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Post-adoption behaviour of farmers towards agronomic soil and water conservation technologies of watershed management in India

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ABSTRACT

ICAR-Indian Institute of Soil and Water Conservation (IISWC) and its Research Centres have developed many model watershed projects in India in the past and implemented many soil and water conservation (SWC) technologies for sustainable watershed management. Although many evaluation studies were conducted on these watershed projects in the past, assessment of the post-adoption status of different agronomic SWC technologies over a longer period has not been done yet. It was imperative to appraise the behaviour of the farmers with regard to the continuance and discontinuance of the technologies adopted, diffusion and infusion that took place and technological gaps that occurred in due course of time on post watershed programme. Therefore, it was realized that the post-adoption behaviour of beneficiary farmers should be studied in detail, who have adopted different agronomic SWC technologies during implementation of watershed projects. The research study was carried out during 2012-15 as core project at Vasad as lead Centre alongwith ICAR-IISWC headquarter Dehradun, and centres Agra, Bellary, Chandigarh, Datia, Kota and Ooty, with the specific objectives of the study to measure the extent of post-adoption behaviour (continue-adoption, discontinuance, technological gap, and diffusion) of farmers towards adopted agronomic SWC technologies of watershed management. In the present study various indices regarding continue adoption, discontinuance, technological gap and diffusion towards agronomic SWC technologies for watershed management were developed for measurement of post-adoption behaviour of farmers. It was revealed that about sixty percent (58.9%) of agronomic SWC technologies were continued adopted and about forty percent (41.1%) were discontinued by farmers. Out of the total continued adopted agronomic SWC technologies by farmers, little more than forty percent (43.7%) of technologies were continued adopted with technological gap. About one-third (32.2%) of agronomic SWC technologies were also diffused to other farmers' fields in nearby villages from the watersheds developed by the ICAR-IISWC and its centres.

1. INTRODUCTION

Post-adoption behaviour is a decision of farmer regarding whether to continue with an adopted technology with or without technological gap or discontinue for adoption of another better technology or his unwillingness to continue with adopted technology. When the farmers are satisfied with whatever new technology they have adopted, they are likely to hold on to it, but if they feel that it does not meet their needs they will discard it (Rogers, 1995). But, in the present times, there are so many other factors, apart from meeting of needs that push a farmer to discard a technology. Adoption of improved technologies will not improve food security and reduce poverty if barriers to their continued use are not overcome (Oladele, 2005). Van Tongeren (2003) investigated the discontinuance of farming innovations and found that the end of subsidies and educational programming explained the majority of discontinuance. It is believed that an effective way to increase productivity is broad-based adoption of new farming technologies (Minten and Barrett, 2008).

Discontinuance is a decision to reject an innovation after it has previously been adopted (Rogers, 2003), he also reported three types of technology discontinuance are: (1) replacement, (2) disenchantment and (3) forced discontinuance. Replacement discontinuance is a decision to reject an idea in order to adopt a better idea that supersedes it. Constant waves of innovations may occur in which each new idea replaces an existing practice that was an innovation in its day. For example, the adoption of tetracycline led to the discontinuance of two other antibiotic drugs (Coleman *et al.,* 1966). E-mail has replaced much postal mail. Disenchantment discontinuance is a decision to reject an idea as a result of dissatisfaction with its performance. Leuthold (1967) concluded from his study of a statewide sample of Wisconsin farmers that the rate of discontinuance was just as important as the rate of adoption in determining the level of adoption an innovation at any particular time. In any given year, there were about as many discontinuers of an innovation as there were first-time adopters. Third type of discontinuance is also reported as forced discontinuance, it happens when individuals are compelled to change, farmers are forced to discontinue the existing practices because of government policies. For example, chemicals like 2,4 Dichlorophenoxyacetic acid and Benzene hexachloride are banned for use in crop cultivation by governments in some countries due to their dangerous effect on human health and environment. Inability discontinuance could also be the fourth type of technology discontinuance. Sometimes farmers discontinued an adopted technology because of his inability to maintain due to high cost or complexity of technology. For example, a poor farmer can't maintain bunding technology properly on his sloppy land and a breached concrete check dam can't be repaired by poor farmers.

The continued use of SWC technologies seemed mainly determined by the actual profitability and, related to that, the labour requirements for recurrent maintenance and use. Moreover, in villages with better future prospects (where SWC was promoted within an integrated development strategy) farmers also performed better maintenance of their measures and replication rates were higher (De Graaff *et al.,* 2008). If many farmers in a specific project area or village adopt a certain measure, farmers in neighbouring villages may also adopt the measures without project assistance (spontaneous diffusion), as was experienced in Mali (Bodnar *et al.,* 2006).

ICAR-IISWC and its centres has developed many watershed projects in India in the past and implemented many agronomic SWC technologies for watershed management. Continued adoption or discontinuance of agronomic SWC technologies *viz.,* inter-cropping, cover cropping, contour farming, mix cropping, mulching etc. depends on availability of resources with adopter farmers and also suitability to their field conditions. Therefore, it was realized that the post-adoption behaviour of beneficiary farmers who have adopted different agronomic SWC technologies for watershed management should be studied in detail regarding their present status of continue-adoption, discontinuance, technological gap and diffusion also, as this is a pioneering institute involved in this kind of conservation oriented watershed projects for the last six decades. Keeping these points in mind this research study was framed with the main objective to measure the extent of post-adoption behaviour (*i.e.,* continue-adoption, discontinuance, technological gap, and diffusion) of farmers regarding adopted agronomic SWC technologies of watershed management.

2. MATERIAL AND METHODS

Study Area

The research study was carried out during 2012 to 2015 in eight states of India as core project at ICAR-IISWC, Research Centre, Vasad, (Gujarat) as lead Centre alongwith ICAR-IISWC headquarter Dehradun, Uttrakhand state, and its centres *viz.,* Agra (Uttar Pradesh), Bellary (Karnataka), Chandigarh (Haryana), Datia (Madhya Pradesh), Kota (Rajasthan), and Ooty (Tamil Nadu). The already developed watersheds by ICAR-IISWC and its centres in the past minimum three years old were selected for the study and 4 or 5 watersheds were selected at each centre. Thus, in total 38 watersheds were selected from eight research centres of ICAR-IISWC in the country (Table 1).

Selection of Respondents

The beneficiary farmers of selected watersheds who have adopted agronomic SWC technologies were selected as respondents in the study. At least 50 respondents were selected from each watershed comprising from all the existing categories of farmers in the watershed. A list of agronomic SWC technologies, which were implemented during each watershed development programme, was prepared. Agronomic SWC technology-wise inventory of respondent farmers, who have adopted the technologies, was prepared with the help of detail project report (DPR) or by organizing meetings with farmers. In the inventory listed out the names of farmers along with size of land holding, who have adopted a particular technology in the watershed and likewise to prepared lists or inventories of farmers for all technologies adopted by them during watershed development programme. Stratified proportionate random sampling plan was adopted to select respondents from different inventories or lists of farmers. At least 50 respondents were selected from each watershed comprising from all the existing categories of farmers in the watershed. Thus, a total of 1902 respondent farmers were selected in the study (Table 1). A detail structural interview schedule was

Table: 1
Centre-wise selected watersheds and number of respondents

Name of centre	Name of selected watersheds with the number of respondents in brackets	Total respondents
Vasad	Navamota (50), Rebari (50), Sarnal (50), Antisar (50), Vejalpur-Rampura (50)	250
Agra	Etmatpur (50), Boman (50), Raghupur (50), Jalalpur (50)	200
Bellary	Joladarasi (50), Chinnatekur (50), PC Pyapli (54), Mallapuram (54), Chilakanahatti (58)	266
Chandigarh	Aganpur-Bhagwasi (50), Mandhala (49), Johranpur (26), Sabeelpur (50), Kajiana (50)	225
Datia	Bajni (50), Jigna (50), Kalipahari (50), Agora (50), Durgapur (50)	250
IISWC, Dehradun	Fakot (50), Raipur (50), Sabhawala (51), Langha (60)	211
Kota	Chhajawa (50), Badakhera (50), Haripura (50), Hanotiya (50), Semli Gokul (50)	250
Ooty	Salaiyur (50), Chikkahalli (50), Eramanaikkanpatti (50), Putthuvampalli (50), Thulukkamuthur (50)	250

developed by the investigators and data regarding personal, psychological, and post-adoption behaviour variables were recorded on developed structured schedule by interviewing the respondents personally.

Measurement of Post-Adoption Behavior of Farmers

To measure the extent of post-adoption behaviour variables *viz.,* continue adoption, discontinuance, technological gap and diffusion, a detail methodology was developed such as data collection schedules, scoring procedure and data analysis with the following developed indices by the first author:

(i) Technologies continue adoption index (TCAI): Number of agronomic SWC technologies continued adopted by farmers out of total initially adopted technologies in a watershed area and it could be worked out as given below:

$$TCAI = \frac{\text{Number of agronomic SWC technologies continued adopted by a farmer}}{\text{Number of agronomic SWC technologies initially adopted by a farmer}} \times 100 \quad ...(1)$$

Overall technologies continue adoption index (OTCAI): It could be worked for agronomic SWC technologies continued adopted on large area or region basis for all watersheds as given below:

$$OTCAI = \frac{\sum_{i=1}^{N} TCAI_i}{N} \quad ...(2)$$

Where, $\sum_{i=1}^{N} TCAI_i$ = Sum total of technologies continue adoption indices of i^{th} farmers; N = Total number of farmers.

(ii) Discontinuance of technology index (DTI): Number of agronomic SWC technologies discontinued a farmer out of total initially adopted technologies in a watershed area and it can be worked out as given below:

$$DTI = \frac{\text{Number of agronomic SWC technologies discontinued by a farmer}}{\text{Number of agronomic SWC technologies initially adopted by a farmer}} \times 100 \quad ...(3)$$

Overall discontinuance of technology index (ODTI):

$$ODTI = \frac{\sum_{i=1}^{N} DTI_i}{N} \quad ...(4)$$

Where, $\sum_{i=1}^{N} DTI_i$ = Sum total of discontinuance of technology indices of i^{th} farmers; N = Total number of farmers.

(iii) Technological gap index (TGI):

$$TGI = \frac{\sum_{i=1}^{N} \left[\frac{R-A}{R}\right]}{N} X\,100 \quad ...(5)$$

Where, R = Maximum possible score on complete adoption of a technology as per the design suitable in the watershed (*i.e.*10); A = Score obtained by a beneficiary farmers on his incomplete adoption of a technology; N = Total number of technologies adopted.

Overall technological gap index (OTGI):

$$OTGI = \frac{\sum_{i=1}^{K} TGI_i}{K} \quad ...(6)$$

Where, $\sum_{i=1}^{K} TGI_i$ = Sum total of technological gap indices of k^{th} farmers; K = Total number of farmers.

(iv) Technology diffusion index (TDI):

$$TDI = \frac{\text{Number of agronomic SWC technologies diffused by a farmer}}{\text{Number of agronomic SWC technologies initially adopted by a farmer}} \times 100 \quad ...(7)$$

Overall technology diffusion index (OTDI):

$$OTDI = \frac{\sum_{i=1}^{N} TDI_i}{N} \quad ...(8)$$

Where, $\sum_{i=1}^{N} TDI_i$ = Sum total of technology diffusion indices of i^{th} farmers; N = Total number of farmers.

3. RESULTS AND DISCUSSION

Continue Adoption of Agronomic SWC Technologies by Farmers

Table 2 reveals about the continue adoption of agronomic SWC technologies in various watersheds developed by ICAR-IISWC and its centres in the country. Pooled data revealed that maximum 44.8% farmers were continued adopted contour farming technology in their fields, whereas the contour farming technology was initially adopted by 53.6% farmers during development of various watersheds implemented by ICAR-IISWC and its centres in the country. Cover cropping technology was continued adopted by 37.3% farmers, whereas 45% farmers adopted it initially during development of various watershed programmes**.** Mix cropping technology was still continued adopted by 35% farmers but during implementation of watershed programmes the mix cropping was adopted by 36% farmers in their fields. Inter-cropping technology was continued adopted by 29.3% farmers but initially it was adopted by 49.0% farmers during watershed development programmes. Green manuring technology was continued adopted by 11.5% farmers whereas, 35.9% farmers adopted it initially during watershed development programmes. Mulching technology was continued adopted by 5.6% farmers but 13.1% farmers adopted it initially during watershed programmes implemented by ICAR-IISWC and its centres in the country.

Discontinuance of Agronomic SWC Technologies by Farmers

The data in Table 3 reveal about the discontinuance of agronomic SWC technologies in various watersheds developed by ICAR-IISWC and its centres in the country. The pooled data show that maximum about one-fourth (24.7%) of farmers were discontinued the green manuring technology from their fields whereas, the green manuring technology was initially adopted by 35.9% of farmers during implementation of watershed programmes. Inter-cropping technology was discontinued by 20.9% of farmers, whereas 45.3% farmers adopted it initially during development of various watershed programmes by ICAR-IISWC and its centres in the country**.** Cover cropping technology was discontinued by 9.1% of farmers but during implementation of watershed programmes the cover cropping was adopted by 34% of farmers initially in their fields. Contour farming technology was discontinued by only 6.8% of farmers but initially it was adopted by 36.7% of farmers during watershed development programmes. Mulching technology was discontinued by 6.2% of farmers, whereas only 10.3% farmers initially adopted it during their watershed development programmes. Mix cropping technology was discontinued by 1% farmers, whereas 36% farmers initially adopted it during watershed programmes implemented by Vasad centre of ICAR-IISWC.

Table: 2
Continue adoption of agronomic SWC technologies by farmers in different watershed programmes implemented by IISWC and its research centres in India

Name of technologies continue adopted in watersheds	Number of watershed farmers at different research centres of IISWC							Pool
	Vasad *Navamota, Rebari, Sarnal, Antisar & Vejalpur (N=250) %*	Chandigarh *Aganpur, Bhagwasi, Mandhala, Johranpur, Sabeelpur & Kajiyana (N=225) %*	Bellary *Joladarasi, Chinnatekur, PC Pyapli, Mallapuram & Chilakanahatti (N=266)%*	Kota *Chhajawa, Badakheda, Haripura, Hanotiya & Semli Gokul (N=250) %*	Agra *Etmatpur, Boman, Raghupur, Jalalpur (N=200) %*	Ooty *Salaiyur, Chikkahali Ermanaikkanpatti, Putthuvampalli & Thulukkamuthur (N=250) %*	Datia *Bajni, Jigna, Kalipahari, Agora & Durgapur (N=250) %*	
Inter cropping	30 (33)	39.68 (48.4)	39.97 (55.3)	-	1 (62)	-	36 (46.4)	29.3 (49.0)
Cover cropping	28.6 (32)	-	-	-	-	-	46 (58)	37.3 (45)
Mix cropping	35 (36)	-	-	-	-	-	-	35 (36)
Contour farming	43.3 (46)	-	-	-	-	-	46.4 (61.2)	44.8 (53.6)
Green manuring	-	-	-	4 (13)	9 (65.5)	-	21.6 (29.2)	11.5 (35.9)
Mulching	-	-	-	-	2 (17)	2 (4)	12.8 (18.4)	5.6 (13.1)

Note: Figures presented in parentheses are also percentage of farmers adopted the technologies initially at the time of implementation of watershed programme.

Table: 3
Discontinuance of agronomic SWC technologies by farmers in different watershed programmes implemented by IISWC and its research centres in India

Name of technologies continue adopted in watersheds	Number of watershed farmers at different research centres of IISWC							Pool
	Vasad *Navamota, Rebari, Sarnal, Antisar & Vejalpur (N=250) %*	Chandigarh *Aganpur, Bhagwasi, Mandhala, Johranpur, Sabeelpur & Kajiyana (N=225) %*	Bellary *Joladarasi, Chinnatekur, PC Pyapli, Mallapuram & Chilakanahatti (N=266)%*	Kota *Chhajawa, Badakheda, Haripura, Hanotiya & Semli Gokul (N=250) %*	Agra *Etmatpur, Boman, Raghupur, Jalalpur (N=200) %*	Ooty *Salaiyur, Chikkahali Ermanaikkanpatti, Putthuvampalli & Thulukkamuthur (N=250) %*	Datia *Bajni, Jigna, Kalipahari, Agora & Durgapur (N=250) %*	
Inter cropping	3 (33)	8.7 (48.4)	15.4 (55.3)	27 (27)	61 (62)	-	10.4 (46.4)	20.9 (45.3)
Cover cropping	3.3 (32)	-	-	-	-	-	12 (58)	9.1 (34)
Mix cropping	1 (36)	-	-	-	-	-	-	1 (36)
Contour farming	2.6 (46)	-	-	3 (3)	-	-	14.8 (61.2)	6.8 (36.7)
Green manuring	-	-	-	9 (13)	57.5 (65.5)	-	7.6 (29.2)	24.7 (35.9)
Mulching	-	-	-	2 (2)	15 (17)	2 (4)	6 (18.4)	6.2 (10.3)

Note: Figures presented in parentheses are also percentage of farmers adopted the technologies initially at the time of implementation of watershed programme.

Bagdi, *et al*. (2018) also reported that the financial provisions should be made in planning for repair and maintenance of SWC technologies after completion of watershed projects. Farm equipments should be provided to poor farmers from watershed development projects so that the SWC structures could be repaired and maintained by farmers in case of non-availability of labours for long-term sustainable benefits to farmers from SWC technologies.

Extent of Technological Gap in Agronomic SWC Technologies by Farmers

Table 4 presents values about the agronomic SWC practices continued adopted with technological gap in various watersheds developed by ICAR-IISWC and its centres in the country. It was found out that maximum 32.6% of farmers were adopted contour farming technology with technological gap, whereas the contour farming technology was continued adopted by 44.8% of farmers for watershed management. Cover cropping technology was adopted with technological gap by 30.1% of farmers, whereas 37.3% farmers continued adopted it for various watershed programmes implemented by Vasad centre of ICAR-IISWC**.** Mix cropping technology was adopted with technological gap by 25% of farmers, whereas 35% farmers were continued adopted the mix cropping technology for management of watersheds implemented by ICAR-IISWC and its centres in the country. Green manuring technology was adopted with technological gap by 18% of farmers but it was continued adopted by 21.6% farmers for watershed management. Inter cropping technology was adopted with technological gap by 17.3% of farmers, whereas 36.4% farmers continued adopted it in their watersheds. Mulching technology was adopted with technological gap by 12% of farmers but 12.8% farmers continued adopted it for watershed management.

Extent of Diffusion of Agronomic SWC Technologies from Farmers' Fields

The pooled values in Table 5 reveal that maximum 23.4% of farmers were diffused contour farming technology from their fields to fields of other farmers', whereas 53.6% farmers initially adopted the contour farming practice in their fields during watersheds development programmes implemented by centres of ICAR-IISWC in the country. Mix cropping technology was diffused from the fields of 22% farmers to other farmers' fields, whereas 36% farmers initially adopted it in their fields in the watersheds developed by Vasad centre of ICAR-IISWC. Green manuring technology was diffused from fields of 19.1% farmers, whereas 35.9% farmers were initially adopted in their fields. Cover cropping technology was diffused from the fields of 18.2% farmers to the fields of other farmers within watershed or nearby villages but the cover cropping technology was initially adopted by 45% farmers during watershed development programmes implemented by two

Table: 4
Technological gap in agronomic SWC technologies by farmers in different watershed programmes implemented by IISWC and its research centres in India

Name of technologies continue adopted in watersheds	Number of watershed farmers at different research centres of IISWC				Pool
	Vasad *Navamota, Rebari, Sarnal, Antisar & Vejalpur (N=250) %*	Chandigarh *Aganpur, Bhagwasi, Mandhala, Johranpur, Sabeelpur & Kajiyana (N=225) %*	Bellary *Joladarasi, Chinnatekur, PC Pyapli, Mallapuram & Chilakanahatti (N=266)%*	Datia *Bajni, Jigna, Kalipahari, Agora & Durgapur (N=250) %*	
Inter cropping	19 (30)	11.9 (39.6)	16.4 (39.9)	22 (36)	17.3 (36.4)
Cover cropping	22.6 (28.6)	-	-	37.6 (46)	30.13 (37.3)
Mix cropping	25 (35)	-	-	-	25 (35)
Contour farming	34 (43.3)	-	-	31.2 (46.4)	32.6 (44.8)
Green manuring	-	-	-	18 (21.6)	18 (21.6)
Mulching	-	-	-	12 (12.8)	12 (12.8)

Note: Figures presented in parentheses are also percentage of farmers adopted the technologies initially at the time of implementation of watershed programme.

Table: 5
Diffusion of agronomic SWC technologies from farmers' fields of different watershed programmes implemented by IISWC and its research centres in India

Name of technologies continue adopted in watersheds	Number of watershed farmers at different research centres of IISWC					Pool
	Vasad *Navamota, Rebari, Sarnal, Antisar & Vejalpur (N=250) %*	Bellary *Joladarasi, Chinnatekur, PC Pyapli, Mallapuram & Chilakanahatti (N=266)%*	Kota *Chhajawa, Badakheda, Haripura, Hanotiya & Semli Gokul (N=250) %*	Agra *Etmatpur, Boman, Raghupur, Jalalpur (N=200) %*	Datia *Bajni, Jigna, Kalipahari, Agora & Durgapur (N=250) %*	
Inter cropping	13(33)	8.6(55.3)	-	10 (62)	17.2 (46.4)	12.2 (49.2)
Cover cropping	10 (32)	-	-	-	26.4 (58)	18.2 (45.0)
Mix cropping	22 (36)	-	-	-	-	22 (36)
Contour farming	24 (46)	-	-	-	22.8 (61.2)	23.4 (53.6)
Green manuring	-	-	2 (13)	44 (65.5)	11.2 (29.2)	19.1 (35.9)
Mulching	-	-	-	-	9.6 (18.4)	9.6 (18.4)

Note: Figures presented in parentheses are also percentage of farmers adopted the technologies initially at the time of implementation of watershed programme.

centres of ICAR-IISWC. Inter cropping technology was diffused from the fields of 12.2% farmers, whereas 49.2% farmers were adopted it during watershed programmes implemented by ICAR-IISWC and its centres in the county. Mulching technology was also diffused from fields of 9.6% farmers to other farmers' fields, but it was initially adopted by 18.4% farmers in the watersheds developed by Datia centre of ICAR-IISWC.

Extent of Post-Adoption Behaviour of Farmers Towards Agronomic SWC Technologies

The data in Table 6 represent the extent of post-adoption behaviour of farmers towards different agronomic SWC technologies implemented during various watershed development programmes implemented by the ICAR-IISWC and its research centres in India. It was revealed that the pooled TCAI value shows that overall 58.9% of agronomic SWC technologies were continued adopted by farmers in the watersheds developed by ICAR-IISWC and its centres in the country for the cause of natural resources conservation. Accordingly, overall pooled DTI value shows that 41.1% of agronomic SWC technologies were discontinued by farmers from their fields in the watersheds developed by ICAR-IISWC and its centres in the country.

The overall pooled TGI data revealed similarly that 43.7% of agronomic SWC technologies were continued adopted with technological gap by farmers in their fields in the watersheds developed by ICAR-IISWC and its centres in the country. Diffusion of agronomic SWC technologies were also studied by technology diffusion index (TDI) and it was found out that 32.2% of agronomic SWC technologies were diffused to other farmers' fields in nearby areas or villages from the fields of farmers who were continued adopted these technologies during the watershed development programmes implemented by ICAR-IISWC and its

Table: 6
Extent of post-adoption behaviour of farmers towards agronomic SWC technologies in watersheds developed by different research centres of IISWC in the country

Name of technologies continue adopted in watersheds	Number of watershed farmers at different research centres of IISWC							Pool
	Vasad *Navamota, Rebari, Sarnal, Antisar & Vejalpur (N=250) %*	Chandigarh *Aganpur, Bhagwasi, Mandhala, Johranpur, Sabeelpur & Kajiyana (N=225) %*	Bellary *Joladarasi, Chinnatekur, PC Pyapli, Mallapuram & Chilakanahatti (N=266)%*	Kota *Chhajawa, Badakheda, Haripura, Hanotiya & Semli Gokul (N=250) %*	Agra *Etmatpur, Boman, Raghupur, Jalalpur (N=200) % (N=250) %*	Ooty *Salaiyur, Chikkahali Ermanaikkanpatti, Putthuvampalli & Thulukkamuthur*	Datia *Bajni, Jigna, Kalipahari, Agora & Durgapur (N=250) %*	
TCAI	93.2	81.9	72.2	30.7	8.3	50.0	76.3	58.9
DTI	6.8	18.0	27.8	69.3	92.3	50.0	23.8	41.1
TGI	73.4	29.9	41.1	-	-	-	74.2	43.7
TDI	46.9	-	15.6	15.3	42.3	-	40.9	32.2

centres in the country for sustainable agricultural production along with natural resources conservation.

Similar findings were also reported by Bagdi (2019) that more than three fourth of SWC technologies were continued adopted for natural resources conservation and one-fifth of technologies were discontinued due to their non-suitability or inability of farmers to continue the technologies. Out of the total continued adopted technologies, about one-third of technologies were adopted with technological gap.

4. CONCLUSIONS

It could be concluded from the study that in the government sponsored watershed development programmes, about 59% of agronomic SWC technologies were continued adopted for natural resources conservation and over 41% of them were also discontinued due to their non-suitability or inability of farmers to continue the technologies. Woldeamlak Bewket (1998) also reported that the major factors that were discouraging the farmers from adopting the introduced SWC technologies on their farms were found to be labour shortage, land tenure insecurity and problem of fitness of the technologies to the farmers' requirements and to the farming system circumstances. Out of the total continued adopted technologies, about 44% of agronomic technologies were also adopted with technological gap. It could be inferred from the findings that the provisions of finance or farm equipments on custom hiring basis should be provided to poor farmers on completion of watershed project from watershed project fund itself so that the agronomic SWC practices could be maintained by farmers in case of non availability of money or labours for long-term sustainable benefits to farmers. About one-third (32.2%) of agronomic SWC technologies were also diffused to other farmers' fields in nearby areas or villages from the fields of farmers who were continued adopted these agronomic SWC technologies during the watershed development programmes implemented by ICAR-IISWC and its centres in the country for the cause of sustainable agricultural production along with conservation of natural resources like soil and water.

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