Chapter - 1

INTRODUCTION
# CHAPTER-I

## INTRODUCTION

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1.1. Introduction

The drought-prone area of Maharashtra is facing both economic and Environmental problems. At the same time environmental problems like degradation of land, biomass and watershed have become serious problems. These problems have posed the question mark on rural development. Therefore it is necessary to find out solution to such problems. The studies in environmental science may formulate proper strategy to enhance the resource base for agricultural development. Keeping this view in mind the present study has been undertaken by selecting the two watersheds in Karmala Tahsil. The Tahsil being the part of drought prone zone provides a fragile ecosystem prone to degradation.

Watershed management has increasingly been recognized as the ideal approach for integrated natural resource management in rain fed areas. The present study attempts to analyse available water resources in the selected watersheds and develop the strategy to utilize the same optimally. This requires the change in cropping pattern along with watershed management program. If this kind of plan shows good acceptance by the local people the same can be replicable in other areas. It is in this sense the topic has a great deal of relevance to the society.

1.2. The Study Area

Watershed basins viz. Kanola and Pondhra in Karmala tahsil have been selected for proposed study. The absolute location of study area can be expressed as from 18°15’N to 18°31’N and from 75°47’E to 75°24’E Longitude. The study area lies in the rain shadow zone of Western Ghats in the middle Bhima basin.

The problem due to water scarcity can be resolved by adopting the strategy of optimization of water resource for agriculture. How to develop such strategy is the major concern of planners. This problem has attracted the attention of environmental scientists, planners, economist and agricultural experts. Therefore, it is proposed to develop an environment friendly planning instrument so as to reduce the use of water without compromising profitability. With this objective in mind the present study has been designed by selecting a small region encompassing two watersheds viz. 1) Kanola 2) Pondhra in the Karmala Tehsil of Solapur Dist. (Maharashtra). A stream originating from Rahekuri is called as Kanhauri and that at Alsunde is known as Kanola. Both the streams
confluence at a point which is located outside the tahsil. Therefore, the Kanola basin under study is the basin downstream side of village khatgaon that is the part of basin in the tahsil. The present work mainly aimed at resolving the issues associated with scarcity of water.

1.3. Statement of Problem

The study area profile has shown that the agriculture in the two watersheds has been found insufficient to cope the given population. This is not only due to scarcity of water but also due to lack of proper techniques to use water. This is the problem due to environmental degradation in the past and also a factor for further degradation in future. This kind of situation has certainly posed the threat to sustainability of agriculture and has direct bearing on increasing poverty. Can there be any environmental solution to establish good agricultural practices in such a way that utilization of water resources may fetch better output? The researcher has to find out ways and means to reestablish
sustainability. The present work attempt to develop the model based on both improving soil and water resources on one hand and optimizing the same on the other.

1.4. Hypothesis

The weakness of the study area may be considered as low rainfall, heavy soil loss, high runoff and hence frequent failure of crops. This weakness may be overcome by adopting watershed management programmes to enhance groundwater which may be used in the period of very low or no rainfall. Further, the sustainability of agriculture may be improved by adopting the technique of optimization of water resource in the region. The technique should take utmost care not to reduce profitability in agriculture so that the model thus developed may get good response from the local people and hence become participatory in nature. With these assumptions in mind the present study may start with the following hypothesis.

“The study area has been facing problem of scarcity of water and hence frequent crop failures. This has restricted the growth of agronomy in the region. This vicious circle may be broken by adopting environmentally sound strategies like watershed development programmes and optimization of water resource in agriculture. If the suggested cropping pattern maintains good level of profitability and provides sufficient employment the agronomic sustainability may be restored”.

1.5. Aims and Objectives

A well felt environmental issue in drought prone areas is scarcity of water for agriculture due to low and erratic rainfall. However, such regions have a groundwater resource which may be used conjunctively with rainfall. Stress on groundwater is quite visible in such regions. This kind of hydrological stress has led to deprivation of both drinking water and water required for agriculture.

The aim of this study would be to develop technique for optimization of water resource to improve sustainability of the agro ecosystem with proper strategic planning of watershed management programmes in the study area.

The objectives of the study may be outlined as they:

6. To study physiographic profile of the Pondra and Kanola basin.
7. To understand cropping pattern of each villages in watershed under study for quantifying requirement of water for agriculture.
8. To understand water stress in the study area.
9. To estimate available groundwater level and to find out extent of depletion of it in the study area.
10. To understand the output and employment status of suggested cropping pattern in the basin.

1.6. Methodology

The methodology to carry out present research work is as follows:

1.6.1. Delineation of Study Area

A study of agro ecosystem demands interdisciplinary approach. However, present study is confined to understand how agro ecosystem is strengthen if inputs are improved by way of conserving soil, water and biomass resources. These two watersheds are: 1. Kanola basin 2. Pondhra basin

Both the watersheds have been demarcated and village boundary map superimposed on the same. Thus, two different sets of villages will be studied with following parameters in mind.

6. Rainfall variability, probability of droughts, potential evaporation etc. These parameters will be used to quantify available water resource from rainfall.
7. Drainage network to understand the movement of water resource within the micro region.
8. A morphostratigraphic study will be carried out along sample profile.
9. Topography slope aspects for soil cover.
10. Cropping pattern to understand the village wise requirement of present agriculture.
1.6.2. Estimation of water resources

The next step of study is to evaluate available water resource from rainfall, groundwater and canals. The requirement of water for agriculture at village level would also be evaluated. These two figures may give us water stress on agro ecosystem. It can be calculated by following methods.

a) Autochthonous water resource (Regional)

Rainfall in meter x TGA = Volume of water in mh.
\[
\frac{RF}{1000} \times TGA = mh
\]
G. W. used for agriculture = \[\sum_{i=1}^{N} (R_i - r_i)\]
Where,
\[
\begin{align*}
A_i & = \text{Area under } i^{th} \text{ crop in hectare based on ground water.} \\
R_i & = \text{Requirement of water by } i^{th} \text{ crop} \\
r_i & = \text{Effective rainfall in the cropping season of } i^{th} \text{ crop.}
\end{align*}
\]

b) Allochthonous water resource –

- Water received from canal

Canal water used for agriculture = \[\sum_{i=1}^{N} A_i (R_i - r_i)\]
Where,
\[
\begin{align*}
A_i & = \text{Area under } i^{th} \text{ crop in hectare based on canal water.} \\
R_i & = \text{Requirement of water by } i^{th} \text{ crop} \\
r_i & = \text{Effective rainfall in the cropping season of } i^{th} \text{ crop}
\end{align*}
\]

- Water received from river.

River water used for agriculture = \[\sum_{i=1}^{N} A_i (R_i - r_i)\]
Where,
\[
\begin{align*}
A_i & = \text{Area under } i^{th} \text{ crop in hectare based on river water.} \\
R_i & = \text{Requirement of water by } i^{th} \text{ crop} \\
r_i & = \text{Effective rainfall in the cropping season of } i^{th} \text{ crop}
\end{align*}
\]
2) Potential Water Resource: Potential water resource is the difference between available and used water resource. If the index is negative village is under stress of water resource. Obviously it affects on yield and also increases pressure on groundwater. Potential of water resource can be calculated by following formula

Formula: \[ P = (1 - \frac{X}{Y}) \times 100 \]

(Rao et.al 1979)

Where, \( P \) = Potential Water Resource.
\( X \) = Total Water Resource used.
\( Y \) = Total Water Resource Available.

1.6.3. Soil Study

Collection of samples from each village have been collected and analyzed for parameters such as pH, N, P, K, Na, CaCO3 etc. By selecting representative micro watersheds soil and other parameters would be studied.

1.6.4. Groundwater Depletion

These studies have been carried out by conducting surveys in the different seasons regarding depth of water. The fluctuations in them depict availability of groundwater resource in summer season.

1.6.5. Employment Status

This has been estimated on the basis of cost benefit analysis based on queries form 50 randomly selected farmers two from each village well spread in the two watersheds under study for major crops. The analysis may give the component of employment generated by each crop per hectare. This component is useful to understand the employment status of the suggested cropping pattern.

1.6.6. Environmental Planning

The strategy for Environmental planning will be based on integrated approach to use soil and water resources optimally. For this, GIS based modeling for spatial analysis of soil and water resources and their utilization may be used.
1. 7. Survey of Literature

The extensive review of the existing literature on various aspect of watershed has been undertaken. This pertains to literature available at international and national level.

At National level

In India, watershed project are located mainly in semi-arid area with rain fed agriculture, dense population and small farms. Watershed level agro-ecosystem studies are essential to relate land management to the external environmental effects produced by agricultural nutrients and to enhance our agricultural nutrient cycle (Richard Lawrence, 1985). Complex livelihood strategies drawn on multiple income sources including agriculture, livestock and labor including seasonal migration where rainfall is less assured, rain fed agriculture is unproductive and watershed project focused on harnessing water resource for maximum agricultural productivity (John Kerr 2006).

Typical watershed in undulating areas of semi-arid India contains good quality agriculture land in lower watersheds, owned by better of people. Lands may be irrigated or with irrigation potential andtend to flatter than in upper watersheds. Upper watershed often contains small farms on poorer soil and uncultivated common projects aim to combat the downstream external effects of this degradation. Water Resource and their management is important in rain-fed areas (Rakesh Kumar et al 2005).

Watershed project in India begins with soil conservation and re-vegetation in uncultivated upper catchment and water harvesting structure for irrigation. During re-vegetation which typically last three years (longer in dryer areas) protects young plants and help transform the landscape from a perennially degraded, low productivity state to a lush pasture. Soils in agricultural fields function as the crop growing medium and in the context of runoff agriculture as the receiver and retainer of water and nutrient inputs for crops (Jonathan et al 2007).

In early watershed project, the benefits of rehabilitating landscapes were assured to be natural with respect to different types of land uses and levels of affluence and poverty (World Bank 1990). Agriculture has been identified as the major contributtor of NPS of water resource (Humenic et al 1987).
As with the green revolution (Leaf 1983) rising income would then trigger other economic activity and transform entire village economies. This scenario has in fact played out in several famous watershed villages including Sukhomajrin Haryana and Ralegaon-siddhi, Hivarebajar and Pimplegaonwagha in Maharashtra (Chopra et al, 1990, famngton and Lobo, 1997, Kerr et al, 2002).

Watershed development in India date back several decades to an assortment of soil and water conservation efforts (Pangare and Gondhalekar 1998). Often in its modern routes are traced back to three famous village level projects initiated in the 1970’s Sukhomajari, Ralegaon-Siddhi, and PaniPanchayat. These highly successful initiatives focused on the link between soil conservation and water harvesting, turning a few small villages from barren waste land into green, productive oasis.

**At International level**

Management at watershed scale is a major challenge facing present and future generations. Watershed management requires integrity, scientific knowledge of ecological relationship within a complex framework of cultural values and traditions to provide socio-environmental integrity (Kohm, K. A. and J. F. Franklin, 1997). Rural water resource development in southern African takes place within catchment management framework. Supported by its new water law this model is focused at the river basin and is mainly aimed at sustainability of water resources. The goal of watershed management is to let all component of human and non human communities exist in a relative but dynamic state of balance (Naiman, 1997).

Watershed management internationally is being strong supported by DFID, GTZ, DGIS and Nordic countries in addition to a number of multilaterals. Both DFID and GTZ have undertaken major watershed program in India while DFID DGIS and GTZ have mean instrumental in developing new water laws and policies in southern and eastern Africa. The bottom-line of any agriculture is crop production. In the content of runoff agriculture, production reflects integration of weather, watershed, soil management and all other component of system (Jonathan A. et al, 2007). Watershed projects are often complicated by the fact that multiple people use upper and lower reaches for the multiple purposes (John Kerr 2002). Runoff plays an essential role in moistening dry soil, which

In Australia and in USA both large scale state led and small scale community based watershed project are popular and fast increasing number. In Australia Murray Darlling river basin is one of the most celebrated and oldest example of Govt. instigated catchment management while informal land care groups are springing up across the country. (DGIS policy support paper, 2001).

1.8. Expected outcomes

The expected result to this study will be:

1) Changes in cropping pattern of the watersheds which would be water saving without compromising income.

2) To suggest strategy for sustainable agricultural development based on optimal use of water.

3) Study may be useful to understand nutrient status of soil.

4) Ground water table is prominent source of water in drought prone areas and hence the study can gives the suggestions regarding optimal use of Ground water.

5) Planning strategy for the strengthening the agro-ecosystem in the study area with proper implementation of watershed management.

1.9. Arrangement of the text

The work is presented in the five chapters as following.

Chapter 1

Chapter I deal with the study of information about study area. It includes introduction, aims and objectives, statement of problem, hypothesis, methodology, survey of literature, etc. This chapter provides introductory information about the study area and its importance.

Chapter 2

The environmental profile and basic information regarding watershed development programme have been outlined in the second chapter. The maps of the basins based on
SOI toposheets are also presented in the chapter. It is clearly observed from the SOI toposheet. It includes the discussion on drainage, climate, soils and population density.

**Chapter 3**

Chapter III mainly deals with the crop Ecology and crop economy. It covers general land use, cropping pattern, cost benefit analysis of the different crop etc.

**Chapter 4**

The study is ready for appraisal of water resources which has been presented in the fourth chapter. It is worth to identify the need of watershed management programmes in both the basins. It is useful to identify the issues related to run off, evaporation and long dry spells.

This chapter has discussed the aspects of water resource along with site specific programmes.

**Chapter 5**

The last chapter has been devoted to give summary and concluding remarks.

**1.10. Resume**

This chapter has given introduction to topic, hypothesis, objectives and methodology. After explanation about the relevance of the study the chapter has highlighted the research questions. The chapter has also presented brief review of literature. The arrangement of text is also mentioned in the chapter. With this preliminary background the study start with environmental aspects of the study area in next chapter.