CONCLUSION & SUMMARY

8.1 Conclusion:

The integrated approach of Remote Sensing (RS), Geographic Information System (GIS) and Global Positioning System (GPS) has the potentialities to study the regional and local forest management institute such as JFM. Under this program, the collaborative efforts of the forest department, local dependent population and various NGOs all shaped the forests of the study area by restoring the degraded forests. Due to the changed scenario there is a need that this vital resource is properly evaluated for its sound planning and management.

The main contributions of RS and GIS in the field of JFM are creation of data base of all spatial and non-spatial data, their integration and analysis. The spatial data acquired through remote sensing techniques and from other conventional sources including topographical maps and the non-spatial data are integrated and processed using Geographic Information System (GIS). The merits of visual as well as digital interpretation had been exploited to obtain the forest density classification of the study area. RS and GIS in conjunction with GPS had aided in mapping of few JFM plantations of the study area, depicting their present status. The micro-level assessment of JFM program based on the four major parameters viz. ecological, economical, social and institutional aspects brought out the sustainability of the JFM plantations in terms of sufficing the needs of the locals dependent on the forests. Statistics of the potential sites for the JFM program generated from the spatial data during this study had brought into focus the forest areas which need immediate attention and need to be restored with the active involvement of the locals. The established relationship of forests as well as other attributes information in a GIS mode as applied in this study, will prove useful for resource inventory, for microlevel planning or while revising the existing working plan in this area.

This study has shown that remote sensing and GIS approach can aid in generating such a plan. It can meet many of the information needs for forest management in a short time at a low cost and in the format desired by the forest department. Thus all plans regarding this resource should aim at sustainable development.

8.2 SUMMARY:

Optimal management of natural resources calls for balancing the developmental needs against the possibility of endangering the environment irreversibly. It therefore, necessitates the monitoring of temporal environmental changes for planning precisely and to lead the biosphere into a sustainable system, before the repair implementation cost become prohibitive. In this context vegetational monitoring is the need of the hour is primary requirement for various management and planning activities at regional and global scale. It has assumed greater importance in view of the shrinkage and degradation of forest area. The first step in the formulation of an environmentally sustainable forest development program is to address development strategy, examine lacunae in the present system of implementation of different forest plantation programs and identify viable alternatives for their sustainable management.

As the existing conventional system does not take into consideration the interdependencies of the natural resources it has certain limitations when compared to the advanced non-conventional and cost effective methods like Remote Sensing (RS) and Geographic Information System (GIS) technology. This technology cuts across the narrow confines of spectral approaches and takes a holistic view of a region as a whole. The present study therefore undertaken to test the potentials of RS and GIS technology and also GPS in assessing Joint Forest Management program in Narmada District, Gujarat.

Narmada district has very good natural forests with almost cent per cent tribal population. This district is entering into fourteen year of JFM implementation; it is, therefore, important to review the magnitude of its success, the extent to which its objectives have been achieved, and the reasons for its failure, so that the problems may be rectified and its sustainability ensured. Thus the entire study can be briefed in the following manner.

1. IRS LISS III satellite data proved to be quite promising in forest density classification for the study area i.e. Narmada district.

2. The extended application of advanced tools such as RS, GIS and GPS in the forestry sector was quite successful in the assessment of JFM plantations in conjunction with detailed phytosociological inventories.

3. The satellite data of the October/November months were found to be most suitable for the forest cover analysis, as this period corresponds to the full foliage stage of most of the tree species in the present study area.

4. Forest classes had distinct spectral features and this could be attributed to different parameters like crown density and plant characteristics. But still the discrimination among various forest type is restrained on satellite data due to environmental setup, intermixing of space, vegetation and topography.

5. Among the various spectral and radiometric enhancement techniques tried during the digital analysis contrast enhancement viz. histogram equalization proved better.

6. Though PCA yielded good results, the best discrimination of the forest and non-forest classes could be achieved only in the combined image of NIR, NDVI and PCA.

7. The RS data of the district, subjected to supervised classification brought out the overall classification accuracy to be less i.e. 74.29%, due to mixed pixel problem between the classes sparse tree cover with agriculture and agriculture.

8. Hybrid approach of classification wherein the spectral classes were modified with the aid of other ancillary data proved to be beneficial and increased the classification accuracy to 91.76%.

9. Three forest density classes viz. Closed, Open and Degraded forest with the crown density being greater than 40%, 10-40% and less than 10% respectively, were delineated based on the tonal variation. These density classes were in accordance with the density classes as proposed by the Forest Survey of India.

10. In addition to the forest classes other classes identified included Agriculture, Sparse Tree Cover with Agriculture, Waterlogged, Canal and River which were also delineated based on the basic elements of interpretation.

11. The study area comprised of 4 talukas viz. Tilakwada, Rajpipla, Dediyapada and Sagbara with the percentage of forest cover to be 2.11%, 32.22%, 62.15% and 29.04% respectively.

12. Criterion based selection of the JFM villages fairly represented the entire JFM plantations of study area i.e. Narmada district, with the sampling percentage being 12%, where the Micro-level study of the JFM villages based on four major parameters viz. ecological, economical, social and institutional aspects helped in impact of the JFM program in the study area.

13. Forest department acts as a catalyst leading to the formation of Forest Protection Committees while the NGOs such as AKRSP & WWF play the role of motivating and mobilizing the rural masses for enhancing people's participation in forestry.

14. *Tectona grandis* Linn was found to be the most preferred species because of its timber value and also as it grows naturally in this area for monoculture as well as polyculture plantations.

15. For monoculture plantations timber yielding trees were given more importance than NTFP yielding tree species.

16. Polyculture JFM plantations were ecologically more sustainable than monoculture plantations.

17. Girth class diversity analysis revealed that the distribution of the plant forms viz. herbs, shrubs and trees in the plantation sites depends on the years of protection given to these sites and also the awareness among the local community regarding forest protection and conservation.

18. The undercover of JFM plantations of were composed of various palatable and non-palatable species such as *Celosia argentea, Tribulus terrestris,, Sida acuta, Xanthium strumarium, Synedrella nodiflora* etc.

19. JFM site being a physically controlled ecosystem showed much lower diversity values for canopy cover as well as under cover and correspondingly higher dominance index values.

20. Density of the undercover showed negative correlation with that of crown density, as lesser canopy closure supported greater herbaceous population. In addition to this, density and diversity of the understorey is controlled by the protection given to JFM plantations against grazing during the post-monsoon period.

21. Some of the JFM sites showed the presence of cultivated species such as *Cajanus cajan* (L.) Millsp indicating the presence of unauthorized cultivation in the JFM area.

22. JFM sites with monoculture plantations showed greater similarity index owing to the similarity in the selection of species for plantation. However no significant similarity could be obtained between polyculture plantation

sites, which reflected that no specific strategy was adopted during the plantation.

23. Standing woody biomass values were not influenced by the plantation strategy adopted but it was related to protection given to these plantation sites against illegal cutting. Higher values of standing woody biomass led to greater values of Mean Annual Increments (MAI) and carbon sequestration rates.

24. Supply potential of the JFM site is dependent on the MAI values and the total forest area under the JFM.

25. These community managed plantations which were assessed for their potentialities in carbon sequestration rates, showed a greater potential of these plantations in acting as carbon sinks. *Butea monosperma* was found to have the highest potential to sequester carbon as compared to other species such as teak.

26. Cattle population showed positive correlation with the percentage of landless in respective village.

27. In the present study, none of the JFM villages of Sagbara taluka were found to be sustainable while in Dediyapada taluka all were found to be sustainable except Pansar. While in Rajpipla taluka only one village was found to have greater supply potential than the demand.

28. Biotic pressure in terms of human and cattle population and also awareness among the villages decided the sustainability of the JFM plantations.

29. The carrying capacity of the JFM plantations of the study area brought out differential capacity of the different plantation sites to sustain the local

dependent population. The major factor controlling the carrying capacity of the plantations is the biotic pressure on these areas.

30. Ranking of the JFM villages brought out that ecology, socio economic and institutional aspects are the major factors controlling the success and failure levels of each JFM village selected for the detailed assessment.

31. Limkhetar secured first rank followed by Dabka and Godada. Limkhetar scored better in ecological parameters, while Dabka and Godada scored better in socio-economic parameters.