

Assessment of Effectiveness, Plan and Design of Watershed Management: A Case Study of Khor Village, Daund Tehsil, Pune District, Maharashtra, India

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ABSTRACT

Water is one of the main components for support system of life. India has 16 percentage of the world population but still has only 4 percentages of water resources. Watershed management is very much necessary in India. In this present study, watershed management techniques will be discussed for khor village. Khor village is located between north latitude 18.413695 and east longitude 74.3176876 in Daund tehsil of Maharashtra state. The Khor village of Pune district lies in western Maharashtra which is always in drought after every 2 or 3 years. To overcome the problem of water scarcity in khor village water conserving structures and techniques for watershed management will be proposed. Another aspect of ground water recharge also supplemented with the same for this particular village which directly benefits the villagers and farmers.

Keywords: watershed management techniques, ground water recharge, rural development, water conservation, water scarcity.

I. INTRODUCTION

Water is important for all the living beings on the earth. Water is used in domestic, agriculture, industry, irrigation and others purposes too. As the population is rapidly growing, the demand for the water is also increasing day by day for different purposes. Thus, conserving water is not only our duty but is also a necessity for the survival for the present and future generation. It has also been forecasted that there would be wars in the future for water. Water almost covers 71% of the earth's surface in which 97% of water is salty, 2% of the water is in frozen form and less than 1% water is fresh which is available for living beings which is useful for us for different purposes. In India, source of water in most of the region of the country is rainfall. Snowfall is also received in some part of northern India. There is a variation of rainfall from year to year as well as place to place in all parts of country. According to irrigation commission of India (1972), 1800 kilometer cube total surface water flow in a year in India out of which only 500 kilo meter cube percolates and become ground water. The requirement of the water

in Maharashtra is more as the population is 9% of the total country. Less rainfall in the parts of Maharashtra leads to frequent droughts. In drought areas, ground water is the rising demand. The area which mainly depends on groundwater and having very less surface water resources are continuously using the water by pumping leads to decline of water table as well as quality. In India especially western Maharashtra the most important issue is the shortage of water in the villages for drinking as well as agriculture and other purposes. Seventy five percentages of the people in the villages in Maharashtra has no facility of water supply for domestic as well as agriculture purposes. Due to continuous drought, there are many cases of farmer suicide. In Maharashtra the farmer suicide cases are very high especially in western Maharashtra. Thus, management and conservation of water are much important in these areas. For managing and conserving of water the biggest tool available is watershed management. In Maharashtra, rain fed agriculture is mostly done so farmers are depended on rainfall. 79% of the rainfall annually occurred in four months from June to September.

Watershed is defined as the area which constitutes the rainwater which drains to a common point. Watershed depends on type of soil, different types of crops, and the vegetation grown in that area. Watershed management is the management of watershed that is the land and the water using technical as well as socio-economic information. Management of watershed is to be done for proper use of all natural resources for the benefits for the people living in the watershed area. It arrests soil erosion and rainfall runoff. It not only stops soil erosion but it also improves soil moisture. It also recharges groundwater. It indirectly also helps in improving hygiene condition in rural areas. It also increases the income and production of the farming. There are many watershed development programs in India for the development of watershed area. Some of them are National Watershed Development Project for Rain fed Areas (NWDPA), Drought Prone Areas Program (DPAP), Integrated Wasteland Development Project (IWDP), Watershed Development in Shifting Cultivation Program (WDSCP), Desert Development Program (DDP), Employment Assurance Scheme (EAS), and Unnat Maharashtra Abhiyan (UMA). Jalyukt Shivar Abhiyaan (JYSA) is a watershed management program in view to make Maharashtra a drought free state and make villages water scarcity problem ended by 2019. Scheme involves changing of streams, construction of farm ponds, check dams etc. The project aims to make 5000 villages free from water scarcity every year. In this present study, watershed management of Khor village will be studied.

II. METHODS AND MATERIAL

A. Literature

John Kerr and Kimberly Chung (2001): this research is based on fact that there are always lessons and experiences of past projects in watershed management programs. However, complexities like technical as well as social in the watershed management evaluation are difficult. There are merits and demerits of both qualitative and quantitative methods. This paper represents the mixed approach for evaluating that is using effective methods by combining quantitative and qualitative. Vidula Arun Swami et al. (2011): this paper shows a case study where ground water recharge is done directly from rain water (large amount). Study area is a small village Somnath Peth in Maharashtra state of India

which is only 15 km from Kolhapur city. They have planned biological and engineering techniques in watershed management which helped in recharging groundwater from excess runoff from rain water. The significance of this work is these types of technologies can be adopted in small villages in different parts of nation under watershed management programs. This type of technology which is discussed in paper also reduces the demand of water from water tanks. Moreover, this also solves many problems related to flood due to runoff excessive rainfall.

B. Problems In Khor Village

- Shortage of drinking water from the month of February to the month of May.
- Water scarcity for the livestock during summer days.
- During months of February to May there is shortage of water for irrigation which results in low production of crops.
- Lack of water directly or indirectly affected the income of the farmer also.
- Less water during summer season affects the production of fodder which is used for livestock in the village.
- Because of absence of canal in village, irrigation is mainly dependent on wells. Continuous usage of well with a high rate rapidly drops the water table.
- Farmers are not using effective irrigation techniques. Drip irrigation is used by very few farmers in the Khor village.
- The nallah which flows in the village is very dirty and silted.
- Water of the public wells is polluted which created water borne diseases.
- There is less awareness in the masses of villages as well as farmers about technical information and government policies.
- Greenery of village is not up to the mark.
- There are very few techniques and structures like farm pond, check dams etc. in Khor village.
- Overhead tanks in village are not effective as they feed only one portion of village.
- Past record of farmer suicide because of drought like situation is also a big problem
- No primary health care center.

C. Study Objectives

Following are the main objectives of this work

- Analysis of socio-economic state of village.
- Analysis of availability of water resources in village.
- Computation of demand of water and analysis of supply.
- Interpretation of results obtained.
- Some remedial measures will be proposed.
- Cost estimation for structures.
- Guidelines for watershed development in village

D. Methodology of Study

Following are the methods used to complete the watershed management in Khor village:

- Literature review regarding the subject.
- As per records, rainfall of Khor village was observed for last 13 years.
- Socio economic survey was conducted.
- Requirement of water for domestic, agriculture and livestock was calculated based on the data collected.
- The data regarding source of fresh water, availability of fresh water was calculated.
- Runoff was calculated based on Ingles and D'Souza formula for Khor village.
- Availability of quantity of water for groundwater recharge was conducted based on runoff and evapotranspiration.
- Demand of water was calculated based on available data.
- Recommendations will be given based on the result and data analysis.

E. Study Area And Data

1. Location

Khor village is in Daund tehsil of Pune district of Maharashtra state in India. It lies between north latitude 18.413695 and east longitude east 74.3176876. It lies in western Maharashtra also known as Paschim Maharashtra. It is fifty nine kilometers away from Pune city. It is located 32 km away from Daund. In the west khor village is associated with Purandar tehsil, in the south is Baramati tehsil, in the east is Shrigonda and in

north is Phaltan tehsil. Marathi and Hindi are languages of khor village.

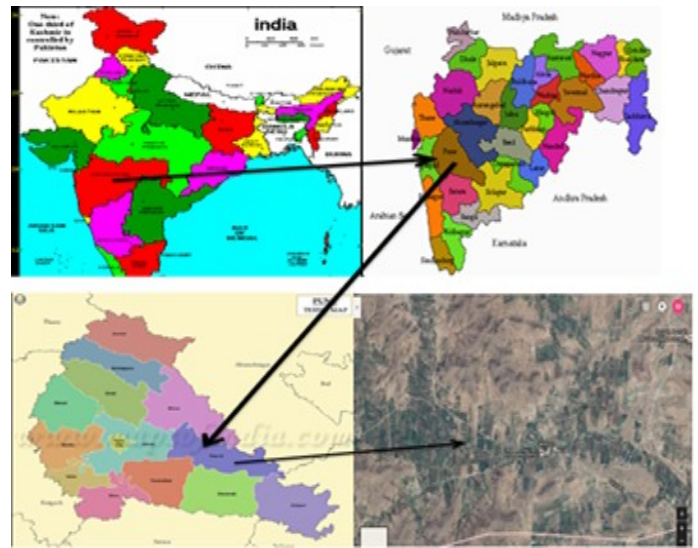


Figure 1. Location of Study Area

2. Climate

The summer season in khor village is very hot during the period of March to June. In this period, the minimum temperature in khor village is 23 degree and the maximum temperature 38 degree. During the monsoon time in the khor village which is from June to September month the minimum temperature is 21 degree and the maximum temperature is 27 degree. During the winter season between the months of October and February the minimum temperature is 11 degree and maximum temperature 29 degree.

3. Rainfall

India is a country which depends upon the monsoon. Rainfall in khor village changes from 150mm to 800mm with a yearly average rainfall of 410mm. Rainfall data is very useful for the management of watershed of any village or area. As rainfall data is one of the main data for the calculation of the water availability throughout the year to the area. The time duration and the amount of rainfall have effect on the infiltration, runoff and other things also. Rainfall data of years of the khor village from the year of 2003 to 2015 is presented in graph below:

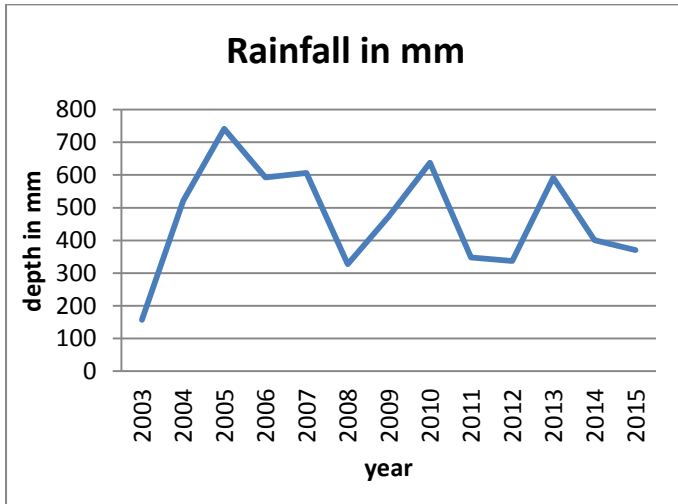


Figure 2. Rainfall pattern from 2003 to 2015

4. Source of Water

Water from Warwand village is carried to Khor village which is twenty km away from the khor village in Daund tehsil and provided to village through overhead tanks. There are 5 overhead tanks installed in the village, out of which only two are working and other 3 are under process. The overhead tanks are not effective as they are only providing a small portion of village for drinking water.

Table 1. Sources of water in village

PARTICULARS	WELLS	BOREWELLS	VILLAGE POND
Number of structures	228	39	3 small
Usage	private 224 public 4	private	Public
Usage for irrigation	Private yes Public no	no	50 percentage
Usage for drinking	Private no Public yes	yes	no
Monthly availability for irrigation	June to January	nil	Till January
Monthly availability for drinking	June to January	May to December	nil

5. Existing techniques

There are very less number of techniques for water conservation in khor village. The runoff generated is wasted as there are less structures for the conservation of water as well as soil. Ground water recharge, water

conservation and soil conservation can be done by the techniques like gully plugs, plantation of trees and grass, roof top rainwater harvesting, farm ponds, check dams, bench terracing, contour bunds, contour trenching, check dam and vanrai bandhara. In khor village most of the techniques are absent

Table 2. Existing techniques

S.NO.	Existing soil and Water conservation structures	condition
1	Gully plugs	Not present
2	Rooftop rainfall harvesting	Not present
3	Contour bunds	In adequate
4	Contour trenching	Inadequate
5	Contour terracing	Not present
6	Plantation of trees and grass	Inadequate
7	Check dam	14
8	Vanrai bandhara	Not present
9	Farm pound	8

6. Socio economic survey

Survey based on questionnaire technique is used for exercising the present scenario of the village regarding the infrastructure, social as well as economic. The survey consists of growth of population aspect, type of houses, income etc.

Table 3. showing population of khor village.

Total population	3280
Male	1697
Female	1583

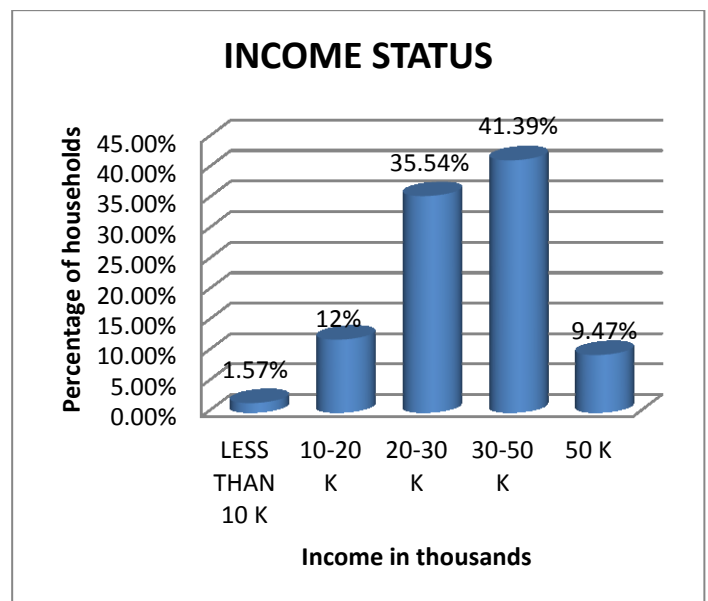


Figure 3. showing income status of khor village.

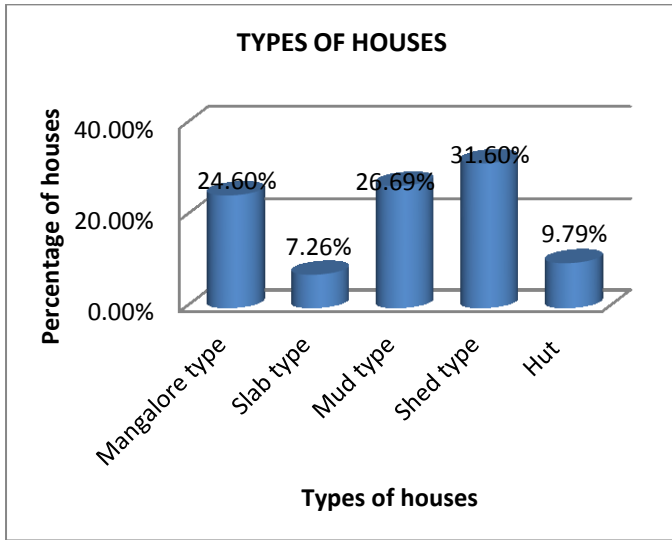


Figure 4. showing different types of houses

III. RESULTS AND DISCUSSION

1. Water Calculations

A. Availability of water for recharge:

Average yearly precipitation considering 15 years of rainfall data = 410 mm

Table 4. showing calculation of water availability in khor village.

Runoff by Ingles and D'Souza formula	Total water available in khor village (area in metre square x rainfall in metre)	Basin recharge (area x average fluctuation x specific yield)	Evapotranspiration (30% of rainfall)	Average runoff (precipitation – basin recharge)	Availability of water for recharge (runoff – Evapotranspiration)
3.7 cm	10475500 metre cube	6132000 metre cube	3142650 metre cube	4343500 metre cube	1200850 metre cube

Availability of water for recharge is 1200850 metre cube

B. Water requirement for village:

Table 5. showing calculation of water requirement for khor village.

S.NO.	PARTICULARS	NUMBER	PER CAPITA DEMAND (LITRE/DAY)	TOTAL YEARLY REQUIREMENT (CUM)
1.	Domestic	3280	40	47880
2.	Livestock			
	Cow	336	60	7358.400
	Buffalo	191	65	4531.475
	Goat	474	10	1730.100
	Sheep	6700	7	17118.500
	chicken	1228	.1	44.822
3.	Irrigation			559500.85 (extra water requirement for rabi crops)
	Total			638172.147

Water supply in khor village = 31468.52 metre cube

Total extra water requirement in khor village = demand – supply = 638172.147 – 31468.52 = 606703.627 metre cube



Figure 5. Check dam in khor village

2. Proposed Work

Table 6 showing Number of proposed structures and water recharge/harvest by structures.

S.NO	STRUCTURE	NUMBER	UNIT WATER RECHARGE (CUM)	TOTAL WATER RECHARGE
1.	Check dam	40	12008.5	480340
2.	Rainwater harvesting a. Shed type b. Mangalore type c. Slab type d. Mud type	200 156 46 169	40.96 36.408 31.857 22.755	8196 5679.65 1465.42 3845.595
3.	farm pond	60	1620	97200
4.	Vanrai Bandhan	45	12008.5	540382.5
	TOTAL			1137109.5

Total 1137109.5 metre cube water which is about 94.69% of total water available for recharge can be used by constructing the above structures.

Extra water available for future and other purposes for khor village = 1137109.5 – extra water requirement of khor village = 1137109.5 – 606703.627= 530405.87 metre cube.

Table 7 showing Cost Estimation of Structures

S.NO	STRUCTURE	NUMBER	UNIT RATE (in rupees)	AMOUNT (in rupees)
1.	Check dams	26	18550	24,23,200
2.	Vanrai bandhara	45	93,200	8,05,950

3.	Roof top rain harvesting	571	17,910	1,05,92,050
4.	Farm pond	52	32,000	16,64,000
Total				1,54,85,200

IV. RECOMMENDATIONS

- Construction of proposed water conserving structures.
- Apart from proposed structures practices like contour bunding, contour trenching, contour terracing should be adopted for conservation of water and soil.
- Growing grass and trees more and more will be benefitted for khor village.
- The nallah flowing in khor village is very silty; silt of nallah should be removed.
- The depth of the bore well should be done according to the government guidelines.
- Public wells which are used for drinking has dirty water. These wells should be cleaned.
- Overhead tanks which are made by government in khor village for drinking purposes are not effective. More overhead tanks should be constructed so that drinking problem of khor village should be ended.
- Some check dams of khor village are not in good condition, these check dams should be maintained properly.
- There should be more growing of cash crops so that the economic condition of farmer as well as the condition of overall khor village should be improved.
- Not only growing cash crops but also growing of crops which require very less time for their growth.

V. CONCLUSION

In khor village, there is water scarcity during months of February to May for drinking as well as for irrigation. Population of khor village is increasing rapidly. The annual average rainfall is also very less but can be used with the help of groundwater recharge techniques and harvesting. Following are the concluding remarks given below:

- Socio-economic survey gives us that 92 % of people in khor village depend upon agriculture and they are poor.
- Living standard and economic condition of people of khor village will improved by implementing watershed management.
- There is no perennial source of water for drinking and irrigation in khor village.
- 1200850 metre cube water is available for recharge of the total rainfall 410 mm annually. By studies, it is found 94.69% of water can be recharged by constructing water conservation structures.
- Watershed management will provide water for drinking purposes as well as for irrigation purposes too in khor village.
- Proposed structures like farm pond, check dam, vanrai bandhara and roof top rainfall harvesting will be useful for counter the situation the dry period as well as drought like situations.
- Maintenance of check dam, removal of silt from nallah, cleansing of dirt from wells will definitely increase ground water level as well as hygiene condition of khor village.
- Growing of cash crops, use of drip irrigation, awareness camps regarding agriculture, irrigation as well as government schemes and subsidy schemes will benefit the farmers of khor village.
- Use of biogas, solar energy, setting up of primary health care will definitely help the people of khor village

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VII. ANNEXURE

Questionnaire for socio economic survey in khor village

- Name of village
- Number of people in household
- Age
- Sex
- Education
- Employment
- Category- SC/ST
- Family income –
- Own Agriculture land if yes Type of crop a) Kharif b) RABI
- Source of income-a) Main cultivator/marginal cultivator b) Main agriculture labor/marginal agriculture labor c) Main household industry/marginal household industry.
- Type of house a) Slab b) Shed c) Mangalore tile d)hut e) mud
- Number and type of animal a) Cow b) Sheep c) Buffalo d) Goat e) Other