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Sustainable development in watershed area through soil and water conservation activities- A case study

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Abstract:- The watershed is located at Amravati to Mardi road at Indla Ghatkhed, Tq. Dist. Amravati. Indla Ghatkhed is located between 77°55'32" East to 77°53'30" East longitude and 20° 55' 56" North to 20° 57' 0" North Latitude. Indla Ghatkhed watershed consist of three villages namely Indla Ghatkhed and Masod with area 925.83ha, 277.92ha, 73.02ha respectively. Agriculture department initiated extension activities from 1995 in small village Indla Ghatkhed under Vidarbh Panlot Vikas Mission program. In this study attempts are made to study the present status of watershed and its development, present state of art and by carrying out survey further watershed activities/ treatments are suggested.

Keywords- Watershed, Irrigation, Agriculture Change, Watershed divide, Area treatment, Drainage line treatment, Vidarbha Panlot Vikas Mission

1 INTRODUCTION

Watershed development is the most important program for rural development especially for the rainfed area region. It enhances the groundwater table and soil moisture is retained for longer period resulting in healthy growth of vegetation. Out of the 329 billion hectares of geographical area 142 billion hectares area is under cultivation and 85 billion hectares is rainfed area. There is a large area under rainfed cultivation which requires arrestation of erosion and increase soil moisture retention period which can be achieved by covering rainfed area under watershed development programme (Father Harman bachlar, Nicha, et.al., 2004).

The aim of this study was sustainable development in the Indla-Ghatkhed watershed area through soil and water conservation activities. Sustainable development is defined as development that meets the need of the present without compromising the ability of future generation to meet their own needs.

Watershed is geographical unit draining at a common point by a system of streams, is called watershed.

2 METHODOLOGY

Methodology Adopted

After the reconnaissance survey, Indla Ghatkhed watershed is selected for detailed study of the measures implemented and their impact on soil and water conservation.

Morphological Study of Watershed

For the detail study of watershed, location of watershed and climate are necessary.

Location of Watershed

The watershed is located at Amravati to Mardi road at Indla Ghatkhed, Tq. Dist. Amravati. Indla Ghatkhed is located between 77°55′32″ East to 77°53′30″ East longitude and 20° 55′ 56″ North to 20° 57′ 0″ North Latitude. The map of the watershed for existing and proposed activities (treatments) are shown in Fig 1 & 2.

Climate

The mean monthly temperature of Amravati ranges from 20.5°C to 30.5°C with recorded minimum and maximum temperature of 11.80° and 48.50° in the month of December and May

respectively. Amravati district falls in assured rainfall zone of Maharashtra having an average rainfall of 790 mm. Rainfall occurs mainly from south-west monsoon originating from Arabian sea normally onsets during the second week of June and gradually recedes in the month of October. Ninety percent rainfall occurs between June to September.

Area of the watershed

Total area of Indla-Ghatkhed watershed is 1246.47 ha (Indla = 925.83 ha, Ghatkhed = 277.92 ha and Masod = 43.02 ha).

Land use pattern in the watershed

Sr. No.	Type of land	Area (in ha)	Percentage
1.	Agricultural (Cultivated)	206.661	21.38
2.	Non-agricultural	51.95	41.66
3.	Forest & Govt. land	958.669	76.89
4.	Area under tanks	29.49	2.36
	Total	**1246.77**	**100.00**

For the present study of Indla-Ghatkhed watershed the following stepwise procedure are adopted

1) A lot of literature is available on this research topic. So number of international and national papers, magazines have been referred and visited the successful watershed at Ralegan Siddhi, Tq. Parner, Dist. Ahmednagar implemented by senior social worker Mr. Anna Hazare and Kakaddara watershed, Tq. Arvi, Dist. Wardha implemented by Engineer and senior social worker Mr. M.N. Khadse (Ex-chairman of Dharamitra Mother NGO, Wardha).
2) After the literature review, started the reconnaissance survey for selection of watershed.
3) After the reconnaissance survey it was found that Indla-Ghatkhed was a ideal watershed for the study. Hence, this watershed is selected for the present study.
4) The data required for study i.e. toposheet from GSDA, Amravati and village map from Revenue Department, are collected.
5) From toposheet and actual survey (observation) the ridge line and exit point of watershed are marked on the map. After that from toposheet and village map field survey map of Indla-Ghatkhed watershed is prepared. After designing the watershed map identified the number of beneficiaries in the watershed were identified.
6) After the completion of survey, field observation called the Gram Sabha, discus with farmers and prepared the existing activity map.
7) After preparation of existing treatment map discussed with the stakeholders about the existing activity in the map and filled the questionnaire from the villagers of Indla-Ghatkhed watershed.
8) After filling the questionnaire they are sorted out according to the opinion of respondents.
9) Graphs of each closed indent questions are plotted.
10) From that graphs the interpretation for each graph was done.
11) Second questionnaire is prepared for the farmers whose land is outside the watershed implemented area.
12) Farmers filled the questionnaire in specially called Gram Sabha.
13) Opinion of the respondents were sorted out from the questionnaires.
14) From the sorting out of the opinions graph of each close indent activity is prepared.
15) Interpretation was drawn from each graph.
16) With the help of survey, field observations and discussion with the farmers proposed treatment map for Indla-Ghatkhed watershed is prepared.
17) Finally results and discussion, summary and conclusion were prepared.

3 Results & Discussion

The data collected from the survey, field observations, questionnaires and discussion with farmers following treatments were observed-

1 Graded bunding

2 Trench Cum Mount (TCM)

3 Water Absorption Trench (WAT)

4 LBS

5 Cement Plug (CP)

6 Continuous Contour Trench (CCT)

7 Irrigation Tank

8 Impact of Land Selling (Urbanization)

9 Impact of aforestation

Facts observed were summarized as given below. Existing structure in the watershed and proposed structure of the watershed are presented accordingly in figure no 1 and 2.

Graded bunding: - It is observed that due to implementation of graded bund activity depth of soil is increased and in-situ soil moisture is also achieved.

Trench Cum Mount (TCM):- With the implementation of TCM nuisance of wild animal is stopped, protection to forest area from animal is achieved, increase in water table and soil erosion is decreased.

Water Absorption Trench (WAT):- With the implementation of WAT water table increased and erosion of soil decreased.

Cement Plug (CP):- Implementation of cement plug increased water table, irrigation and crop production; farmers use this water for spraying fertilizers. (Wasre, Dr.Pawar R.P.,Pawar C.B, et,al.,2010)

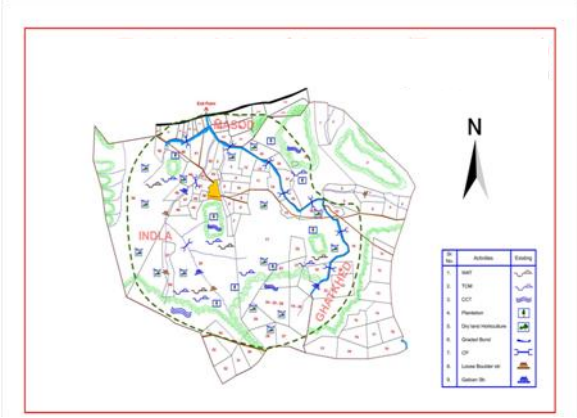

Fig. 1: Existing Map of Activities (Treatments)

To analyse the data collected from the survey of the watershed area and from beneficiaries of Indla and Ghatkhed area. The details of plots and its interpretations are given in details.

Analysis of Data Obtained from Questionnaire:

In the specially called Gram Sabha data collected from the farmers with the help of questionnaires, Section - A - for the treatments of land in the Indla-Ghatkhed watershed area and Section - B - for treatments of land outside the watershed area. Data collected with the help of questionnaire is presented in the tables.

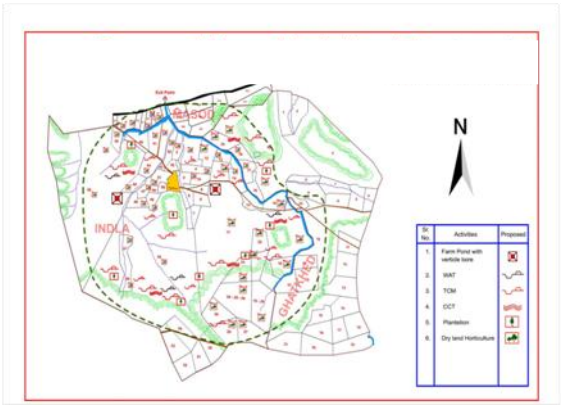

Fig. 2: Proposed Map of Activities (Treatments)

Section - A] For the treatment of land in the watershed (Indla-Ghatkhed)

Table 1 indicating Existing Activities In The Watershed

Sr. No.	Activity	No of Respondents	Percentage
1	WAT	15	23.00
2	TCM	5	8.00
3	Loose boulder structure	10	23.00
4	CCT	20	31.00
5	Plantation	18	28.00
6	Dry land Horticulture	17	26.00
7	Graded bunding	58	89.00
8	Gabian structure	8	12.00
9	CP	5	8.00

From the above collected data, it was observed that according to 89% respondents graded bund activity was exist. According to 23%, 31%, 23%, 28% and 26% respondents WAT, CCT, loose boulder structure, plantation and Dryland horticulture activities were exist in the study area. The existence of TCM and CP is found very low i.e. 8% each. Related graph is shown in fig. 3.

It indicates that graded bund activity exist in large scale in the study area along with WAT, CCT, loose boulder structure, plantation and Dryland

horticulture. But existence of TCM, Gabian structure and CP activity is very low.

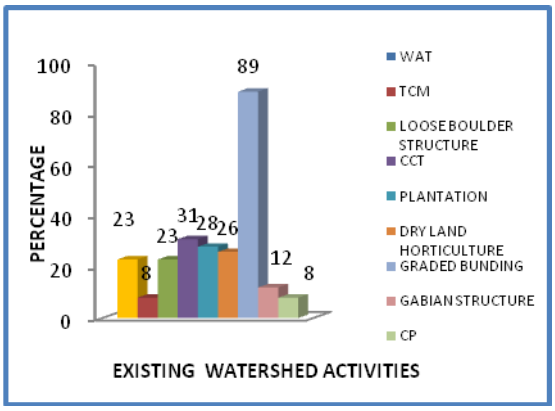

Fig. 3: Graphical representation of existing watershed Activities In The Study Area.

Table 2 indicating Farmer's Opinion About The Completed Treatment of Watershed

S. No.	Opinion	No of Respondents	Percentage
1	Fully satisfied	50	77.00
2	Partially satisfied	12	18.00
3	Not satisfied	3	5.00
	Total	65	100.00

From the above collected data, it was observed that out of 65 respondents 77% were fully satisfied for the completed treatment of watershed, 18% were partially satisfied and remaining 5% were not satisfied. Related graph is shown in fig. 4.

It indicates majority of respondent were satisfied for the completed treatment of watershed.

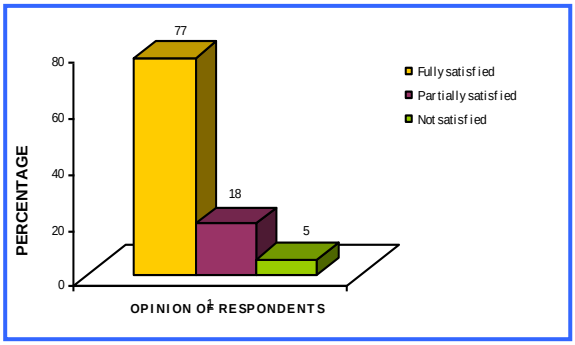

Fig. 4: Graphical representation of satisfaction of respondents about completed treatments of watershed.

Table 3 indicating farmers participation in implementation of watershed development program

S. No.	Opinion	No of Respondents	Percentage
1	Fully satisfied	45	69.00
2	Partially satisfied	15	23.00
3	Not satisfied	5	8.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents 69% were fully satisfied, 23% were partially satisfied and remaining 8% were not satisfied for their participation in the watershed development programme. Related graph is shown in fig. 5.

It indicates majority of respondents were satisfied for their participation in watershed development programme. Related graph is shown in fig. 5.

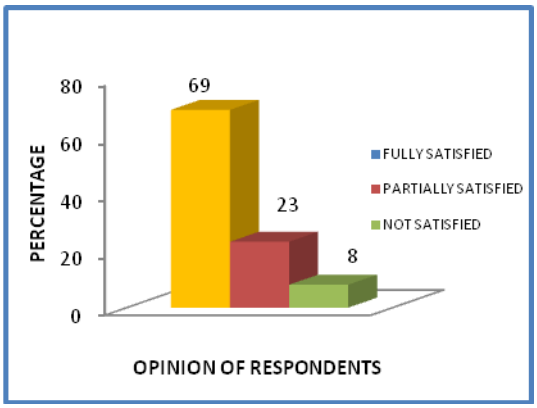

Fig. 5: Graphical representation of satisfaction of respondents about their participation in watershed development programme.

Table 4 indicating improvement in soil texture due to watershed development activities

S. No.	Improvement in soil texture	No of Respondents	Percentage
1	Fully satisfied	47	72.00
2	Partially satisfied	14	22.00
3	Not satisfied	4	6.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents 72% and 22% respondents opined that fully and partially improvement in the soil texture of their field respectively. Remaining 6% were of the opinion that there is no change in soil texture due to the watershed development activities in their fields.

It indicates that majority of respondents is in favour of improvement in soil texture due to watershed development activities. Related graph is shown in fig. 6.

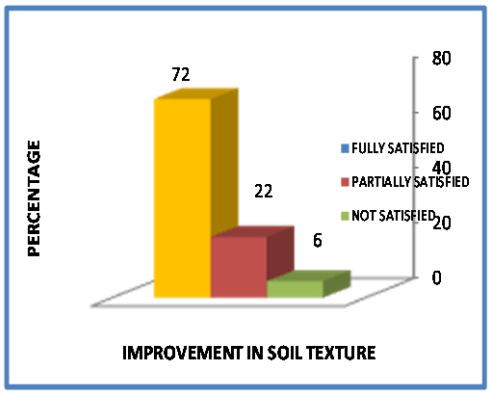

Fig. 6: Graphical representation of respondents about improvement in soil texture due to watershed development activities.

Table 5 indicating increase in thickness of soil due to watershed development activities

S. No.	Increase in thickness of soil	No of Respondents	Percentage
1	Fully increase	52	80.00
2	Partially increase	9	14.00
3	Not increase	4	6.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, according to 80% respondents the soil thickness is fully increased while 14% responded partial increase. Remaining 6% were of the opinion that there is no change in soil thickness due to the watershed development activities in their fields. Related graph is shown in fig. 7.

It indicates the soil thickness of majority of respondents field was increased due to watershed development activities.

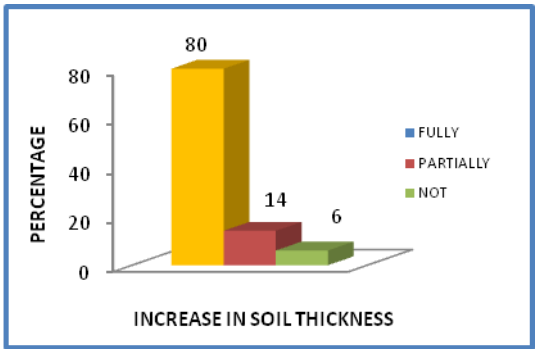

Fig. 7: Graphical representation of respondents about increase in soil thickness due to watershed development activities.

Table 6 indicating increase in crop production due to watershed development activities

S. No.	Increase in crop production	No of Respondents	Percentage
1	Fully increase	42	65.00
2	Partially increase	16	24.00
3	Not increase	7	11.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 65% and 24% respondents were in favour of fully and partial increase in crop production due to watershed development activities, respectively. Only 11% respondents were of the opinion that there is no change in crop production. Related graph is shown in fig. 8.

It indicates that according to majority of respondents, the crop production was increased due to watershed development activities.

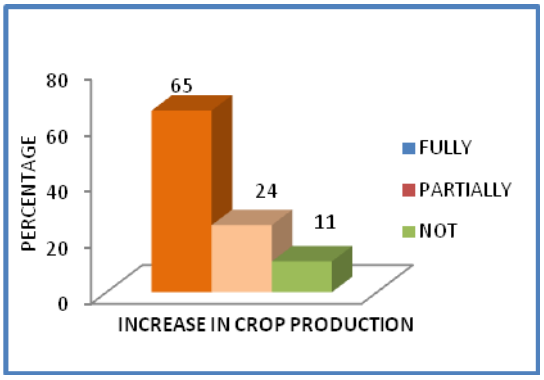

Fig. 8: Graphical representation of respondents about

increase in crop production due to watershed development activities.

Table 7 indicating increase in crops stress bearing capacity during a dry spell between two consecutive rains due to watershed development activities

S. No.	Increase in crop stress bearing capacity	No of Respondents	Percentage
1	Fully increase	54	83.00
2	Partially increase	8	12.00
3	Not increase	3	5.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 83% and 12% respondents were in favour of fully and partial increase in crops stress bearing capacity during a dry spell between two consecutive rains due to watershed development activities, respectively. Only 5% respondents were of the opinion that there is no change in crops stress bearing capacity. Related graph is shown in fig. 9.

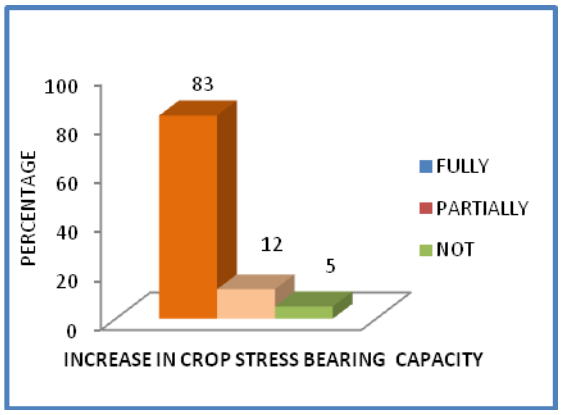

Fig. 9: Graphical representation of respondents about increase in crops stress bearing capacity during production due to watershed development activities.

Table 8 indicating increase in availability of fodder due to watershed development activities

S. No.	Increase in availability of fodder	No of Respondents	Percentage
1	Fully increase	49	74.00
2	Partially increase	10	16.00
3	Not increase	6	9.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 74% and 16% respondents were in favour of fully and partial increase in availability of fodder due to watershed development activities, respectively. Only 9% respondents were of the opinion that there is no change in availability of fodder. Related graph is shown in fig. 10.

It indicates that according to majority of respondents, there is a increase in fodder availability due to watershed development activities.

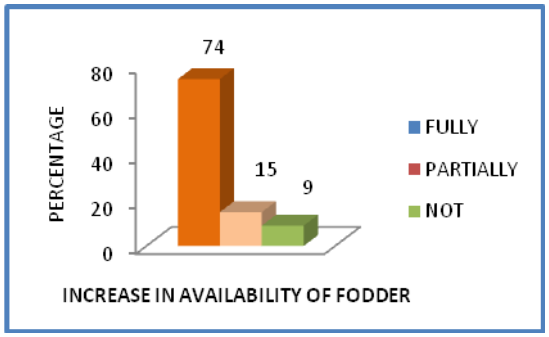

Fig. 10: Graphical representation of respondents about increase in availability of fodder due to watershed development activities.

Table 9 indicating decrease in soil erosion due to watershed development activities

S. No.	Decrease in soil erosion	No of Respondents	Percentage
1	On large scale decrease	54	83.00
2	Partially decrease	7	11.00
3	No change	4	6.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 83% and 11% respondents were in favour of fully and partial decrease in soil erosion due to watershed development activities, respectively. Only 6% respondents were of the opinion that there is no change in soil erosion. Related graph is shown in fig. 11.

It indicates that according to majority of respondents, there is a decrease in soil erosion due to watershed development activities.

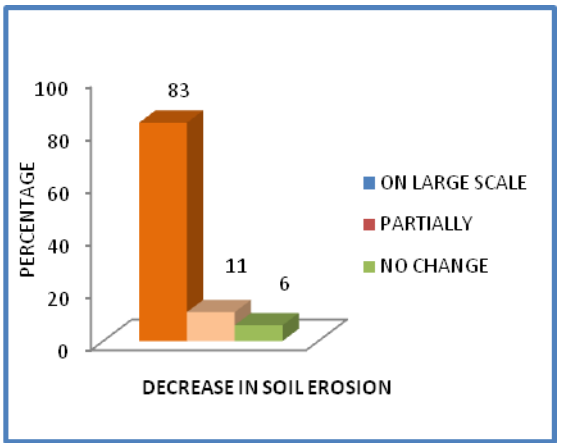

Fig. 11: Graphical representation of respondents about decrease in soil erosion due to watershed development activities.

Table 10 indicating enhancement in socio-economic status of the people due to watershed development activities

S. No.	Enhancement in socio-economic status	No of Respondents	Percentage
1	On large scale	56	86.00
2	Partially	6	9.00
3	No	3	5.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 86% and 9% respondents were in favour of large scale and partial enhancement in socio-economic status of people due to watershed development activities, respectively. Only 5% respondents were of the opinion that there is no change in socio-economic status of the people. Related graph is shown in fig. 12.

It indicates that according to majority of respondents, there is enhancement in socio-economic status due to watershed development activities.

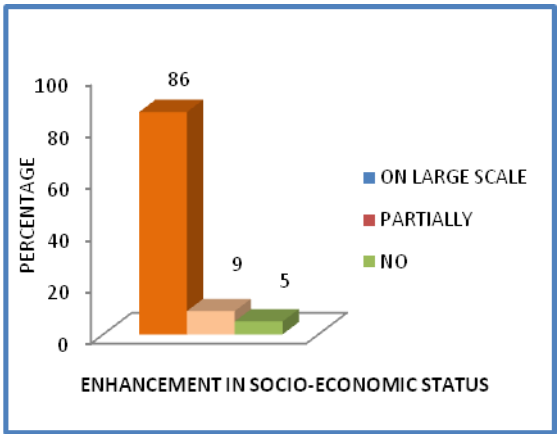

Fig. 12: Graphical representation of respondents about enhancement in socio-economic status of people due to watershed development activities.

Table 11 indicating increase in irrigation due to watershed development activities

S. No.	Increase in irrigation	No of Respondents	Percentage
1	On large scale increase	48	73.00
2	Partially increase	13	20.00
3	No increase	4	7.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 86% and 9% respondents were in favour of large scale and partial enhancement in socio-economic status of people due to watershed development activities, respectively. Only 5% respondents were of the opinion that there is no change in socio-economic status of the people. Related graph is shown in fig. 13.

It indicates that according to majority of respondents, there is enhancement in socio-economic status due to watershed development activities.

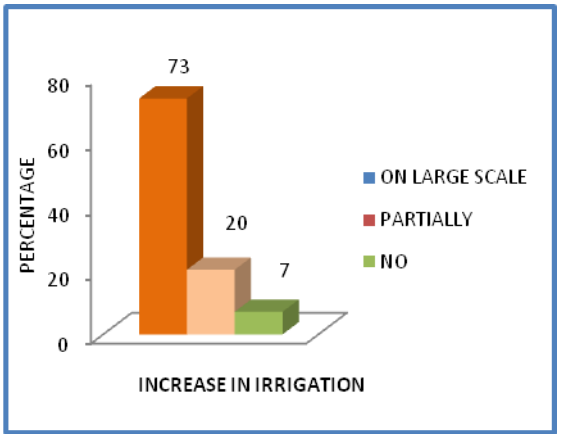

Fig. 13: Graphical representation of respondents about increase in irrigation due to watershed development activities.

Table 12 indicating increase in soil fertility due to watershed development activities

S. No.	Increase in soil fertility	No of Respondents	Percentage
1	On large scale increase	51	78.00
2	Partially increase	9	14.00
3	No increase	5	8.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 78% and 14% respondents were in favour of large scale and partial increase in soil fertility due to watershed development activities, respectively. Only 8% respondents were of the opinion that there is no change in soil fertility. Related graph is shown in fig. 14. It indicates that according to majority of respondents, there is increase in soil fertility due to watershed development activities.

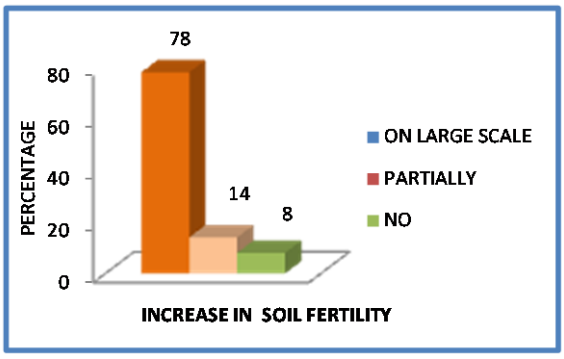

Fig. 14: Graphical representation of respondents about increase in soil fertility due to watershed development activities.

Table 13 indicating increase in water table due to watershed development activities

S. No.	Increase in water table	No of Respondents	Percentage
1	On large scale	53	81.00
2	Partially	8	12.00
3	No	4	7.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 81% and 12% respondents were in favour of fully and partially increase in water table due to watershed development activities, respectively. Only 7% respondents were of the opinion that there is no change in water table. It indicates that according to majority of respondents, there is increase in water table due to watershed development activities. Related graph is shown in fig. 15.

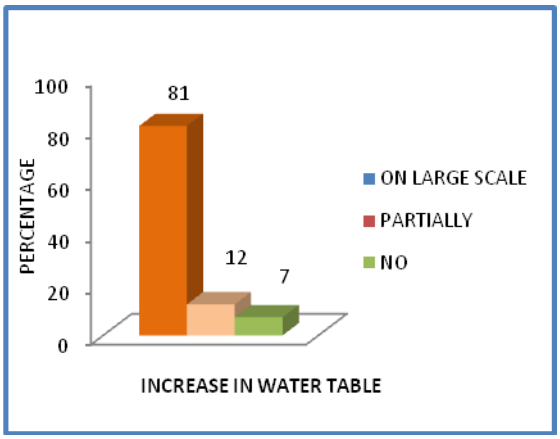

Fig. 15: Graphical representation of respondents about increase in water table due to watershed development activities.

Table 14 indicating availability of drinking water due to watershed development activities

S. No.	Availability of drinking water	No of Respondents	Percentage
1	On large scale	52	80.00
2	Partially	8	12.00

3	No	5	8.00
	Total	65	100.00

From the above collected data, it was observed that out of total 65 respondents, 80% and 12% respondents were in favour of large scale and partial increase in availability of drinking water due to watershed development activities, respectively. Only 8% respondents were of the opinion that there is no change in availability of drinking water. Related graph is shown in fig. 16.

It indicates that according to majority of respondents, there is increase in availability of drinking water due to watershed development activities.

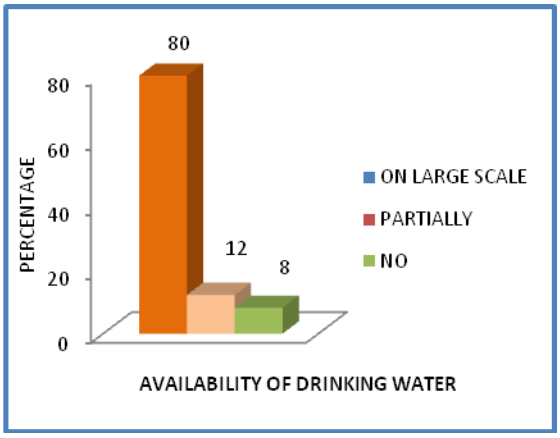

Fig. 16: Graphical representation of respondents about increase in availability of drinking water due to watershed development activities.

Table 15 indicating activities proposed by farmers in the watershed

S. No.	Activity	No of Respondents	Percentage
1	Farm pond with vertical bore	20	31.00
2	WAT	20	31.00
3	TCM	40	61.00
4	Loose boulder structure	50	77.00
5	CCT	19	29.00
6	Plantation	35	54.00
7	Dry land Horticulture	24	37.00
8	Gabian structure	25	38.00
9	CP	5	8.00

From the above collected data, it was observed that according to 77%, 61% and 54% respondents loose boulder structure, TCM and plantation activity is proposed, respectively. According to 31%, 31%, 29%, 38% and 37% respondents proposed farm pond with vertical bore, WAT, CCT, Gabian structure and Dryland horticulture activities in the study area. Only 8% respondents proposed to repair existing CP. Related graph is shown in fig. 17.

It indicates that majority of respondents strongly proposed loose boulder structure, TCM and plantation activities in the study area along with farm pond with vertical bore, Gabian structure, WAT, CCT and Dryland horticulture activities. Very few respondents proposed the repair of existing CP.

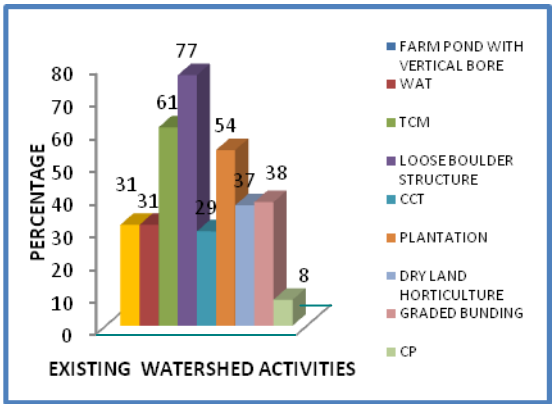

Fig. 17: Graphical representation of proposed watershed activities in the study area.

Section - B] for the treatment of land outside the watershed

Table 16 indicating information about watershed development program me

S. no.	Response	No. of respondents (N=30)
1	Yes	24(80%)
2	No	6(20%)

From the analysis of the data of the respondents we found that 80% of the respondents have fair

idea of watershed development program. Related graph is shown in fig. 18.

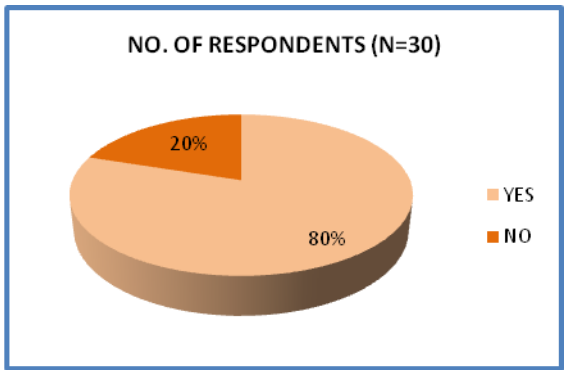

Fig. 18: Graphical representation of information about watershed development programme

Table 17 indicating sources of information about watershed development programme

S. no.	Source of Information	No. of respondents (N=24)
1	Farmer, Friends , Relative	7(29.17%)
2	NGO	11(45.83%)
3	Magazine	3(12.50%)
4	Government office	3(12.50%)

Majority of the respondents have gained information from NGO and Farmers, Friends, Relative which proves that NGO has sound work carried who for giving farmers upgraded facility and have change the traditional misconception, belief ruling them. Related graph is shown in fig.19.

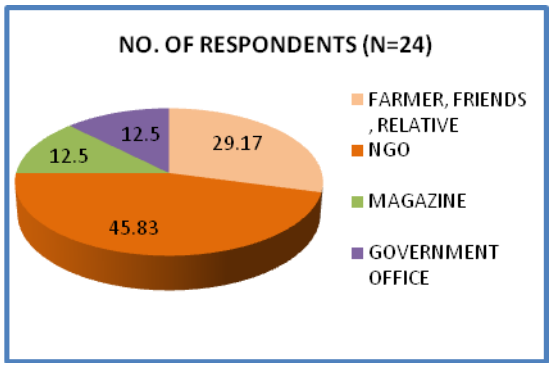

Fig. 19: Graphical representation of sources of information about watershed development programme

Table 18 showing the advantages & disadvantages learned from sources of information related watershed development program me.

S. no.	Advantage / Disadvantage	No. of respondents
1	Enhancement of water level	19(79.17%)
2	Increase in output / hectare	22(91.67%)
3	Additional no of Crops / year	18(75.00%)
4	Less dependence on rain fed cultivation	17(70.83%)
5	Land divides in parts	4(16.67%)
6	Non convenience for traditional farming activity	2 (8.33%)

From the analysis found that more output per hectare and enhanced water level are prime motive driver on advantage side for most of the farmers. On the other hand very few disadvantage side land divides in a parts is drawback for which government and NGO has to seriously work onto to give remedial solution at the earliest. Related graph is shown in fig. 20.

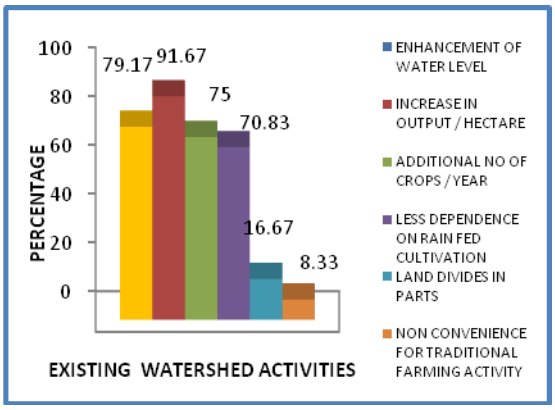

Fig. 20: Graphical representation of advantages & disadvantages learned from sources of information related watershed development program.

Table 19 showing the satisfaction level of various farmers who participated in watershed development program me

S. No.	Satisfaction Level	No. of respondents
1	Fully Satisfied	19(79.17%)

2	Partially Satisfied	4(16.67%)
3	Unsatisfied	1(4.16%)

From the analysis it was found that majority of farmers have positive word of mouth publicity for the watershed development programme. This will be positive note for government to catch new prospect at ease. Related graph is shown in fig. 21.

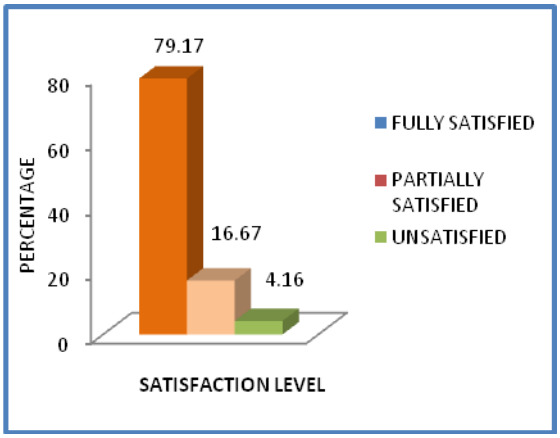

Fig. 21: Graphical representation of satisfaction level of various farmers who participated in watershed development programme

Table 20 showing the months in which well water facility available for irrigating crops

Sr. No.	Month wise availability of water	No of Respondents
1	January	21(87.50%)
2	February	12(50.00%)
3	March	6(25.00%)
4	April	3(12.50%)

The data analysis shows that January is a last month up to which majority of the farmers have liberty to the utilized the water resources for irrigating their farms. Later on there is drastic reduction which hampers the farmers for going to additional crop which culminate into lower earning per year. Related graph is shown in fig. 22.

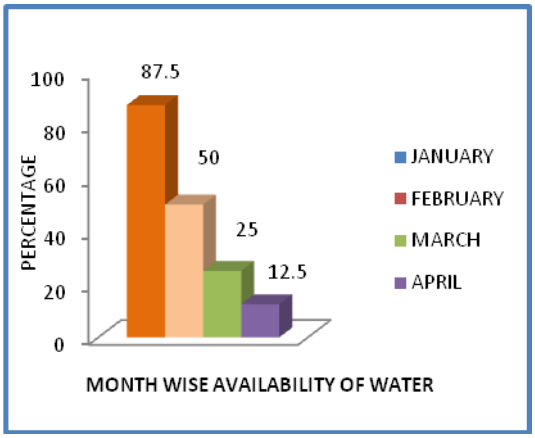

Fig. 22: Graphical representation of months in which well water facility available for irrigating crops

Table 21 showing water table is receding every year

Sr. No.	Reduction in water table year wise	No of Respondents (N=24)
1	Up to 0.5 meter/year.	11(45.83%)
2	Up to 1 meter	7(29.17%)
3	Up to 1.5 meter	3(12.50%)
4	Up to 2 meter /year.	3(12.50%)

From the data analysis found that almost all the farmers are experiencing regular reduction in water table as the year pass. This is serious concern issue and has countervailing effect on vegetative cover, agriculture output, and overall ecology. The global warming issue is affecting worldwide countries; India is not exception to it. Related graph is shown in fig. 23.

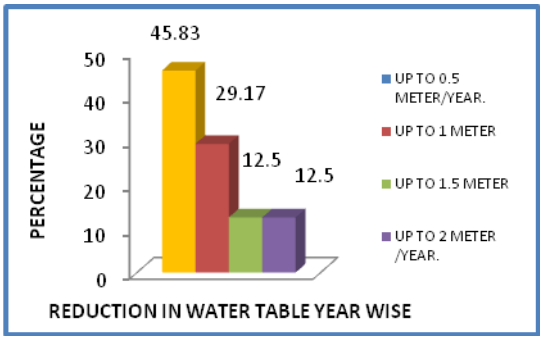

Fig. 23: Graphical representation of water table is receding every year

Table 22 showing income in Rs. /Hectare from farming

Sr. No.	Income Rs. Per hectare	No of Respondents (N=24)
1	Up to Rs. 20,000/ Hectare	15(62.50%)
2	Up to Rs. 25,000/ Hectare	6(25.00%)
3	Up to Rs. 30,000/ Hectare	3(12.50%)

The data analysis shows that the farmer have very limited gross income in a range of Rs. 20,000 to Rs. 30,000 per hectare. The expenses are yet to be deducted from this income that why farmers are in clutches of moneylenders / banks as expenses are rising sharply and regularly. Related graph is shown in fig. 24.

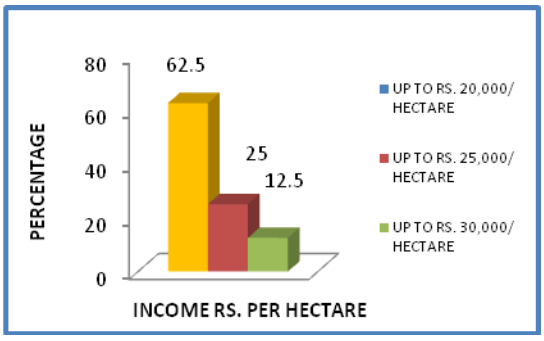

Fig. 24: Graphical representation of income in Rs./Hectare from farming

Table 23 showing net profit in Rupees/Hectare

Sr. No.	Net income Rs. Per hectare	No of Respondents (N=25)
1	Up to Rs. 10,000/ Hectare	16(64.00%)
2	Up to Rs. 15,000/ Hectare	7(28.00%)
3	Up to Rs. 20,000/ Hectare	2(8.00%)

From the data analysis we found that majority of the farmers lie in income group of Rs. 10,000 per hectare, which is below the normal standards of worldwide countries Government has to rectify at immediate effect. Government has category worked out new strategies marking agriculture also as priority sector for current 11th five year plan and would be extended to coming 12th five year plan. They are expecting 4% contribution towards GDP to revive this sector employing majority of population. Related graph is shown in fig. 25.

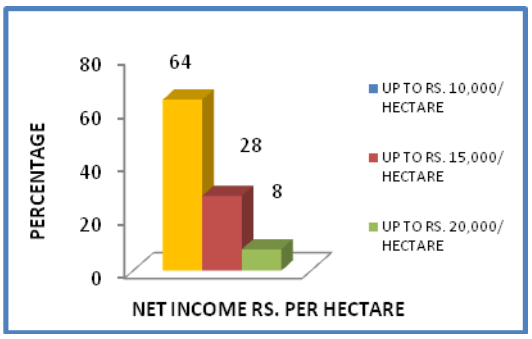

Fig. 25: Graphical representation of net profit in Rupees/Hectare

Comparative Analysis of watershed development programme implemented with non implemented area. Water

Table 24: Water Table Enhancement.

Year	Watershed Implemented area	Non Implemented area
1	+0.5	-0.5
2	+1.0	-0.1
3	+1.25	-1.5
4	+1.5	-1.75
5	+2.0	-2.25

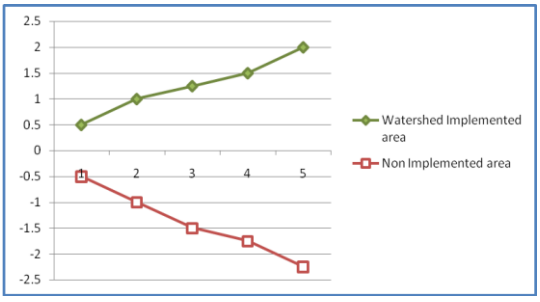

Fig. 26: Graphical representation of Water Table Enhancement

Table 25: Ground water storage capacity (in percentage)

S. No	Month	Watershed Treatment Implemented area	Watershed Treatment Non Implemented area
1	Jan	60%	50%
2	Feb	55%	40%
3	Mar	50%	25%
4	April	45%	10%
5	May	40%	5%
6	June	35%	0%

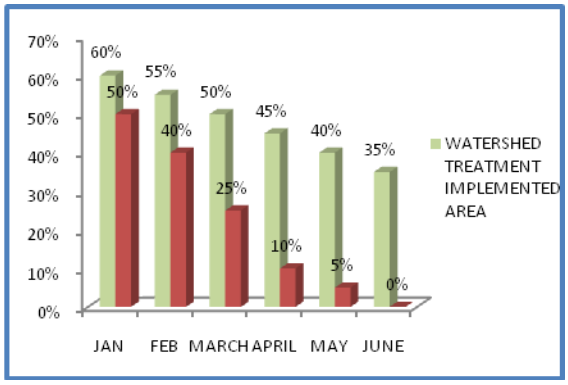

Fig. 27: Graphical representation of Ground water storage capacity

Table 26: Average crop output in quintals per hectare

S. No	Crop	Watershed Treatment Implemented area	Watershed Treatment Non Implemented area
1	Soyabin	22	13.5
2	Pigeon Lentils	15	9
3	Cotton	20	9
4	Wheat	22	11.5
5	Jowar	18	11
6	Horse gram	15	9.5

From the study of data it was found that water table gap is widening between watershed development programme implemented area and non implemented area. This given special thrust for India to keep agriculture production, shape drinking water, industrial development. We are sure that watershed development programme will changed the current drastic situation in coming times as government will provide additional budgetary allocation to keep inclusive growth format and related socio-economic upheaval of total Indian society. Related graph is shown in fig. 28.

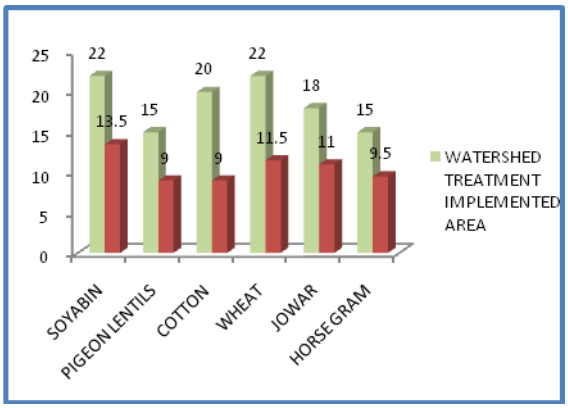

Fig. 28: Graphical representation of average crop output in quintals per hectare

4 Conclusions

From the observation and analysis of data following conclusions appears to be justified.

It has been observed that watershed development measures implemented in Indla-Ghatkhed watershed created favourable impact on soil and water conservation in entire area and vegetative cover in a forest land. Long interaction with the farmers in particular and entire population in watershed in general have been benefited due to soil and water conservation. Also due to soil and water conservation activities the soil has improved resulting in enhance crop yield. Since ground water level has come up more area has come under irrigation and drinking water problem in all the three villages has been adequately solved. Increase in the vegetative cover in the forest land resulted in arresteation of erosion of the land and flowing of stream for longer period than before the treatment.

From the study it has been revealed that watershed area needs additional treatments for better results. Therefore, following additional treatments have been recommended.

1. Farm pond with vertical bore

2. WAT

3. TCM

4. Loose boulder structure

5. CCT

6. Plantation

7. Dry land Horticulture

8. Gabian structure

9. Repair of CP

It is felt that if the above treatments are implemented more ground water will be available for irrigation, and additional fodder for the cattles will be available from the wasteland.

By adopting these additional measures in watershed area of Indla Ghatkhed, the water conservation aspect and development in water shed area through soil and water conservation seems to be achieved w.r.t. sustainable development.

From above study and data obtained from field observation, it is concluded that sustainable development in the watershed area through soil and water conservation activity is mostly achieved.

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