CHAPTER 8

CONCLUSIONS

8.1 CONCLUSION OF THE STUDY

In the background of several questions being raised on the sharing of water and review of the interstate agreement of Parambikulam-Aliyar Project (PAP), a study was carried out in the command areas of Aliyar project located in the downstream of the PAP system to come out with a decision support system. The main objectives of the study are: (i) to understand the present irrigation demand and operational features of the Aliyar project of the PAP, (ii) to recognise the onfarm operational efficiency, and (iii) to come out with a decision support system for the Aliyar reservoir. The simulation and optimisation techniques were made use of to understand the efficiency of operation.

A preliminary analysis was carried out with the data obtained from different departments and agencies concerned, to have an understanding of the area under different crops, water availability, crop evapotranspiration, effective rainfall and irrigation water demand of the Aliyar project area of the PAP.

As part of the diagnostic analysis, the performance and sustainability levels were evaluated considering the reliability, resilience and vulnerability criteria. The sustainability indices of the Aliyar system and all its sub-systems, viz., the canal sub-system, regulator sub-system, and the CPP sub-system, were arrived at. The sub-system of the regulators showed high reliability and resilience values, even for meeting the full demand; a high Sustainability Index (SI) value of 85% was obtained.
for this sub-system. However, these values were very low for the canal and the CPP sub-systems. Comparing the canal and CPP systems, the latter is more sensitive to the demand-release relationship. The CPP showed very low sustainability for meeting the full demand all the time; the SI value is just 28% and there is only an increase of 7% when the demand is reduced to 80%. Even for satisfying 50% demand, the SI comes close to 50%, clearly indicating water deficit. From the decade-wise analysis carried out, it is observed that when the SI value of canal system goes up, the SI values of regulator system and the CPP comes down showing that the performance of sub-systems influences each other. The SI values for all the three decades considered were in the range of 30% for the total Aliyar system. This exercise has brought to light that the CPP is having water deficit and the performance of the Aliyar system is very much influenced by the performance of the CPP sub-system.

The need for a detailed field survey to evaluate the performance was recognised. A preliminary survey was conducted among 10% of farmers in the command areas of the regulators in Tamil Nadu and the CPP in Kerala by random sampling. The results indicated that the command area of the regulators are getting required quantity of water from the canal system whereas the farmers of the CPP are depending considerably on other sources of water such as wells, for their agriculture. Further, a detailed survey was conducted in the CPP area covering 395 farmers. The guidelines of the Central Water Commission (CWC) were followed in carrying out this performance evaluation. The canal discharges were also measured at representative locations of the CPP to understand the performance of the physical system. The survey brought to light that: (i) water supply is inadequate in most of the command area - 20% of the respondents at the tail-end of the CPP opined that less than 25% of their water demand is met by canal water; (ii) there has been a rise in the groundwater table; (iii) the land value has gone up in the area; (iv) labour shortage is felt; (v) shift of crops from rice to coconut is observed; (vi) incentives / subsidies are not often received by the farmers with small land-holdings; and (vii) the officials are not often taken into confidence by the farmers. Several suggestions were obtained from
the farming community as well as the officials to improve the state of affairs.

Based on a detailed literature survey, it was found expedient to go for heuristic models for the optimization and simulation study. A web-based Genetic Algorithm (GA), ResOS, was used for optimisation considering its various advantages. This model uses planning time, inflow into the reservoir, demands, evaporation coefficients and reservoir properties as input data. In the GA, one of the important parameters is the population size; different population sizes were tried to improve the performance of modeling and the significant point occurred for a population size of 20. The objective was to minimize the deficit; the planning period was taken as 11 years. The total deficit for 11 years, obtained using optimized releases is 2050.84 Mm$^3$, compared to a value of 2404.60 Mm$^3$ obtained based on actual releases; a decrease of 15% in annual deficit is achieved through optimisation.

The fuzzy logic and the Artificial Neural Network (ANN) were used for the simulation study. The fuzzy logic has certain advantages with regard to its ability to incorporate expert opinions and qualitative or ‘fuzzy’ statements, making it more flexible and better acceptable to operators. The ANN has the ability to recognize patterns by the automatic weight adjustments even for vague and incomplete data and to generalize the patterns in complex systems, thus making it also a powerful tool for water resources engineers.

Modelling was done using the fuzzy logic and the ANN by considering different combination of inputs; six combinations of inputs were considered for both the ANN and fuzzy models and the releases to the Pollachi canal, VP canal and to the downstream river were simulated. The performance was assessed by comparing the model releases with the actual releases, using the statistical indices namely RMSE-observations Standard deviation Ratio - RSR, Nash-Sutcliffe Efficiency - NSE, and percent bias - PBIAS. Both the ANN and fuzzy models with 4 inputs were showing a satisfactory performance for all the 3 releases, better simulation being obtained for
the fuzzy models.

Five scenarios were arrived at based on the feedback from the farming community and the officials and also from the detailed study of the CPP sub-system. Scenario analysis was carried out using the ANN; the results show that, the average annual deficit in the CPP is 36.5% for Scenario 1 with long duration rice crop and the maximum monthly deficit is 60% in the month of February. For Scenario 2, considering the alternate sluice method in the command areas of the CPP, the average annual deficit came down to 19% and maximum monthly deficit to 37%. In Scenario 3 adopting medium duration variety of rice and in Scenario 4 adopting short duration variety of rice, the average annual deficit came down to nearly 15%. In Scenario 5 also with long duration rice crop and vegetables, the deficit is much reduced. Scenarios 3, 4 and 5 are giving better performance and SI values even with low simulated releases as observed from the sustainability analysis of these scenarios. From the scenario analysis, Scenario 4 is found to be suitable now, as the annual demand for this scenario is 218.43 Mm$^3$, which is close to the present entitlement of Kerala - 205.3 Mm$^3$.

The study is relevant in the context of large-scale interlinking of rivers envisaged by the Government of India, since the present case study brings to light the various aspects encountered in such projects. The study has brought to light that with better water management practices, the efficiency of the system can be improved. Based on the analysis, Scenario 4 may be adopted initially considering the entitlement of Kerala State. The results of the study will be helpful at the time of reviewing the interstate agreement by the states of Tamil Nadu and Kerala.

8.2 SCOPE FOR FURTHER RESEARCH

A few suggestions for further research are outlined below:

• In the present study, the different cropping scenarios were considered only for the CPP command area. This can be extended to the Pollachi and VP canal
command areas and also the commands of regulators. More relevant scenarios also may be considered so that better irrigation efficiency can be achieved in all the command areas coming under the Aliyar project.

- Though a detailed study on yield and returns would have enhanced the value of performance evaluation, it was not possible to obtain data on these either from the departments concerned or from the farming community. In fact, the farmers had reluctance to disclose this data especially because they were craving for incentives and subsidies from the Government. A study focussing on the economic benefits of the project may be undertaken.

- The present study focussed on the Aliyar project and particularly on the Chitturpuzha project coming directly under it. However, a detailed study on the entire Parambikulam-Aliyar Project with all the reservoirs and diversions for irrigation and hydropower components would be really useful for increasing the level of performance of the entire system.

- A study on the indirect benefits of the project, such as groundwater recharge, improvement in drinking water status, increase in land value and overall development of the area would be really useful.