock. The percentage of children below 6 years of age with respect to the total population for the project affected villages is presented in the table.

6.1.6 Children below 6 Years.

The percentage of children below 6 years in the project affected villages is higher than the Mulshi C. D. Block (Rural) and comparable to the All India (Rural) average. This shows that, the impact of birth control measures in the villages under study is very limited. Low level of literacy for both male and female adult and especially in females also could be the cause of high percentage of children. However, as the total population figure it is the deceptive because of heavy out migration of

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male population, the percentage of children in total population could be considered as normal (Table 6.5).

6.1.7 Religion and castes:

The main religion of the population in the project affected villages is Hindu followed by a mere percentage of Buddhists. No other religion has been reported during study period. The Maratha community forms around 85% of the total population followed by scheduled tribes and scheduled castes. Village wise population of S.C. and S.T. as observed from the census 2001 is presented in table no.6.6

6.1.8 Literacy:

The percentage of literates to the population (excluding 0-6 age group) in each of the project affected villages is presented in table no.6.7.

In spite of the fact that primary level education is available in each project affected villages the percentage of literates, both male and female is very low. Village Wegre has a medium school but has lower literacy than Temghar.The primary school at Temghar, Lavharde and Vedhe are managed by one teacher only. As the teachers are taking necessary efforts to improve the attendance in the school, especially in the agricultural season, the students are deprived of the education and lose interest in it; therefore % of drop out is also considerable.

6.1.9 Dependent population on agriculture

An attempt has been made in this analysis to infer the % of dependent population on the agricultural activity; therefore following computations have been performed on the following lines.

i) The percentage of main workers to the total population
ii) The percentage of cultivators to the main workers
iii) The percentage of agricultural laborers to the main workers
iv) The percentage of marginal workers to the total population.

It can be seen from the table no.6.8 that, village wise percentage of working population in the project affected persons clearly indicates that, the people engaged in agricultural activity (agricultural workers to working population) directly or indirectly

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accounts to 57.2% and total population of workers is around 77.50% including marginal workers. Village Vedhe accounts to 36.1% of agricultural workers to total workers and 73.1%, 63.8%and 56.0% of population of villages Temghar, Lavharde and Wegre respectively.

Thus, agriculture is the main economic activity in the villages under study and they are also involved and dependent on some of the fruit trees like Mango, Jamun, Jackfruit and other trees. They are satisfactory in living and activities. Similarly, dairying is also an activity which supports the livelihood Because of adequate income from own agriculture, the percentage of persons mainly working as agricultural labourers-which includes landless and small farmers-is low, this is so noticed for the village Lavharde where most of the S.C. and S.T. families are landless and therefore they are labourers.

6.1.1.0 Number of households below poverty line

The survey was carried out to know the village wise number of households below poverty line whose annual income is below Rs. 20000/- as present these details in the table along with their percentage with respect to the total households recorded in the year 2009. The village wise number of households below poverty line is recorded in the table no. 6.9 and it can be noticed that the majority of households below poverty line belongs to SC/ST category. These households are mainly in labour category and dependent upon the employment which is made available at the village level. They are known as landless labourers.

6.2 Settlements /Shelter

In the study area, the pattern of settlements are scattered or decentralized. The main reason is non-availability of plain area and the terrain has been extremely undulating. The settlement although are scattered but houses are extremely clustered wherever they have been settled.

More than 80% of the houses are of semi-pucca type. They have used stone/ brick for construction and tin sheet/ Mangalore tile for roofing. Around 5% houses are constructed with cement concrete while the rest are hamlets which are known as '*Kachha* houses' in Maharashtra. During survey, it has been observed that, S.C. / S.T. people have these types of houses.

D-11

There are 10 landless households in Temghar and Wegre respectively and 25 such households in Lavharde. Out of the 25 households in Lavharde, 15 are affected by the project.

6.3 Agriculture

It has been noticed that, more or less people are dependent on agriculture in the study area. Mainly agriculture in the form of paddy cultivation is practiced in monsoon season (Kharif) and hill slopes are used for growing millets.

Details regarding cropping pattern, irrigation yield, prices, etc. have been collected through discussion with the local people. Landuse pattern has been obtained from census handbook (2001).

6.3.1 Land use pattern

The area wise details of land use pattern for the villages under study are given in the table no.6.10. From the above table, it can be seen that a good forest cover is available only for Temghar village. Most of it is retained even after the construction of dam. The census information indicates that there is no irrigated land in the project area. However, actual field visits indicates that the farmers do provide irrigation for part of the rabbi crops. Overall, the villages under study have higher percentage of agricultural land and less percentage of non-cultivable land as compared to the total of the Tahasil.

6.3.2 Availability of agricultural land

Taking into consideration the total area cultivated (excluding cultivable waste) and number of households as per 1991 census, the average area cultivated per household is tabulated in Table no.6.11.

Considering the livelihood of some landless households, the average cultivable land available per household is less. This availability of adequate land, even though un-irrigated, is the main reason that, there are very few households below poverty line.

D-13

6.3.3 Utilization of agricultural land

In the discussion with villagers, it is observed that, around 50% of the total agricultural land is available. This land is favorable for cultivation of paddy and wheat. The rest of the land is used for cultivation of small millets and seems to be mere important for potential horticulture.

6.3.4 Cropping pattern

In the study area, due to the relief constraint the size of the land is comparatively very low. Hence, there are limitations on the systematic practices in the cultivation of various crops.

As indicated earlier, paddy is the main crop grown in the area. The varieties of paddy grown are Karjat-84 and Ambemohar-57 which are fine-grained varieties with fragrance and having good price. It is grown only during Kharif season.

After harvesting of paddy, if the soils have retained moisture wheat is sown. Generally, wheat covers around 25% of the paddy land. Around 50% of the wheat also receives irrigation using river water. Thus about 12.5% of the total agricultural land is double-cropped and 6.25% is irrigated. Small millets (*Nachani*) are also an important crop which is grown in kharif season by transplanting the saplings on the slopes of the hills.

Horticulture is practiced on the bunds of the agricultural plots as well as on the hill slopes Mango; jackfruit and *Karwand* (jungle berry) are the main fruit bearing trees. Earlier the area was known for its local mangoes. However using the grafting techniques during the last 15 years the trend of growing of Alphonso and payari varieties has increased substantially. The other trees like jackfruit, jamun do not receive special attention but can grow naturally. The bush type plant of *karwand* is found in abundance on the hill-slopes. Other trees are *ani, hirda and jam (toran).*

6.3.5 Yields

The average yield of paddy is around 2.5 tons/ per hectare. The yield can reach up to 3.5 tones, if moisture and climatic conditions are good. Rice processing mills are locally available, mostly of them are hullers. The yield is about 65-70% of the paddy. Thus, a farmer gets around 1.65 to 1.70 tonnes of rice per hectare.

Comparatively the yield of wheat crops and small millets is low. From one hectare of wheat crop hardly 1.5 tone of wheat is received.

Among fruits, considering average age of tree as 10 years, the yields are as follows:

1) Mango
   a) Alphonso - 300 nos.
   b) Payari - 1500 nos.
   c) Raywal - 2500 nos.
2) Jackfruit - Around 70–100 out of which 50% are cut raw for marketing as vegetable. This also helps in proper growth of the rest of the fruits.
3) Jamun - Around 40 -75 Kg per tree
4) Karwand - Around 3-4 Kg per bush

6.3.6 Prices and marketing

Among the cereals mainly rice is marketed while wheat and millets are for home consumption. The fruits are mainly marketed. The prices received in the market are as follows:

1)	Rice	Rs. 1400 to 1600 per quintal.
2)	Wheat	Rs. 700 to 800 per quintal.
3)	Small millets	Rs. 500 to 600 per quintal.
4)	Mango	
	a) Alphonso	Rs. 500 to 600 per100 fruits
	b) Payari	Rs. 250 to 300 per 100 fruits.
	c) Raywal	Rs. 50 to 60 for 10 kg (around 50-60 fruits)
5)	Jackfruit-	Rs. 5 per Kg. when raw.
		Rs. 15 per piece when mature.
6)	Jamun	Rs. 10 per Kg.
7)	Karwand	Rs. 5 per Kg.

The trade of both cereals and fruits is handled by the private traders. As has been indicated earlier, from each family some youths have migrated to Pune and Mumbai. These youngsters try to market the home produce to their friends and acquaintances fetching better price for the produce. Horticulture is very important to

the farmers because it generates good income during the otherwise lean season for agriculture. Further once the plants are grown up, they require very little maintenance.

6.3.7 Livestock

Village-wise population of selected livestock is given in table no 6.12 it can be seen from the table that, all the villages have sizeable number of cows and buffaloes. However, the percentage of improved varieties is very less. The situation is similar in case of poultry. The approximate number of each variety of livestock per household is presented in table no. 6.12.

As the cows and buffaloes are mainly of local variety and are mainly fed on the rice straws and grass, they yield very little quantity of milk. Although each of the villages under consideration has milk collection centers, the average collection per centre varies between 300-400 liters during peak season and between 150-200 liters during summer. Goat milk is consumed locally and they are mainly kept for sale. Each goat fetches minimum price of Rs. 400=00. The yield of eggs from poultry is also very poor-15-20 eggs per hen per month. However, the local variety is more resistant to diseases and requires little care. Vendors regularly visit the villages for collection of eggs and the eggs when sold fetch Rs one per egg.

6.3.8 Loss of agricultural land due to the project

From the table 6.13 it can be seen that, hardly 14% of the total agricultural land is lost in the project. This will leave large part of the land for cultivation. About 451 ha of land in Temghar and 1925 ha of land in Wegre will be available for cultivation in the future. However, most of the rich paddy land may be lost, leaving only land suitable for millets and horticulture. Further, along with the gaothans of these villages, the approach roads also submerged due to the project. Thus even if a cultivator wants to cultivate these land or maintain the fruit trees, it will not be possible until new roads are developed.

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D-15

6.4 Amenities in the villages

6.4.1 Education

Anganwadi is available only in two villages, i.e. Wegre and Lavharde, while primary school exists in all villages. However, in villages Temghar and Vede the schools are run only by one teacher each. Education up to 7th standard is available only in village Wegre. The nearest High school up to 10th standard is at Ambewadi which is about 9 KM from village Wegre. For Jr. / Sr. college education, Pune city which is about 45 KM from Lavarde is the nearest centre. Because of one teacher schools, the literacy levels in the area are low.

6.4.2 Drinking water

All the villages have functioning drinking water supply schemes based on wells in the river basin. The raw water is distributed in each village with the help of a number of hand pumps. There are however no household connections has provided, nor do the people feel the need for the same. The water supply sources are perennial wells and river is also the source used by the individuals for domestic and animal consumption.

6.4.3 Sanitary system

There are no private or public latrines in any of the villages under study, because the villages are small and surrounded by shrubs and trees on the slope, the need for latrines are not felt.

6.4.4 Electricity

All the villages are provided with electricity and more than 80% of the houses have domestic connections. Every village has a number of street lights which are maintained by the respective Gram Panchayat.

6.4.5 Post and telegraph facility

None of the villages under study have any of the post and telegraph facility. The nearest post office is located at Kolavade which is 7 KM from the village Wegre

while telegraph office is at Pirangut which is 25 KM away. Public telephone is available at village Kharavade located at about 9 KM from village Wegre.

6.4.6 Approach roads

All the villages under the study have both types of kaccha and pucca road. Lavharde to Wegre and Wegre wadi have kaccha road while village Lavharde, Temghar and Vedhe are connected with pucca roads but are not being maintained properly. Lavasa project initiated in 1998 since then all roads has been being constructed.

6.4.7 Stores and commercial establishment

The village Wegre has two grocery shops, one flour mill and one rice mill. Similarly Lavharde has four grocery shops, one flour mill and one rice mill. Villages Temghar and Vedhe do not have any commercial establishment.

6.4.8 Health status

There is no Primary Health Centre (PHC) or sub-centre in any of the villages under study. Nearest government facility is available at the place Mutha, which is about 14 km from village Wegre. The malaria workers from PHC visit the villages every 15 days to identify and help the needy. There is a private medical practitioner available at village Lavharde. The hospitalization facility is available only at Pune which is 45 KM from the village Wegre. Veterinary dispensary is available for animal at village Kolavade, about 7 KM from village Wegre.

6.5 Present status of rehabilitants at various sites

In order to infer the present socio-economic status of project affected villages, extensive household survey has been conducted during the month of May (20-21, 2009). The survey was conducted in various villages which were fully and partially affected under the study area (Photo plates 19 to 27); it is inferred that, in all total 286 households are directly affected. 100% survey has been completed and the detailed qualitative and quantitative information has been compiled with the help of questionnaire and interview methods (Appendix II). This is to understand the present

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status of the project affected families. The findings for each village are summarized in the following lines. Village Temghar and village Wegre are fully affected, while Lavharde and Vedhe are partially affected. For the rehabilitation of families who have lost their houses and land in Temghar irrigation project, the authorities have selected five sites for their rehabilitation. Some of the sites are located in benefited zone of Chaskaman project command area. Table No. 6.14 & 6.15.

6.5.1 Rehabilitation site at Shel-Pimpalgaon in Khed tahsil (Rehabilitation of village Temghar)

This village is located near about 42 Km from Pune city and 92 Km (Fig.6.3 a, b, and c) from the project affected village that is Temghar. The site for rehabilitation is selected near Mohite-wadi which is isolated part of village Shel –Pimpalgaon (Photo plates 28 to 30).

Village Temghar is almost affected site and the process of rehabilitation has been started in 1993. In 1998 proper migration /rehabilitation of affected families were started and up to 2000 it has been completed. Total 40 families were rehabilitated in this village.

Earlier this village was developed for the rehabilitation of families from Chaskaman Project and additionally this site is utilized to rehabilitate the people affected due to Temghar irrigation project.

Land is purchased by government authorities from the local villagers and distributed to the project affected families as per rules and regulation of Maharashtra state.

Area allotted for rehabilitation at this site has been given in the table no. 6.15. It can be observed from the table that affected village Temghar has been rehabilitated at this site and around 137.32 ha. land allotted for agriculture, 5.8695 ha. for residential purpose, 1.7723 ha. for internal roads and 1.5795 ha. land for gaothans and other purpose (mainly raising temple, open space, samaj mandir, Chawadi, school, etc.)

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6.5.2 Rehabilitation site at Kondhapuri in Shirur tahsil (Rehabilitation of village Lavharde and Temghar)

This village is located near about 52 Km from Pune city and 102 Km (Fig.6.3 a, b, and c) from the original affected villages are Temghar and Lavharde. The site for rehabilitation is selected at Kondapuri. This is isolated village in tahsil Shirur in Pune district (Photo plates 31).

Villages Temghar and Lavharde were fully affected sites, so that the process of rehabilitation has been started in 1993. In 1998 proper migration /rehabilitation of affected families were started and up to 2000 it has been completed. Earlier this village was developed for the rehabilitation of families from Chaskaman Project. However, this site is utilized to rehabilitate the project affected people of Temghar project.

Land is purchased by government authorities from the local villagers and distributed to the project affected families as per rules and regulation of Maharashtra state. Area allotted for rehabilitation at this site has been given in the table no. 6.15. It can be observed from the table that, affected villages Temghar and Lavharde have been rehabilitated at this site and around 106.55 ha. land allotted for agriculture, 4.7540 ha. for residential purpose, 1.1837 ha. for internal roads and 1.7723 ha. land for gaothan and other purpose (mainly raising temple, open space, samaj mandir, Chawadi, school, etc.)

The families/ farmers who have more than 10 acres and lost in the project, they have received zero *ha* two *are* areas for residence and 6-8 acres of agricultural land. This ratio is approximately same in above cases but less than that have received two *are*. Area for residence and proportionally same size agricultural land.

6.5.3: Rehabilitation site at Rautwadi in Shirur tahsil (Rehabilitation of village Lavharde)

This village is located near about 52 Km from Pune city and 102 Km(Fig.6.3 a, b, and c) from the original affected village i.e. Lavharde. The site for rehabilitation is selected at village Rautwadi, in Shirur tahsil in Pune district,

Area allotted for rehabilitation at this site has been given in the table no. 6.15. It can be observed from the table that, affected village Lavharde has been rehabilitated

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at this site and around 106.55 ha. land allotted for agriculture common for affected village Wegre and Lavharde, 2.8395 ha. For residential purpose, 1.2218 ha. For internal roads and 1.2175 ha. Land for gaothan and other purpose (mainly raising temple, open space, samaj mandir, Chawadi, school, etc.)

6.5.4. Rehabilitation site at Vitthalwadi in Shirur tahsil (Rehabilitation of village Wegre)

The site is selected and developed for the rehabilitation of part of affected village Wegre. This site is situated near about 46 Km from Pune city and 96 Km(Fig.6.3 a, b, and c) from the original affected village Wegre.

Area allotted for rehabilitation at this site has been given in the table no. 6.15. It can be observed from the table that affected village Wegre has been rehabilitated at this site common for Wegre and around 137.32 ha. Land allotted for agriculture, 5.8695 ha. For residential purpose, 1.7723 ha. For internal roads and 1.5795 ha. Land for gaothan and other purpose (mainly raising temple, open space, samaj mandir, Chawadi, school, etc.)

6.5.5. Rehabilitation site at Apti in Shirur tahsil (Rehabilitation of village Wegre)

The site is selected and developed for the rehabilitation of village Kahu from Chaskaman project but some families are rehabilitated from the Temghar project part of affected village Wegre. This site is situated 4 Km from Vadu village and near about 46 Km from Pune city and 96 Km (Fig.6.3 a, b, and c) from the original affected village Wegre (Photo plates 32).

Area allotted for rehabilitation at this site has been given in the table no. 6.15. It can be observed from the table that affected village Wegre has been rehabilitated at this site and around 219.44 ha. Land allotted for agriculture, 4.6759 ha. For residential purpose, 2.3089 ha. For internal roads and 4.4552 ha. Land for gaothan and other purpose (mainly raising temple, open space, samaj mandir, Chawadi, School, etc.)

There are however around 22 families of Wegre who have been rehabilitated under Temghar project and 15 families of Kahu village.

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6.6 Status of provision of infrastructural facilities

An attempt has also been made to examine the status of infrastructural facilities at each and every rehabilitation site and following observations are quoted.

1. As promised by government project authorities, the residential plots were allotted / provided.
2. Electricity supply with individual meters and street lights are provided.
3. Water supply lines are also constructed. Common point of tap has been provided for four houses.
4. Internal roads are constructed, which are not at all in good condition and maintenance is not regularly done.
5. Four units of latrines have been constructed for the entire rehabilitants as specified sites.
6. School building with 7 classrooms has been constructed.
7. Open drainage were properly constructed with cement concrete.
8. Chawadi is also constructed.
9. Open space/plot has been provided with ground.
10. No additional space has been provided for market, shops, bus stand and cattle shed.

6.7 Major constraints before rehabilitants

i) They have been allotted non-irrigated fallow lands. However local people and original owner do not allow them to carry out agricultural practices.

ii) Government authorities do not provide necessary support, and it has become a routine picture of confrontation between rehabilitants and local people.

iii) Drinking water supply is not regular and has to walkover a considerable distance. In addition to this local people does not allow them to take water from their sources of water.

iv) At the new site, Gram-Panchayat has not yet (after 10 years) been formed due to the minimum number of families and native people are not involving them in to their panchayat, so that they are deprived from government programmes and facilities.

6.8 Field observations and real facts of rehabilitation:

Meetings conducted at various rehabilitation sites and discussions with the rehabilitants indicated the following facts.

Government project authorities assured that they will get agricultural land against the land lost. However, till after 8-9 years near about 30% families have not yet been received agricultural land in their names and thus they are still landless and jobless. The agricultural land which is received, it is also far away (1-6 KM) from the residential plots, so that it has become quiet difficult to practice them regularly. The land allotted for agriculture is almost 100% barren lands which are un productive in nature, irrigation source have not yet been made available. Agricultural land which is received is not a regular piece of land and is in patches elsewhere, for example, if farmer received 8 acres land, it is divided like 2-3-3 acres in various parts of the village.

The dealings committed between government authorities and native/local farmers (whose land in benefitted zone has been acquired) regarding the purchase of their agricultural lands, have not yet been completed successfully, hence, various problems have been created like,

a. Native/local farmers have not yet been received payment of land from the rehabilitation authorities. Technically 7/12 extracts are not been up dated and cleared, so that the acquisition of land is not possible hence claim for the same piece of land is being done from both the sides. Problems of 7/12, extract in names of rehabilitants, pending of revenue bills and tenancy cases etc has become a matter of court processes which may take a prolong time. In short, the rehabitants have not getting proper acquisition of agricultural land and local people are still practicing their fields.
b. In order to make the process of rehabilitation very easy and soft going government authorities has committed several promises to affected people like being non irrigated land around 600 rupees will be given per month till the lands are provided with irrigation facilities as well as one member from affected families will be given a job etc. it is observed that these promises turn in to a false promises.
c. It is also observed that, Local peoples in the benefitted zone have not accepted these affected people as their counterpart hence they have been rehabilitated

around 1 to 2 kms away from major settlements and not yet been involved in their Grampanchayat therefore they are deprived from the facilities and various government schemes meant for uplifting the poor and still they are struggling for their basic and infrastructural needs.

d. Local political leaders (Self Government) are not at all paying any kind of attention towards these affected families nor are they interested in them for any venture hence development of these rehabilitants from all dimensions remain obscure in near future.

e. As far as economy is concerned it is also observed that, income has certainly risen of these rehabilitants but expenses and income are not at all in balance and there is always a deficit in income for example fuel, was almost free at their native place but here they have to purchase it. Food grains, seeds, fruits etc were produced in their farms here they have to pay for it. There was a definite source of income from all these commodities at their native place.

f. In case of residential plot allotment most of the families are still deprived of it. On the contrary, some families are in receipt of agricultural land but not yet received residential plot. The cumulative effect of this is they are now engaged in labour work at local farmer's field. Those families not yet received plots for residence they are staying on rent basis.

g. Families which are below poverty line in affected areas they are in receipt of residential plots as well as agricultural land but due to being so poor they cannot afford cement concrete houses and can not practice agriculture.

h. It is observed that affected families have been dragged to rehabilitation sites practically and physically, they are missed of almost their relatives, racial, religious and cultural customs. Thus they can be described as broken heart people.

i. Rehabilitants have also formed a organization called '*Kruti Sangharsha Samitee* 'which will deal to monitor rehabilitation work. It is also observed that, committee members of this organization are in constant communication of district rehabilitation centre at Pune but the response from government side is not satisfactory.

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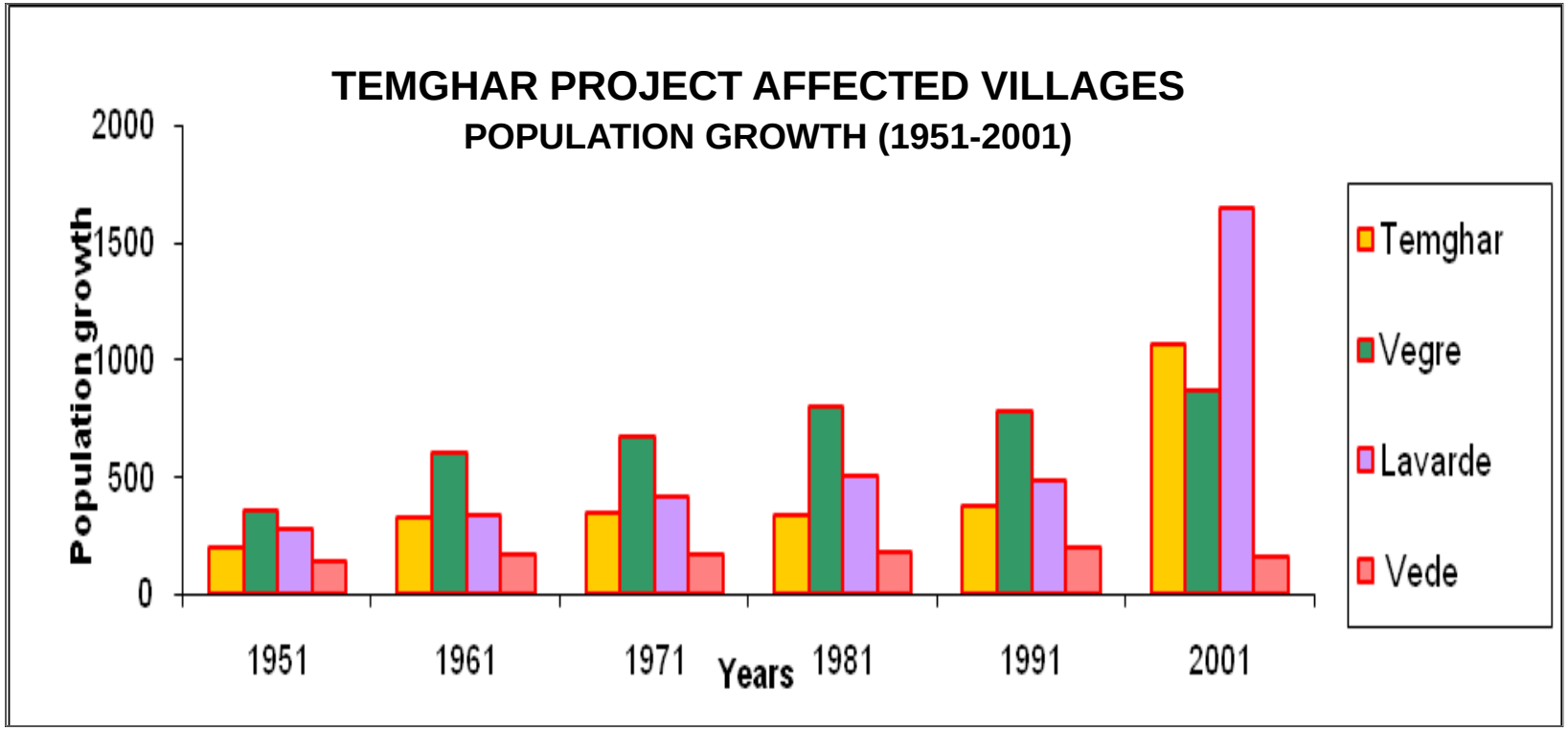

TEMGHAR PROJECT AFFECTED VILLAGES
POPULATION GROWTH (1951-2001)
Population growth
2000
1500
1000
500
0
1951
1961
1971
1981
1991
2001
Years
Temghar
Vegre
Lavarde
Vede

Fig no. 6.1

TEMGHAR REHABILITATED VILLAGES
POPULATION DENSITY (2001)

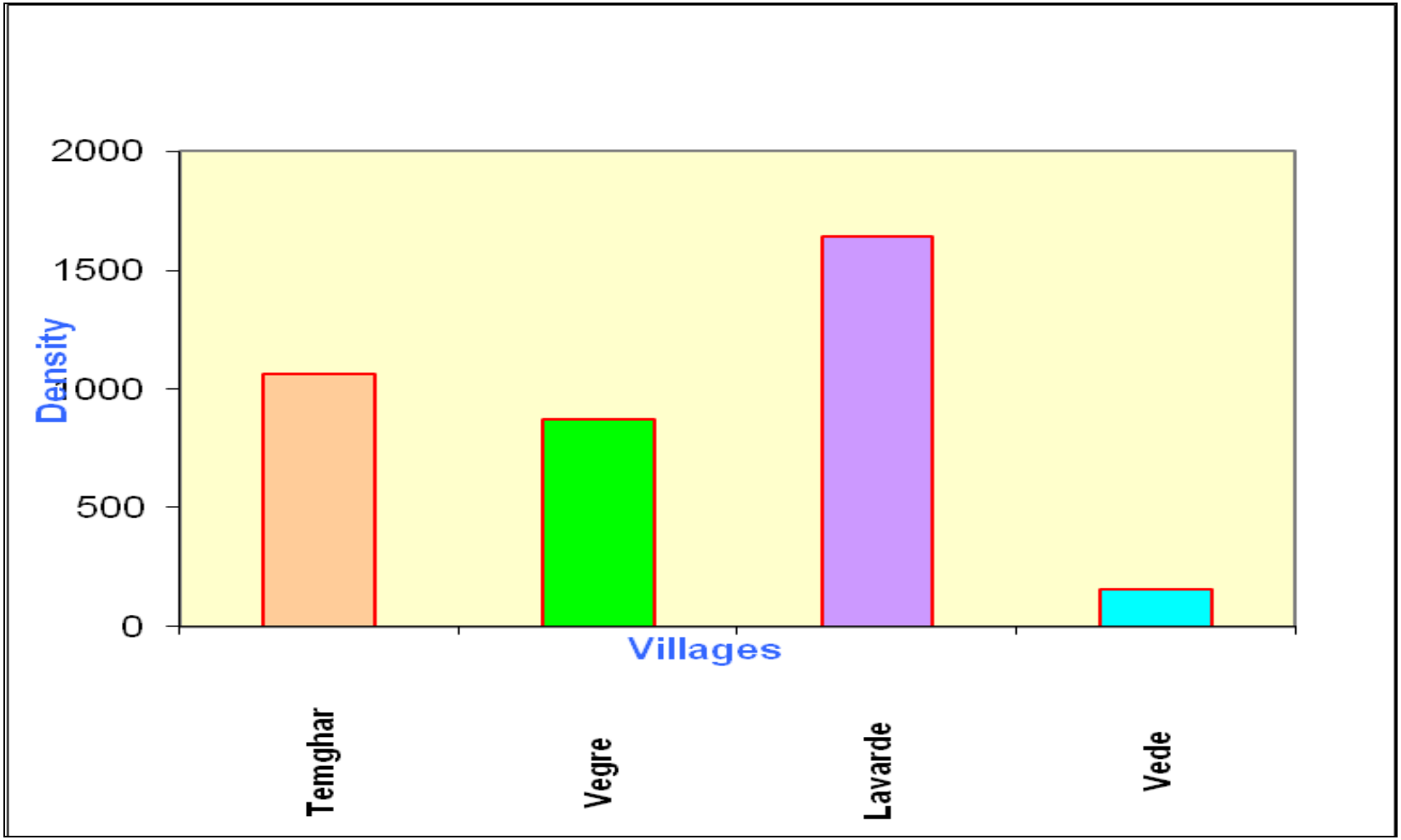


Fig. no. 6.2

SPATIAL LOCATIONS OF AFFECTED AND REHABILITATED VILLAGES

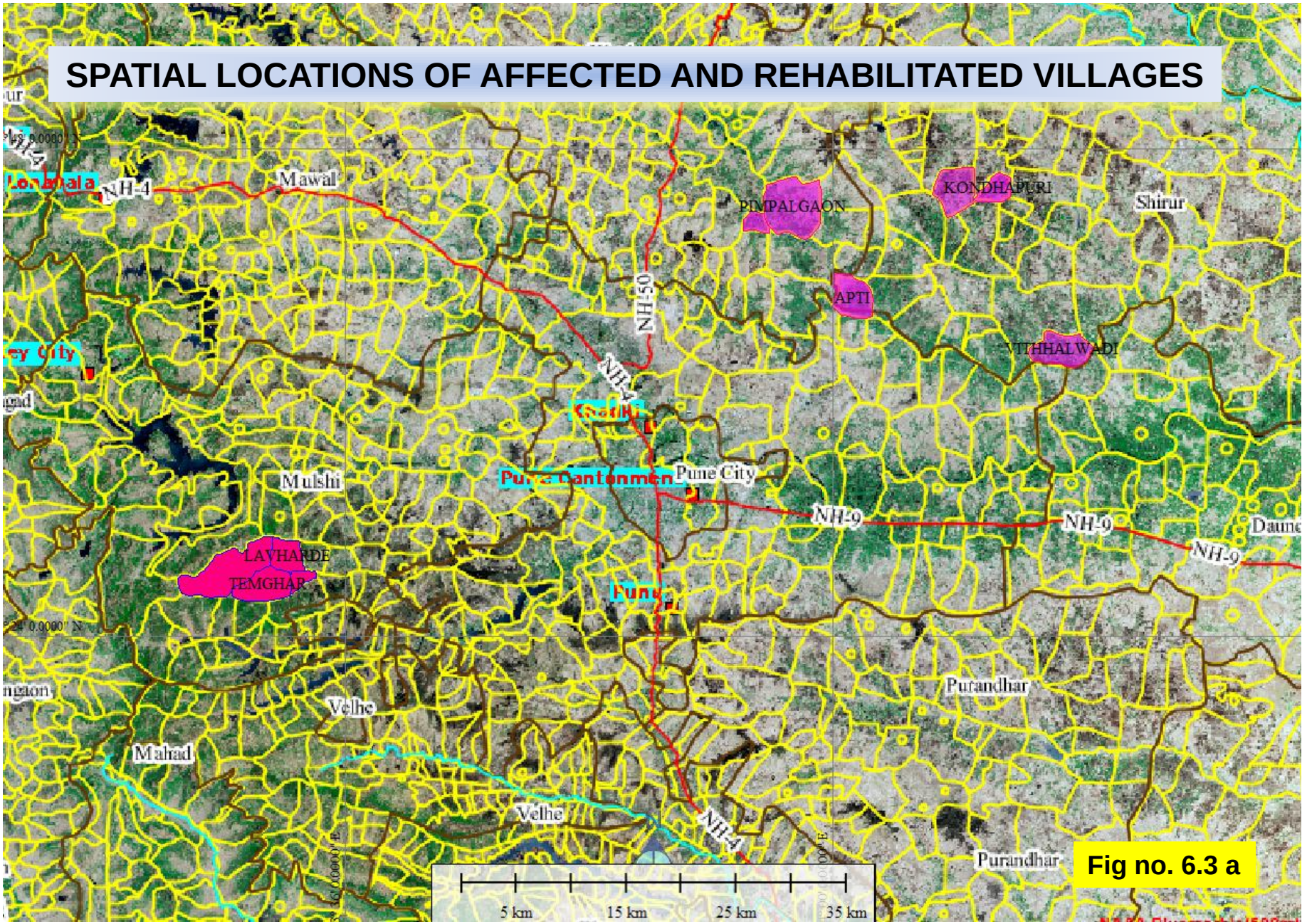


Fig no. 6.3 a

3-D VIEW OF SPATIAL LOCATION OF AFFECTED AND REHABILITATED VILLAGES

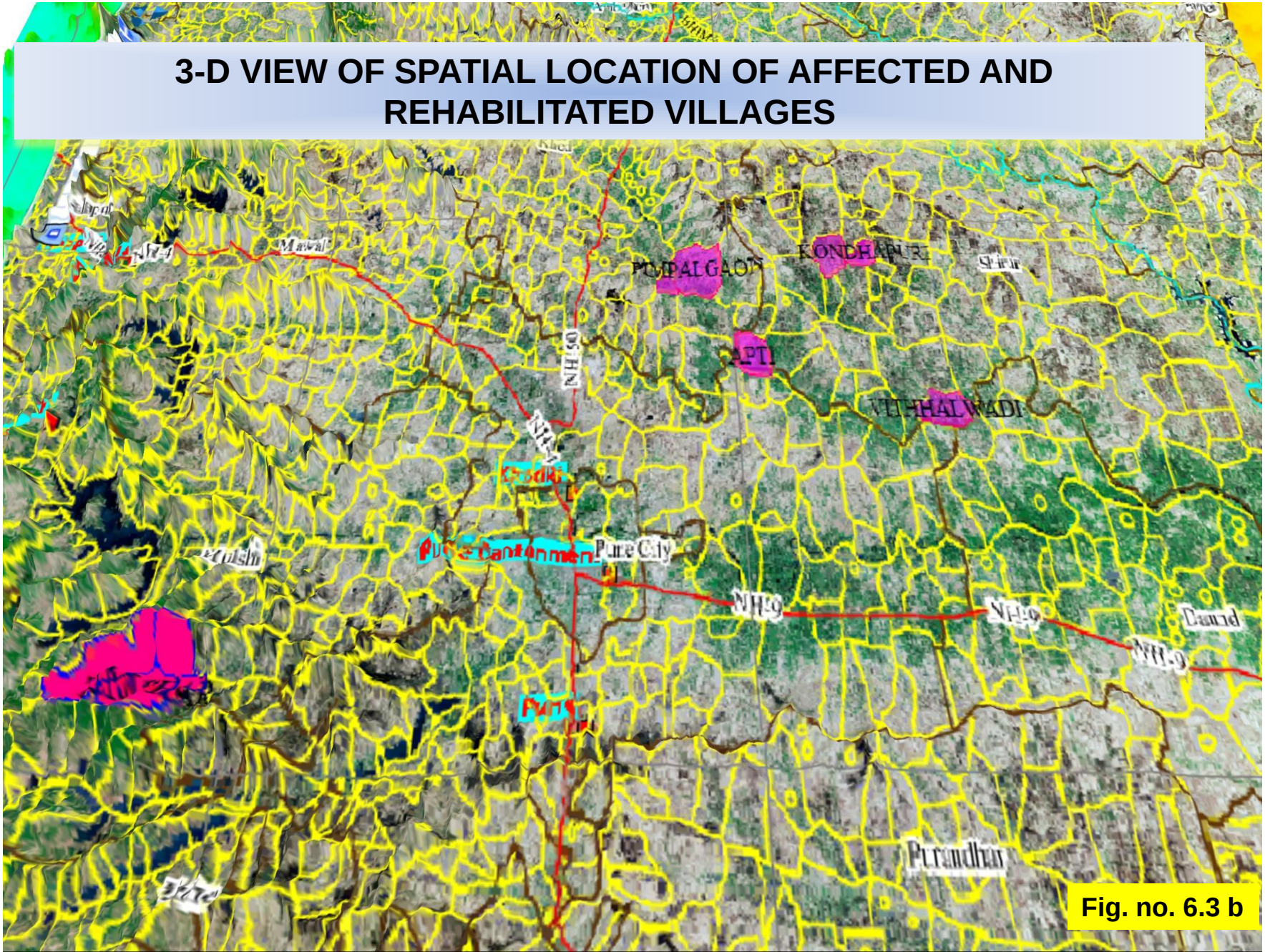


Fig. no. 6.3 b

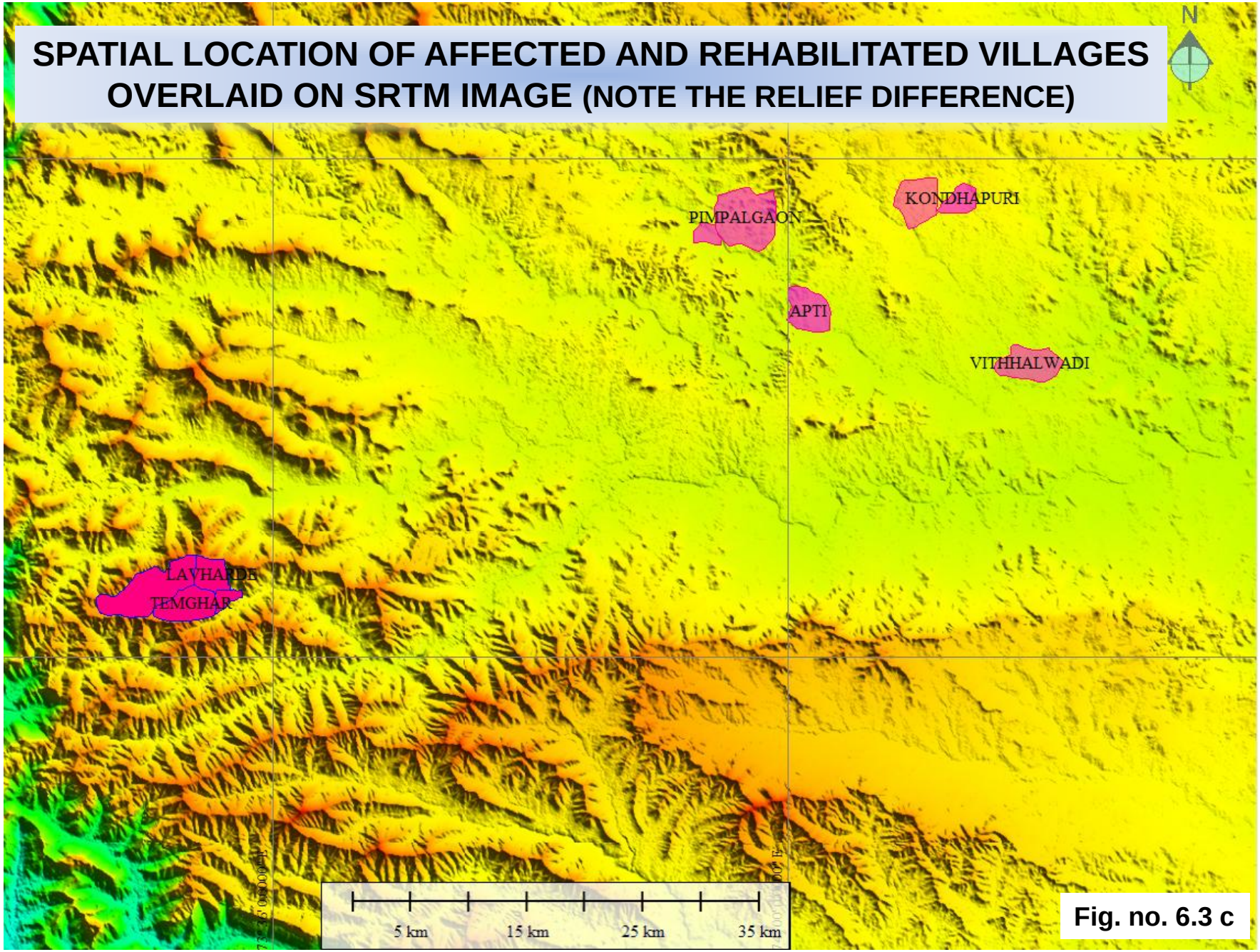

SPATIAL LOCATION OF AFFECTED AND REHABILITATED VILLAGES
OVERLAID ON SRTM IMAGE (NOTE THE RELIEF DIFFERENCE)
N
PIMPALGAON
KONDHAPURI
APTI
VITHHALWADI
LAVHARDE
TEMGHAR
5 km
15 km
25 km
35 km

Fig. no. 6.3 c



19. SCHOOL AT WEGRE AND SECONDARY DATA COLLECTION –AFFECTED VILLAGES



20. SUBSISTANCE AGRICULTURE – NOTE POOR QUALITY OF LAND





21. SOCIAL LIFE OF TRIBALS IN PROJECT AFFECTED AREA



22. HUTS OF TRIBALS IN PROJECT AFFECTED AREA



23. SETTLEMENTS IN PROJECT AFFECTED AREA



24. SUBMERGED TEMPLE AND SCHOOL EXPOSED IN SUMMER (TEMGHAR BACKWATER AREA)



25. REHABILITANTS STILL COME TO THEIR NATIVE PLACE FOR GETTING BLESSINGS FOR THEIR FAMILY MEMBERS – WEDDING CARDS PUT IN FRONT OF GOD- A SYMBOL OF RELIGIOUS AND CULTURAL ATTACHMENT



26. EXPOSED LAND SURFACE AREA-AGRICULTURAL FIELDS IN SUMMER



27. BROAD VIEW OF EXPOSED LAND SURFACE AREA-AGRICULTURAL FIELDS IN SUMMER



28. PLOTS ALLOTED TO REHABILITANTS –SHEL PIMPALGAON (FOR TEMGHAR AFFECTED VILLAGE) VIEW 1



29. PLOTS ALLOTED TO REHABILITANTS –SHEL PIMPALGAON (FOR TEMGHAR AFFECTED VILLAGE) VIEW 2







30. RESETTLEMENT AND ALLOTED PLOTS TO REHABILITANTS AT SHEL PIMPALGAON –KHED TAHSIL (AFFECTED VILLAGE TEMGHAR)





31. HOUSE HOLD SURVEY OF REHABILITANTS AT KONDHAPURI VILLAGE –SHIRUR TAHSIL (AFFECTED VILLAGE LAVHARDE)



32. HOUSE HOLD SURVEY OF REHABILITANTS AT APTI VILLAGE SHIRUR TAHSIL (AFFECTED VILLAGE WEGRE)

Table no. 6.15: land allotted for rehabilitation

Affected village	Rehabilitation site (village)	Agriculture area in ha	Residential area area in ha	Internal roads area in ha	Gaothan and other area in ha	Total area in ha
Temghar	1.Shel Pimpalgaon (Khed tahsil) 2. Kondhapuri(Shirur tahsil)	137.32	5.8695 4.7540	1.7723 1.1837	1.5795 1.7723	
		137.32	**10.6235**	**2.9660**	**3.3518**	**154.2613**
Wegre	1.Apti (Shirur) 2.Vitthalwadi (Shirur)	219.44	4.6759 ----------	2.3089 ----------	4.4552 ----------	**230.88**
Lavharde	1.Kondhapuri (Shirur) 2.Raut wadi(Shirur)	106.55 ----------	---------- 2.8395	---------- 1.2218	---------- 1.2175	**111.8288**
Vedhe	***Village Vedhe has not been rehabilitated due to partial land acquisition (i.e. 42.92 ha)**	42.61	-	-	-	**42.61**
	Total Area in ha	**505.92**	**18.1389**	**6.4967**	**9.0245**	**539.5801**

Source: District rehabilitation center Pune 2006

Table no 6.14: Land acquired from affected area for Temghar irrigation project

Affected village	Agriculture area in ha	Residential area area in ha	Internal roads area in ha	Gaothan and other area in ha	Total area in ha
Temghar	137.32	3.0137	4.6998	1.3310	**146.3645**
Wegre	219.44	7.6776	9.7421	2.7694	**239.6291**
Lavharde	106.55	1.4504	3.0793	0.8753	**111.955**
Vedhe	42.61	-	-	-	**42.61**
Total area in ha	**505.92**	**12.1417**	**17.5212**	**4.9807**	**540.5586**

Source: District rehabilitation center Pune 2006

Table no. 6.13 Loss of agricultural land due to the project (area in Ha.)

Sr. No.	Name of the villages	Total agricultural land	Acquired for the project land	Balance land	Percentage of land lost	Percentage of Balance land
1	Temghar	589.00	137.32	451.08	23.4	74.60
2	Wegre	2144.51	219.44	1925.07	10.2	89.80
3	Lavharde	549.98	106.55	443.43	19.4	80.60
4	Vedhe	359.64	42.61	317.03	11.8	88.20
Total		**3643.13**	**505.92**	**3136.61**	**13.9**	**86.10**

Source: Field survey 2009

Table no. 6.12 Average no. of livestock per household in project affected villages

Sr. No.	Name of Villages	Average no. of livestock per household				
		Bullocks	**Cows**	**Buffaloes**	**Goats**	**Poultry**
1	Temghar	01	02	01	01	05
2	Vegre	01	01	01	01	04
3	Lavarde	01	02	01	03	05
4	Vede	01	03	01	02	08
Total		**04**	**08**	**04**	**07**	**22**

Source: Panchayat samitee Pune 2009

Table no. 6.11 Average cultivated land per household in project affected villages

Sr. No.	Name of the village	Average cultivated land per household (km^2)	Average cultivated land per household (Ha.)
1	Temghar	0.084	8.4
2	Vegre	0.127	12.7
3	Lavarde	0.066	6.6
4	Vede	0.065	6.5
Total		**0.097**	**9.7**

(Source: Panchayat samitee, Paud, Pune, 2009)

Table No. 6.10 Land use pattern of project affected villages (% area)

Sr. No.	Name of the village	Land use (as % of total geographical area)				
		Forest land	**Irrigated land**	**Un irrigated land**	**waste land**	**Not available for cultivation**
1	Temghar	25.4	00	63.9	0.0	**10.7**
2	Vegre	0.0	00	88.2	6.3	**0.1**
3	Lavarde	10.2	00	74.7	0.5	**14.6**
4	Vede	0.0	00	80.7	15.8	**3.5**
% of total area		**7.2**	**00**	**80.0**	**4.8**	**8.0**
Mulshi C.D. Block (Rural)		**16.7**	**1.5**	**80.0**	**4.8**	**1.0**

Source: Panchayat Samitee, Paud 2009

Table No. 6.9 Households below poverty line in project affected villages

Sr. No.	Name of the village	Total no of Households	No of households below poverty line	% of total households
1	Temghar	073	07	9.58
2	Vegre	171	12	7.01
3	Lavarde	094	30	31.91
4	Vede	049	05	10.20
Total		**387**	**54**	**58.70**

(Source: Panchayat Samitee- Paud 2009)

Table no. 6.8 Percentage of workers in economic activities in the project affected villages

Sr. No.	Name of the village	Percentage of workers			
		Agricultural workers to total workers	**Marginal workers to workers population**	**Total workers to main populations**	**Total population of workers**
1	Temghar	73.1	2.1	2.1	**77.30**
2	Vegre	56.0	6.9	2.0	**64.80**
3	Lavarde	63.8	12.2	4.0	**80.00**
4	Vede	36.1	8.2	17.7	**62.00**
Total		**229.00**	**29.40**	**25.80**	**284.20**

Source :Author (Based on census handbook 2001

6.7 Percentage literacy in project affected villages (2001)

Sr. No.	Name of the village	Percentage of Literates		
		Total	**Male**	**Female**
1	Temghar	48.5	61.6	21.9
2	Vegre	42.0	56.0	28.4
3	Lavarde	48.1	59.5	28.1
4	Vede	68.4	84.6	53.5
Total		**207**	**261.7**	**131.9**

Source: Census handbook 2001 and field survey 2009

Table no. 6.6 S.C. and S.T. population in affected villages in 2001

Sr. No.	Name of the village	Percentage of SC population		Percentage of ST population	
		2001	**2009**	**2001**	**2009**
1	Temghar	2.5	4.5	7.5	11.58
2	Vegre	2.9	4.9	7.1	11.02
3	Lavarde	3.2	-1.6	12.1	-2.86
4	Vede	27.2	37.1	7.0	-13.4
Average		8.9 %	11.22	33.7	1.58

Table no 6.5 Proportion of children below 6 years in project affected villages

Sr. No.	Name of the village	Children as % of population	
		2001	**2009**
1	Temghar	16.1	17.2
2	Vegre	19.5	21.1
3	Lavarde	18.0	19.3
4	Vede	16.0	16.4
Total		**69.6**	**74.0**
Average for four villages		**17.4 %**	**18.5%**

Source- Census handbook 2001 and field survey 2009

Table No. 6.4 Sex ratio in project affected villages

Sr. No	Name of the village	Sex Ratio (000 Female) (2001)
1	Temghar	259
2	Vegre	1026
3	Lavarde	614
4	Vede	1107

6.2 Population density in project affected villages

Name of the Village	Area (HA.)	Population Density (No. of persons/Ha.) (2001)
Temghar	922.31	1064
Vegre	2268.51	871
Lavarde	731.28	1643
Vede	372.64	158
Total	**4294.74**	**3736**

Table no 6.3 Average sizes of the households in project affected villages

Sr. no	Name of the village	No. of Households		Population	
		2001	**2009**	**2001**	**2009**
1	Temghar	73	79	389	406
2	Vegre	171	176	885	1000
3	Lavarde	94	108	541	612
4	Vede	49	51	211	222
Total		**387**	**414**	**1996**	**2340**

Source: Census handbook 2001 & household survey (Fieldwork 2009)

Table no. 6.1 Growth of population in project affected villages

Sr. No	Name of the Village	Population in the year					
		1951	**1961**	**1971**	**1981**	**1991**	**2001-09**
1	Temghar	201	325	349	339	373	407-434
2	Vegre	354	605	670	799	783	767-754
3	Lavarde	280	335	416	498	478	458-442
4	Vede	140	171	169	181	200	219-234
Sr. No	**Name of the Village**	**Decennial Growth**					
		1951-61	**1961-71**	**1971-81**	**1981-91**	**1991-2001**	**2001- 09**
1	Temghar	61.69	7.5	-2.9	10	185.25	4.28
2	Vegre	70.9	10.7	19.3	-2.1	11.23	13.02
3	Lavarde	19.6	24.2	19.7	-4	243	13.07
4	Vede	22.1	-1.2	7.1	10.5	-21	5.27

CHAPTER VII

INTEGRATED LAND RESOURCE MANAGEMENT

7.1 Importance of land resources and its management

Land is comprehensive natural resource which is the core element of the biosphere and responsible to survive all living things. It is an important natural resource, supports all living organisms including plants as well as every primary production system such as roads, industries, communication, storage for surface and grounds water, amongst others. Land is as non-renewable resource, which reserve energy itself related to a host of other element. Rapid urban development and increasing land use changes due to the increasing population and economical growth in selected landscapes is being witness of late in India and other developing countries. Land have been the basic factor of life support system on our planet since dawn of civilization .In recent year, the land resources has been subjected to a variety of pressures. Still it is surviving and sustaining mankind's these difficulties merit emphasis from the outset. Land surface, depending on the definition of what should be considered as land, can be measured accurately in units of area. They also can be classified fairly readily in broad terms by geographical or soil features or by climatologically and related ecological-vegetative grouping.

Land resources management is the actual practice of the use of land by the local population, which should be sustainable/appropriate techniques. In a broader sense it includes land-use planning, administrative and institutional execution, inspection and control of adherence to the decisions, solving of concession for plant and animal extraction. Improved land management that ensures better resource use and promotes long term sustainability is basic to future food production and to the economic welfare of communities. Because of the dynamic aspect of land management, a flexible and adaptive process, approach for monitoring the quality and quantity of the land resources such as soil, water, and natural vegetation etc. and for determining how human activities affects their resources is essential.

7.2 Need of Land Resource Management (LRM)

There is growing consensus that an effective way to control land degradation and enhance the long term sustainability of agricultural and rural communities is through locally based planning and management at the watershed scale. Coordinated resource management of a watershed requires the simultaneous of physical and socio-economic interrelationship and impact. In order to address these considerations, it is necessary to integrate a large amount of spatial information and knowledge from several disciplines. To be useful, information and knowledge must be made available to maker in a rational framework.

Advances in remote sensing, geographical information system GIS, multiple objective decision making, and physical simulation make it possible to develop user-friendly, interactive, decision support systems for watershed planning and management.

Study of land resources for economic development has been recognized as an essential component of development planning. It has assumed much greater importance in India now with acceptance of multi level regional development planning. Drainage basin or watersheds from the most convenient as well as most appropriate spatial units for the study of natural resources like land, forest and water.

Appraisal of resources and diagnosis of problems involved in management of the availability of these resources is particularly important in areas of scarce resources. Another striking problem arises in developmental planning especially in dam side areas that is submergence of land under water and resultant rehabilitation problems of the villagers. The problem this kind seems to be severe from point of view of the project affected people.

Increasing population ultimately exerts a pressure on natural resources, obviously, land resources are severely exploited due to increasing human interferences in natural ecosystems, therefore it is a urgent need to assess such kind of resources and create awareness in the society. Degradation or depletion of such kind of resources may lead to adverse effects on naturally balanced ecosystems.

Land assessment is concerned to a better balance between land potential and land practices. Proper management of natural resources is essential for sustainable development. Now it is realized fact that the optimum utilization of any resources should be a pre-requisite goal of management of natural resources. Management of

natural resources calls for delicate balance between competing demands and protection of fragile environment.

It is realized fact that comprehensive integrated information on natural resources is an essential prerequisite for integrated land use planning of an area. Land use bears a close correspondence with terrain characteristics especially in the tropical countries, where farming is much kin to the natural ecosystems. There is a direct impact of relief, geology, soil fertility status and micro climatic conditions in laying out the land use pattern. Recently, terrain evaluation has become a very important technique for the development planning purposes. Terrain analysis of an area provides the data base for the classification purposes.

7.3 Land degradation assessment based on soil loss estimation

In view of rehabilitation of project affected people in the same parcel of land it becomes inevitable to assess the natural resources in general and land resources in particular. Temghar lake catchment area thus assessed for the above mentioned purpose revealed that, it needs detail assessment of land resources to understand the present status and ultimately the steps to be followed to undertake for its management purpose.

An attempt has been made to assess the land degradation applying USLE has led to suggest priority levels for conservation planning and management.

7.4 Integrated Land Resources Management for Temghar lake catchment

Watershed is a natural hydrological entity from which surface run-off flows to a define drain, channel, stream or river at a particular point. Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetation cover, and other structural and non- structural action that are taken in watershed management objectives. Watershed deterioration is a common phenomenon in most part of the world. Amongst several causes, the major ones are improper and unwise utilization of watershed resources without any proper vision. Sustainable development is no doubt the appropriate policy strategy. Drainage basin, catchments and sub- catchments are the fundamental units of the management of land and water resources. The watershed management concept recognizes the inter relationships among the linkage between

uplands and low lands. Soil and water conservation is the key issue in watershed management while demarcating watersheds. While considering watershed conservation work.

7.4.1 Catchments area treatment plan

It is well established fact that, reservoirs formed by weirs on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediments in reservoir reduces its capacity, and thus affecting the water availability for the designated use (Photo plates 33, 34, 35). The eroded sediment from catchment when deposited on stream beds and banks, causes breaching of river reach. The removal of the top fertile soil from catchment adversely affects the agricultural production. Thus, a well designed Catchment Area Treatment (CAT) plan is essential to ameliorate the above mentioned adverse process of soil erosion.

Soil erosion may be defined as the detachment and transportation of soil. Water is the major agent responsible for this erosion. In many locations wind, glaciers etc. also caused soil erosion. **Soil erosion leads to:**

- Loss in production potential
- Reduction in infiltration rates
- Reduction in water holding capacity
- Loss of nutrients
- Increased in tillage operation cost
- Reduced transport and storage capacity and
- Reduction in water amiability

The Catchment Area Treatment (CAT) plan pertains to preparation of a management plan for the treatment of erosion prone areas in the catchment area of a water resources project. In the catchment area of a hilly area like that being considered for the Temghar irrigation project, water erosion is a common phenomenon and the same has been studied as a part of the Catchment Area Treatment (CAT) plan.

D-1

D-2

D-3

The Temghar lake catchment treatment plan is based on priority levels determined for conservation planning and related landforms (table no.7.1 and fig 7.1) various conservative measures are introduced in the plan for land resource management

The overall objectives of land resource management programme area to;

- Increase the tree cover
- Increase infiltration into soil
- Control excessive runoff and soil loss
- Manage and utilize runoff for useful purpose
- Reduce rate of siltation

Land conservation means reducing the amount of soil erosion and maintaining soil fertility, it relies on increasing the amount of water seeping into the soil reducing the speed

Table no.7.1 depict the catchment treatment plan of Temghar lake catchment suggested various conservation measures to protect the land from degradation in the study area.

Following Engineering (Fig 7.2a) and Biological measures (Fig 7.2b) have been suggested for the catchment area treatment.

Engineering measures:

- Gully plugging
- Earth bund
- Retaining wall
- Slope modification by terracing

Biological measures:

- Plantation of fruit trees and medicinal plants
- Afforestation with contour terracing & vegetable hedges
- Fodder plantation
- Horticulture

The first priority level conservation plan suggested for hilly summit zone is as follows:

D-4

D-5

D-6

D-7

7.4.2 Engineering measures

7.4.2.1 Gully plugging

Gullies can rapidly erode valuable topsoil and expose the sub soil or bedrock and making the land very fertile. It is important to halt the process of gully formation early, before they have had a chance to erode a large area. It reduces the amount of soil erosion down slope.

7.4.2.2 Earth bund

It consists of transforming relatively steep land in to a series of level or nearly level strips or steep running across the slope. The soil materials that are excavated from the upper part of the terrace is used in filling the lower part and a small bund is also raised along the outer edge of the terrace to check the downward flow of rainwater and also soil erosion.

7.4.2.3 Retaining wall

Contour bunding consists of building earthen embankment at interval across the slope and the contour line of the field. A series of such bund divide the area into strips and as barrio to the flow of water. As a result, the amount and velocity of runoff are reduced, resulting reducing the soil erosion. Contour bunding made on land where the slope is not very steep and the soil is fairly permeable. Contour bunds are also called level terraces, absorption type terraces or ridge type terraces.

7.4.2.4 Slope modification by terracing

A terrace is an embankment of ridge of earth constructed across the slope to control runoff and to minimize soil erosion. A terrace reduces the length of the hill side slope, thereby reducing sheets and rill erosion and prevents formation of gullies.

7.4.3 Biological measures

7.4.3.1 Plantation of fruit trees and medicinal plants

Plantation of Medicinal Aromatic plants vegetation provides organic matter to the soil. As a result, the fertility of soil increases and the physical condition of soil is improved. It is also provides ecological and economic benefits to the region. Table no 7.2 showing list of medicinal plant suitable for study area

Agroforestry involves planting trees or shrubs in the farm, or keeping those that are already there. Trees can conserve the soil erosion in many ways. They cushion the impact of raindrop on the soil, so reducing the amount of rain-splash erosion. Their roots bind the soil. They can interrupt the flow of water running of the surface. They shade the soil, reducing the soil temperature and cutting the amount of water that evaporates into the air. They break the wind, reducing the amount of wind erosion. They recycle nutrients from deep in the soil, and leguminous trees fix nitrogen that can benefit for crops.

7.4.3.2 Afforestation with contour terracing & vegetable hedges

Afforestation means growing of forests where there were no forests before owing to lack of seed trees or due to adverse factor such as unstable soil, aridity. Along with afforestation, reforestation should be undertaken which means replanting of forests at places where they have been destroyed by uncontrolled forests fire, excessive felling and lopping. Aforrestation is the best means to check the soil erosion.

7.4.3.3 Fodder plantation

Cultivation of row crops in sloppy lands permits soil erosion. In this field, the crops particularly cereals, fodder crop etc. should be broadcasted and the plants remain haphazardly in field. As a result, the movement of water gets obstacle and more water is absorbed in the soil, thus reducing soil erosion. Mixed and intercropping practice checks the soil erosion and avoids the risks of the crop failure.

D-8

7.4.3.4 Horticulture

This region suitable for vegetables, flowers, perishable fruit cultivation not only climatic condition is suitable for that but also this region is accessible to nearest Pune urban area due to this the nearest nest of urban region create lot of demand for fresh vegetables, flowers, fruits. These crops maintain the fertility of soil.

7.5 Proposed models for integrated land resource management

Temghar lake catchment comprises, around 33.71km^2 land surface area without water body, water body with a FRL level up to 710.12 m ASL admeasures about 4.99 km^2 i.e. 13.24 % of the entire area.

Geomorphic and soil study of the entire catchment on different aspects provides very important information pertaining to the quality of land and restrictions of physical determinants. Studies, on the same line reveal that, entire area is hilly terrain, coupled with high proportion of waste lands. Soil environment is poor and does provide realistic status of the quality of soil in terms of productivity, land capability and neither suitability, which is not so good nor it provides favorable condition for enhancement. Soil loss estimation study also resembles very serious thought as it is to the higher degree and leads to degradation of soil environment. Thus the eroding surfaces of hill slopes are bare in nature and being converted to useless land surfaces in the study area. Severe soil loss in this way not only become the problem of increase in the proportion of waste lands but it is also contributes high sediments influx to the water body and results into high rate of siltation.

In order to overcome this limitation present study mainly focuses on agricultural development, wasteland regeneration, forest development and identification of tourist spot for generation of employment for local poor. These themes are as however considered as model for integrated land resource management of the study area, and are explained in the following lines.

7.5.1 Model for agriculture development:

Agriculture in the study area accounts to about 0.26 km^2 of the total land surface area (without water body) and can be seen in patches. Paddy fields are less in numbers and are in the form of patches.

Detailed examination of morphological factors and soil environment in the study area clearly demonstrates that a physical determinant is the only factors which accumulate retardation of agricultural growth. Applying principles of integrated land resource management it is possible to convert vast proportion of waste land into agricultural land. Implementation of soil conservation measures in the form of afforestation programs, modification of slopes, continues contour trenches with vegetation hedges (fig no 7.2b) can help in restoration of wastelands and can be transformed into arable lands provided rehabilitation of the people is done in the same area. Agricultural land use pattern has to be changes and can be adopted keeping in the mind to raise the economy level of the affected people, therefore it is suggested that marginal portion of the backwater area and sites suggested (fig7.2 b) for agricultural practices should be utilized to their maximum and land use pattern should be changes to staple food production, horticultural practices and growing of medicinal plants so as to the can earn money. Thus the 20% of the land of the total land surface is amenable land and can be transformed to arable land.

7.5.2 Model for wasteland development (Wasteland regeneration)

Land use/ land cover analysis reveals that around 70% (69.85%) of the total land surface area is wasteland and can be regenerated by adopting catchment treatment plan suggested in the earlier pages. Vast stretches of waste lands thus can be transformed applying these techniques like slope modification, continuous contour trenches, contour terracing and applying agroforestry as well as social forestry principles. These land surfaces however has to be kept for continuous modification, monitoring and feedback should be ascertained with certain time interval. Possible outcome of these is reduction in the sediment yield and soil loss. Sedimentation in the backwater region of Temghar Lake Catchment can thus be checked as well as land degradation can also be minimized. The monitoring and initiation of work can be

done in the time interval. Within the span of two to three years wastelands can thus be minimize.

Table no. 7.3 indicates that, in the study area around 69.94% of the total land surface area owing to wasteland i.e. 7.27% (barren land) and 62.67% land with/without scrub land. Vegetation cover only amount to 9.38 km^2 i.e. 28.66% of the total land surface area. It therefore thought to develop and regenerate these vast proportions of wastelands through the principles of Integrated land resource management as well as to rehabilitate the affected population.

7.5.3 Model for forest development

The term is being concern with the development of forest by raising plantation. The work of compensatory afforestation in the catchment of forest area diverted for non- forestry purpose as per the provisions of the govt. but for the improvement/ balance of bio-diversity there should be exact plans of afforestation. Accordingly, the Temghar lake catchments having the appropriate geomorphic as well as climatic condition. Thus the following steps to be taken in to consideration; traditionally, the study area has huge bio-diversity so the species of plants may be suggested in to two groups i.e., Horticultural plants and tree plat. In Horticultural plants, Mango, Jamun, Jackfruits, local Berry (karvande) etc.species of plant and in the tree plantation, Bamboo, *teak, kair, and Haldu* etc. There should be a massive programme of afforestation and tree plantation. The forest should have an adequate share of land for productive, protective and aesthetic functions. There is also proper implementation of social forestry will provide fuel wood, small timber and employment opportunities to the project affected peoples. Rural fuel wood plantation schemes should be introduced. After planting care is important in the wasteland afforestation programmes. It is very important to go in for a mixed plantation, no single species should cover more than 10% of the area, along with other species, fodder grasses and legumes can also introduced, pioneer trees can be pruned for mulching the other species. The number of weeding, replacement of causalities, application of insecticides and fungicides need to be worked out. A number of species are being raised in afforestation of wasteland, but wasteland investigations are necessary with regard to their optimum use, chemistry of forest products for extraction of number of useful commercial chemicals needs to be investigated.

D-10

Total vegetation cover estimated for the entire lake catchment admeasures about 9.38 km^2 (28.68%) of the total land surface area. Despite submergence of 0.0045 km^2 (50 ha) land of forest. By enlarge forest cover in the catchment area does not exhibit a good cover as there is vast proportion of wastelands in the study area. It is to be mentioned that forest cover in the afforestation programmes and in the form of introduced plantation in the view of horticulture and medicinal plants can be raised. In the catchment treatment plan a very good technique that is contour trenching and terracing with vegetation hedges can be applied which could be useful for restoration of degradation land as well as increased in the vegetative cover. However, it is to be mentioned that, extensive afforestation programmers has to be implemented of by studying each and every segments of slopes and land limits monitoring of vast plantation programmes in the form of horticulture and medicinal plants should be left to the local people as they are only caretaker and observer. Out of this exercise they will also enrich their socio economic life, moreover forest land under government control should also be strictly monitor. Multipurpose plants species in this way certainly will helps to enhance the quality of soil as well as land resources. Thus implementation of these techniques is a certainly for assured income as well as development of forest cover in the study area. Nursery development can be undertaken to generate economy in the study area.

7.5.4 Model for ecotourism development – identification of spots

Study area is having a ample scenic beauty is especially in the rainy session at least three to five spots for these purpose have been identified in the backwater area. This will certainly help to generate income to the local people and ultimately flows of tourist will help them to raised their income as well as development of infrastructure.

Western ghat region has intensive potentials for tourism. Various tourist attractions are available in terms of natural, religious spots. In such manners, Temghar lake catchment has natural attractions such as dense forests, waterfalls, dam sites, tribal traditions and recently developed planned urban town that is Lavasa. Due to the Lavasa, accessibility has been increased, roads, hotels, motels are constructed. All infrastructural facilities are responsible in sudden growth of tourism activity in and around the study area. Impact of this situation has associated with the surrounding

villages. Socio- Economical development has been take place. So the influence of the tourist activity directly related to the study area.

In the study area, lake catchment and surroundings, dense forest are the main recreation spots, which can be a part of economical activity to increased the employment opportunities to the project affected peoples.

❑❑❑

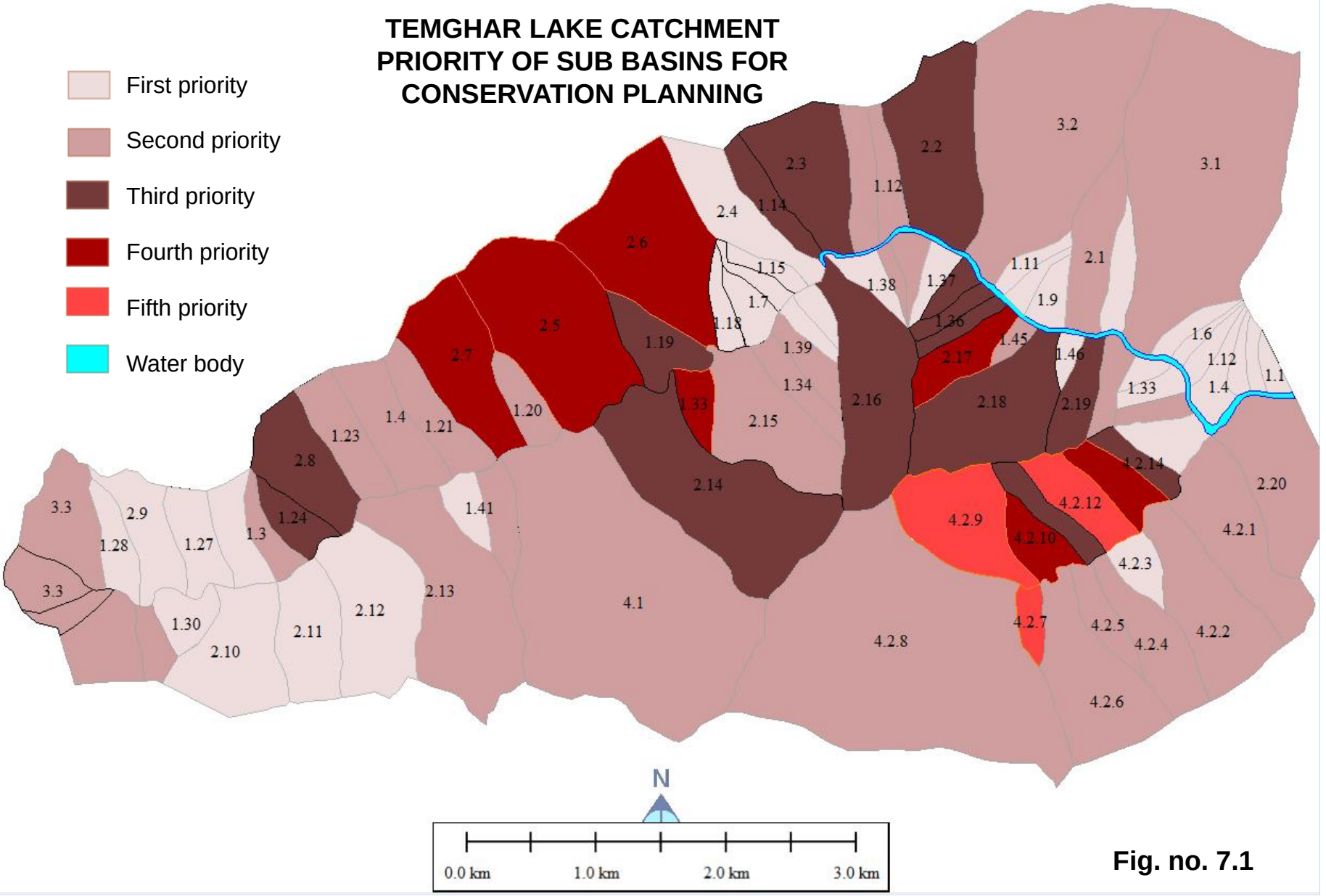

TEMGHAR LAKE CATCHMENT
PRIORITY OF SUB BASINS FOR
CONSERVATION PLANNING
First priority
Second priority
Third priority
Fourth priority
Fifth priority
Water body
3.2
3.1
2.3
2.2
1.12
2.4
1.14
2.6
1.15
1.38
1.37
1.11
2.1
1.9
1.7
1.18
1.36
2.5
1.19
1.39
1.45
1.46
1.6
1.12
1.1
2.7
2.17
1.34
1.33
1.4
1.4
1.21
1.20
1.33
2.16
2.18
2.19
2.15
1.23
2.8
4.2.14
2.20
2.14
4.2.12
3.3
2.9
1.41
4.2.9
4.2.1
1.24
1.28
1.27
1.3
4.2.10
4.2.3
3.3
2.13
4.1
1.30
2.12
4.2.7
4.2.5
4.2.2
2.11
4.2.8
4.2.4
2.10
4.2.6
N
0.0 km
1.0 km
2.0 km
3.0 km

Fig. no. 7.1

TEMGHAR LAKE CATCHMENT

CATCHMENT TREATMENT PLAN (ENGINEERING MEASURES)

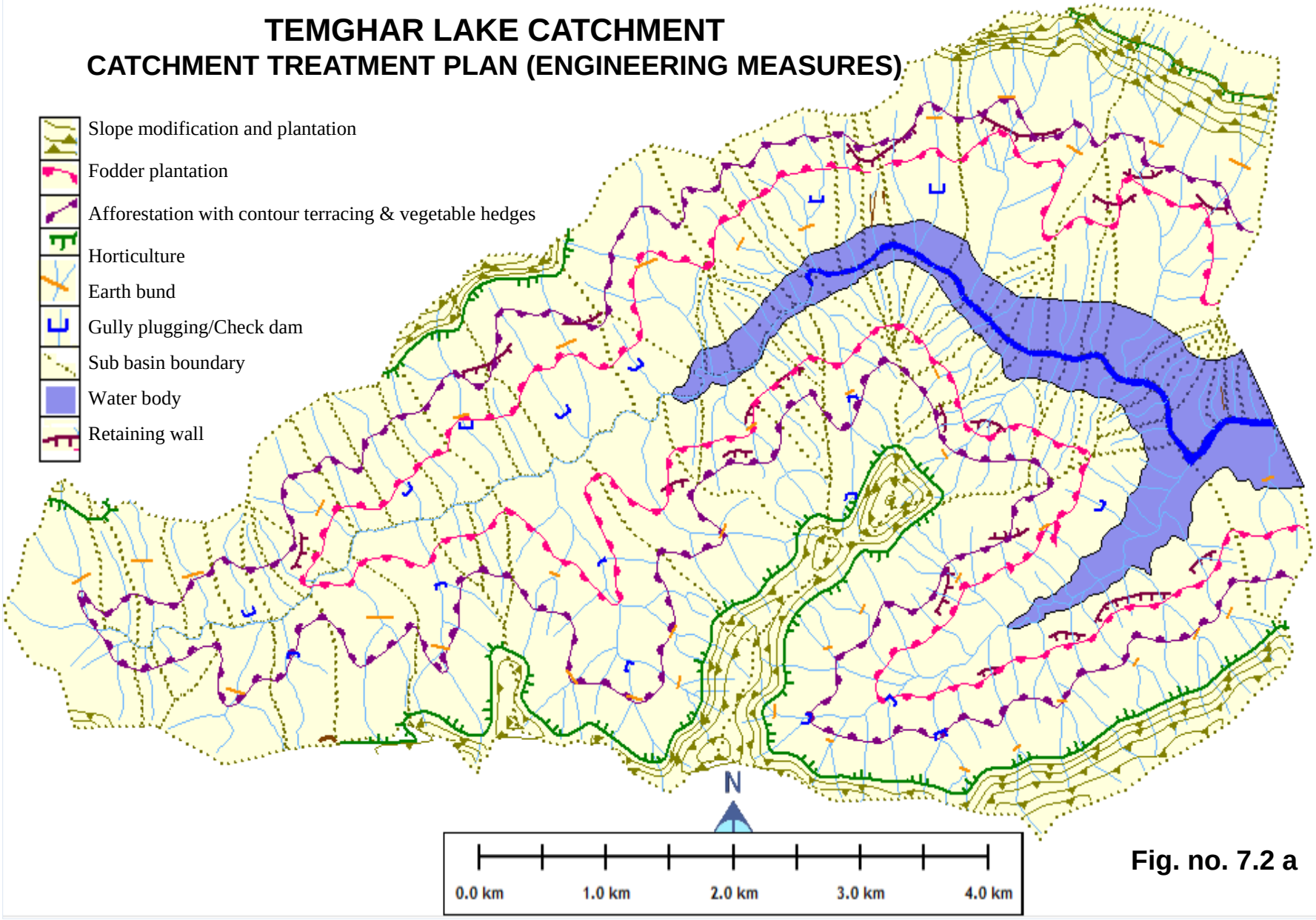


Fig. no. 7.2 a

TEMGHAR LAKE CATCHMENT

CATCHMENT TREATMENT PLAN (BIOLOGICAL MEASURES)

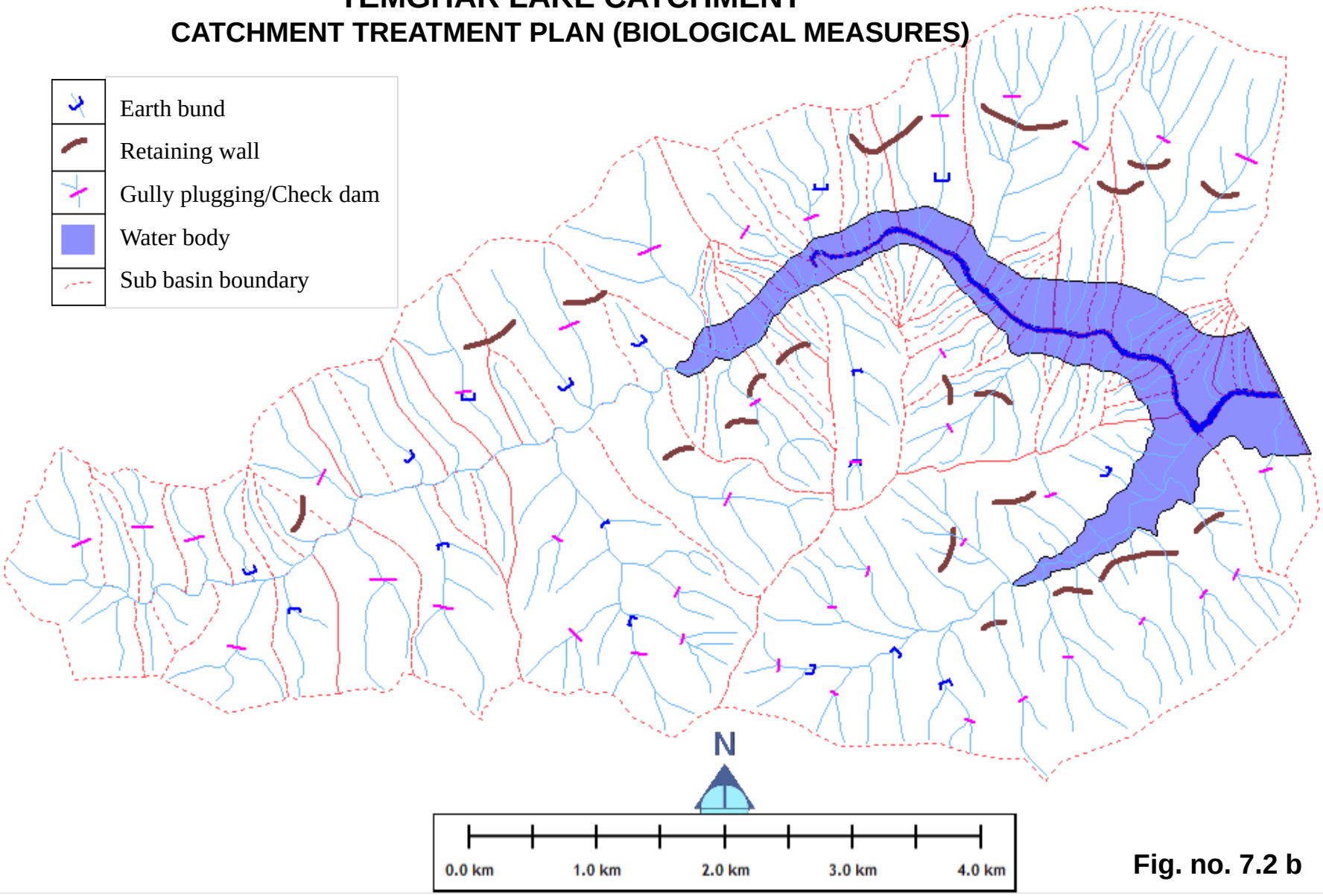


Fig. no. 7.2 b

Table 7.3 Altitude wise land use /Land cover analysis (Total land surface area)

Sr. No.	Height (M)	Built up land (Road)	Built up land (Settlements)	Agricultural land	Wasteland (Barren land)	Wasteland (Land with/ without scrub)	Vegetation cover	Alluvium deposits	Area (Km^2)	% to Total land surface area
1	<700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	700-720	0.00	0.01	0.00	0.30	0.11	1.08	0.01	**1.50**	4.59
	(%)	0.00	0.33	0.00	19.96	7.12	71.72	0.86	100.00	
3	720-740	0.00	0.01	0.07	0.26	0.86	0.33	0.00	**1.53**	4.68
	(%)	0.00	0.91	4.38	16.98	56.17	21.55	0.00	100.00	
4	740-760	0.01	0.00	0.03	0.35	0.87	0.40	0.00	**1.66**	5.06
	(%)	0.85	0.18	1.81	20.91	52.27	23.99	0.00	100.00	
5	760-780	0.01	0.00	0.05	0.31	0.77	0.41	0.00	**1.55**	4.74
	(%)	0.64	0.00	3.22	19.99	49.65	26.50	0.00	100.00	
6	780-800	0.01	0.00	0.02	0.20	0.93	0.41	0.00	**1.56**	4.78
	(%)	0.70	0.00	1.28	12.47	59.46	26.09	0.00	100.00	
7	800-820	0.01	0.00	0.00	0.18	0.87	0.50	0.00	**1.56**	4.76
	(%)	0.71	0.00	0.00	11.56	55.88	31.86	0.00	100.00	
8	820-840	0.01	0.00	0.00	0.15	0.83	0.55	0.00	**1.54**	4.70
	(%)	0.65	0.00	0.00	9.75	53.97	35.63	0.00	100.00	
9	840-860	0.01	0.00	0.00	0.05	0.88	0.58	0.00	**1.52**	4.65
	(%)	0.66	0.00	0.00	3.09	57.89	38.36	0.00	100.00	
10	860-880	0.01	0.00	0.00	0.05	0.98	0.58	0.00	**1.62**	4.95
	(%)	0.62	0.00	0.00	3.09	60.57	35.72	0.00	100.00	
11	880-900	0.01	0.00	0.00	0.04	1.37	0.70	0.00	**2.12**	6.49
	(%)	0.47	0.00	0.00	1.98	64.55	33.00	0.00	100.00	

Contd....

Contd....

12	900-920	0.01	0.00	0.00	0.06	1.86	0.75	0.00	**2.69**	8.21
	(%)	0.37	0.00	0.00	2.27	69.27	28.08	0.00	100.00	
13	920-940	0.01	0.00	0.03	0.08	2.11	0.80	0.00	**3.03**	9.25
	(%)	0.30	0.00	1.09	2.48	69.77	26.36	0.00	100.00	
14	940-960	0.01	0.00	0.00	0.11	1.93	0.64	0.00	**2.68**	8.20
	(%)	0.19	0.00	0.00	4.17	71.93	23.70	0.00	100.00	
15	960-980	0.01	0.00	0.03	0.04	1.25	0.39	0.00	**1.71**	5.23
	(%)	0.58	0.00	1.75	2.05	73.10	22.51	0.00	100.00	
16	980-1000	0.02	0.00	0.03	0.02	1.01	0.24	0.00	**1.32**	4.03
	(%)	1.52	0.00	2.28	1.52	76.63	18.06	0.00	100.00	
17	1000-1020	0.01	0.00	0.00	0.02	0.87	0.21	0.00	**1.11**	3.38
	(%)	0.90	0.00	0.00	1.81	78.14	19.15	0.00	100.00	
18	1020-1040	0.01	0.00	0.00	0.03	1.24	0.25	0.00	**1.53**	4.67
	(%)	0.65	0.00	0.00	1.90	81.15	16.30	0.00	100.00	
19	1040-1060	0.00	0.00	0.00	0.04	0.66	0.20	0.00	**0.90**	2.76
	(%)	0.00	0.00	0.00	4.42	73.01	22.57	0.00	100.00	
20	1060-1080	0.00	0.00	0.00	0.06	0.49	0.21	0.00	**0.76**	2.32
	(%)	0.00	0.00	0.00	7.37	64.47	28.16	0.00	100.00	
21	1080-1100	0.00	0.00	0.00	0.05	0.29	0.16	0.00	**0.50**	1.52
	(%)	0.00	0.00	0.00	10.26	58.35	31.39	0.00	100.00	
22	>1100	0.00	0.00	0.00	0.00	0.33	0.00	0.00	**0.33**	1.01
	(%)	0.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	
Total Area (Km²)		**0.16**	**0.02**	**0.26**	**2.38**	**20.50**	**9.38**	**0.01**	**32.71**	100.00
(%)		0.49	0.07	0.79	7.27	62.67	28.66	0.04	100.00	

Table no.7.2 List of suggested medicinal plants

Sr. No.	Botanical name	Local name
1	Zingiber officinale	*Sunth*
2	Piper nigrum	*Miri*
3	Coriandrum sativum	*Dhane jire*
4	Azadirachta indica	*kadu neem*
5	Vertiveria Zizanoides	*khas gavat*
6	Terminalis chebula	*Hirada*
7	Aloe barbadensis	*Korphad*
8	Withania somnifera	*Dhor gunj*
9	Punica Granatum	*Dalimb*
10	Trminalia belerica	*Behda*
11	Curcuma longa	*Halad*
12	Justicia adhatoda	*Adulasa*
13	Asparagus recemosus	*shatavari*
14	Amaranthus viridis	*Chiraet*
15	Costor oil	*Erandel tel*
16	Citrus lemon	*Edalimbu*
17	Embelia ribes	*Wavding*
18	Holarrhena pubescens	*Pandhara kuda*
19	Cyterus Roundus	*Nagarmotha*
20	Lowsonia intermis	*Mehandi*
21	Moringa oleifera	*Shevaga*
22	Ecllpta prostrata	*Maka*
23	Mimosa pudica	*Lajalu*
24	Cynodon Doctylon	*Durva*
25	Tinsopora Codrifiolia	*Gulvel*
26	Ocimum teniflorum	*Tulas*
27	Hibiscus rosa	*Jasvand*
28	Hemidesmus indicus	*Upalsari*
29	Leptadenia reticulata	*Khan Dodaki*
30	Cyperus rotundus	*Motha*
31	Holarrhena pubescens	*Kudha*
32	Ipomoea mauritians	*garvel*
33	Phyllanthus amarus	*Bhui Awala*
34	Centella asiatica	*Manduk parni*
35	Baco1pa monnicri	*Brahmani*
36	Andrographis paniculata	*Kalmegh*
37	Plantago ovata	*Esabgol*
38	helicteres isora	*Murudshen*
39	Rubia cordifolia	*Manjishtha*
40	Rauvolfia Serpentina	*Serpagandh*
41	Clerodendrum serratum	Bhavnagi
42	Cinnamomum nitidum	*Tamalpatri*

Table no. 7.1 Catchment area treatment plan

Soil loss study Priority level for conservation planning		Total numbers of sub basins	Sub basins order	Sub basins in Temghar lake catchment	Suggested measers Conservation measers code			Area in Sq. Km	Area in %
1	Very severe	3	4	TEM 4.2.7, TEM 4.2.9, TEM 4.2.12	GC/CD	SBP	SM	0.45371	1.3871
2	Severe	1	1	TEM 1.33	Res of DL	GC/CD	H & MP		
		4	2	TEM 2.5, TEM 2.6, TEM 2.7, TEM 2.17	Res of DL	BT	H & MP		
		2	4	TEM 4.2.10, TEM 4.2.13	Res of DL	RW	H & MP	3.30481	10.103
3	High	7	1	TEM 1.14, TEM 1.19, TEM 1.24,TEM 1.41, TEM 1.42, TEM 1.43, TEM 1.44	SM AFF	GC/CD FP	RW Res of DL		
		7	2	TEM 2.2, TEM 2.3, TEM 2.8, TEM 2.14, TEM 2.16, TEM 2.18, TEM 2.19	SM	AFF	Res of DL		
		2	4	TEM 4.2.11, TEM 4.2.14	SM	AFF	Res of DL	5.83911	17.851
4	Medium	17	1	TEM 1.12, TEM 1.13, TEM 1.20,TEM 1.21, TEM 1.22, TEM 1.23, TEM 1.25,TEM 1.29, TEM 1.32, TEM 1.34,TEM 1.35,TEM 1.36 TEM 1.39, TEM 1.40,TEM 1.45, TEM 1.47, TEM 1.50	Res of DL AFF	H & MP GC/CD	BT		
		4	2	TEM 2.1, TEM 2.13, TEM 2.15, TEM 2.20	AFF				
		3	3	TEM 3.1, TEM 3.2, TEM 3.3	SM	AFF	Res of DL		
		7	4	TEM 4.1, TEM 4.2.1, TEM 4.2.2, TEM 4.2.4, TEM 4.2.5, TEM 4.2.6, TEM 4.2.8	SM	AFF	Res of DL	16.01381	48.957
5	Low	25	1	TEM 1.1, TEM 1.2, TEM 1.3,TEM 1.4, TEM 1.5, TEM 1.6, TEM 1.7,TEM 1.8, TEM 1.9, TEM 1.10,TEM 1.11,TEM 1.15, TEM 1.16, TEM 1.17,TEM 1.18, TEM 1.26, TEM 1.27,TEM 1.28,TEM 1.30, TEM 1.31, TEM 1.37,TEM 1.38, TEM 1.46, TEM 1.48, TEM 1.49	FP	AFF	H & MP		
		5	2	TEM 2.4, TEM 2.9, TEM 2.10, TEM 2.11,TEM 2.12	FP				
		2	4	TEM 4.2.3, TEM 4.2.15	BT	AFF		7.09856	21.701
Engg. & Biological measers		Sr.No	Code	Measers					
			GC/CD	Gully control/Check dams					
			RW	Retaining wall					
			SM	Slope modification					
			BT	Bench terracing					
			Res of DL	Restoration of degraded land					
			AFF	Afforastration					
			FP	Fodder plantation					
			H & MP	Horticulture and medicinal plantation	Total land surface area			32.71	100



33. SUBMERGED TREES –A LOSS OF BIODIVERSITY IN THE BACKWATER AREA



34. EROSION AND TRANSPORTATION OF SEDIMENTARY DEPOSITS IN THE BACKWATER –DISTANT VIEW



35. EROSION AND TRANSPORTATION OF SEDIMENTARY DEPOSITS IN THE BACKWATER - CLOSE VIEW

CHAPTER VIII

DISCUSSION, CONCLUSION & SUGGESTIONS

8.1. Discussion

The area selected for the present study is a area of Temghar lake catchment from western Maharashtra. This is one of the minor irrigation projects under *Krishna Khore Vikas Mahamandal*. (Krishna Basin Development Corporation).The Temghar dam commenced in the year 2000. The dam has been constructed keeping in view the increasing population of Pune city and thus linked to Khadakwasla irrigation project. The main purpose of these minor/medium projects is to supply water for Pune city as well as for irrigation in Haveli, Daund, Indapur, and Baramati etc tahsils. There is growing consensus regarding rehabilitation problems all over the country. Lots of procedures involved in terms of rehabilitation of affected areas and areas where these people has to be rehabilitated.

Rehabilitation has always been a major problem, not only because moving people from their hearts and homes is always a shocking experience for the affected people, but also because of the legal and logistical difficulties experienced by the governments all over the world.

The argument put forward by supporters of large dams is that, some people have to sacrifice for the sake of national development and public interest and that the affected people can always be compensated. Even if displacement is accepted as an inevitable consequence of a development project, the counter question immediately arises is development of whom? Whose interest? And at whose cost? compensation paid to the affected people was neither appropriate nor adequate.

There are complex interrelationships between economic, environmental, social, technical, political and cultural factors. A number of risks have been identified in the literature on displacement and resettlement.

Apart from being asked to give up their socio-cultural life and their land, the affected people are forced to give up their traditional occupation of pasturing and grazing for the so called modern farming. Invariably, the affected people, who do not possess any economic or political power to press across

their demands and views, Their organization and education is very important to make them aware of matters regarding their life. Local organizations along with other groups such as conservative groups, political figures, intellectuals and media can be of much more use, nationally and internationally in influencing policy makers in their favors.

Involuntary resettlement consists of two closely related social processes: the displacement of people and the reconstruction of their livelihoods. Reconstruction is concerned with how the displaced people recover their capacity to maintain an adequate livelihood, and form a new community or be integrated into existing communities. The involuntary resettlement of such predominantly disadvantaged groups as women and rural peasants, is, and will remain, a contentious issue not only in the countries concerned, but also in the wider international community.

Governments, no doubt, offer compensation to the affected people, in terms of land or cash or both for tangible property lost, but this compensation often do not counter-balance the social, cultural and psychological disturbances. They need to be rehabilitated, not only economically i.e. by offering land and cash, but also socially and psychologically as well.

Many resettlement schemes have shown that, the traditional patterns are invariably ignored while planning for the resettlement schemes. Socio-cultural variables are overlooked in the name of modernization. Often resettlement of affected people takes place in an unfamiliar environment – socially as well as climatically. Many times the host population has physically prevented settlers from cultivating their allotted land.

Displacement often entails fragmentations of large family life, because the resettlement villages have always been according to past experiences smaller than their original villages. The decision regarding the choice of the site is most crucial since it decides the destiny of a large number of displaced people. The criteria for deciding the site in many schemes are mainly economic.

The socio-cultural, historical and environmental aspects are often ignored by the government. The original socio-economic beliefs and values should be taken in to account in the process of planning for resettlement. The

change to be brought about by the resettlement should be realistic and workable.

Social integration of the new settlers into the community life with the hosts should be regarded as an important and basic objective of the resettlement as no two groups with conflicting interests and values can hope to realize desired standard of living or healthy social life. Collective rehabilitation of the whole village is most appropriate as it can reduce the effects of hostility from host population.

Integrated land resource management for economic development has been recognized as essential component of development planning .It has assumed much greater importance in India now with acceptance of multi level regional planning. In India various issues regarding depletion and deterioration of forest, water and soil resources are being discussed by various scholars, social thinkers and development planners. All the developments projects are essentially designed to serve the public interest in the best possible manner. The projects are the tools or the instrument through which or with which the developmental perspectives and the intention of the policy makers are carried out. However, such projects invariably need land for their normal operational activities; this implies either voluntary or involuntary rehabilitation of people owning that land since it is not always possible to get waste land devoid of any crop or habitation. Eventually this involuntary acquisition of assets for projects gives rise to the planning for rehabilitation and resettlement of the project affected people. The rehabilitation action plan outlines the rehabilitation and resettlement measures necessary to ensure compensation for assets acquired at replacement cost and mitigation of loss of livelihood for all PAPs so that their income is sustained and they are not made worse off due to project implementation.

The present study has been initiated to assess available natural resources in general and land resources in particular in the lake catchments area itself and to ascertain the potential of it to hold these populations along with their activities in the same catchments.

In view of this it is to be noted that, Temghar lake catchment lack in proper soil and water conservation measures leads to increase in silt flow in the backwater area of the Temghar dam .The increased run off from the denuded

hill slopes, with the accelerated soil erosion through a network of gullies and streams, carrying sediments with its flow. The most important sources of this sediment flow, immediately entering into the rivers, are gully and stream bank erosion. Another important factor that adds to the sediment load, and which contributes to soil degradation is grazing pressure. A large number of cattle, sheep, and goats graze the hill slope pastures during monsoon and winter season continuously for about more than six months. Due to this pressure, the productivity of these pastures is also declining further. The lack of proper vegetal cover is a factor to cause degradation and thereby results in severe run off/soil erosion, and subsequently premature siltation in the lake. Thus, the soil erosion in the catchment would reduce the productivity of land. Instead of carrying out expensive and difficult operations of desilting of the lakes and water downstream, it is wise to treat the catchment of the river, to reduce the silt inflows. Proper gully treatment and water harnessing structures are required which could be provided in the catchment area so as to reduce runoff and sediment flow. The forest cover in the catchment area is 28.68 % of the total area. To check siltation, it is imperative that massive afforestation programme has to be also taken up in the area. Thus the catchment treatment would involve both biological and engineering measures for arresting the soil erosion process and controlling the sediment transfer to a certain extent.

The Catchment Area Treatment Plan (CAT Plan) envisages controlling the soil erosion process such as gully and sheet erosion, and subsequent sediment transfer to lake.

The CAT Plan targets towards overall improvement in the environmental conditions of the region. All the activities are aimed at treating the degraded and potential areas of severe soil erosion. The plan provides benefits due to biological and engineering measures, and its utility in maintaining the ecosystem. The plan with objectives addresses issues such as prevention of gully erosion, enhancing the forest cover for increasing soil holding capacity; and arresting sediment flow in the lake and flowing waters. The present CAT Plan comprises details of field investigations, identification of biological and engineering control measures for sediment arrest. Considering the topographic factors, soil type, climate, landuse /landcover in the catchment area following engineering and biological measures has been suggested and can

to be undertaken with the aim to check the soil erosion, prevent/check siltation of lake and to maintain its storage capacity in long run.

CONCLUSIONS:

In depth examination of physical determinants (relief,soil,land capability, suitability and productivity), Land use/Land cover analysis, assessment of socio-economic status of affected population due to Temghar irrigation project and the resultant implementation of rehabilitation of the same, various socio-economic, cultural dimentions and problems of the rehabilitants, present study arrives at following conclusions.

1. Relief analysis of Temghar lake catchment portrayed physical make up of the area which is very important and forms initial step in the assessment of natural resources and thereby resource management.
    a. Very low to moderate absolute relief category covers around 79% of total land surface area and extremely low relative relief covers around 65% of the total land surface area indicates this is a potential land surface unit and amenable for various kinds of uses.
    b. Extremely low dissection index also provides around 68.39% of total land surface area and altitudinal zone between 780 to 1000 m (73.197% of the total land surface area) as a zone for reclamation and can be practiced for various purposes especially for rehabilitation and agricultural practices.
    c. Area under moderate to steep sloping category covers around 79% of total land surface area and seems to be the most eroding sites and a potential surface area for horticulture and erecting some anti erosional structures provided management practices are initiated.
    d. It is also noticed in the hypsometric analysis that the entire catchment is in youthful stage of development (hypsometric Integral value 78.70%) and subjected to the process of denudation.
    e. Denudation of the surface area is also evident in the form of vast stretches of waste lands in the form of barren rocky surfaces and scrub land / without scrub lands (around 70% of the total land surface area) which are ultimately producing high surface runoff and

thereby high sediments influx in the backwater of Temghar lake catchment.

f. Soil environment in the study area has certainly reflected the effect of terrain characteristics and do show very poor quality and degrading in a nature. This has ascertained in the assessment of land capability, suitability and productivity.

2. In an attempt to simply identify the correlation among the fourteen different variables pertaining to physical determinant like elevation, absolute relief, relative relief, % dissection index, percentage slope, soil type, soil depth, infiltration rates, geomorphic units, soil capability, suitability, soil productivity, land use land cover and estimated soil loss etc. It can be observed that,

   a. Absolute relief, relative relief and dissection index and infiltration rate are moderately positive to highly positive correlated to each other.

   b. Elevation (height), absolute relief and relative relief shows moderately positive correlation with % dissection index and infiltration rate.

   c. Percentage dissection index have highly positive correlation with infiltration rate and percentage slope shows very much sensitive to soil loss.

   d. Soil types have very strong correlation with suitability classification.

   e. Soil depth has strong positive correlation with geomorphic units,

   f. Soil capability however have strong correlations with soil productivity and land use/ land cover where as soil suitability does not show very good correlation to any other variable except soil loss (very low positive correlation) soil productivity have a very strong correlation with land use/ land cover. (Table 8.1)

3. Government authorities claim that, this is the only project where 100% rehabilitation plan has been implemented successfully is a false claim and real picture of which envisage that, these rehabilitants facing lots of socio cultural problems as mentioned in the earlier lines, therefore this claims remains on a paper only and facts are different and unfocused.

D-1

4. Acquisition of land in the affected area has remained a land of no practice because of legal constraints. Ratio between acquired land for project and allotted land is considerably unbalanced where almost in all affected villages, more than 75% of agricultural land is in balance but acquired land therefore no agricultural practices can be initiated. This seems to be the wastage of land resources and due to lack of maintenance it becomes permanent fallow lands.
5. Considering the soil quality as deduced and inferred from land capability, suitability and productivity assessment it is inferred that there is a degradation of soil environment due to lack of conservation structures and maintenance.
6. In land capability classification studies, class I (very intensive cultivation) and II (intensive cultivation) in nature are totally absent, in soil suitability classification studies, class S1 and S2 are of (highly and moderately suitable respectively) almost absent and remains only a class S3 (Marginally suitable) and N1 (currently not suitable), N2 (permanently not suitable) type of land. Productivity assessment of soil also indicates that entire area almost showing poor productivity. This seems to be great environmental threat to the area in terms of degradation of soil environment presently and as well as in the near future also.
7. Land use / land cover analysis also indicates that high proportions of waste lands which will happen to degrade the land surface area in the form of severe runoff and soil loss.
8. Project affected families (PAF's) forcefully rehabilitated at sites very far from their native place has to face day to day life conflict with host population due to non acceptance and involvement by them.
9. It is also inferred that government has almost spent Rs-70.51 Crores for this project .It can be certainly stated that , If only 60% of amount of this cost is spent for Integrated land Resource Management. It would be more worth, feasible and environmentally sustainable.
10. In EIA studies of this irrigation project it is also mentioned the Cost - Benefit – Ratio i.e. 1.17 indicates that this project is not that much beneficial.

Suggestions:

Since the present study intends to rehabilitate the people in the same piece of land. Land resources in the study area needs to be scientifically and systematically manage through the principles of Integrated Natural Resource Management (INRM) in general and Integrated Land Resource Management (ILMR) in particular. As a initial step in the management process it is certainly observed that, the area requires catchment treatment and can be achieved through engineering and biological measures to reclaim the land resources and to conserve them.

1. CAT (Catchment Area Treatment Plan) suggested though engineering measures and biological measures will certainly helpful in maintaining the natural environment of the area. (Fig 7.2 a & b)
2. Site suitability analysis performed for rehabilitation of project affected families indicates that altitudinal zone between 780 to 1000 m is a suitable altitudinal zone for rehabilitation along with agricultural practices.
3. In ILRM, it also expected to have a participatory involvement of local people to make the management successful and fruitful that can be described as "participatory management done by the people for the people".
4. In order to maintain social, religious and psychological attachment of the people to their native areas; it is wise to change rehabilitation policy by giving attention in management of local resources.
5. As initiation of ILRM, sub basins identified in the study of prioritization of them for conservation planning should be taken accordingly (Table 7.1)
6. The models suggested for regeneration of waste lands, agriculture (including horticulture), forest and ecotourism should be initiated as a development of natural resources and as a basic step towards sustainable planning and management. However these models may be used as role model in such kind of situation and rehabilitation polices to be implemented in future.

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Table 8.1 Correlation matrix of geomorphic ,soil variables, LU/LC and soil loss

Variables	HEIGHT	AR	RR	DI	PS	ST	SD	IR	GMU	SC	SS	SP	LULC	SL
HEIGHT	**1**	**0.993**	0.535	0.614	0.252	-0.894	-0.081	0.706	-0.070	-0.045	-0.809	-0.024	0.052	0.177
AR	0.993	**1**	0.434	0.524	0.354	-0.842	-0.105	0.624	-0.134	-0.126	-0.746	-0.076	-0.012	0.294
RR	0.535	0.434	**1**	**0.988**	-0.674	-0.714	-0.143	0.807	0.160	0.317	-0.717	0.094	0.227	-0.685
DI	0.614	0.524	0.988	**1**	-0.609	-0.727	-0.254	0.775	0.030	0.185	-0.705	-0.029	0.107	-0.574
PS	0.252	0.354	-0.674	-0.609	**1**	-0.007	0.232	-0.240	-0.105	-0.270	0.050	0.013	-0.076	0.880
ST	-0.894	-0.842	-0.714	-0.727	-0.007	**1**	-0.241	-0.946	-0.342	-0.393	**0.986**	-0.362	-0.453	0.220
SD	-0.081	-0.105	-0.143	-0.254	0.232	-0.241	**1**	0.370	**0.938**	0.860	-0.371	**0.969**	**0.928**	-0.244
IR	0.706	0.624	0.807	0.775	-0.240	-0.946	0.370	**1**	0.547	0.624	-0.980	0.536	0.635	-0.513
GMU	-0.070	-0.134	0.160	0.030	-0.105	-0.342	0.938	0.547	**1**	**0.984**	-0.489	**0.993**	**0.992**	-0.560
SC	-0.045	-0.126	0.317	0.185	-0.270	-0.393	0.860	0.624	0.984	**1**	-0.539	**0.958**	**0.979**	-0.694
SS	-0.809	-0.746	-0.717	-0.705	0.050	0.986	-0.371	-0.980	-0.489	-0.539	**1**	-0.501	-0.589	0.332
SP	-0.024	-0.076	0.094	-0.029	0.013	-0.362	0.969	0.536	0.993	0.958	-0.501	**1**	**0.991**	-0.460
LULC	0.052	-0.012	0.227	0.107	-0.076	-0.453	0.928	0.635	0.992	0.979	-0.589	0.991	**1**	-0.541
SL	0.177	0.294	-0.685	-0.574	0.880	0.220	-0.244	-0.513	-0.560	-0.694	0.332	-0.460	-0.541	**1**

Appendix I SOIL RATING CHART

(Storie soil Index Rating = factor A* factor B* factor C* factor X)

FACTOR A- Rating on character of Physical Profile

Sr. No	Particulars	Percentage
I	Soil on recent alluvial fans. Flood plains or other secondary deposits having undeveloped profiles	**100**
	X- Shallow phases (on consolidated Material) 2feet deep	**50-60**
	X-shallow phases (on consolidated Material) 3feet deep	**70**
	g- extremely gravelly sub soils	**80-95**
	s-stratified clay sub soils	**80-95**
II	Soils on young alluvial fans. Floods plains or other secondary deposits having slightly developed Profiles	**95-100**
	X- Shallow phases (on consolidated Material) 2feet deep	**52-60**
	X- Shallow phases (on consolidated Material) 3feet deep	**70**
	g- extremely gravelly sub soils	**80-95**
	s-stratified clay sub soils	**80-95**
III	Soils on older alluvial fans. Alluvial plains or terraces having moderately developed profiles (moderately dense sub soils)	**80-95**
	X- Shallow phases (on consolidated Material) 2feet deep	**40-60**
	X- Shallow phases (on consolidated Material) 3feet deep	**60-70**
	g- extremely gravelly sub soils	**60-90**
IV	Soil on older plains or terraces having Strongly develop profiles (dense clay sub soils)	**40-80**
	Soils on older plains or terraces having hard pan sub soil layers	

Sr. No	Particulars	Percentage
	at less than 1 foot	**5-20**
	at 1 to 2feet	**20-30**
	at 2 to 3feet	**30-40**
	at 3to 4feet	**40-50**
	at 4to 6feet	**50-80**
VI	Soils on older terraces and upland areas having dense clay sub soils resting on moderately consolidated or consolidated material	**40-80**
VII	Soils on upland areas underlain by hard igneous bed rock	
	at less than 1 foot	**10-30**
	at 1 to 2feet	**30-50**
	at 2 to 3feet	**50-70**
	at 3to 4feet	**70-80**
	at 4to 6feet	**80-100**
	At more than 6 feet	**100**
VIII	Soils on upland areas underlain by consolidated sedimentary roc	
	at less than 1foot	**10-30**
	at 1 to 2feet	**30-50**
	at 2 to 3feet	**50-70**
	at 3to 4feet	**70-80**
	at 4to 6feet	**80-100**
	at more than 6 feet	**100**
IX	Soils on upland areas underlain by softly consolidated material	
	at less than 1feet	**20-40**
	at 1 to 2feet	**40-60**
	at 2 to 3feet	**60-80**
	at 3to 4feet	**80-90**
	at 4to 6feet	**90-100**
	at more than 6 feet	**100**

FACTOR B- Rating basis of surface structure

I	Medium Textured	Percentage
	Fine sandy loam	**100**
	Loam	**100**
	Silt loam	**100**
	Sandy loam	**95**
	Silty clay loam, calcareous	**95**
	Silty clay loam non calcareous	**90**
	Clay loam, calcareous	**95**
	Clay loam non calcareous	**85-90**
II	**Heavy or fine textured**	**Percentage**
	Silty clay, high calcareous	**70-90**
	Silty clay non calcareous	**60-70**
	Clay, highly calcareous	**70-80**
	Clay, non calcareous	**50-70**
III	**Light or coarse textured**	**Percentage**
	Coarse sandy loam	**90**
	Loamy sand	**80**
	Very fine sand	**80**
	Fine sand	**65**
	Sand	**60**
	Coarse sand	**30-60**

IV	Gravelly	Percentage
	Gravelly fine sandy loam	**70-80**
	Gravelly loam	**60-80**
	Gravelly silt loam	**60-80**
	Gravelly sandy loam	**50-70**
	Gravelly clay loam	**60-80**
	Gravelly clay	**40-70**
	Gravelly sand	**20-30**
V	**Stony**	**Percentage**
	Stony fine	**70-80**
	Sandy loam	**60-80**
	Stony loam	**60-80**
	Stony silt loam	**50-70**
	Stony sandy loam	**50-80**
	Stony clay loam	**40-70**
	Stony clay	**10-40**
	Stony sand	**Below 10**

FACTOR B- Rating basis of surface structure

FACTOR C- Rating on basis of slope	Percentage
A—nearly level (0to2%)	**100**
AA—gently undulating (0to2%)	**95-100**
B—gently sloping (3-8%)	**95-100**
BB—Undulating (9-15%)	**85-100**
C—moderately sloping (9-15%)	**80-95**
CC—Rolling (9-15%)	**80-95**
D—strongly sloping (16-30%)	**70-80**
DD—Hilly (16-30%)	**70-80**
E—Steep (30-45%)	**30-50**
F—Very steep (45%and over)	**5-80**

FACTOR X- Rating of conditions other than those in factors A,B and C

Drainage	**Percentage**
Well-drained	**100**
Fairly well drained	**80-90**
Moderately waterlogged	**40-80**
Badly waterlogged	**10-40**
Subject to overflow variable	**variable**
Alkali	**Percentage**
Alkali free	**100**
Slightly affected	**60-95**
Moderately affected	**30-60**

Moderately to strongly affected	**15-30**
Strongly affected	**5-15**
Nutrient (fertility) level	**Percentage**
High	**100**
Fair	**95-100**
Poor	**80-95**
Very poor	**60-80**
Acidity according to degree	**80-95**
Erosion	**Percentage**
None to slight	**100**
Detrimental deposits	**75-95**
Moderate sheet erosion	**80-95**
Occasional shallow gullies	**70-90**
Moderate sheet erosion with shallow	
gullies	**60-80**
Deep gullies	**10-70**
Moderate sheet erosion with deep	
gullies	**10-60**
Severe sheet erosion	**50-80**
Severe sheet erosion with shallow	
gullies	**40-50**
Severe sheet erosion with deep	
gullies	**10-40**
Very Severe erosion	**10-40**
Moderate wind erosion	
Severe wind erosion	**80-95**

Micro relief	Percentage
Smooth	**100**
Channels	**60-95**
Hog wallows	**60-95**
Low hummocks	**80-95**
High hummocks	**20-60**
Dunes	**1-40**

Appendix II PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

PHYSICAL PROPERTIES OF SOIL

SR.NO.	Lat.	Long.	Sy.No.	Profile No.	Depth cm.	CaCo3 %	Organic Carbon%	Air dry Moist%	Machanical Analysis				Texture
									Coarse Sand%	Fine Sand%	Silt%	Clay%	
1			3	4	5	6	7	8	9	10	11	12	25
Wegare													
1	73.498	18.455	63	1	0.18	3	1.42	3.5	12.46	27.63	21.5	33.5	SCL
2	73.508	18.452	44	2	0.1	3.3	1.02	4.2	9.32	39.21	17.5	28.75	SCL
3	73.508	18.448	50	3	0.22	2.7	0.84	4.3	8.41	31.45	27.25	27.75	SCL
4	73.521	18.453	452	4	0.21	2.4	1.47	5.35	3.41	37.52	21.75	30.5	SCL
5	73.514	18.452	468	5	0.22	2.1	1.41	4.75	10.44	35.47	13.75	28.75	SCL
6	73.521	18.467	172	6	0.2	2	1.44	4.2	0.96	28.15	24.25	27	C
7	73.507	18.441	53	7	0.18	2.8	1.41	4.25	4.4	39.17	24	26.75	SCL
8	73.499	18.432	77	8	0.2	3.1	1.42	4.3	6.83	31.47	27.25	28.75	SCL
9	73.497	18.466	129	9	0.23	2.3	1.44	5.25	12.96	25.6	26.75	27	SCL
10	73.496	18.442	83	10	0.14	2.6	1.48	5.25	4.57	46.94	17.25	2 4.50	SCL
11	73.501	18.45	57	11	0.19	2.2	1.28	6.6	4.95	24.17	19	48	C
12	73.518	18.474	228	12	0.14	2.4	0.68	5.4	5.59	23.83	19	45	C
13	73.489	18.457	128	13	0.12	2.5	0.38	6	0.71	29.41	25	3 8.5	C
14	73.483	18.439	133/1	14	0.21	3.1	0.9	4.5	8.18	44.42	14.5	27.5	SCL
15	73.49	18.445	111/1	15	0.18	2.4	0.74	4.25	2.28	45.48	19.71	27.5	SCL

16	73.472	18.445	111/3	16	0.16	3	0.78	5	3.53	36.69	21	33	SCL
17	73.468	18.433	101/3	17	0.17	3.2	0.96	6.65	7.42	23.97	25	33	C
18	73.488	18.434	111/4	18	0.1	2.2	0.48	6.45	0.75	38.82	26.5	27	SCL
19	73.529	18.474	236	19	0.2	3.3	0.78	6.2	4.35	26.92	27.75	34	CL
20	73.509	18.469	136	20	0.8	2.8	0.6	5.9	4.03	31.22	29.5	28	CL
Temghar													
21	73.515	18.431	70	1	0.25	3.8	0.54	9.06	2.45	20.7	14.75	43.5	C
22	73.529	18.426	40	2	0.22	3.5	1.62	9.38	9.4	11.95	16.25	51.4	C
23	73.532	18.442	55	3	0.16	3.1	1.02	8.02	14.68	7.53	20.75	48	C
24	73.54	18.44	21	4	0.35	4	0.75	9.34	13.15	17.3	15.25	44.25	C
25	73.539	18.433		5	0.15	1.5	0.81	9.57	10.59	4.78	13	62.15	C
26	73.548	18.439	16	6	0.2	2.6	0.45	8.1	15.02	19.43	16.5	49.5	C
27	73.54	18.447	138	7	0.2	2.3	0.81	9.93	8.94	35.15	15.5	48.2	C
28	73.531	18.45	115	8	0.14	3.3	1.38	4.9	2.6	23.11	19	49.25	C
29	73.537	18.453	129	9	3.3	3.1	0.66	3.5	4.36	29.74	14.5	17.25	C
30	73.523	18.446	120	10	1.38	2.4	1.62	6.4	10.06	20.17	20	4.75	C
31	73.545	18.45	148	11	4.9	2.6	0.99	5.4	2.41	18.7	15.25	57.25	C
32	73.516	18.44	93	12	2.6	3.8	1.62	4.25	5.53	22.6	11	55	C
Vede													
33	73.55	18.432	4	1	0-18	7	0.69	7.94	4.86	18.26	12.25	56	C
34	73.539	18.426	14	2	0-29	8.7	0.57	8.19	2.32	38.17	11.5	39.25	C
35	73.537	18.473	38	3	0-3	8.1	0.57	8.3	7.14	19.99	10.5	53.5	C
						113.2	35.03	214.6	229.06	975.12	674.21	1241	

Appendix II contd.... **CHEMICAL PROPERTIES OF SOIL**

SR.NO.	Lat.	Long.	Sy.No.	Profile No.	Exchangable meq 100%				Available		Single Value constant					
					pH 1:02	EC	Ca	Mg	Na	K	P	MWMC	App Density gm/cc	Absolute Sp.Gr.	Pore space%	Valume expansion
1			3	4	13	14	15	16	17	18	19	20	21	22	23	24
Wegare																
1	73.498	18.46	63	1	6.43	0.27	19.08	10.75	1.17	12	1.12	68.42	1.08	1.71	55.52	15.84
2	73.508	18.45	44	2	6.59	0.14	24.48	4.73	1.17	39	0.36	65.89	1.08	1.82	55.98	9.83
3	73.508	18.45	50	3	6.31	0.15	22.68	16.34	1.83	53.75	1.04	56.17	1.13	1.84	54.92	10.08
4	73.521	18.45	452	4	6.82	0.57	27	17.2	1.27	31.75	0.8	60.59	1.1	1.73	55.52	13.73
5	73.514	18.45	468	5	6.52	0.35	15.84	9.03	1.03	36	1.04	57.48	1.77	1.73	52.11	10.38
6	73.521	18.47	172	6	6.21	0.15	13.32	5.59	0.68	15	1.3	59.19	1.01	1.6	52.58	10.23
7	73.507	18.44	53	7	6.67	0.13	30	21.21	1.4	14	0.68	56.59	1.24	1.99	58.97	14.99
8	73.499	18.43	77	8	6.44	0.19	28.44	18.49	1.36	7	1.04	54.31	1.08	1.75	52.77	9.79
9	73.497	18.47	129	9	6.36	0.16	19.8	18.49	1.03	22.5	0.8	63.18	0.99	1.77	57.66	8.34
10	73.496	18.44	83	10	6.28	0.11	12.24	5.5	1.13	13	1.2	58.12	1.12	1.98	54.08	9.12
11	73.501	18.45	57	11	6.31	0.16	8.1	3.87	0.63	12.25	0.92	72.51	0.87	1.73	59.07	5.232
12	73.518	18.47	228	12	6.39	0.15	15.69	3.87	0.68	24.5	0.8	70.91	0.95	1.67	58.63	12.45
13	73.489	18.46	128	13	6.31	0.11	15.12	6.68	0.74	24.5	0.68	65.5	0.97	1.73	66.5	10.91
14	73.483	18.44	133/1	14	6.33	0.15	22.68	10.02	0.74	23.5	1.04	69.98	0.92	1.77	61.23	8.31
15	73.49	18.45	111/1	15	6.3	0.12	13.5	8.18	0.78	34.75	0.6	67.23	0.96	1.68	59.99	10.62
16	73.472	18.44	111/3	16	6.22	0.12	17.82	13.33	0.83	22.5	1.12	79.19	0.85	1.6	66.61	13.18
17	73.468	18.43	101/3	17	6.29	0.19	22.14	11.61	0.74	21.5	0.8	62.11	1.04	1.93	61.94	19.26
18	73.488	18.43	111/4	18	6.37	0.16	13.5	6.02	0.68	20	0.52	71.59	0.93	1.72	61.5	13.34
19	73.529	18.47	236	19	7.07	0.33	31.86	15.48	1.03	12.25	1	64.63	1.2	2.05	61.5	14.53
20	73.509	18.47	136	20	6.64	0.16	15.66	5.59	0.63	21.5	0.92	69.21	1.07	1.9	32.33	12.7

Temghar																
21	73.515	18.43	70	1	6.07	0.07	16.76	4.3	0.68	5	0.68	67.12	1.07	1.78	57.82	12.55
22	73.529	18.43	40	2	5.57	0.08	16.92	6.02	0.78	13	0.68	67.69	0.98	1.59	58.21	12.83
23	73.532	18.44	55	3	6.08	0.1	21.24	8. 60	1.09	25	0.8	64.14	1.04	1.78	58.9	11.45
24	73.54	18.44	21	4	6.11	0.11	15.48	8.17	0.83	6.25	1.04	69.92	1.03	1.81	61.69	12.23
25	73.539	18.43		5	6.22	0.12	14.7	7.31	0.87	6.25	0.92	61.78	1.07	1.83	62.03	15.05
26	73.548	18.44	16	6	6.12	0.08	13.68	7.74	0.87	8.25	0.6	66.14	1	1.97	62.66	10.2
27	73.54	18.45	138	7	6.48	0.12	17.28	9.89	0.78	5	1.2	68.2	1.06	1.79	58.98	12.33
28	73.531	18.45	115	8	6.04	0.08	18.32	12.04	0.87	18.25	0.5	68.01	1.01	1.61	57.39	13.76
29	73.537	18.45	129	9	6.05	0.08	1.68	5.79	0.54	8.25	0.5	70.4	1	1.71	60.2	11.77
30	73.523	18.45	120	10	5.71	0.07	16.2	5.16	0.87	24.5	0.6	63.31	1.05	1.64	76.42	14.6
31	73.545	18.45	148	11	6.1	0.08	15.84	10.32	1.09	14	1	67.16	1.16	2.09	62.48	12.65
32	73.516	18.44	93	12	6.2	0.1	21.24	6.45	1.3	17.25	1.12	64.09	1.15	2.17	63.65	10.81
Vede																
33	73.55	18.43	4	1	5.54	0.28	27	11.07	1.57	17.25	0.8	61.74	1.14	1.79	52.74	13.2
34	73.539	18.43	14	2	5.87	0.08	23.76	12.71	1.27	25.5	0.5	57.76	1.15	1.79	53.55	13.8
35	73.537	18.47	38	3	5.53	0.11	29.88	10.25	1.45	17.25	0.52	65.45	1.1	1.95	59.68	12.92

Appendix III

: प्राथमिक सर्वेक्षण :

: आपत्ती ग्रस्त गावांसाठी प्रश्नावली :

१. नाव : _____

२. गाव : _____ ता. _____ जि. _____

३. मूळगांव : _____ ता. _____ जि. _____

४. किती वर्षापासुन या गावात रहाता ? ☐

५. घरातील व्यक्तींची संख्या : ☐

पुरुष : ☐ स्त्रिया ☐ मुली ☐

६. उदरनिर्वाहाचे प्रमुख साधन कोणते ? _____

७. अर्थ प्राप्तीचे विविध मार्ग :

१) शेती : ☐

२) नोकरी : ☐ सहकारी ☐ खाजगी ☐

३) शेतमजूरी : ☐

४) मजूरी : ☐

८. मिळकत करणाऱ्या व्यक्तींची संख्या : ☐

९. स्वयं रोजगार आहे का ? ☐ होय ☐ नाही

१०. असल्यास कोणता? ☐

११. उत्पन्न किती? ☐

१२. शेतमजूरी करता का? ☐ होय ☐ नाही असल्यासकिती जण? ☐

१३. शेतमजूरीचा स्त्रोत कोणता ? _____

१४. एकूण मिळणारे उत्पन्नः ☐

१५. एकूण मालकी शेतीचे क्षेत्र : ☐

१.बागायती ☐

२. जिरायती ☐

३. पडीक ☐

४. वनाखाली ☐

३५. पशुधनाचा हेतू _____

३६. वनातील वस्तू गोळा करता का? | होय | नाही |

३७. उत्पन्न मिळत असल्यास किती? | |

३८. **सामाजिक**

धर्म | | जात | | पोटजात | |

३९. गावची लोकसंख्या | |

४०. घरांची संख्या किती ? | |

४१. आजूबाजूस गावातील लोकांनी केलेल्या वस्त्या / पाडे ? _____

४२.नाते संबंध असणाऱ्या आजूबाजूच्या गांव/पाडे/व वस्त्यांची नावे -

४३. घरांची वर्गवारी

१) | पक्की | २) | कच्ची | ३) | अर्धकच्ची | ४) | तात्पुरती |

४४.गावांतील स्तरीकरण - विभाजन - | आळी | गल्ली | एकत्रित |

४५.समाज मंदिर आहे का? | होय | नाही |

४६. गावांतील सर्व ग्रामस्थ एकत्र येण्याचे ठिकाण कोणते ? _____

४७. बोली भाषा | | | |

४८. गावातील महत्वाचा उत्सव / सण / जत्रा - _____

४९. गावातील धार्मिक स्थळे-

| मंदिर | चर्च | विहार | विहार | मशिद |

५०.ग्रामदैवत कोणते - _____

शैक्षणिक

५१. प्राथमिक शाळा - | सरकारी | खाजगी | | मराठी | इंग्रजी |

५२. माध्यमिक / उच्चमाध्यमिक / पदवी सोय - _____

५३. प्राथमिक शाळा नसेल तर काय सोय ? _____

५४. कॉलेजची सोय कोठे आहे? | |

५५.उच्च शिक्षित किती ? | |

पदवीधर | | उच्च माध्यमिक | | माध्य | | प्रौढ साक्षरता | |

५६. मुलींच्या शिक्षणाचे प्रमाण | |

५७. गावची साक्षरता - स्त्री | | पुरुष | |

आंतर रचनात्मक सुविधा

५८. पिण्याचे पाणी - स्थिती - स्त्रोत _____

५९.सांडपाणी व्यवस्था _____

६०. कचरा निर्मूलन _____

६१. हागंदरी व्यवस्था _____

६२. दूरदर्शन आहे का ? | होय | नाही |

६३. | केबल | डिटीसी | डिश | व्हिसीआर | संगणक |

६४. मनोरंजनाच्या सुविधा - | सिनेमागृह | नाटयगृह | खूले नाटयगृह |

६५. प्राथ. आरोग्य केंद्र - | डॉक्टर | नर्स | सेवक |

६६. वारंवार होणारे साथीचे रोग कोणते ? _____

६७. औषध भांडार आहे का ? | होय | नाही |

६८. रस्ते - | कच्चे | पक्के | गाडी रस्ता | पाऊलवाटा |

६९.वाहतूक व्यवस्था : वैयक्तिक | चारचाकी | दुचाकी | सायकल |

७०.सार्वजनिक वाहतूक व्यवस्था | सरकारी | खाजगी | एसटी/ बस | जीप / ट्रक |

७१. पेट्रोल पंप आहे का ? | होय | नाही |

७२. गॅस वितरण व्यवस्था आहे का? | होय | नाही |

७३. | टेलिफोन | मोबाईल | नेट | यापैकी काय आहे ?

७४. इंधन म्हणून कशाचा वापर ? (घरगुती स्वयंपाक) -

| रॉकेल | गॅस | सरपण | विदयुत |

७५. विदयुत स्थिती कशी आहे ?

१) कोठून मिळते - २) खंडीत / अखंडीत ३) मीटर्स आहे काय ?

४) भारनियमन | होय | नाही | असल्यास किती तास? | |

५) भारनियमनास पर्यायी व्यवस्था _____

७६. बाजारपेठ स्वरुप -

१) दुकाने किती ?कोणती?

२) बाजाराचे ठिकाण

३) बाजारपेठ / मंडई / आठवडे बाजार

४) जवळपासचे बाजारपेठ ठिकाण _____

७७. धरण बांधले ? - योग्य / अयोग्य

७८. धरणाखाली जमीन गेली का ? | होय | नाही | गेल्यास किती ? [ ]

७९. मोबदला मिळाला का ? | होय | नाही | मनाप्रमाणे | होय | नाही |

८०. किती दिवसांनी ? [ ]

८१. आपण धरणासाठी विरोध केला का ? | होय | नाही |

८२. केला असेल तर कोणत्या स्वरुपात ? _____

८३. पुनवर्सन योग्य प्रकारे केले आहे काय ? | होय | नाही |

८४. पुनवर्सन संबंधी मत _____

८५. धरणाच्या पाण्याचा फायदा होतो का? _____

८६. पोस्ट आहे का? _____

८७. वर्तमानपत्र कोणते घेता? _____

८८. गावातील मंडळाची संख्या [ ]

८९. धर्मादाय मंडळे [ ]

९०. सेवाभावी संस्था [ ]

❑❑❑

Appendix IV

पुनर्वसन झालेल्या गावांसाठी प्रश्नावली

१. नाव :

२. मूळगांव : ता. जि.

३. पूनर्वसन झालेले गावं ता. जि.

४. पुनर्वसन झाल्याचे वर्ष

५. पुनर्वसन करिता लागलेला कालावधी

६. पुनर्वसन करिता प्रक्रिया कधीपासून सुरुवात झाली? १) छोटे / मोठे
२) कच्चे / पक्के

७. आत्ताचे घर १) छोटे / मध्यम / मोठे
२) कच्चे / पक्के

८. घरासाठी वापरात आलेले साहित्य ..... कच्चे पक्के

९. मिळालेली एकूण निवासी जागा क्षेत्र / चटई क्षेत्र ..... किती ?

१०. घरातील व्यक्तींची संख्या

पुरुष	स्त्रिया	मुले	मुली

११. शिक्षण

	पदवी	
	पदवी पूर्व	
	उच्च माध्यमिक	
	माध्यमिक	
	प्राथमिक	

आर्थिक

१२. उदर निर्वाहाचे प्रमुख साधन सध्या कोणते ?
१) नोकरी — सरकारी / खाजगी
२) व्यवसाय — स्वतंत्र / एकत्रित
३) शेती
४) शेतकाम / शेतमजूरी
५) घरकाम

१३. मिळकत असणाऱ्या व्यक्तींची संख्या

१५. पुर्नवसना पूर्वी कोणते मिळकतीचे मार्ग

१६. सर्व मार्गाने येणारे एकूण मासिक / वार्षिक उत्पन्न अंदाजे :–

१७. पूर्वी असणाऱ्या निवास क्षेत्राचे स्वरुप : सपाट उतारावर पाणथळीवर

१८. पूर्वी किती निवासी क्षेत्र होते ?

१९. आत्ता किती मिळाले आहे ?

२०. मोबदल्यात मिळालेले क्षेत्र तुलनात्मक दृष्ट्या :– अत्यल्प / मध्यम

२१. पूर्वी मूळगांवी असणारे शेती क्षेत्र किती ?
१) बायायती २) जिरायती ३) कोरडवाहू
४) पडीक ५) वनाखालील

२२. सध्या किती क्षेत्र मिळाले आहे ?

स्वरुप	१) बागायती	२) जिरायती	३) कोरडवाहू	४) पडीक

२३. पू. जमीनीची प्रत कशी उत्तम / बरी / खराब

२४. आत्ता जमीनीची प्रत कशी / उत्तम / बरी / खराब

२५. शेतीतून मिळणारे एकूण उत्पन्न पूर्वी सध्यस्थितीत

२६ शेतसारा भरता का ? पूर्वी / आत्ता

२७. साधारण वर्षाला किती ?

२८. पाणीपट्टी भरत होता का ? होय / नाही किती

२९. पूर्वी भरत होता का ? होय / नाही – किती

३०. शेती मशागत साधने

पूर्वी आत्ता

३१ पारंपारिक / आधुनिक

नांगर / लाकडी / लोखंडी

ट्रॅक्टर

सिंचन मशागत कशी

शेतीसाठी जलसिंचन स्त्रोत

कालवा / उपसा / लिफ्ट / विहिर / तलाव

३२. कोणत्या सिंचन पद्धतीचा अवलंब करता होता

१) मोकाट २) सारा ३) वाफा ४) सरीवरंबा ४) आळे

३३. सध्या कोणत्या ?

३४. आधुनिक सिंचन पद्धतीचा अवलंब करता का ?

होय कोणता ? ठिबक / तुषार

३५. नाही तर का नाही – आर्थिक कमकुवत

– जलउब्धता नाही

– क्षेत्र कमी

– पीक तशाप्रकारचे नाही

३६. शेतीतून वार्षिक / हंगामात – एकपिक / बहुपिक घेता ?

३८. कोणती पीके घेता ?

३९. कोणती घेत होता ?

४०. हंगामातील एका पिकासाठी अंदाजे येणारा खर्च ?

४१. खर्चाच्या तुलनेत उत्पन्न ?

४२. सध्या व पूर्वी काय फरक ?

४३. पूर्वी शेतीसाठी कर्ज घेतले का ? होय / नाही होय तर कोणाकडून बॅंक / सावकार / पतपेढी / स. बॅंक

४४. सध्या कर्ज आहे का ? होय / नाही

४५. शेतीसाठी गुंतवणूक स्त्रोत / वित्त व्यवस्था कोणती ?

१) शेती उत्पादन २) व्यवसायातून ३) कर्ज ४) व्याजावर

४६. शेती उत्पन्नात फायदा होतो का नेहमीच तोटा – फायदा / तोटा

४७. तोटा झाल्यास तो भरुन काढण्यासाठी काय करता ?

४८. सध्या पूरक व्यवसाय – पूर्वी

४९. पशुधन आहे काय ? – पूर्वी

१) बैल / बैलगाडी

२) गाय / संकरीत गाय

३) म्हैस ४) शेळी ५) इतर

५०. पशुधनाचा हेतू :

५१. उत्पन्न मिळते का ? होय – नाही

५२. अंदाजे माहिती – वर्षाला किती ?

५३. पूर्वी हीच स्थिती होती का ?

५४. नसल्यास कशी होती ? वेगळी – बरी – उत्तम – नव्हती?

५५. घरापासून किती अंतरावर शेत आहे ?

५६. घरापासून किती अंतरावर शेत होते ?

५७. शेतीची कामे कोण करतो स्वतः / मजूरीने

५८. मजूरीने असेल तर ? मजूर मिळतात का ? कोठून

५९. मजूरी दिवसाला / महिन्याला

६०. मजूरी किती ?

<u>सामाजिक</u>

६१. मूळ गावः जन्मगाव : धर्म : जात : पोटजात

६२. सध्या गावची लोकसंख्या पूवीच्या

६३. घरांचे स्वरुप : १) सघन / विखुरलेल्या

२) कच्ची / पक्की / सुधारीत

३) एकमजली / दुमजली / झोपड्या

६४. घरांची वर्गवारी पूर्वी :

१) पक्की ?

२) कच्ची ?

३) अर्धकच्ची ?

४) तात्पुरते ?

६५. घरांसाठी वापरातील साहित्य सध्या पूर्वी

६६. गावात सामाजिक स्तरीकरण आहे का ?

विभाजन – आळी गल्ली एकत्रित

६७. सांस्कृतिक मंदिर / हॉल / समाजमंदिर आहे / नाही पूर्वीच्या

६८. गावातील सर्व ग्रामस्थ एकत्र येण्याचे ठिकाण निकड

६९. गावातील महत्वाचा सण – उत्सव पूर्वीचा

७०. मंदिर / चर्च / विहार / मशिद

७१. ग्रामदैवत – आहे / नाही असल्यास कोणते ?

७२. बोली भाषा – मराठी (माणदेशी / खाणदेशी / कोकणी / वऱ्हाडी / प्रभाषा)

७३. जवळपासच्या गावात नातेवाईक आहेत का ? होय / नाही कोणत्या ?

७४. नातेसंबंध / कूळ यांचा जवळचा गावात संबंध आहे का ?

७५. असल्यास – कोणत्या नात्याने :–

१) सासर २) इ. नाते ३) माहेर

७६. शिक्षणाची सोय :

१) प्राथ. शाळा आहे का ? होय / नाही

खाजगी / सरकारी

२) मराठी माध्यम / इंग्रजी माध्यम

३) साधारण शाळेत (प्राथमिक) मुले किती आहेत

७७. माध्यमिक शाळा आहे का ? होय / नाही

खाजगी – सरकारी

मराठी माध्यम – होय / नाही

७८. कनिष्ठ / वरिष्ठ महाविद्यालय आहे का ? होय / नाही

७९. असल्यास १) कला – वाणिज्य / शास्त्र / तंत्रज्ञान / कृषी / व्यावसायिक

२) विद्यार्थी संख्या

३) खाजगी / सरकारी

४)

८०. नसल्यास : जवळपास शिक्षणाची सोय कोठे आहे.

गाव :

अंतर :

प्रवासाची (जा - ये होण्याचे साधन) सोय

८१. घरातील शिक्षितांचे प्रमाणे (%) संख्या – पूर्ण शिक्षण झालेले

१) प्राथमिक

२) माध्यमिक

३) उच्च माध्यमिक

४) उच्च माध्यमिक

५) व्यावसायिक शिक्षण

८२. मुली शिकलेल्या आहेत का ? नसल्यास का ?

८३. गावातील साक्षरता किती ? स्त्री % पुरुष %

८४. विवाह वय – मुलीचे – मुलांचे

<u>आंतररचनात्मक सुविधा :</u>

८६. पिण्याच्या पाण्याचा स्त्रोत – विहिर / पाण्याची टाकी / कुपनलिका

८७. शुद्ध पाण्याचा पुरवठा कसा होतो ?

८८. किती अंतरावूरुन पाणी आणावे लागते ?,

८९. पाणी पुरेसे मिळते का ?

९०. सांडपाणी व्यवस्था : १) गटारे – बंदिस्ती / खुली

९१. कचरा – व्यवस्था आहे का ?

९२. हागंदरी व्यवस्था – शौचालय आहेत का ? उघड्यावर

९३. प्राथ. आरोग्य केंद्र – आहे / नाही

९४. असल्यास – व्यवस्था उत्तम / बरी / वाईट / नाहीच
– किती डॉक्टर्स
– नर्स
– सेवक

९५. औषधोपचार होतो का ? होय / नाही

९६. औषधे मिळतात का ? होय / नाही

९७. वारंवार होणारे साथीचे रोग ? कोणते

९८. रस्ते – पाऊलवाटा / कच्चे पक्के

९९. वाहतूक व्यवस्था
खाजगी / सरकारी

१००. खाजगी असल्यास – कोणती ?

१०१ वैयक्तिक असल्यास – चारचाकी – दुचाकी – सायकल

१०२. सामूहिक वाहतूक व्यवस्था
सरकारी – एस. टी./ बस
खाजगी – जीप / ट्रक

१०३. पेट्रोल पंप आहे का ? – होय / नाही

१०४. गॅस वितरण व्यवस्था आहे का. होय / नाही

१०५. टेलिफोन / मोबाईल / नेट

१०६. दूरदर्शन आहे का ? होता का ?

१०७. केबल आहे का ?

१०८. डीटीसी / डिश / व्हिसीडी / व्हीसीआर

१०९. संगणक

११०. वर्तमानपत्र

१११. मनोरंजनाच्या सुविधा
सिनेमागृह / नाट्यगृह / खुलेनाट्य गृह

११२. विद्युत व्यवस्था कशी आहे – पूर्ण / खंडीत / भारनियमन

११३. लाईटबील किती येते.

११४. घरात स्वयंपाकाकरिता इंधन कोणते ?
चूल (लाकूड) स्टोव्ह / गॅस / सोल्डर / इले. साधन

११५. घरातील प्रमुख कोणते आहे
पूर्वी कोणते होते ?

११६. बाजारपेठ आहे का ? होय / नाही

११७. असल्यास – किरकोळ / घाऊक / दररोज / आठवडा बाजार

११८. धरण बांधणार याची तुम्हाला किती अगोदर कल्पना मिळाली ?

११९. धरणासाठी तुमचे गाव व क्षेत्र सरकारला आवश्यक असल्याचे आपणास कसे कळले ? पत्र / सभा / गावपातळी / गावतलाठी / जिल्हाधिकारी नोटीस

१२०. धरणग्रस्त होणार हे सरकारी पातळीवर कळल्यानंतर आपल्याला काय वाटले ? उत्तम / बरे / वाईट

१२१. उत्तम / बरे वाटले असल्यास
१) पर्यायी व्यवस्था होईल ?
२) मोबदला चांगला मिळेल ?
३) घर बांधून मिळेल ?
१२२. वाईट वाटले असल्यास प्रतिक्रि काय ?
१) ग्रामसभा २) नातेवाईकात ३) विरोधासाठी आंदोलन
१२३. धरणाखाली किती जमीन गेली
१२४. सरकारने आपल्याला मोबदल्य ती जमीन दिली ?
१२५. इतर मोबदला मिळाला का ?
१२६. अपेक्षेप्रमाणे मिळाला का ?
१२७. किती दिवसांनी ? कोणत्या स्व रोख / जमिनीच्या स्वरुपात कशाप्रकारे ?
१२८. आपण येथे स्थाईक झालात ? / अयोग्य
१२९. जवळपास नवे नातेवाईक झाले ?
१३०. गावातील समाजकारणात सहभ आहात का ?
१३१. गावातील ग्रामपंचायत मदत क का ?
१३२. ग्रामपंचायत निवडणूकीत सहभ झालात का ?
१३३. सण / उत्सव सगळे गावकरी क करतात का ?
१३४. सरकारी पातळीवर तुम्हाला वि काय मदत केली का ?
१३५. उत्तर

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