### CHAPTER – V
### SUMMARY AND CONCLUSION

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Particulates</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.</td>
<td>Introduction</td>
<td>107</td>
</tr>
<tr>
<td>5.2.</td>
<td>Major Findings</td>
<td>107</td>
</tr>
<tr>
<td>5.2.1.</td>
<td>Characteristic Features of Terrain</td>
<td>107</td>
</tr>
<tr>
<td>5.2.2.</td>
<td>Drainage</td>
<td>108</td>
</tr>
<tr>
<td>5.2.3.</td>
<td>Ground Water</td>
<td>108</td>
</tr>
<tr>
<td>5.2.4.</td>
<td>Climate</td>
<td>108</td>
</tr>
<tr>
<td>5.2.5.</td>
<td>Nutrient Status of Soils</td>
<td>109</td>
</tr>
<tr>
<td>5.2.6.</td>
<td>General Land use</td>
<td>109</td>
</tr>
<tr>
<td>5.2.7.</td>
<td>Population Density</td>
<td>110</td>
</tr>
<tr>
<td>5.2.8.</td>
<td>Agricultural Land use</td>
<td>110</td>
</tr>
<tr>
<td>5.2.9.</td>
<td>Water Resources:</td>
<td>111</td>
</tr>
<tr>
<td>5.3.</td>
<td>Major Recommendations</td>
<td>112</td>
</tr>
<tr>
<td>5.3.1.</td>
<td>Strategy for Sustainable use of Water Resource</td>
<td>113</td>
</tr>
<tr>
<td>5.3.2.</td>
<td>Strategy I- Recharging of Ground Water</td>
<td>114</td>
</tr>
<tr>
<td>5.3.3.</td>
<td>Strategy II - Optimization of Water Resource for Agriculture</td>
<td>114</td>
</tr>
<tr>
<td>5.3.4.</td>
<td>Strategy III - Efficient Method of irrigation</td>
<td>115</td>
</tr>
<tr>
<td>5.3.5.</td>
<td>Strategy IV - Improvement of Cash Flow</td>
<td>115</td>
</tr>
<tr>
<td>5.3.6.</td>
<td>Strategy V - Utilization of Human Resource</td>
<td>116</td>
</tr>
<tr>
<td>5.4.</td>
<td>Limitation of the Study</td>
<td>116</td>
</tr>
<tr>
<td>5.5.</td>
<td>Scope for further study</td>
<td>116</td>
</tr>
<tr>
<td>5.6.</td>
<td>Conclusion</td>
<td>117</td>
</tr>
</tbody>
</table>
5.1. Introduction

The study as mentioned in the previous chapter has now reached to the concluding stage. It is worth to summarize the observations made in the present work. The study area is the part of drought prone areas dominated in the tahsil. The areas benefited by surplus water resource have shown overuse of soil and water resources. Consequently, the environment is degraded. While suggesting any kind of strategy for overcoming the drought-proneness and poverty, it is essential to undertake a thorough appraisal of the characteristics of the physical and socio-economic environment. After attempting to design village-wise planning strategy for sustainable agricultural development in the Kanola and Pondhra basins. The present investigation has revealed that suggested cropping pattern can be achieved without compromising the output. More importantly the study observes that optimization of water resource may lead to check environmental degradation and inclusive growth. Similarly watershed management programmes can improve the water resource by accelerating infiltration and conserving soils. This chapter mainly deals with summary, suggestions and concluding remarks. It is worth to mention the limitation of the study as understood by the candidate. The scopes for further studies have also been discussed in this chapter.

5.2. Major Findings

Appraisal of resources and formulation of planning strategies for proper utilization of water resource are the major objectives of the present study. While introducing the study area it was remarked that the study area has insufficient water resource to cope present cropping pattern. Major findings of the detailed investigations are briefly outlined as following.

5.2.1. Characteristic Features of Terrain

7) Terrain evaluation with landscape approach has resulted in to four main micro-stratigraphical division’s viz. Mal-region, Hill-top surface, Sloping surfaces and River terraces.

8) The micro-stratigraphic units are closely associated with soil and vegetation cover in the study area.
9) The Mal-region which is the largest landscape unit has a good potential for developing biomass resources.

10) Morphostratigraphic studies have helped in assessing the quality of environment in different types of geomorphic situations and hence have provided the basis for the formulation of strategies and construction of suitable models for development.

11) The morphostratigraphic study revealed the relationship between type of land use and land cover at micro level. This may be useful to design site specific watershed management programmes.

5.2.2. Drainage

Kanola is 5th order and Pondhra basin is 4th order stream.

5.2.3. Ground Water

3) Kanola Basin
The pre-monsoon groundwater level in the Kanola basin is ranging from 5.9 mbgl to 10 mbgl and the post-monsoon groundwater level ranging from 2.5 mbgl to 5 mbgl. The average pre-monsoon and post-monsoon ground water levels are 8.06 mbgl and 3.6 mbgl respectively. The average fluctuation is 4.42.

4) Pondhra Basin
The average pre-monsoon groundwater level in the Pondhra basin is found to be 6.2 mbgl to 9.7 mbgl and those in post-monsoon season are ranging from 1.5 mbgl to 4.2 mbgl. The average fluctuation in the basin is found to be 4.53 m.

5.2.4. Climate

1) Air is highly humid in SW monsoon and mostly dry during rest of the year.

2) Saptial variation of rainfall shows that the rainfall increases from SW to NE in both the basins.

3) Rainfall distribution with PE shows that there is a prevalence of dyness throughout the year.

4) The speed of the wind ranges from 4.3 km/hr to 17.3 km/h. So there is almost no scope for wind farming in both the basins if present technology is applied.
5) The study of climatic parameters observes that the basins have scarcity of water normally. It becomes severe problem in the year of drought and probability of which is quite high.

5.2.5. Nutrient Status of Soils

The study reveals that soils from the Kanola and Pondhra basins are moderately alkaline in Nature. The result of EC reveals that the soil is free from salinity in both the basins. The available nitrogen and phosphorus in the soils are in low category. However, medium to higher content of K was observed in the soils.

5.2.6. General Land use

1) TGA (Total Geographic Area) for both the basins is about 33946.20 hect.

Kanola Basin

2) Kanola basin has about 15837.55 hect. of the TGA of the same about 76.75% is the net sown area (NSA).

3) About 91.91% NSA is unirrigated. Only 8.08% NSA is irrigation by source of which mainly seasonal rivers and wells.

4) The canal irrigation facility is mainly available for a very small part of agricultural area is nearly 1%.

5) The importance of culturable waste is worth noting as 6.63% of TGA.

6) The area under forest is meager (7.31% TGA). The quality of forest is very low as revealed in the field study.

Pondhra Basin

1) This basin is about 18108.65 hect. of the TGA of the same about 71.84% is the net sown area (NSA).

2) About 92.75% NSA is unirrigated. Only 7.23% NSA is irrigation by source of which mainly seasonal rivers and wells.

3) The canal irrigation facility is mainly available for a very small part of agricultural area is nearly 1%.

4) The importance of culturable waste is worth noting as 12.02% of TGA.
5) The area under forest is meager (2.41% TGA). The quality of forest is very low as revealed in the field study.

5.2.7. Population Density

1) Density of population is about 99 persons/ sq km in year 1991 and 120/sq Km in the year 2001 in Kanola basin.

2) Density of population is about 99 persons/ sq km in year 1991 and 121persons /sq Km in the year 2001 in Pondhra basin.

3) In Kanola Basin 55.80% of the population is total working population. The main work population in the basin is 49.99%.

4) Pondhra basin out of the total population 59.69% of the population is total working population. The main workers contribute to 45.4% to the total population in the basin.

5.2.8. Agricultural Land use

1) The NSA in the Kanola basin is 8487.59 hect. in the year 2009-2010 2010 of which maximum area is occupied by cereals 6030.26 hect. (78.1% NSA).

2) In the Pondhra basin the NSA is 9641.96 hect. in the year 2009-2010 of which maximum area is occupied by cereals 8312.95 hect. (86.97% NSA).

3) The area of Sorghum (Jowar) in the Kanola basin is 6170.43 hect. (72.70% NSA) and in Pondhra basin 7855.05 hect. (81.40% NSA).

4) Sorghum is the dominant crop in both the basins.

5) Pulses contribute to 469.55 hect. (5.55% NSA) in Kanola basin and 539.80 hect. (5.58% NSA) in Pondhra basin.

6) Oilseeds contribute to 141.48 hect. (1.65% NSA) in Kanola basin and 169.4 hect. (1.75% NSA) in Pondhra basin.

7) Vegetables contribute to 45.13 hect. (0.53% NSA) in Kanola basin and 43.6 hect. (0.45% NSA) in Pondhra basin.

8) Onion contributes to 2.4 hect. (0.021% NSA) in Kanola basin and 95.4 hect. (0.98% NSA) in Pondhra basin.
9) Fruits contribute to 322.15 hect. (3.79% NSA) in Kanola basin and 681.90 hect. (7.07% NSA) in Pondhra basin.

10) Sugarcane occupied an area of 844.7 hect. (9.69% NSA) and 496.87 (5.15% NSA) hect. in Kanola and Pondhra Basins respectively.

11) One hect. are of sugarcane requires 4.16 mh of water. If this logic is applied for both the basins it may be stated as about 38.61% water source in Kanola basin and 21.14% in Pondhra basin has been consumed by sugarcane.

12) Both the basins have good soil resource limited to narrow belts along the streams. About more than 70% of this belt is under sugarcane. This means that both the basins have diverted soil resource to this crop.

13) It is observed that the present cropping pattern is unable to provide employment to existing workers engaged in agriculture.

14) The employment generation is maximum in case of the sugarcane followed by sorghum, Fruits, Pulses, Wheat, Oilseeds, Vegetables, Bajra, maize, Onion etc.

15) The cash outflow from the basin is lowest for the crop like maize (4.77%) and highest for the sugarcane (20.92%) as revealed in the field survey.

16) Although sugarcane cultivation generates good employment it consumes maximum water with significant outflow income.

**5.2.9. Water Resources**

13) The average annual rainfall in the Kanola basin is 588.66 mm and to that of Pondhra basin is 567 mm.

14) The Kanola basin receives 9332.118 mh of rainwater and Pondhra basin receives 10454.55 mh of rainwater.

15) The available rainwater resource from rainfall in Kanola basin is 3732.84 mh in Kanola basin and 4181.81 mh in Pondhra basin after considering the loss by way of evaporation and infiltration.

16) The groundwater potential was computed by considering the water requirement of different crops under well or tube well irrigation. The groundwater availability in both the basins is 1469.3 mh.
17) The total water resource including groundwater and available water is 11506.04 mh.

18) The requirement of water for present cropping pattern is 19032.61 mh.

19) Kanola basin has canal water resource of about 1592 mh and is about 530.04 mh in Pondhra.

20) It is observed that out of 26 village’s 16 villages show negative water balance and 10 villages show positive water balance in both the basins.

21) It has been shown that in Kanola basin the villages viz. Vanjarwadi, Limbewadi, Raogaon, Punwar, Wadgaon (N), Wadgaon (S), Mangi, Bhose, Pimpalwadi, and Dhykhindi these villages shows negative balance it means that these villages are under the stress of water scarcity. The villages viz. Pothre, Nilaj, Hiwarwadi, Karmala, Roshewadi shows positive water balance.

22) It has been observed that in Pondhra basin the villages viz. Veet, Pondhra, Manjargaon, Undergaon, Ritewadi, Umrad show negative balance it means that these villages are under the stress of water scarcity. However, the villages viz. Sogaon, Morwad, Vihal, Anjandoh, Jhare, shows positive water balance.

23) The villages showing surplus water in the year of rainfall normal or more may show deficiency of water in the year of rainfall less than mean.

24) The field study has revealed that there is overuse of water wherever water resource is surplus. Therefore method of irrigation should be made more efficient.

5.3. Major Recommendations

This is the study of two basins lying in the drought prone zone, both the basins suffers from the water scarcity and hence the agricultural development is restricted. It is not just optimistic but quite practical to suggest optimization of water resources for agriculture and watershed management programmes.

The study recommends that agro ecosystem in the study area should be strengthened. The ecology and economy go hand in hand and hence in any recommendation for restoring ecology must be viewed with economic aspect. So far as general recommendations are concerned the study suggests five major changes to be adopted in the drought prone basin.
i. **Recharging of Ground Water**

Groundwater table should be enriched by implementing watershed management programmes so that this storage can support agro ecosystem even in the event of famine frequency of which is once in three year.

ii. **Optimization of Water Resource for Agriculture**

The study has taken into account the distribution of water resource for agriculture. It recommends chane in cropping pattern so as to reduce water requirement.

iii. **Efficient Method of irrigation**

The present methods of irrigation are flow irrigation consuming water far more than the ecological requirement. If blue water is converted into green water efficient methods of irrigation should be adopted.

iv. **Improvement of cash flow**

There are some of the crops fetching good income but significant part of it goes to urban sector as observed in cash flow analysis. The crops sowing good cash flow viz Sorghum, sugarcane, Wheat, Pulses etc are recommended. If they are grown with proper irrigation the yield and quality of grain would be better than at present one.

v. **Utilization of Human Resource**

It is observed that the present pattern of agriculture is insufficient to provide employment of available cultivators and landless labourer. The crop selection should also be based on the view to generate employment.

**5.3.1. Strategy for Sustainable use of Water Resource as Recommendations**

It is necessary to adopt a five-fold strategy according to five major recommendations. First one is to optimize use of water resource for agriculture and second one is to conserve the rainwater so that the amount of infiltration can be improved by reducing run-off, third it is necessary to adopt efficient methods of irrigating the farms, fourth to generate employment and fifth to improve cash flow. The detail strategy may be outlined systematically as given below
5.3.2. Strategy I - Recharging of Ground Water

The water in the form of overland flow and run-off may be checked to improve groundwater recharge so that water stress may not become severe even in the famine years. This may be understood in the areas specific ‘action plan’ as mentioned in the Chapter IV.

**Action Plan - Strategy I**

For this strategy the ‘action plan’ has been suggested for three major programme of watershed management.

1) *Continuous Countour Trenches (CCT) Work:*

This has been suggested for the suitable sites and the specific areas have been identified and mapped.

2) *Check Dams:*

About 7 check dams in Kanola and 5 check dams in Pondhra have been suggested. The suitable sites have been identified and shown with the help of maps.

3) *Channel Deepening:*

It is expected that deepening of channel may remove the silt accumulated in the past and infiltration rate may be improved. Such channels may act as water storage for conjunctive use for the adjoining farms.

5.3.3. Strategy II - Optimization of Water Resource for Agriculture

Optimization of cropping pattern has been carried out using trial and error method. It has been observed that the water stress in a village can be reduced significantly. Such examples have been given in the study. Here only one example may be quoted.

If area under sugarcane is reduced by 33% (i.e about 275 hect.) the Kanola may become water surplus. It is also revealed in the field study. The sugarcane crop may be replaced by Sorghum, Pearl Millet, and Wheat etc. This may have similar than that of sugarcane i.e about 550 hect’.
**Action Plan- Strategy II**

The strategy may be implemented with the help of the action plan as suggested in the study. It suggests that the optimized cropping pattern coupled with watershed management programmes may be carried out in one selected village for demonstration in first phase. This requires participatory approach. If the village shows good yield more villages may come forward to adopt the strategy in the next phase. The field study has shown good degree of feasibility of such ‘action plan’.

**5.3.4. Strategy III - Efficient Method of irrigation**

If the methods of irrigation are improved and the water resources are used judiciously the cost on pumping water can be reduced. Also the cost on fertilizer, pesticides is also been reduced and crop yield increased. However, for this sprinkler and drip irrigation Method have been suggested. The author is aware about the high capital investment required for such practices. It is suggested here to develop suitable indigenous techniques. For this following action plan has been suggested.

**Action Plan – Stretegy III**

The phase wise action plan is as follows

Phase 1:

Training should be given to local youth for preparing appropriate net of tubes used in drip irrigation. If such locally made drip irrigation is used the cost is reduced by 50% without compromising the quality.

Phase 2:

Local youth may develop as entrepreneur to establish the business of preparing suitable drip irrigation network.

**5.3.5. Strategy IV – Improvement of Cash Flow**

The study has carried out cash flow analysis for each crop. This should be taken into account while suggesting new cropping pattern. The action plan in this regard is just to aware the farmers about improved benefits due to improved cash flow in case of suggested cropping pattern.
5.3.6. Strategy V - Utilization of Human Resource

The social issues associated with environmental degradation are unemployment and its impact on society. The suggested cropping pattern should be such that it would absorb the locally available labourers. Thus, the recommendations made by the study are based on strength and weaknesses of the study area. The recommendations are converted into designing strategy and formulation of phased action plan. This would certainly be able to achieve both environmental conservation and sustainable development in both the basins.

5.4. Limitation of the Study

The study has a good multivariate and multidate database. Attempt has been made to tap practically all possible sources of data. Similarly, relevant issues involved in management and planning process of water resource for agriculture have been studied by candidate. Nevertheless, the candidate is aware that the study suffers from several inadequacies and limitations. Some of the major limitations are mentioned below:

1) It was proposed to study agricultural setup with the help of periodical data. The village wise cropping pattern for the years prior to 2008 could not be obtained. It is also observed that there is no change in cropping pattern in the period 2009-2010. Hence, agricultural setup presented in the present study is based on data regarding hectarage under different crops for the year 2009-2010.

2) In order to evaluate the level of productivity, the yield data for different crops could not be obtained, even at the study area level. Therefore, output of each crop is based on field enquiry.

3) The amount of water going out of the basin has not been estimated.

4) Study of multi-date satellite imageries would have given a much better idea about the temporal changes in land use.

5.5. Scope for further study

The study may be used as ground truth for designing watershed management programmes in different micro watershed using Remote Sensing (R.S) techniques. The
present work can be used for preparing draft plan for watershed management programmes by supporting the cost of various works. The study may have roots of further studies regarding rural development, environmental assessment of agricultural activities, soil conservation in basin etc.

5.6. Conclusion

Thus, the study has been reached to concluding remarks. It has proved that proper management of the soil and water resources can achieve sustainability in agriculture. It is further observed that five-fold strategy suggested in study may be useful to achieve development of both natural as well as human resource. The suggested cropping pattern and related strategies are useful to reduce consumption of water resource without compromising output. It is also evident that such action plans may improve infiltration thereby groundwater storage on one hand and generate better employment on other. Thus, it may be concluded that the hypothesis stated in the beginning has been proved.