CHAPTER VII

SUMMARY AND CONCLUSIONS

This is a summary of the study reported in this thesis. For the purpose of presenting the findings and conclusions, in a nutshell, the entire thesis is summarised in a capsuled form. Towards the end of the chapter, however, suggestions for further research are given.

1. The 'flying-bird' shaped Amaravathy Basin has low rainfall because of its location in the rainshadow. This results in a series of conditions, of low water table and mostly infertile soils. It is essentially an agricultural region. It is marked by high density of population and means of transport and communication well developed. Although it is a basin, agriculture has suffered for want of irrigation facilities and adequate water supply.

2. The spatio-temporal investigation of the general land use of the basin reveals that the forests occupy 12.4 per cent of the total geographical area during 1991-92. Forests are however confined to the hilly tracts of the south. Between 1971-72 and 1991-92, the forest cover has declined from 133,181 ha to 130,707 ha. This is due to the deforestation as a consequence of felling of trees to meet the demands for timber and firewood. There is an urgent need to increase the area under forests to build and maintain the ecological balance.
3. Land not available for cultivation accounts for 14.3 per cent of the total geographical area. This has however shown an increase in the share, from 13.1 per cent in 1971-72 and 14.3 per cent in 1991-92. This may be attributed to the decreasing rainfall and sprawling urban centres. Uncultivated lands account for 1.8 per cent in 1991-92, which was 2.9 per cent and 2.2 per cent in 1971-72 and 1981-82, respectively. The scope for reclaiming these lands is limited. Long fallow accounts for 9.1 per cent in 1991-92. There are spatial disparities. The percentage of change over the years account for a small increase at 1.8 per cent.

4. Leaving the ploughable land under fallow is a great misuse of land resources. Early and effective measures are needed to reclaim this land for agriculture and horticulture. The current fallow is however fluctuating. It was 17.8 per cent in 1971-72, 20.7 per cent in 1981-82 and 19.5 per cent in 1991-92. Between 1971 and 1991, most blocks have registered an upward trend in the current fallow. Prominent changes have occurred in the current fallow of the PAP Canal area and in the Kodaganar basin. The trend in overall current fallow is not a healthy one. This has to be checked by encouraging the farmers to bring their fallow back into use.

5. The net sown area in the basin has decreased by 35,590 ha, from 488,266 ha to 452,676 ha during the period under consideration. Development of irrigation has played a major role in increased gross-irrigated area. Decreasing rainfall, lesser profits from dry farming, labour problems and
increasing cost of cultivation have resulted in a decreasing net sown area over the years.

6. Declining rainfall has considerably restricted the area under net sown area during the two decades under study, even while minor irrigation projects have been built in the basin. There is however vast scope for increasing the net sown area through building more irrigation works, preferably small systems in the newer and drier parts of the basin.

7. There has been a steady decline in the GCA of the basin, too. Its share has declined from 47 per cent in 1971-72 to 44 per cent in 1991-92. The volume of change calculated using the Weaver's index puts the magnitude of change at 4.7 per cent during 1971-91. Increasing trends in land put to non-agricultural uses, current fallow and long fallow and the decreasing area covered by pastures and the miscellaneous tree crops are the major reasons for the change in the general land use pattern. In 9 out of the 25 blocks, the change has been significant, with more than 10 per cent. In 10 blocks, it is moderate with 5 to 10 per cent. Land use pattern has attained stability in the remaining blocks.

8. As for the decennial variations in the overall volume of change, the first decade (1971-81) shows more dynamism than the second (1981-91). As for the intensity of cropping is concerned, it is 102.7 per cent in 1971-72 as against 104.4 per cent in 1981-82 and 106.5 per cent in 1991-92. This means that there is a low cropping intensity in the basin. There are micro
regional variations, from 100 per cent in Aravakurichi to 117 per cent in Madathukulam block, in the intensity of cropping, low to very low intensities being widespread.

9. Although irrigation plays an important role in determining the degree of intensity, it does not enjoy the same prominence everywhere. There are areas where double cropping can be attempted, efficiently, provided irrigation facilities are made available.

10. It is somehow a steady increase in land use efficiency in the basin, from 64.9 per cent in 1971-72 to 66.6 per cent in 1981-82 and 68.9 per cent in 1991-92. There are however wide spatial variations, ranging from 53.6 per cent to 88.2 per cent. The levels of efficiency is high to very high in canal oriented agricultural areas. In terms of change between 1971 and 1991, 14 out of 24 blocks have registered upward shifts. Yet the rate of change is not at a satisfactory level.

11. The dynamism in agriculture in the basin is manifest not only in the improvements in irrigation and general land use but also in the transformation of its cropping pattern. The cropping pattern in the basin has moved forward in commercialisation through increasing acreage under sugarcane, vegetables, fruits and coconut. In fact, all these crops which became more profitable primarily through the creation of better market facilities and assurance of purchases by the government have gained in area under them and risen in their relative positions in the cropping
complex of the basin. Development of irrigation, timely distribution of fertilisers and pesticides, credit facilities and the role of the Department of Agriculture have made a significant contribution to this transformation.

12. The land use analysis of the basin has revealed that the foodgrains are more important than the other crops. Food crops occupy 70 per cent of the GCA. Thus, they dominate the agricultural landscape, everywhere, with some spatial variations. Food grains which include paddy, cholam, cumbu and pulses play an excessively predominant role in the cropping pattern of the basin.

13. Cholam or sorghum is the most important crop of the basin that its cultivation is most widespread. It has been the staple food of the majority in the rural areas. It has ranked as the first important crop in 13 of the 24 blocks considered in 1971-72, 17 blocks in 1981-82 and 16 blocks in 1991-92. It has been the second ranking crop in 7 blocks in 1971-72, 6 blocks in 1981-82 and 5 blocks in 1991-92. This shows the predominance of cholam in the basin. The concentration index for cholam has a range of 41.3 per cent (in Madathukulam) to 147.6 per cent (in Oddanchatram) in the basin. The volume of change analysis indicates to an increase of 3 per cent in the basin during the study period. Cholam has gained areas in the dry tracts than in the irrigated tracts.

14. Pulses are the second ranking crop of the basin, covering 13.4 per cent of the GCA. These are inter-cropped with groundnut and cholam in dry
areas and are sown in the irrigated areas after the harvest of paddy. Pulses are found in concentration in Coimbatore and Periyar districts. Just as cholam, these are also widely cultivated in the basin and their concentration ranges from 8.2 per cent (in Karur block) to 182.8 per cent (in Thoppampatti). Pulses are the first ranking crops in Gudimangalam block and second ranking in 6 blocks during 1991-92. They have been gaining grounds in Dindigul-Anna district. The share of the pulses in the GCA increased from 12.0 per cent in 1971-72 to 13.4 per cent in 1991-92. As these crops can be grown in a wide variety of soils, the farmers should be encouraged to grow these, for augmenting nutrition.

15. **Paddy**, the leading irrigated crop of the basin, is cultivated in 48,666 ha in 1991-92. In 1971-72, it was the first ranking crop in two blocks but in 1991-92 it has ranked first in four blocks. It is highly concentrated in the old ayacuts of the basin. As such, it is concentrated highly in Palani and Madathukulam blocks. The range of concentration index has been decreasing from 381.1 in 1971-72 to 241.9 per cent in 1991-92. This has been a much fluctuating crop in the basin. The share of it in GCA has increased from 9.5 per cent in 1971-72 to 11.8 per cent in 1981-82 but declined to 10.5 per cent in 1991-92. Just as groundnut, this crop is also losing its grounds in the traditional strongholds and, on the other, encroaching on newer areas. Farmers have a pride in cultivating this crop and that is why this is gaining grounds in the newer ayacuts and newly irrigated areas.
16. **Groundnut** is the leading oilseed, accounting for 9.4 per cent of the GCA of the basin. It is the second ranking crop in five blocks in 1991-92. Its cultivation has been concentrated in Dindigul-Anna district due primarily to the predominance of red soils which are well suited to the cultivation of this crop. It may be stated that this crop is unevenly cultivated over the basin as the concentration index varies from 30.9 per cent (in Athoor) to 229.8 per cent (in Vadamadurai). As regards the volume of change, the basin as a whole has registered a decrease to the limit of -0.7 per cent; yet, there are spatial variations. Groundnut has lost areas in the traditional pockets of Dindigul-Anna and Tiruchirappalli districts but gained newer areas in the other two districts: Coimbatore and Periyar.

17. **Cumbu or pearl millet** is the localised crop of the basin. In 1971-72, its concentration index has ranged from 0.8 per cent in Madathukulam to 360.8 per cent in Aravakurichi. In the following decade, however, it has been increased from 1.3 per cent in Gudimangalam and Sultanpet to 585.0 per cent in Aravakurichi. This means that cumbu is becoming more and more localised. In 1991-92, nearly 75 per cent of the total cumbu acreage has been in four blocks - K. Paramathy, Thanthoni, Aravakurichi and Gujiliamparai. A well-marked cumbu belt has been developed in Karur block of the basin. It has covered 13 per cent of the GCA in 1971-72 but only 8.0 per cent in 1991-92. Cholam is capturing the cumbu areas in the lower reaches of the basin.
18. **Vegetables** are gaining importance among the cropping systems of the basin. Their area increased from 24,627 ha in 1971-72 to 32,006 ha in 1981-82 and to 36,179 ha in 1991-92. Its cultivation is concentrated in Dindigul-Anna district, especially in those blocks which have hilly tracts. Dindigul-Anna district has accounted for 86.2 per cent of the total acreage under these crops in 1971-72 but this proportion decreased to 76.1 per cent in 1991-92. There has been a spread of these crops to other blocks and other districts as well. These crops have shown declines in their traditional strongholds, however. Reddiarchatram and Thoppampatti alone have shown a negative change, during the two decades of study. In the last decade, the farmers have introduced these crops as cash crops wherever irrigation is limited to raise other crops, extensively.

19. **Coconut** is the most dynamic component of the cropping pattern in the basin. The acreage under this crop has risen from 2,366 ha in 1971-72 to 20,074 in 1991-92, that is by 748.4 per cent. It is highly concentrated in Athoor, Udumalpet, Gudimangalam and Sultanpet. In the PAP Canal areas, the farmers prefer coconut in place of paddy and other crops due to labour problem and cost of production. The crop has improved its position during the period of study, very much, in the western parts of the basin than in the other parts.

20. **Cotton** is the most affected of the crops in the basin. The area under cotton has declined from 39,554 ha in 1971-72 to 14,652 ha in 1991-92. In its cultivation, there is wide spatial variation. It is highly concentrated
in Udumalpet, Gudimangalam and Kundadam blocks. The spatial variation has been reduced during the period of study. The leading, cotton growing blocks are Palani, Udumalpet, Gudimangalam, Sultanpet, Pongalur and Kundadam. They together accounted for 80.7 per cent of the total area under cotton in 1971-72 but in 1991-92 their share has been reduced to 57.2 per cent. This shows that the western parts of the basin, which is the stronghold of cotton, have experienced the highest overall quantum of change in the cropping pattern. South and southeastern parts of the basin have followed suit. But cotton cultivation has declined all over the basin due to uncertainties in its prices and strong competition from other crops for space.

21. **Sugarcane** is the newly emerging cash and irrigated crop of the basin. It is strengthening its position in the cropping pattern of the basin. In the wetter areas, it is successfully competing with paddy for areas. It is also a localised crop of the basin as its concentration index ranges from 3.9 per cent in Aravakurichi block to 554.8 per cent in Karur block. The blocks of Udumalpet, Madathukulam, Palani, Dharapuram, Reddiarchatram and Karur accounted for 83.6 per cent of the total sugarcane area in the basin. Seven tank areas in Udumalpet block are considered to be the sugarcane bowl of the basin. In the old ayacut areas, it has successfully replaced the traditional irrigated paddy crop.

22. **Oilseeds** such as gingelly and sunflower have not come to the limelight, as for cropping pattern is concerned. Among the crops, these are the least
important in the basin. Their acreage has declined from 18,097 ha in 1971-72 to 9,943 ha in 1991-92, that is, by 45 per cent. Its cultivation is highly concentrated in Vellakoil, K. Paramathy and Thanthoni blocks. It is associated with cumbu in the northeastern parts of the basin. In moisture favourable areas, groundnut has been preferred and in moisture deficit areas other oilseeds are cultivated.

23. Food crops dominate the agricultural scene of the basin. Of the 10 crops considered for analysis, all crops except groundnut, cumbu, cotton and oilseeds have improved their position in the cropping pattern. Oilseeds, including groundnut, have accounted for only 11.6 per cent of the GCA and hence the farmers should be encouraged to raise these crops in the basin. Increasing trends in sugarcane, paddy, vegetables and fruits and coconut are a healthy trend that should be encouraged.

24. Increasing irrigation facilities and the parallel interests in crops such as sugarcane, vegetables and coconut will fetch good income to the farmers. These have also been responsible for the dynamism the basin represents in its agriculture. The shift in the last few years has been from inferior grains (cumbu and minor millets) to superior grains (paddy and cholam) or from grains to cash crops (sugarcane, coconut and vegetables). The basin thus has great agricultural potential and awaits more outstanding and dynamic swings.
The study of crop combination provides for a composite picture of crop geography. The basin as a whole had four-crop combinations, formed by cholam, cumbu, pulses and groundnut in 1971-72, in 1981-82, however, cumbu was replaced by pulses and, in 1991-92, cholam, pulses, paddy and groundnut formed the combination of the basin. As of now, at the micro-regional context, three combinations exist extensively in the basin.

The crop combinations have undergone considerable changes which are due to the changes in the ecological as well as economic conditions. There is no monocrop region in any given period. There was one block (K. Paramathy) with a two-crop combination in 1971-72 while in 1991-92 two blocks have had the two-crop combination. Three-crop combinations existed in 15 blocks during 1971-72 which however came down to 8 blocks during 1991-92. The number of blocks with four-crop combinations increased from 4 to 9 during the 20-year period. There were 3 blocks with 5-crop combinations in 1971-72 which declined to 2 blocks in 1991-92. One block has 6-crop combination and two blocks have 7-crop combinations and these combinations have not been in existence before. In the process of agricultural development over the years, crop combinations have become complex and the number of crops has increased in most combinations. This shows the diversifying nature of the cropping in the basin.

The basin has a fairly high diversification of crops. However, there has been a slight change in the index of 84 per cent during 1971-72 and 83
per cent 1991-92. There are however micro-regional variations. Between 1971-72 and 1991-92, 17 blocks have registered an upward trend in crop diversification. No change has been recorded in 3 of the blocks and a downward trend has been registered in 4 other blocks. Thus, there has been an increasing crop diversification in the cropping pattern of the basin. Nevertheless, it may be said that there has been and still is considerable misuse of land in the basin.

28. **Irrigation** is an important aspect of the agricultural development of the basin. Irrigation facilities should be improved all over the basin. Many farmers' organisations have drawn the attention of the Government Departments, giving suggestions for the improvement of water management system. They are:

a) Rehabilitation of the feeding systems for canals and channels.
b) Rehabilitation of tanks and anicuts.
c) Removal of rock outcrops in the canals and widening and lining of the canals.
d) Rehabilitation of service roads and formation of approach roads.
e) Provision of adequate gate and/or proportional dividers to the sluices.
f) Maximisation of rainfall utilisation with the revised crop calendars: First crop - July to October, Second crop - November to March.
g) Avoiding releases in hot months.
h) Encourage farmers to develop groundwater to offset uncertainties.
i) Managing shortfall by rationing and distributing in large areas of command, to promote equitable recharge of groundwater and developing a system of priority, zoning and abandoning of areas rotated over the years.

j) Developing an operational plan for the entire basin.

k) Serious consideration to be given to the overall control of the entire system which is now with the Irrigation wing of the Public Works Department.

l) Conjunctive use of groundwater to help conserve surface water.

m) Assured and timely releases to encourage farmers to start agricultural activities in time, resulting in compressed crop periods for the two seasons. Timely deliveries should be possible in most years.

n) Controlled distribution of water besides reducing wastage to help with equitable distribution so as to increase cropped area and yields.

o) Improvements and revised operational plans, with farmers involvement and cooperation.

p) Reviving the annual practice of desilting the tank during the festival of the village deity, on a regular basis. Contrarily, however, raising the levels of dam and the tank rather than desilting, which is expensive, must be attempted.

q) Improving tank irrigation towards conserving the soil moisture and facilitating better utilisation of rain water during the season.
r) Horizontal expansion in dry tracts as against vertical expansion in wet tracts. Extension of canals and setting up minor irrigation projects. In this way, the Main Canal of the Amaravathy basin could be extended by about 10 km. Similarly, extension of the PAP Canal System into K.Paramathy block.

29. In the new command of Palar-Porandalar system, the farmers make ineffective use of groundwater and also the rains that should be used effectively. In the left main canal command, they are reluctant to commence agricultural activities with the residual moisture due to rains or with the available water. In the old commands, however, roots are affected due to uncontrolled irrigation and the leaching of fertiliser causes low yield. Controlled flow could, on the other, generate more yields.

30. There has been unauthorised cultivation of tank beds and this has been a serious problem, particularly in seven tanks area of Udumalpet block. This is so also in the many tank areas of the district of Dindigul-Anna. Siltation has been a problem, year after year.

31. It has been found, from the survey of the Amaravathy main canal command, that the existing water use is substantially higher than the recommended levels in paddy (57 per cent) than in sugarcane (28.1 per cent). This is mainly due to the tendency of the farmers to over-irrigate their fields, to check weed growth on the one hand and to avoid uncertainty of the next turn. The excess of water use has had no effect on
the cost of irrigation to the unit area: water is priced at the unit area (ha) in the canal irrigation schemes. It is however estimated that the water demand-supply gap in the command areas is widening.

32. There are two possible ways of bridging the gap: one, to increase water supply and/or to reduce the existing water use by the crops through efficient water management practices. But with the scope for the former being limited, the rational use of water is the only pre-requisite to extend the irrigation facilities in the entire command and to maximise returns from crop production. It is good to work out a devise for soil-plant-water relationships.

33. **Drip or sprinkler irrigation** could be attempted to effectively use the available water. Sprinkler irrigation eliminates channel and levelling of land. It is better than flow irrigation. It is specially suited for sandy and undulating topography. Financial assistance should be provided by the government for those wanting to install sprinkler irrigation. Technical education should also be imparted to the farmers. Sprinkler adoption may also be covered under the crop insurance schemes.

34. Existing land use pattern has shown that there is not much scope for expanding irrigation. Irrigated land should be used more effectively for multiple or double cropping, in order to meet the requirements of the increasing population in the basin. Land use and population balance must be kept within the carrying capacity of the soils.
35. **Dry farming technologies** may be followed in these areas. Drought prone areas may be delineated and drought prone area programme may be implemented effectively here. Dairy, poultry and fish farming could be attempted wherever possible. The development of the basin could be on the lines of integrated agro-industrial development.

36. **Fragmentation**, because the land holdings are constantly being subdivided, must be checked as the marginal farmers have no capacity to invest capital and follow the scientific methods of cultivation. Consolidation therefore should be encouraged and attempted.

37. Most marginal farmers have been cultivating low value crops such as cholam, cumbu and other millets. Hence, the forces that prevent them from cultivating commercial crops such as sugarcane, oilseeds and vegetables should be identified. Behavioural factors such as perception and attitude of the farmers, their conceptualisation of farm prosperity and their adherence to a particular way of farming predominate. The Government should therefore visualise the socio-cultural milieu of the farmers before introducing any scheme.

38. It has been observed that there is a overall lack of technological change and diffusion of agricultural innovations. Steps to improve knowledge, skill, attitude of the farmers with regard to adoption of innovations must be taken: use of fertilisers, improved variety of seeds, irrigation and implements, moisture conservation practices should be given serious
attention by the change agents, research workers, educators and development administrators.

39. **Regional variations in agricultural development** of the basin have been noticed. The analysis of agricultural problems have indicated that agricultural planning for the basin requires a comprehensive and integrated approach, based on regional resources and government policies.

40. The **PCA** application to the survey data, with 40 variables entered into the analysis has given rise to an eight-component structure, revealing the eight important dimensions of agriculture in the Amaravathy basin. The eight dimensions of agriculture have accounted for a total variance of 51.58 per cent. The component dimensions extracted from analysis are:

a) Irrigated Agriculture and Important Inputs  
b) Dry land farming, Fallow and Smallstock  
c) Mechanised Agriculture  
d) Irrigated Agriculture and Land Leasing  
e) Tank irrigated Agriculture  
f) Pricing of Agriculture  
g) Livestock  
h) Age

Greater changes in agriculture have been shown through the dimensions extracted and the changes are positively significant in terms of dimensions b), d) and h) while a large proportion of farmers have shown negative
inclinations in terms of other dimensions extracted from the PCA analysis reported in the last chapter.

Suggestions for Further Research

Many areas of research suggest themselves from the consideration of the results obtained through the analysis and discussion in the thesis. They are:

1. The study has shown that there are enough scope and possibilities for adjustments in land use in the future. The cropping patterns may be analysed however with respect to changes in soil and land capability. Land capability may be studied for the entire basin using two-stage approach to land evaluation, namely, the physical and the socio-economic approaches.

2. Crop profiles and farm planning may be analysed in respect of optimal uses to which and can be put to. It would be ideal also to prepare a land evaluation map which could form the basis for determining suitability for crops.

3. Input-output relationships in crop production and factors affecting crop systems contributing to development and welfare may be looked at from various angles to derive developmental perspectives. The problem of wastelands and possibilities for its reclamation may be studied, in depth, to provide for sustainable agriculture.
4. Remotely sensed data for the basin may be used in a variety of ways, from crop area estimation to crop production estimation. Images are available for the study area for a considerable period of time and as such image analysis, taking various problems of analysis, may be attempted on a large scale. Crop production estimation, change detection of agricultural land uses and crop and agricultural land use planning taking land mapping unit offer potential areas for future research.

5. The study may be extended in the area of land evaluation and land management for agricultural development using a GIS approach. Geographical Information Systems may be used in the land uses analysis and also environmental impact analysis focusing on chemical pollution caused by fertilisers, pesticides and insecticide uses. Trace elements in water and water quality may also be analysed as part of another major study.