CHAPTER VI:

CONCLUSION

6.0 Conclusion:

The world is experiencing rising demands for crop production, stemming from one of the key forces namely continuous enhancing human population. To meet these growing demands as well as to provide food security, some good researches on the trend analysis of important crops with respect to their area, production and yield has become a need of the hour. In the present work, an attempt was made to examine the trends in area of three important crops namely cotton, castor and banana at country (India), state (Gujarat) and district (Vadodara) level. Trends in production at state and district level, and trends in yield at district level were also examined. Results demonstrated the variations in area, production and yield of the selected crops. The study can aid the planners in deciding the growth rates to be achieved in accordance with the planned targets. Further, it can contribute towards basis for predicting the future supply. Area

increase nowadays has become constraint so focus should be given to yield increasing measures rather than increasing area under a specific crop.

Agricultural land faces pressure not only from the rising demands for crop production but also from the climate change. It places a new and challenging demand on agricultural productivity. Agriculture sector is more vulnerable to climate change compared to other sectors. Impact of climate change induces changes in crop production and prices, therefore scientifically assessing agricultural vulnerability to climate change is of large importance to the formulation of rational and effective adaptation strategies. Vulnerability assessment study for agrilands of Vadodara district and its adjoining six districts was carried out and the results showed least vulnerability of Vadodara district to the climate change. District's nearby vicinity is vulnerable to the climate change which calls for reviewing the agricultural strategies and research priorities for sustainable agriculture in these areas. Present work can be used as the baseline for monitoring development status of a particular district.

Crop condition monitoring during growing season is vital for the national food security. It can be of immense value to planners and decisions makers both in government and private sectors for working-out of agricultural policy and commissariat trade, which will be essential premise for crop production estimation. Obtaining such information during early stages of crop growth is even of more significance than acquiring the accurate production estimates after harvest time, especially when large scale commissariat shortage or surplus happens. Conventional crop growth estimates based on filed reports are often expensive, prone to large errors, and cannot provide real-time, spatially explicit estimates or forecasts of crop condition. Non-conventional

remote sensing techniques provide temporally and spatially continuous, cost effective, error free and real-time data covering large areas using relatively few instruments. Thus, remote sensing imageries act as good source for decision making related to crop monitoring. Using spatial data, crop condition monitoring during its development cycle can be done by acquiring information regarding crop biophysical and biochemical parameters which describe the actual status of agricultural crops during the growing season.

In the present study, both the conventional and the non-conventional approaches for the estimation of crop biophysical and biochemical parameters of Cotton, Castor and Banana growing in Vadodara district of Gujarat are explored. The work demonstrates the strong role remote sensing plays in the retrieval of these parameters. The non-conventional approach was identified to be better potent and time efficient means for the retrieval of crop parameters. Optical remote sensing data namely Landsat 5 TM and LISS IV proved its potential in the estimation of crop parameters namely Leaf Area Index, Chlorophyll Content and Relative Water Content for cotton, castor and banana plants. Use of high spatial resolution LISS IV data enabled the estimation of these parameters with an improved accuracy. The unique contribution of the work is the development and validation of regionally applicable spectral indices based models viz. NDVI-LAI, RVI-LAI, NDVI-CC, RVI-CC and NDWI-RWC for the selected three crops using an optical data. The whole analysis showed the high closeness of the modeled results to the real values. Parameters retrieved for the selected crops using these established models were used in the development of Vegetation Health Index. This index is an indicator of crop condition which can be used in the site crop management

practices for proper crop growth monitoring. In the present study, regression equations for predicting crop biomass using optical data have also been developed. The regression models developed herein viz. NDVI-Biomass and RVI-Biomass from both Landsat 5 TM and LISS IV data for cotton and banana crops are suitable for biomass estimation from these crops growing in the study area. Further scope exists for improvement of these empirical models using multiple regression with multiple spectral indices. The major constraint of these empirical models is the saturation of vegetation indices at higher LAI. Moreover, model coefficients require frequent revision after a certain interval to take account of crop response to deviations of environmental conditions from their long term mean. Therefore, physical inversion approach of canopy radiative transfer simulation models using surface reflectances would be ideal in the estimation of these parameters to eliminate such limitations.

Though optical data proved its potential in the crop parameter retrieval, but unfortunately its use is often limited by cloud cover in kharif season which then hampers continuous crop condition monitoring, an important premise for crop production estimation. In such circumstances, remote sensing data with longer wavelength i.e. microwave data proved to be useful as it is capable of observing crop growth irrespective of cloud coverage. Investigation of the sensitivity of C-band Envisat ASAR data in the estimation of LAI in cotton and banana crops proved potential of this data in the estimation of the parameter. Backscatter values for cotton and banana crops extracted from C-band ASAR data were correlated with LAI. Both polarization of data, HH and VV were proved to be impotent in LAI retrieval while VV/HH ratio gave the

promising results. Hence VV/HH backscattering ratio can be used as potential estimator of crop LAI.

A primary requirement for the management and planning of an agriculture sector is to obtain information on the spatial distribution of land use under agriculture cover. The knowledge of actual land under agriculture practice can help the planners to know how much more land should be converted to agriculture or else how much increase in yield from each unit of land should be achieved for the food security reasons. Space-borne remote sensing offers the possibility to acquire information on actual land cover and could thus aid in monitoring changes in time and in a cost effective way. In the present study, landuse classification was performed to identify land under agriculture use using Landsat 5 TM and LISS IV satellite imageries. LISS IV data due to its high resolution proved its better potential in the identification of different landuse types when compared to Landsat 5 TM data. Improvement in the classification accuracy for landuse was observed when higher resolution viz. LISS IV data was introduced for this task. Capability of SAR data in discriminating major land use types was also evaluated and results suggested that this data is capable enough in delineating different landuse types viz., cropland, waterbody, fallow fields, builtup areas and scrubland.

Any shortage in the production of an important crop would have great impact on the crop, on its by product industry and in the end also on the country. Henceforth, the preparation of specific crop maps in order to be well equipped for any shortage in agricultural produce is very much required. The present study also illustrates the importance of Landsat 5 TM and LISS IV data for land cover classification of specific crops in Dabhasa village. LISS IV data showed better potential in the crop classification

due to its high spatial resolutoin. As mentioned previously, in India during kharif season as regular data acquisition in the shortwave range of the Electromagnetic Spectrum is troublesome, the utility of radar spaceborne satellite sensors, such as ASAR becomes of great significance for the continuous crop monitoring. The classification results achieved using a mono-temporal ENVISAT ASAR image are rather poor on comparison with the classification results gained with operational optical sensors. However, for the selected crops namely cotton and banana the classification results obtained are quite promising. On the use of multi-temporal dataset or fused optical-microwave images, results can be expected to be much better.

In the present study, the NDVI and RVI, optical remote sensing derived indices were used for the estimation of crop parameters due to their mathematical robustness to atmospheric effects upon remotely sensed reflectances. The other not used indices may show more robustness to the influence of variations in soil surface reflectance. Hence, in the further work evaluation of other remote-sensing indices in the retrieval of crop parameters can be carried out. Moreover, the present study makes use of co-polarization data for the estimation of LAI at C-band. Further, cross polarization data acquired at different bands can be evaluated for the LAI retrieval.

It can be concluded that the results obtained in the present thesis can be of practical use to the farmers, agriculture department or to the planners of the district. The remote sensing based approach is relatively fast, easy, cheaper and it requires less labour. In situ costs of acquiring information preclude the use of the conventional methods whereas non-conventional remote sensing derived information aids a farmer in the spatial prediction of crop variables such as chlorophyll content and LAI at early

stages of the crop development. Farmers getting facilitated in locating deficient areas in their agricultural fields thereby get a clear understanding for taking site specific decisions. Such decisions in relation to an economic investment like identification of what?, where? and which type of fertilizers? required at specific location within the field can benefit them monetarily. This information not only proves vital in efficient use of the crop inputs like fertilizers but also for more environmentally sound and sustainable practices in the farm. E.g. Non-conventionally estimated crop parameters in the present study can prove to be useful inputs

1) For better understanding condition of the crops early during growing season.
2) For the determination of within-field variability which is an important aspect of site-specific management.

These facts highlight that specifically an utility of high resolution data is very important for the site specific management. Coarse resolution data has their own limitations due to heterogeneity and small field size of agricultural fields in the study area. It can therefore be concluded that for cropland study, higher resolution optical data along with microwave data with more repetivity can prove fruitful in site specific management by accurately identifying the sites for crop management.