CHAPTER 7

SUMMARY AND CONCLUSIONS

7.1 GENERAL

Droughts are defined based on different factors and their efficient management depends mainly on the correct assessment. Many studies have been concentrating only on a few factors which have led to non-productive results with no impact on drought mitigation planning and ultimately to the society. There is a need to develop a drought assessment procedure which would consider all aspects of drought causing parameters. The following sections summaries the salient aspects of study undertaken in that direction and its outcomes.

7.2 SUMMARY

The present study was aimed at developing a drought assessment procedure in meteorological and agricultural contexts and to develop a GIS based approach to combine all the aspects of drought to formulate an Integrated Drought Severity Index. The Integrated Drought Severity Index was applied to identify drought prone areas. Vellore, a chronic drought prone district, located in the North-East part of Tamil Nadu State, India, was selected as the study area. It lies between 12°15’23” N and 13°12’32” N Latitudes and 78°24’16” E and 79°54’56” E Longitudes. It has been divided into 7 taluks which are further subdivided into 20 blocks.
The meteorological drought severity assessment was carried out using IMD method. Meteorological drought severity map was generated using GIS to identify the spatial distribution of drought over the study area. The results of the drought assessment methods using the IMD and proposed Meteorological Drought Severity Index using frequency analysis were studied. It is observed that stations namely, Ambur, Tiruppathur, Sholinghur, Alangayam, Jolarpet, Vellore, Gudiyatham, Vaniyambadi, Ranipet, Ponnai anicut, and Kaveripakkam are prone to moderate and severe droughts based on IMD method. These stations are chronically drought prone over the years. This is very well observed from frequency based Meteorological Drought Severity Index developed in this study. According to this proposed methodology, the stations namely Ambur, Tiruppathur, Gudiyatham, Vaniyambadi, Sholinghur, Alangayam, Jolarpet were prone to moderate and severe droughts. Both the above methods have the same origin and basis and the proposed methodology is an improvement on the IMD method. The meteorological based assessment may not be a true indicator for drought in a region, since the rainfall spread is assumed to be uniform over an area. It has the disadvantage that small periods of rainfall records may not be suitable for drought assessment of a region.

The agricultural drought severity assessment was carried out with the objective of estimating agricultural drought severity by developing an Agricultural Drought Severity Index (ADSI), which involves crop land and fallow land that were delineated from remote sensing data using NDVI analysis. This approach considers landuse/ land cover aspect only. A land parcel may be fallow at times due to various reasons such as soil condition, rotation of crop, financial condition of farmer etc., This may lead to a propensity of over estimating moderate and severe drought conditions in a region.
Integrated drought severity assessment was carried out in a GIS environment by integrating various parameters affecting drought which comprises of spatial and non-spatial data. Overall fourteen drought parameters have been identified and used for drought analysis in this study. Saaty’s pair-wise comparison method was used in assigning weights to the parameters. It’s advantage is that only two criteria have to be considered at a time and takes into account the inter parameter influences in assigning a normalized weighting score. The integrated drought severity map was generated season wise by using weighted sum overlay technique in Arc GIS software package. The method was tested with three different sets of parameters (14p, 9p and 7p) based on their importance towards drought severity. The integrated drought severity assessment carried out for the study area revealed that very mild and mild drought areas are found extensively in the eastern portion of the study area. The moderate and severe drought areas cover mainly the western portion of the study area. From the analysis of the integrated drought assessment choosing the three cases (14 p, 9 p and 7 p), it is observed that in many number of blocks the results obtained are similar. The CR obtained in case of 9 parameters is comparatively more consistent than the other two cases.

Drought severity maps developed using GIS is very useful to study the spatial variation of drought occurrences across the study area. The drought severity map would help to point out severity of drought experienced at the block level. This information is of utmost importance to planners and administrators to take precautionary measures which would avoid a much more disastrous and serious at a large stage, if neglected. The information generated at block level can be useful for prioritizing blocks for immediate drought combat measures like drought relief, soil and water conservation including rainwater harvesting, drought management and mitigation, environmental planning etc.,
7.3 CONCLUSIONS

Drought has been defined and analysed in many ways. There has been a lack of proper drought assessment procedure, which combines all the drought causing parameters. This study proposes an Integrated Drought Assessment procedure by incorporating various drought causing parameters. This presents a wholesome and complete description of practical field situation. The specific conclusions made out of this study are:

(i) Analysis of monsoon seasonal rainfall shows that rainfall during Northeast monsoon varies spatially from 263.3 mm at Jolarpet to 539.7 mm at Arakonam, while rainfall during Southwest monsoon varies spatially from 291.9 mm at Sholinghur to 458.2 mm at Kaveripakkam. The analysis of crop seasonal rainfall shows that the average rainfall during Samba, Navarai and Sornawari seasons are 690.1 mm, 110.6 mm and 395.8 mm respectively. The analysis indicates that the mean seasonal rainfall values for the study area during Samba season are more compared to the Navarai and Sornawari season rainfall values. Samba crop season which is the main crop season in the district is influenced by both Northeast as well as the Southwest monsoons.

(ii) Groundwater analysis in the study area shows that groundwater level fluctuation is higher in Samba season during which first paddy crop is grown. In Navarai season, there is considerable fluctuation during which second paddy crop is grown. In Sornawari season, the water level fluctuation is less compared to other two seasons during which only dry crops are grown.
(iii) Quantification of water deficiency is helpful in drought mitigation activities. In this study, an attempt was made to develop Meteorological Drought Severity Index (MDSI) using thirty five years of rainfall data. The results are presented in the form of a drought severity map in GIS environment. It is observed that all the western blocks of the study area are prone to moderate and severe droughts, which needs drought proofing measures.

(iv) Agricultural Drought Severity Index (ADSI) developed in this study, involves area under crop land and fallow land, delineated from remote sensing data based on the NDVI response during the major crop season. It provides a better assessment of the scenario on temporal basis as it takes into account of the landuse /land cover aspect. The analysis of meteorological drought using rainfall data and agricultural drought using remote sensing data indicates that a good correlation exists between rainfall and crop area in the study area and the extent of crop land and fallow land may be considered as the true indictors of the monsoon variations.

(v) An Integrated Drought Assessment procedure was proposed by incorporating various drought causing parameters to develop an Integrated Drought Severity Index using AHP and GIS. This is found to be effective in reflecting the actual field situations realistically. It can be applied in identifying areas for inclusion or exclusion under the DPAP of the Government of India. Hence, IDSI will be useful for planning short-term drought mitigation measures in drought prone areas of the country.
7.4 SPECIFIC CONTRIBUTIONS OF THE PRESENT WORK

Specific contributions of this study for drought research are listed below:

(i) Comprehensive review of drought literature with a critical review towards the need for the Integrated Drought Assessment procedure.

(ii) Improvement to India Meteorological Department method (Widely used in Government departments) of meteorological drought assessment.

(iii) A new approach in agricultural drought assessment using remote sensing data with crop land and follow land.


(v) Application of Integrated Drought Severity Index (IDSI) in identification of drought prone areas for DPAP.

7.5 LIMITATIONS OF THE PRESENT WORK

Limitations of the present study are listed below:

(i) As the rainfall spread is assumed to be uniform over an area, the meteorological drought assessment may not be a true indicator for drought in a region. It has the disadvantage that small periods of rainfall records may not be suitable for drought assessment of a region.

(ii) Agricultural drought assessment using remote sensing data considers only landuse/land cover aspect, which may lead to a
propensity of over estimating moderate and severe drought conditions in a region.

(iii) Integrated drought assessment using AHP & GIS requires large volumes of water related data and the collection of the same is the biggest obstacle.

7.6 FUTURE DIRECTION OF WORK

Recommendations for the future direction of work may be as follows:

(i) Drought forecasting by using appropriate technology may be attempted to the proposed drought assessment procedure for early warning on crop condition and reduction in crop yield for the major crops in any study region.

(ii) Using the proposed drought assessment procedure, attempts can be made to develop a well designed Drought Information System (DIS) and Decision Support System (DSS) to effectively manage drought mitigation and response efforts.

(iii) An attempt can be made to develop a common drought model for all types of agro climatic regions which would serve as a tool for drought assessment, monitoring and management.