CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- The present study was carried out to understand the impact of LU/LC changes on hydrologic parameters in the Meenachil river basin of humid tropic south-west India, where, rubber plantations are replacing natural vegetation and mixed crops and also large scale urbanisation processes are in progress.

- Hydrologic and climatologic data for a period of 29 years were available for analysis; the survey of India toposheets and satellite data for different periods were available for understanding the LU/LC changes in the Meenachil river basin.

- The survey of India map for 1969 and satellite data for 1990, 1999, 2005 and 2010 were made use of to understand the LU/LC status of 1969, 1990, 1999, 2005 and 2010. It is found that the most salient change in land use
from 1969 to 2010 has been the sharp increase in rubber plantation from 5.0% to 85.95%, with a subsequent decrease in mixed crop from 87.35% to 0.27%. This increase in area under rubber plantation is mainly due to the increased market price of rubber, which led to human intervention in the area to cultivate more rubber. The built up area has increased from 0.25% in 1969 to 4.69% in 2005 and a slight decrease of 1.27% is observed from 2005 to 2010. The area under rice shows an increase of 5.13% from 1969 to 1973 but after that period the rice fields have been filled and converted into rubber plantation or built up areas. About 7.49% of rice fields has been filled up for various purposes. Due to various socio-economic factors, rice cultivation is not sustainable in the area. This can be the main reason for the conversion of rice fields. Another reason is the increasing demands for habitation space due to the increasing population; the local people have not also realised the long lasting consequences of conversion of rice fields. In addition, expected support is not received by the rice cultivators from the government. However, the climate in the river basin is suitable for rice cultivation. Changes in other land uses are comparatively less.

- An analyses of hydrologic and climatologic data were carried out using Mann-Kendall non-parametric test to understand the trends during a period of 29 years from 1979 to 2007, for the three sub basins in the Meenachil river basin, gauged at Cheripad, Pala and Peroor. An increasing trend of 2.8% per year in annual streamflow is observed at the downstream sub basin gauged at Peroor where as, a decreasing trend of 2% per year is observed for the upstream sub basins gauged at Pala and Cheripad. Also, a 5.2% increase per year is observed for annual peak flow at Peroor and a 2% decrease per year is observed at Pala. Frequency analysis carried out for the annual total streamflow as well as for the annual peak flow shows that the frequency has increased for the flow values at Peroor and the frequency has decreased for the flow values at Pala and Cheripad. The analyses brought to light that the LU/LC changes influence the hydrology of the Meenachil river basin.
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- Since the trend analysis brought to light that the LU/LC change might be responsible for modification of hydrologic characteristics of the Meenachil river basin, an attempt was made to apply the SWAT model to predict the streamflow making use of the available data on topography, LU/LC, soil, hydrologic and climatologic data. The model helped in understanding the modifications to the hydrologic characteristics of the basin due to LU/LC changes. A 50% increase in area under rubber plantation reduce water yield by 9.6%, surface runoff by 12.8% and increase evapotranspiration by 3.3%.

- Based on the recommendations of CPCRI, 1979, the following mixed crop pattern is suggested for areas in the foothills of western ghats and midlands (7.5 - 75m above mean sea level) situated in the wet humid tropic zone of Kerala:

  i) Upper canopy layer : coconut and arecanut
  ii) Mid canopy layer : nutmeg, cloves or cocoa
  iii) Lower layer : pineapple and tubers like tapioca or fodder grass

The suggested mixed cropping system has the advantage of efficient use of sunlight and also appropriate utilisation of soil moisture and nutrients from different layers of soil.

- While going for construction works, proper care should be given to ensure groundwater recharge, since urbanisation trend in Kerala has considerably brought down ground surface facilitating recharge.

- The results of study are expected to help in future developmental planning within the river basin and similar other basins in the thickly populated Kerala State situated on south-west India, and coming under the humid tropical zone.
7.2 Limitations and scope for future work

The accuracy of monthly streamflow prediction using SWAT can be improved, if the entire river basin is sub divided into more sub basins. But when the river basin is sub divided into more sub basins, the land use types in each sub basin may become less. SWAT converts a land use type (say type 1) to other (say type 2) only if both type 1 and type 2 are present in that sub basin, when the change is given in the land use update file. Hence, while studying the impact of LU/LC change, proper care should be given in dividing the sub basins so that the conversion of land use is possible. There is a possibility of improving this software so that the land use/land cover changes can be introduced unconditionally.