CHAPTER 8

SUMMARY AND CONCLUSIONS

Present chapter summarizes the study carried out by the analyst, then potential for further improvement and also few reclamation procedures on wastelands using remote sensing and GIS in Nagalar sub-watershed, Tamil Nadu. Presentation of the methodology and results of analysis are described systematically from introducing the problem and objectives, related previous studies, analysis methods and findings and finally to relevant suggestions for reclamation activities.

Nagalar sub-watershed mainly comprises charnockitic terrain with intermittent gneissic areas. Veins of quartzite are also seen in this area. It has structural hills in the eastern part, bazada zones along the foothills, flood plains in the north, along the river course of Vaigai and undulating terrain in the central part of the study area. It is mainly drained by an ephemeral river Nagalar and hence the name Nagalar sub-watershed. Vaigai river flows along its northern boundary. Besides Nagalar, Araliuttu odai and Ettakovil odai are the other two rivers draining the study area.

The watershed, on an average receives 630 mm of annual rainfall mostly contributed by northeast monsoon. The region experiences a hot
summer with high temperature and humidity. The maximum rainfall occurs during the northeast monsoon, with a few flash floods on the hillside and the uplands. There is no prominent water harvesting structures except a few tanks to store the rainwater in the peak period. This forms one of the factors for the water scarcity in the sub-watershed. Due to steep and moderately steep slopes run-off is relatively larger compared with infiltration.

In the sub-watershed, the land holding by margin farmers accounts for 62 % and the small farmers account for 24 %. About 10 % of the holders come under medium farmers and number of large farmers is very small (only 4 %). The income generated is mostly from the agricultural sector, which depends upon the monsoon, introducing another dimension to the problem namely socio-economic condition. Employment and fluctuation of income are among the economic factors responsible for lowering the economic welfare for the inhabitants in general and cultivators in particular.

Geomorphological map derived from remote sensing data showed landform units such as structural hill, residual hill, inselberg, pediment, buried pediments of shallow, medium, and deep and bazada zones, flood plain and sand dunes in the study area. Soil map revels that Entisol is the major soil unit occuring in the hills and undulating terrain and it slowly matured to inceptisol, alfisol and vertisol. Inceptisols and alfisols showed closer relation with fluvial landforms. Vertisols are observed in the flat terrain of the study area.

The areal extent of double crop from 1990 through 1995 to 2000 showed a decreasing trend from 9.60%, through 9.49% to 7.43% respectively. Similarly, single crop showed 17.8% during 1990, 14.08% during 1995 and 10.58% during 2000 and plantation showed an increasing trend from 5.43% to
6.02% during the years 1990 and 2000 respectively signifying transformation of the agricultural crops to plantation. The changes in the areal extent of landuse units reveal a general degradation, which may be due to certain natural problems as well as socio-economic conditions. An increase in the areal extent of land with or without scrub implies constraints in agricultural landuse. Salt-affected land, which was not seen during 1990, showed an areal extent up to 2.13 % during 2000. From the land use maps it is also observed that the area of dense forest seen during 1990 (12.74%) has been degraded and showed only 5.24% of the total geographical area during 2000. Increase in the areal extent of Open forest (from 8.84% during 1990 to 9.39% during 2000) and degraded forest (from 6.28% to 13.17%) indicates general degradation of forest resources in the study area.

The groundwater details derived from rainfall, water level, water quality, well yield and resistivity showed various degrees of potential groundwater zones and also seasonal fluctuation in groundwater. An excellent degree of groundwater recharge is observed in the northwestern part and southern part during northeast monsoon. Very good, good and moderate degree of recharge is observed in the central part. But during summer, many of the places are observed dry or groundwater level is observed at a greater depth of 20 mts. The spatial trend of water level analysis implies occurrence of recharge during northeast monsoon and maximum depletion in summer, which may be due to extraction and other climate related parameters (evapotranspiration and evaporation). The spatial trend of the water level distribution also showed a strong relationship between groundwater condition and hydro geomorphological units.
Groundwater quality is generally good in the study area but a seasonal analysis revealed a contrasting trend during summer compared to that of northeast monsoon. Spatial variations in water quality may be due to local phenomena such as rock weathering and contamination by leaching. This is further explained through analysis of groundwater quality using USSL classification and it is observed that groundwater is suitable for agricultural purposes except in a few places in the northwestern part where salinity is major problem.

Spatial maps derived from remote sensing data and isopleth maps generated from secondary data are integrated and analyzed using GIS techniques and resources potential zones are extracted. Spatial pattern of resources potential zones map (RPZ) shows excellent degree (covering an area of 16.0%) which is mostly associated with fallow in the southern and northeastern parts and double crop area in the northwestern (flood plain area) parts. Very good (29.95%) and good (25.54%) resources potential zones are mostly associated with double crop, plantation and fallow land in the southern and central parts. Moderate potential zones (28.41%) are associated with forest area. The derived RPZ map is again overlaid on the land use classes to show the various degrees of resources utilization in the study area and generated a composite map showing resources potential utilization zones (RPUZ).

From the RPUZ map, proper utilization of available resources for agricultural activities (both excessively utilized and optimally utilized areas) is estimated to be 31.92% and remaining 62.56 % is not fully utilized. This includes moderately utilized, under utilized and least utilized zones. In forest area, 51.37% of the available resources are properly utilized and nearly 46.23% of the area is available for further utilization. The zones that are not
fully utilized (moderate, under and least utilized zones) are regrouped to show Potential zones Available for Wasteland Developmental (PAWD) activities.

Temporal analysis of wasteland in the study area as observed from the satellite data showed an increasing trend from 34.52% during 1990 through 41.41% during 1995 to 49.78% during 2000 indicating a general increase in wasteland units in this area. Permanent wasteland units that are derived from the temporal analysis of remote sensing data over a period of 10 years are integrated with the PAWD using GIS techniques.

From such GIS overlay of PAWD with permanent wasteland units Prioritization Zones for Wastelands Development (PZWD) could be arrived, which ranges from PZWD-1 to PZWD-5. Prioritization, in the context of wasteland development activities, implies maximum degree of reclamation of land with minimal effort. For example, permanent fallow in PAWD-1 could be easily reclaimed to agricultural land use with minimum or no conservation measures.

Most of the land use classes falling in PZWD-1 are permanent fallow, and land with or without scrub and these could be readily reclaimed with minimal effort. This zone occupies an area of 9.2% of the total geographical area. PZWD-2 covering an area of 16.05% is associated with permanent fallow with a large area of scrub land and patches of lands affected by salinity. These areas may be readily reclaimed with moderate effort. PZWD-3 comprising 10.19% of the total study area, includes wasteland categories such as land with or without scrub, land affected by salinity, sandy area and few patches of permanent fallow and requires special effort to reclaim. PZWD-4 (13.17%) covers degraded forest and may be regenerated with minimal effort such as social forestry, joint forest management practices
and growing grasses vegetative barrier along the hill slope to prevent soil erosion. PZWD-5 (9.2%) is observed with seasonal variations in agricultural practices leading to moderate utilization of resources and may not be considered for wasteland developmental activities.

The analysis at regional level gave an insight on resources available in the study area, problems pertaining to wasteland and prioritizing them for reclamation activities. Cadastral level analysis using GIS brings out local phenomena pertaining to the problem of wasteland and provides suggestions for reclamation purposes. Two cadastral sites are chosen within the study area (Pulimankombai mini-watershed), so as to represent agricultural predominant and forest predominant micro-watersheds. Information extracted from the high-resolution satellite data are compared with revenue records and cadastral level (1:12,500 scale) wasteland map has been prepared. From the cadastral wasteland map the field sub-division, area, ownership, type of wasteland have been identified. Field sub-divisionwise soil series were mapped through Detailed Soil Survey conducted in the cadastral sites, since, it is a pre-requisite for wasteland reclamation. Further, ranking the soil series according to the land capability, land irrigability and crop suitability helped to suggest the alternate landuse. Overlaying the wasteland categories on the resources potential zones, the resource potential of the wasteland categories has been arrived at. Suggestions for wasteland development have been arrived at based on the resources availability in the wasteland categories. Two options are given for reclamation of each land parcel based on the physical and economic constraints grouped under the heads of minimal and maximum efforts. Field verifications were carried out to assess the suitability of the measures suggested and also interaction sessions were held with local farmers to ascertain their level of acceptability of the suggestions made.
The level of acceptability by farmers is by and large great. The acceptability of farmers for reclamation processes based on their land holding size suggests that the large farmers readily accepted the first option and for the second option, which involves maximum effort, only 50% of them agreed and remaining 50% of them agreed with some reservations. In the case of medium farmers the acceptability for the first option is estimated to be 50% and 33% for the second option. Small farmers showed a high percentage of acceptance for the first option (83%) and 17% for the second option, whereas the acceptability by marginal farmers showed 80% and 8% for the first and second options respectively.

The pattern of farmer’s willingness in accepting the suggestions for reclamation activities indicate a general disinclination of the local community to adopt conservation measures with maximum effort. This may be due to lack of fund, inability to cope with the modern techniques and societal framework. But this condition may be remedied if the success of these reclamations is proved in the fields of farmers those who agreed with the suggestions. This may be possible by the co-operation of government organization, semi-government organization and other non-governmental organizations.

The results of the present study brought out the following conclusions and a few recommendations.

1. Remote sensing data with their synoptic view and repetitive coverage provide more meaningful information on terrain parameters such as geology, landforms, landuse and soil condition and wasteland types in the study area.
2. Temporal analysis of remote sensing satellite data helps to derive information on changes in spatial pattern of various wasteland categories and infer problems and constraints responsible for such changes by associating with collaborative field data.

3. Remote sensing data analysis, in conjunction with field data, of various terrain parameters and the groundwater condition of the study area is helpful in delineating the land and water resources of the study area and also in bringing out the inherent limitations.

4. Geographic Information System (GIS) is helpful in identifying various resources potential zones in the study area and the extent of utilization of land uses.

5. Analysis of wastelands using remote sensing and GIS at regional level reveals the status of Wasteland and helps in prioritizing them for reclamation activities.

6. The usefulness of cadastral level analysis for wasteland development is demonstrated in the present study using an integrated approach combining remote sensing and GIS techniques along with intense field level interaction.

7. The data from revenue records (Adangal register) are updated based on the information derived from large-scale satellite image so that nature of problem pertaining to wasteland may be identified and adequate measures may be taken at local level.
Summing up it may be concluded that GIS analysis using satellite data and conventional data enables the assessment of resources available in the study area and thus provides baseline information for wasteland reclamation activities both at regional and at cadastral level. Field interviews of farmers are helpful in bringing out the reasons for negligence of proper land utilization, which leads to an increase in wasteland extent.

From the cadastral level analysis using GIS, it is possible to assess the suitability of the land parcels for a particular land use and to advise the individual farmer on the course of action to be taken as done in this study. The methodology is simple and can be adopted for any area. Therefore, it is recommended that the agencies interested in Wastelands Development may follow this analysis pattern for on micro-watershed level planning which is in consonance with the Watershed approach in developing wastelands currently preferred by the Union and State Governments to promote poverty alleviation programmes.

Increasing the agricultural production through reclamation of wastelands is the need of the hour to meet the needs of the growing population. The 'Green Revolution' results in increased production since early 70s, but it also triggered some environmental problems, therefore, it has become necessary to stop any further deterioration of natural resources and to restore the productivity for which wastelands development is expected to play a major role.