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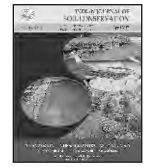

Impact of integrated watershed management programme on yield and economic parameters of farmers in Wardha district

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ABSTRACT

The present study was conducted in Wardha district of Maharashtra State in the Vidarbha region. For the impact study of Integrated Watershed Management Program (IWMP) on developmental parameters of farmers, descriptive design namely, ex-post facto research design was used. IWMP has been implemented in the district since 2010 with its integrated Soil and Water Conservation (SWC) activities. This project has almost completed the period of four years. Hence, the project needs to be evaluated for its impact on developmental parameters. The impact was determined by the changes in developmental parameters of farmers before and after watershed development program. In the study, behavioral variables like knowledge and adoption were studied; however, yield parameters and income generating variables were also the key points to study the impact of IWMP. After critical analysis, it was observed that 90% of the respondents had high level of knowledge regarding watershed practices, while 87.5% farmers adopted at medium level. Change in production and productivity was observed due to implementation of IWMP. Similarly, cropping intensity increased by 12.28%, while employment and income increased by 19.57 and 50.71%, respectively. Overall impact of IWMP on yield and economic parameters in Wardha district was 50.64%. During the IWMP, yield and economic parameters significantly changed. Knowledge and adoption of watershed practices played an important role in increasing the production, productivity, cropping intensity, employment generation and income of farmers which show positive and highly significant relationship between behavioral variables of farmers and their developmental parameters.

1. INTRODUCTION

In Maharashtra, 84.36% area is rainfed and the major source of water is rainfall received from south west monsoon during the period from June to September. Limited availability of water is the most serious constraint for crop production in rainfed farming system. This problem can be addressed through conservation of the potential rain water as possible by *in-situ* conservation and by harvesting and storage of excess runoff. This can be best achieved by using the watershed approach and management of land and water resources.

The concept of watershed development has gained much importance in the recent past due to realization of need for conservation of most valuable natural resources like soil, water, forest and so on. Watershed development approach itself is a prerequisite for sustainable agricultural development of farmers. This approach concentrates not only on agriculture and allied activities, but also the homestead vocations and situation specific economic activities. For conservation and management of natural resources Government of Maharashtra started implementing the program called Integrated Watershed Management Program (IWMP). The former area development programs of the Department of Land Resources, including the Drought Prone Areas Programme (DPAP), the Desert Development Programme (DDP) and the Integrated Wastelands Development Program (IWDP) have been integrated into a single modified program called IWMP and launched in 2009-10. In view of the importance of IWMP, it was thought opportune to know how far the program was successful in bringing about the desirable changes in the beneficiary farmers. Hence, the present investigation was undertaken to find out the changes that may have occurred in cropping intensity, production, productivity, employment and income of the beneficiary farmers due to the adoption of SWC practices under IWMP.

2. MATERIALS AND METHODS

IWMP has been implemented in Wardha district since 2010 with its integrated soil and water conservation activities. This project has almost completed the period of four years. Hence, the project needs to be evaluated for its impact on developmental parameters. The impact was determined by the changes in developmental parameters of farmers such as production, productivity, income, employment before and after watershed development program. Base year for the study was 2010 and study year was 2014.

For the evaluation of watershed development program on developmental parameters of farmers, descriptive design namely ex-post facto research design was used. There were eight watershed blocks in Wardha district. Out of those, three blocks were considered for the study on the basis of coverage of project area. In the selected three blocks, 11 projects were carried out. From the selected three watershed blocks, 12 villages were purposively selected on the basis of larger project area, maximum beneficiaries covered and maximum activities implemented. From the selected twelve villages 10 beneficiaries from each village were randomly selected from the list. In total, 120 beneficiary farmers were selected with the help of simple random sampling method. The data were collected by contacting personally the selected farmers on their convenience with the help of interview schedule containing questions related to impact of watershed development program and their developmental parameters were summarized. Descriptive statistics were computed to assess the impact.

3. RESULTS AND DISCUSSION

Knowledge of Watershed Practices under IWMP

It was observed from the data that highest mean knowledge index (92.5%) was recorded for NRM activities followed by plantation (87.5%), Self Help Group (SHG) activities (86.67%), water harvesting structures (58.99%), soil moisture conservation (51.25%) and vegetative and engineering structures (49.00%), respectively in Table 1. Overall knowledge index of IWMP activities was 70.99%.

It clearly indicated that relatively farmers had greater interest to know about livelihood (NRM), plantation and group programs, which provide income generating activities in the project area. Less interest of farmers was observed regarding the activities of soil and moisture conservation, vegetative and engineering structures and water harvesting structures, as these activities could require physical and financial contribution in the project.

Table: 1
Distribution of the respondents according to knowledge and adoption of major recommended practices under IWMP

S.No.	Watershed activities	Mean knowledge index (n=120)	Mean adoption index (n=120)
1	Soil moisture conservation activities (Area treatment)	51.25	23.75
2	Vegetative and Engineering Structures	49.00	32.00
3	Water harvesting structures	58.99	18.32
4	Plantation	87.50	87.50
5	NRM activities	92.50	57.50
6	SHG activities	86.67	56.67
	Overall	70.99	45.96

Adoption of Watershed Practices under IWMP

It was observed from the data presented in Table 1 that mean adoption index of plantation activities was highest (87.5%) followed by NRM activities (57.5%), SHG activities (56.67%), vegetative and engineering structures (32.00%), soil moisture conservation (23.75%) and water harvesting structures (18.32%), respectively. The overall adoption of recommended practices of IWMP was 45.96%.

It is inferred from the finding that most of the watershed beneficiaries have adopted the plantation, because forest trees and horticultural trees were provided under IWMP for plantation on bunds. In NRM activities, ₹ 15000 was provided to asset-less persons (BPL) for farm or any livelihood operations. Different SHGs were prepared by IWMP through which financial assistance was provided to the farmers for different income generating activities. In these activities, production system and micro enterprises, gotary, dairy, group farming and setting up dal mill were adopted by the SHG members. In the financial assistance, 50% subsidy and 25% bank loan was provided to the group members.

Similar findings were reported by Kale (2011) regarding adoption of soil moisture conservation activities by the farmers.

Impact of IWMP on Knowledge of Farmers

It could be observed (Table 2) that before watershed program, majority of respondents (87.5%) had medium knowledge about activities of IWMP. But, after implementation, majority of the respondents (90%) had high level of knowledge about these activities whereas, 5.84 and 4.16% of the respondent farmers were having medium and low level of knowledge about IWMP activities.

It is, therefore, concluded that majority of respondents upgraded from medium to high level of knowledge about

Table: 2
Distribution of the respondents according to their extent of knowledge and adoption of watershed practices under IWMP

S.No.	Level	Respondents (n=120)			
		Knowledge		Adoption	
		Before	After	Before	After
1	Low (Up to 33.33)	15 (12.50)	05 (4.16)	111 (92.50)	08 (6.67)
2	Medium (33.34 to 66.66)	105 (87.5)	07 (5.84)	09 (07.5)	105 (87.50)
3	High (Above 66.66)	00 (00.00)	108 (90.00)	00 (00.00)	07 (5.84)
	Total	120 (100.00)	120 (100.00)	120 (100.00)	120 (100.00)

soil and water conservation activities, livelihood activities, plantation and group activities after implementation of IWMP in the study area. It could be inferred that the farmers were more intended towards the activities of project which provided definite benefits for their better livelihood, hence tried to get maximum information of project activities. Bhople (2002) also observed that majority of the respondents having high level of knowledge about dryland technology.

Impact of IWMP on Adoption of Farmers

It could be observed from the Table 2 that, before watershed programme, great majority of respondents (92.5%) had low adoption about IWMP. But, after watershed majority of the respondents (87.5%) came in to medium level of adoption about the IWMP activities. Whereas, 6.67% and 5.84% of the respondent farmers were having low and medium level of adoption about the recommended SWC practices.

It is, therefore, concluded that adoption level of farmers in IWMP area was increased from low to medium level of adoption. That has been facilitated by the IWMP for overall sustainable development of farming community. Deshmukh *et al.* (2007); Kale (2011) also observed the similar results as observed in the present study.

It clearly indicated that there was gap between knowledge and adoption of watershed practices recommended under IWMP. This gap was plausibly because of technical and expensive treatments that farmers are unable to adopt on their own.

Yield Parameters and Income Generating Variables

It is revealed from data (Table 3) that the production of major crops of 60% respondents increased up to 33% *i.e.,* lower change in production followed by 35.84% respondents having medium change in production (34 to 66%). Only 4.16% respondents could find high change in production *i.e.* 67% and above. In the similar trend, productivity of major crops of the respondents was recorded *i.e.* low (60%), medium (34.16%) and high (35%).

Table: 3
Distribution of respondents according to per cent change in production, productivity, cropping intensity, employment and income

S.No.	Parameters	Level	F (n=120)	(%)
1	Change in production	Low (Up to 33%)	72	60.00
		Medium (34 to 66%)	43	35.84
		High (67% and above)	05	4.16
2	Change in productivity	Low (Up to 33%)	73	60.84
		Medium (34 to 66%)	41	34.16
		High (67% and above)	06	05.00
3	Change in cropping intensity	Low (Up to 25%)	109	90.83
		Medium (26 to 50%)	05	4.17
		High (51% and above)	06	05.00
4	Change in employment	Low (Up to 33%)	101	84.17
		Medium (34 to 66%)	12	10.00
		High (67% and above)	07	5.83
5	Change in income	Low (Up to 33%)	03	2.5
		Medium (34 to 66%)	111	92.5
		High (67% and above)	06	05.00

The study area comes under rainfed and distress prone area of Vidarbha where irrigation facilities are limited and agriculture is mostly dependant on rainwater. Implementation of SWC activities under IWMP could help to increase the soil moisture and subsequently recharged the irrigation sources that were eventually available for the crop grown in the area. Thus, it resulted in increase in production and productivity of crops. But, previously it could be observed that the adoption of soil and moisture conservation practices was low, hence the change in production and productivity was recorded low. These findings are supported by Rathod (2003).

The data regarding per cent change in cropping intensity (Table 3) indicated that over four fifth of respondents (90.83%) recorded lower change in cropping intensity (up to 25%) followed by 5.00 and 4.17% of respondents who observed high (51% and above) and medium (26 to 50%) increase in cropping intensity.

It clearly indicated that the soil and moisture conservation activities helped to increase the soil moisture and recharged the sources of irrigation that could encourage the farmers to take *rabi* crops, vegetables crops *etc.* that contributed to increase in cropping intensity. But, this increase could be low due to lower adoption of soil and water conservation practices by the farmers in study area. The finding corroborates with finding of Mapari (2005).

From the similar table, increase in employment was found to be low (up to 33%) by the majority farmers *i.e.* 84.17%. It was followed by medium (34 to 66%) and high (67% and above) level of change as recorded by 10 and 5.83% respondents. Increase in employment leads to increase in income, but increase in income was found to be medium (34 to 66%) in case of 92.5% respondents. IWMP is the integration of soil and moisture conservation activities and employment generation activities. SWC activities increased the cropping intensity which could increase the on farm man days of farmers and their family members, while other enterprises could help to increase the off farm man days of farmers. In the employment generation activities IWMP have provided subsidy and credit facility to the farmers, hence the income of respondents change to medium level through the employment recorded. These finding are in consonance with the finding of Rathod (2003).

Impact of IWMP on Developmental Parameters of Beneficiary Farmers

Impact of IWMP on various developmental parameters of farmers was studied in detail and parameter wise impact is presented in Table 4.

The perusal of data with regard to the impact of IWMP on production of major crops indicated that average production of cotton before IWMP was 9.95 q which was increase to 26.61 q after four years of implementation of IWMP, the increase was recorded up to 62.60% over period of time. Regarding the tur crop, an average production of the respondents could change from 1.61 to 2.16 q and it was 25.46% increased. In case of soybean and sorghum, only 5.04 and 3.63% increase in production was recorded, respectively. Among the *rabi* crops, an average production of wheat and gram could have been increased by 58.95 and 64.07%, respectively. Production of wheat was increased from 3.05 to 7.43 q and production of gram was increased from 3.28 to 9.13 q over the period of IWMP. The Z value indicated that the change in production of cotton, wheat and gram before and after IWMP was significantly changed at 0.01 level of probability.

Table: 4
Impact of IWMP on production, productivity, cropping intensity, employment and income

S.No.	Developmental parameters	Mean		% change	Z value
		Before IWMP	After IWMP		
1.	Production (q)				
a	Cotton	9.95	26.61	62.60	13.81**
b	Tur	1.61	2.16	25.46	1.68
c	Soybean	10.72	11.29	5.04	0.71
d	Sorghum	0.53	0.55	3.63	0.081
e	Wheat	3.05	7.43	58.95	4.26**
f	Gram	3.28	9.13	64.07	6.01**
2.	Productivity (q ha^{-1})				
a	Cotton	9.77	23.79	58.93	26.70**
b	Tur	2.95	4.5	34.44	3.13**
c	Soybean	11.20	15.06	25.63	6.03**
d	Sorghum	1.08	1.41	23.40	0.61
e	Wheat	4.14	8.93	53.63	4.18**
f	Gram	5.12	10.02	48.90	4.88**
3.	Cropping intensity (%)	121.65	138.68	12.28	5.68**
4.	Employment				
a	Member (No.)	2.63	2.92	9.93	2.082*
b	Man days	205.16	255.08	19.57	9.58**
5.	Income (₹)	61357.66	124505.9	50.71	9.97**
6.	Overall impact	2806.85	5686.56	50.64	8.26**

**Significant at 0.01 level of probability; *Significant at 0.05 level of probability

Regarding the productivity of major crops studied, an average productivity of cotton crop was 9.77 to 23.79 q ha^{-1} due to the SWC treatments in the study area, 58.93% change in productivity was recorded. In tur crop, average productivity was changed from 2.95 to 4.5 q ha^{-1} (34.44% increase). Productivity of soybean was increased from 11.20 to 15.06 q ha^{-1}, the change was recorded up to 25.63%. An average productivity of sorghum before IWMP was 1.08 q ha^{-1} which was changed to 1.41 q ha^{-1}, it means 23.40% increase over a period of time. Productivity of wheat and gram also increased from 4.14 to 8.93 q ha^{-1} and 5.12 to 10.02 q ha^{-1}, their per cent change was 53.63 and 48.90%, respectively. Z value of the crops except sorghum indicates significant change over period of time at 0.01 level of probability.

An average cropping intensity before IWMP was 121.65%. Due to effects of SWC treatments, it increased to 138.68%. The change was recorded to 12.28% which was highly significant as indicated by Z value.

From the data presented in Table 4, it could be observed that an average employment before IWMP was 205.16 man days which increased to 255.08 man days, the change recorded was 19.57% which was found to be significant at 0.01 level of probability. Similarly, an average income of respondents before IWMP was ₹ 61,357, it was increased to ₹ 1,24,505 after IWMP. The change was up to 50.71%. The Z value calculated was highly significant over a period of IWMP.

The overall impact of IWMP in Wardha district was 50.64% on developmental parameters of farmers which was found highly significant.

Therefore, it is concluded that SWC activities of IWMP helped to recharge the ground water that could enhance the water availability through irrigation source. Increase in the irrigation resulted to increase in the production, productivity and cropping intensity of farmers. SWC and group activities were found effective in generation of employment which leads to increase in income of farmers significantly.

Correlates of Knowledge and Adoption

The correlation coefficient of knowledge with personal, socio-economic, situational, communicational and psychological characteristics of the respondents has been depicted in Table 5.

It is evident from the Table that amongst personal, situational, and psychological characteristics of respondents, age, extension contact and source of irrigation were positively and significantly correlated with knowledge of respondents at

0.05 level of probability. Whereas, land holding, farming experience, annual income and social participation were positively and significantly correlated with knowledge of respondents at 0.01 level of probability. Similarly, age and farming experience were significantly correlated with adoption, while land holding, annual income, social participation and sources of irrigation were found to be highly and significantly correlated with the adoption of soil and water conservation and income generating activities of IWMP.

It means that increase in the levels of those variables increase the knowledge and adoption of watershed activities. This implies that senior and experienced farmers could like to know the new ideas of SWC by exerting more to contact the extension personnel. That tends to adopt the SWC practices. It could recharge the ground water that might help to establish significant relationship between irrigation sources and knowledge and adoption of SWC practices.

It is of general opinion that education help in desirable thinking that favours in acquisition of knowledge by the farmers and its analysis on their own perspectives, decision may take to use that knowledge. But, the watershed practices are more technical and need technological skills that could restrict the farmers to take their insights and use it on their own. Hence, the education, innovativeness and risk orientation were found non-significant with knowledge and adoption of SWC practices.

The above results indicated that maximum characteristics of the respondents had influence on their knowledge and adoption about SWC activities by the farmers. These results obtained are in conformity with finding of Rathod (2003).

Table: 5
Correlation coefficient of independent variables with knowledge and adoption of soil and water conservation practices

S.No.	Independent variable	Knowledge (r)	Adoption (r)
1.	Age	0.267*	0.207*
2.	Education	0.043	0.097
3.	Land holding	0.732**	0.763**
4.	Farming experience	0.302**	0.220*
5.	Annual income	0.814**	0.820**
6.	Social participation	0.418**	0.328**
7.	Extension contact	0.212*	0.133
8.	Source of irrigation	0.249*	0.366**
9.	Innovativeness	0.111	0.106
10.	Risk orientation	0.055	0.092

**Significant at 0.01 level of probability; *Significant at 0.05 level of probability

Correlation Matrix

A perusal of Table 6 indicates that the variables *viz.* land holding, annual income, social participation, sources of irrigation, knowledge and adoption are the common variables that have high influence on production and productivity of crops. It means, these variables had significant relationship with production and productivity at 0.01 level of probability. Similarly, age and risk orientation are also significantly correlated with production and productivity but at 0.05 level of probability. Whereas, farming experience are also significant with production and productivity of crops, but at 0.05 and 0.01 level of probability, respectively.

As discussed in Table 6, it was already noted that most of the independent variables were having influence on intervening variables *i.e.* knowledge and adoption and it was apparently discussed. Now, it is understood that when knowledge and adoption of watershed activities increase, obviously the production and productivity of crops increase.

Therefore, in the present study increases in knowledge and adoption of SWC practices could recharge the ground water that subsequently increased the water availability through sources of irrigation. It then consequently helped to increase the production and productivity of crops as well as the allied enterprises adopted by the respondents in group activities. These findings corroborate with the findings of Rathod and Ingle (2003); Shivanappan (2005); Chauhan *et al.* (2009).

Regarding cropping intensity as dependent variable, annual income, sources of irrigation, knowledge and adoption had

Table: 6
Correlation coefficient of independent variables and intervening variables with developmental parameters

S.No.	Variables	Production	Productivity	Cropping intensity	Employment	Income
1	Age	0.216*	0.223*	0.139	0.258*	0.203*
2	Education	0.116	0.105	0.148	0.160	0.120
3	Land holding	0.823**	0.819**	0.224*	0.333**	0.932**
4	Farming experience	0.262*	0.271**	0.096	0.222*	0.232*
5	Annual income	0.877**	0.884**	0.353**	0.382**	1
6	Social participation	0.415**	0.412**	0.248*	0.227*	0.370**
7	Extension contact	0.167	0.173	0.044	0.0013	0.204*
8	Source of irrigation	0.411**	0.399**	0.444**	0.446**	0.325**
9	Innovativeness	0.280**	0.159	0.098	0.153	0.138
10	Risk orientation	0.222*	0.211*	0.174	0.213*	0.166
11	Knowledge	0.868**	0.878**	0.336**	0.358**	0.814**
12	Adoption	0.839**	0.849**	0.312**	0.367**	0.820**

**Significant at 0.01 level of probability; *Significant at 0.05 level of probability significant relationship at 0.01 level of probability, while land holding and social participation were correlated significantly at 0.05 level of probability. It clearly indicated that cropping intensity was increased with increase in the level of these variables.

Watershed treatments are land base, hence the land holding of an individual farmer play an important role in envisaging their participation. It is also a fact that watershed benefits go to the large land holders because, more the land create more scope of land treatment specially in dry land area, subsequently investment might be more also. The finding of Dolli (2006) indicated that increased land holding had enhanced the participation of farmers in the project activities. The active involvement and contribution of farmers in watershed project effectively increased the water for irrigation. Availability of irrigation water and group activities encouraged the farmers for double or triple cropping by taking *rabi* crops, vegetable crops and fodder crops resulted in increase in cropping intensity. The above findings are in consonance with the findings of Anonymus (2001); Mapari (2005); Rathod (2008).

The twin variables *viz.,* employment and income when studied their relationship with the independent and intervening variables it was found that most of the variables were having positive and significant relationship with employment and income except education and innovativeness were two common variables found non-significant. Age, farming experience, social participation and risk orientation were significantly correlated with employment at 0.05 level of probability, while land holding, annual income and source of irrigation had significant relationship with employment at 0.01 level of probability, intervening variables (knowledge and adoption) were also found highly correlated with employment. In case of income of farmers age, farming experience and extension contact were correlated significantly with income at 0.05 level of probability, while land holding, social participation, source of irrigation, knowledge and adoption had positive and significant relationship with income at 0.01 level of probability.

Age, land holding, farming experience, social participation, source of irrigation, knowledge and adoption were the common variables found significant influence on employment and income of the respondents. Plausibly, the senior farmers with farming experience could realize the need of watershed activities for sustainable agriculture. In the interest of making use of the opportunity for developing their land, the farmers have actively involved and contributed in the SWC activities and group activities. Different SHGs were formed under IWMP which provide employment to the farmers through employment generating activities like goat raring, poultry, dairy and group farming. At the same time, SWC activities could help to increase the cropping intensity due to soil moisture conservation, which provide additional on farm employment to the farmers and their family member also. Increase in employment means increase in income, which enables them to increase their socio-economic status. The above findings are on the same lines with the findings of Ahire (2000); Dolli (2006).

In all knowledge and adoption as intervening variables found significantly correlated with the change in production, productivity, cropping intensity, employment and income of the farmers in the study area.

4. CONCLUSIONS

Majority of respondents were found to have high knowledge level about soil and water conservation, but their adoption was at medium level because of more technical and expensive treatments that need to focus by extension agencies which can be easily understood by the farmers and also need to increase the coverage of subsidised soil and water conservation treatments. Knowledge and adoption were significantly correlated with yield parameters and income generating variables, hence the participation of farmers in watershed development programme is very important that responsible to explain variation in overall impact of watershed development programmes. The government or the non-government institutions engaged in watershed development project need to work hard to achieve active involvement of farmers in watershed development project.

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