



WATERSHED MANAGEMENT FOR VEJEGAON VILLAGE IN SANGLI DISTRICT, MAHARASHTRA

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Abstract: Watershed is land surface bounded by a divide which contributes runoff to a common point. Watershed management basically involves management of land surface and vegetation so as to conserve and utilize maximum water that falls on the area of watershed and also conserve the soil for long term benefits to the farmer and his society. Watershed management implies the wise use of soil and water resources so as to provide clean, uniform water supply for beneficial use and to control damaging overflow. Study area for this project work is Vejegaon village, which is comes in Khanapur tehsil, Sangli district of Maharashtra state. It is facing acute water scarcity problem due to insufficient rainfall every year. Watershed development techniques like check dam, vanrai bandhara, farm pond etc. are suggested to make the village self-sufficient in case of water demand.

Index Terms - Runoff, rainfall, farm pond, watershed management.

I. INTRODUCTION

Watershed development means the process of creating and implementing plans, programs and projects to sustain and enhance watershed functions that affect the plant, animal and human communities within a watershed boundary. Watershed development is not so much about managing natural resources, but about managing human activity as it affects these resources. The drainage area of the river provides the natural boundary for managing and mitigating human and environmental interactions. Because human activity includes actions by governments, municipalities, industries, and landowners, watershed management must be a co-operative effort. Effective watershed development can prevent community water shortages, poor water quality, flooding and erosion. The expense of undertaking watershed management is far less than the cost of future remediation.

For development of agriculture and drinking water resources the basic elements required are land and water. Because of tremendous rise in population, urbanization, industrialization and agriculture area, resulting in steep incline water demand line, Indian agriculture sector is lot more dependent upon the monsoon. But from last 3-4 years, due to inadequate rainfall, people are looking towards the underground water as alternative sources without regarding to its recharge resulting in deepening of ground water table 100-200m below the ground surface.

Rainfall is the important element of Indian economy. Although the monsoons affect most part of India, the amount of rainfall varies from heavy to scanty on different parts. There is great regional and temporal variation in the distribution of rainfall. Over 80% of the annual rainfall is received in the four rainy months - June to September. The average annual rainfall is about 125 cm, but it has great spatial variations.

II. STUDY AREA AND DATA COLLECTION

Vejegaon is a small village located at a distance of 20 km's from vita city, It is located in Khanapur taluka of Sangli district. The total geographical area of village is 1724 hectares. Vejegaon has total population of 2,384 peoples. There are about 571 houses in vejegaon village. Pin code of vejegaon village locality is 415310. The source of water are available in watershed area are canal and groundwater structures like wells and bore wells. These resources of water fulfill the demand of daily use of water but these water sources are not enough for agricultural land available in Vejegaon. Therefore need of watershed management is required.

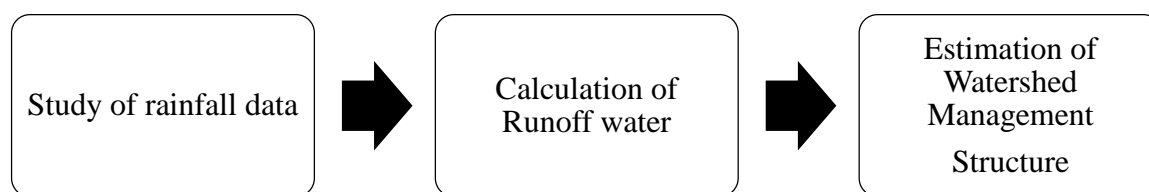
Table 1 – Basic details of Vejegaon village

Details	Quantity
Geographical area	1724hectars
Irrigated area	635 Hectares
Households	571
Population	2,384
Female population	1,111
Male population	1,273
Average rainfall	63.22cm
Depends on farming	58%

III. OBJECTIVES

1. To study low intensity rainfall region Vejegaon.
2. To calculate runoff water for managing and utilizing the water for useful purpose.
3. To prepare the estimate of effective method of watershed management technique for watershed management in Vejegaon village.
4. To provide best solution for sustainable watershed management in Vejegaon village.

IV. METHODOLOGY



A. Vejegaon village rainfall data

Rainfall in the country is typically monsoonal in nature. The zone where the Vejegaon village is present it receives 63.22 cm average annual rainfall.

Rainfall data is very important data in planning the watershed management for study area. It is a meteorological parameter to decide a quantitative approach for arriving at water avail ability in a watershed. Climate is a determining factor for the management of all aspects of watershed. Amount of rainfall, duration have a profound influence on watershed as to runoff, infiltration, land management etc. Rainfall data for 10 years is to be collected from meteorological department.

- From year 2013 – 2022 rainfall data is given as below;

Table 2 – Rainfall Data for Vejegaon village

Year	Rainfall for year (cm)
2013	65
2014	82.2
2015	48.1
2016	48.5
2017	43.5
2018	45.1
2019	83.1
2020	74.2
2021	53.6
2022	45.2

- The average of rainfall for last 10 years in Vejegaon village is 58.85 cm. Maximum annual rainfall is 83.1cm in 2019 and minimum rainfall is 43.5 cm in 2017.
- Rainfall data is very important for calculate quantity of runoff water.
- Using Inglis and DeSouza formula we find the total availability of water in watershed area in one monsoonal season.

B. Calculation of runoff water

Inglis and DeSouza (1930) evolved two regional formulae (one for the ghat regions and other for the Deccan plateau) for relationship between annual rainfall and runoff after a careful study in 53 sites in the Bombay Deccan of Western Ghats based on 25 years river and rain gauge data in the Bombay Presidency. They developed two equations connecting rainfall runoff for the ghat and non-ghat regions. The formula developed for the ghat region is used for the present study and is as follows,

$$R = 0.85P - 30.5$$

Where,

R = Annual runoff in cm

P = Annual Rainfall in cm

The formula developed for the Deccan Plateau (plain areas) is used for the present study and is as follows,

$$R = 1/254 P (P - 17.8)$$

C). Watershed management techniques

- We are going to visit watershed management structures in order to get proper information of that particular structures to propose the best possible solution of watershed management in vejegaon.

-In these visits we got to know the importance of watershed management structures, and its effects in surroundings.

-In these visits we got to know proper way of selecting areas and planning of watershed management techniques.

- To solve the entire problem or to reduce intensity of problem water availability as well as water management is very important. To overcome these problem watershed management techniques such as check dam, vanrai bandhara and farm pond are essential. These techniques improve water availability also increase the ground water table. Following techniques will be suggested for Watershed management in Vejegaon:

1. Farm pond
2. Vanrai Bandhara
3. Check dam

-Following steps are followed for planning of watershed management techniques:

1. Selection of Site for planning of watershed management techniques.
2. Collection of the data required for preparation of the estimate.
3. Preparation of the estimates of structures to suggest the effective solution for water management.

V. EXPERIMENTAL WORK

A) Calculation of runoff water

There are different methods to calculate runoff water, but in Maharashtra most suitable method is Inglis formulas. So we use Inglis formulas to calculate runoff water.

Inglis formula for calculating Runoff

Based on studies carried out for catchments in Western Ghat and plains of Maharashtra, C.C. Inglis gave the following relation:

For Non Ghat (Hilly) area with Rainfall P less than 200cm.

$$R = [P (P-17.78)] / 254$$

Where, P is precipitation expressed in cm.

R is runoff expressed in cm

Runoff Calculation:

1. Average yearly rainfall in vejegaon = 58.4 cm
2. Area of watershed = 50 hectare

A) Runoff by Inglis formula

$$R = \frac{P (P - 17.78)}{254}$$

$$R = \frac{58.4 (58.4 - 17.48)}{254}$$

$$R = 9.33 \text{ cm}$$

B) Total available water

$$= \text{Area of watershed (sq.m)} \times \text{Rainfall}$$

$$= 500000 \times 0.584$$

$$= 292000 \text{Cu.m.}$$

1) Ground water recharge

$$= \text{Area of watershed} \times \text{Avg. fluctuation} \times \text{specific yield}$$

$$= 500000 \times 1.5 \times 0.15$$

$$= 112500 \text{Cu.m.}$$

2) Evapotranspiration

$$= 30 \% \text{ of precipitation}$$

$$= 0.3 \times 292000$$

$$= 87600 \text{Cu.m.}$$

C) Runoff by using basic formula

$$= \text{Precipitation} - \text{Basin Recharge}$$

$$= 292000 - 112500$$

$$= 179500 \text{Cu.m.}$$

D) Water available for artificial recharge for watershed development.

$$= \text{Runoff} - \text{Evapotranspiration}$$

$$= 179500 - 87600$$

$$= 91900 \text{Cu.m.}$$

E) If structures were constructed

a) There would have water recharge by farm pond

$$= \frac{(15 \times 15) + (9 \times 9)}{2 \times 3}$$

$$= 459.00 \text{Cu.m.}$$

(Assuming it is recharged 4 times)

$$= 4 \times 459.00 \text{Cu.m.}$$

$$= 1836.00 \text{Cu.m.}$$

b) There would have water recharge by Vanrai bandhara, Check dams

$$= 91900 \times 10\%$$

$$= 9110 \text{Cu.m. /bandhara}$$

✓ **Water available for artificial recharge for watershed development is 91900 cub. m.**

B) Estimate

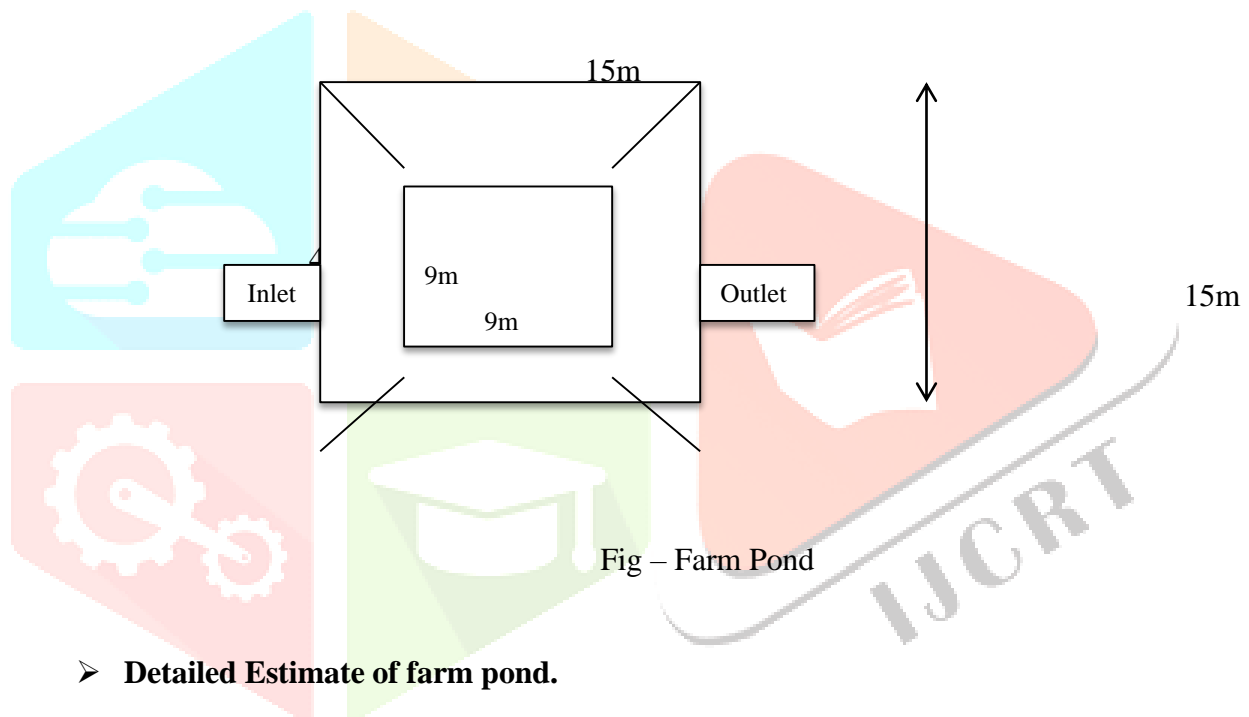
Preparing estimate of watershed management structures, Farm Pond is suitable and very useful structure for the village water management. So preparing a farm pond estimate because all the other watershed management structures like farm pond, vanrai bandhara are constructed in vejegaon. These structures fulfill the demand of daily use water. Water need is required for farming, so farm ponds are best option for watershed management in vejegaon village.

- Following factors are considered while constructing farm pond.

- Area selected for farm have gentle ground slope.
- Water released into the pond is sediment free
- Rate of inflow into the pond is slightly more than the infiltration capacity of the entire pond.
- Effective size of the square pond is 15m x 15m x 3m. It is decided on available Space & topographic conditions of land.

Design details.

- | | | |
|---|---|---|
| 1) Excavation detail:
Top dimensions of pond = 15m x 15m,
Bottom dimensions of pond = 9m x 9m,
Depth of pond = 3m,
Side slope to excavation = 1:1 | 2) Side earthen bund details:
Top width = 0.41m,
Height = 0.225m,
Side slope = 2:1 | 3) Inlet and outlet details:
Length = 2m
Width = 4m
Depth = 0.4m |
|---|---|---|



➤ Detailed Estimate of farm pond.

Table 3- Measurement sheet

Item No.	Description of items	No.	Length (m)	Breadth (m)	Depth (m)	Qty.
1)	Excavation					
A)	Excavation of farm pond					
	Top area	1	15	15	-	225sq.m
	Bottom area	1	9	9	-	81sq.m
	Average area= $225+81/2$					153sq.m
	Earth work volume = Average area x Depth = 153×3					459cu.m
B)	Total earth work					
	For inlet and outlet	2	2	4	0.3	4.8cu.m
						<u>463.8cu.m</u>

2)	Arrangement of stones					
A)	Slanting portion of farm pond along Length	2	12	3.82	0.225	20.62cu.m
B)	Slanting portion of Farm pond along Width	2	12	3.82	0.225	20.62cu.m
C)	Bottom of pond	1	9	9	0.225	18.22cu.m
D)	Inlet and outlet	2	2	4.41	0.225	3.97cu.m
						<u>63.43cu.m</u>

➤ **Abstract Estimation**

Table 4- Abstract sheet

Sr. No.	Description of Items No.	Qty.	Rate	Per.	Rs.
1)	Excavation	459cu.m	70/-	Cu.m	32130/-
2)	Cost of stone for 225 mm Thick rough stone dry Pitching.	63.43cu.m	200/-	Cu.m	12686/-
3)	Labour charge for rough Stone dry pitching.	63.43cu.m	120/-	Cu.m	7611/-
	Total amount				52427/-

➤ **Cost of watershed techniques for proposed entire watershed**

Table 6 – Proposed cost of watershed structures

Sr. no.	Type of structure	No. of structures	Cost of structure	Total Cost
1.	Farm Pond	10	52427/-	524270/-

VI. RESULTS

- Water to be recharged in watershed area.

Table 5 – Recharged water in watershed area

Sr. no.	Type of structure	No. of structures	Water to be recharged (cub.m)	Total water available (cub.m)
1.	Farm Pond	10 nos.	18,360	91,900
2.	Check dam	2 nos.	13,273.48	
3.	Vanrai Bandhara	3 nos.	19,910.22	
Total = 51,550 cub.m				

- ✓ Hence 56.09% water will be recharged if we construct water conservation structures in Vejegaon.

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