Impact of Watershed Development Programmes on Adoption of Crop Production Technologies

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Introduction

Watershed Development Programme has been carried out on large scale in India, with an annual allocation of funds to the tune of about Rs.1000 crores, with an objective of developing and stabilizing natural resources in addition to improving productivity of crops, employment opportunities to rural people, income generation and standard of living of rural people in arid / semi-arid regions in India. During the past three decades, many crop production technologies were evolved and spread to farmers' fields. Since 1983-84, technologies of dryland crops were also transferred to farmers' fields effectively on watershed basis, as technological options and choices available to dryland farmers are many and varied and it may be a problem for farmers to choose a package of technologies suitable to their fields.

Though it is difficult to enlist any single component of technology that would bring out rapid and dramatic transformation, yet it is possible, by adoption of a series of improved components of technologies, to minimize instability in yield which is a common characteristic of dryland farming. The improved production technologies in dryland consist of high monetary inputs (fertilizer, plant protection chemicals etc.), low monetary (seed, weeding etc.) and non-monetary (timeliness and precision) inputs. Thus a dryland farmer is in a better position to choose varieties, crops, crop mix and agronomic practices to suit the local environmental conditions. Recommendations on soil and water conservation, alternate land use systems, soil and crop management are also available to farmers to make efficient use of resources and environment. The dryland technologies in relation to crop production at Research Stations are to be transferred to farmers' fields through effective extension agencies. Farmers' management adequacy and resource facilities that farmer could draw upon ultimately decide the success or failure of a viable improved crop production technology which is determined by a

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number of socio-economic parameters and constraints. An attempt has been made in this study to know the levels of adoption of dryland technology in different parts of India and reasons for non-adoption.

Materials and Methods

The four components of improved crop technology viz. improved seed, application of fertilizers, plant protection chemicals and weeding were considered for this study in different Watershed Development Programme areas vis-à-vis non-watershed areas (adjacent to watershed area) under different agro-eco system regions. The data were collected from 50 farmers in watershed villages and 50 farmers in non-watershed villages during 2001-2002. Detailed information was collected and data analysed using tabular analysis method. The study focuses on adoption levels of four components of dryland crop technologies covering 3700 farmers from 37 locations representing different agro-eco regions and covers an area of about 7250 hectares.

Results and Discussion

Thirty seven locations from where the farmers were covered were fairly well served by Extension Agencies in watershed villages but in non-watershed villages, farmers learnt from watershed farmers / Agricultural Officers / magazines / seed and pesticide companies etc. Thus the farmers in watershed villages are exposed to crop production technologies in addition to soil and water conservation technologies whereas farmers in non-watershed villages were not exposed directly but they observed farmers practicing in watershed villages in addition to learning from Agricultural Officers, magazines, and advertisements etc., which have an indirect influence on the farmer in non-watershed villages. Though there were a number of crops at each location and crops also varied based on soil type, environment, topography of soil, rainfall and its distribution etc. from location to location, the average adoption of technologies by farmers at each location has been summarized in this paper to have an overall view of adoption of improved dryland technologies in different parts of the dryland tracts in the country. Though the data pertains to agriculture year 2000-2001 in watershed and non-watershed villages, data were also collected after withdrawal of the watershed programme. The watershed programme was carried out for 5 years and then withdrawn. The stage of watershed programme withdrawal may be any time during 1990 to 2000 at the locations. Thus there was a scope to learn from watershed area farmers by non-watershed village farmers.

Adoption of Improved Dryland Technologies

The adoption levels of improved seed, fertilizer, plant protection resources and improved weeding are presented in Table 1.

It is clear from results in the Table-1 that the adoption of technologies by farmers varied from location to location and even among the farmers within the location. Moreover it is clear that more farmers adopted technologies in watershed area compared to non-watershed villages due to exposure to technologies and confidence developed by farmers in the watershed area.

Adoption of Improved Seed

The adoption of improved / hybrid seed was more among watershed area farmers compared to non-watershed area farmers. However, adoption of technologies by farmers varied widely over locations in the country. The percentage of farmers who adopted improved seed varied from 6% at Ramanthapuram (Tamil Nadu) to 92% at Solapur in watershed villages as against 2% at Ramanthapuram (Tamil Nadu) to 86% at Indore in non-watershed villages. The adoption rate of improved seed was more in commercial crops followed by coarse grains at all locations in watershed and non-watershed villages. The availability of adoption of improved seed is very high over locations.

Table 1: Percentage of farmers who adopted under different crop production technologies under two situations at different locations in India

NWDPRA Watersheds

S. No.	State	Watershed location	Watershed development programme villages				Non-watershed villages			
			Seed	Fertilizer	Plant protection	Weeding	Seed	Fertilizer	Plant protection	Weeding
1	Andhra Pradesh	Chittoor	12	48	6	98	8	42	4	86
2	Assam	Jorhat	42	68	18	88	36	52	12	66
3	Bihar	Ranchi	16	82	22	72	10	75	16	70
4	Chattisgarh	Raipur	45	90	42	80	40	86	30	76
5	Gujarat	Banaskantha	68	86	36	96	50	82	24	88
6	Karnataka	Chitradurga	20	60	16	100	12	38	8	92
7	Madya Pradesh	Indore	90	92	70	80	86	90	64	76
8	Maharashtra	Solapur	92	84	52	92	82	76	38	82
9	Orissa	Pulbhani	18	36	4	66	8	30	4	60
10	Punjab	Relmajra	76	92	36	98	74	90	30	96
11	Tamil Nadu	Madurai	50	56	24	82	30	40	20	70
12	Uttar Pradesh	Agra	28	78	68	96	26	76	66	94
13	Uttar Pradesh	Mirzapur	18	42	18	78	14	36	10	74

MRD Watersheds

S. No.	State	Watershed location	Watershed development programme villages				Non-watershed villages			
			Seed	Fertilizer	Plant protection	Weeding	Seed	Fertilizer	Plant protection	Weeding
15	Karnataka	Gollahally	36	78	48	98	30	72	40	92
16	Maharashtra	Kolhapur	26	68	26	76	20	62	16	72
17	Orissa	Koraput	20	58	22	78	18	56	18	70
18	Punjab	Hoshiarpur	40	86	76	92	36	82	70	88
19	Rajasthan	Bhilwara	28	66	18	82	22	62	8	80
20	Tamil Nadu	Coimbatore	22	62	12	76	16	54	6	74

ICAR Watersheds

21	Haryana	Bhiwani	30	86	22	88	22	78	16	82
22	Karnataka	Bellary	16	70	16	86	8	62	6	80
23	Karnataka	Bijapur	18	66	12	82	10	60	4	78
24	Karnataka	Kolar	10	52	10	88	8	48	8	82
25	Maharashtra	A'nagar	38	72	22	94	26	60	10	80
26	Rajasthan	Kota	26	68	12	86	18	52	8	82
27	Uttar Pradesh	Jhansi	32	76	28	88	20	60	18	84

International Agency supported Watersheds

28	Haryana	Adilabad	24	66	18	92	12	52	8	82
29	Karnataka	Maheswaram	28	70	22	86	26	66	18	84
30	Karnataka	Junagadh	60	72	60	98	48	72	28	88
31	Karnataka	Tiptur	32	68	18	88	16	54	10	80
32	Tamil Nadu	Ramanatha puram	6	38	4	60	2	26	0	52

NGO Watersheds

33	Andhra Pradesh	Anantapur	28	72	32	94	18	60	18	84
34	Mahara shtra	Ralegon Siddhi	60	88	60	100	40	62	20	82
35	Tamil Nadu	Dharma puri	12	38	8	86	10	30	8	84
36	Uttar Pradesh	Faizabad	16	82	38	88	12	78	18	82
37	West Bengal	Purulia	18	52	16	78	14	38	6	66

The variation in using latest seed / variety over locations is due to availability of different seed varieties with marginal advantage of latest seed. However, hybrid seeds were reported to be costlier and could not sustain under unfavorable (low / high erratic rainfall situations etc.) conditions. Improved seed was reported to be requiring fertilizer plant protection chemicals, improved agronomic practices, whereas local seeds could be produced by farmers in their fields serving and providing yields under adverse situations unlike hybrid seeds. Rabi sorghum (M-35-1) has been in the field for the past 50 years as no other variety replaced as yield advantage variation received fast adoption. Thus the variability was seen based on socio-economic factors and agro-climatic conditions. The adoption rate was slightly low in non-watershed areas.

Adoption of Fertilizers

Among the four components of technology, fertilizer is the costliest. Therefore a majority of farmers did not apply recommended doses for crops. The application of fertilizers by farmers varied between 10% to 60% in case of grain / pulse crops and 20-75% of the recommended doses in case of oilseed crops / commercial crops. In case of cotton in Vertisols and soybean in Indore area, very few farmers apply more than recommended doses. Nevertheless, a majority apply fertilizers to all crops but the quantity varied based on economic conditions of farmers and expected income of crops. Even farmers, by and large, applied more quantity of fertilizers to the latest varieties. The application of fertilizer over locations was found to be more due to non-availability of Farm Yard Manure, which was utilized for irrigated crops which receives not only FYM but also higher fertilizer doses due to assured yields / income. Thus the Indian farmer is clever enough to use his resources more effectively for maximizing his income. The adoption of fertilizers in a number of farms and the quantity is low in non-watershed area.

Plant Protection Chemicals

The use of plant protection chemicals for dryland crops was reported to be low. However, commercial crops receive more attention. Pigeonpea, chickpea, castor etc. are sprayed with plant protection chemicals. Even dryland cotton receives more attention in this regard and the cost of plant protection is reported to be higher in case of cotton. Seed treatment is also becoming a common practice at all locations in most of the crops. Thus all hybrids are taken care of by plant protection chemicals in all crops over all locations. Thus even dryland crops have been receiving attention by way of use of plant protection chemicals. However, it is low in non-watershed villages.

Improved Weeding

Family labour could be used for weeding. Even marginal and small farmers practice exchange of labour at all locations. Thus it is considered as a low monetary input. The adoption levels were by and large higher except in crops grown under broad casting. All line saving crops are given more importance in improved weeding.

However, farmers in non-watershed area also practice improved weeding practice to a large extent. However adoption was marginally low in non-watershed area compared to watershed area farmers

Extent of Area under Adoption of Improved Technologies

The percentage of area adopted under the four crop production technologies is presented in Table 2.

Table 2: Percentage of area adopted under different crop production technologies at different locations in India

NWDPRA Watersheds

S. No.	State	Watershed location	Watershed development programme villages				Non-watershed villages			
			Seed	Fertilizer	Plant protection	Weeding	Seed	Fertilizer	Plant protection	Weeding
1	Andhra Pradesh	Chittoor	8	40	3	90	6	30	4	82
2	Assam	Jorhat	38	58	8	82	30	50	10	60
3	Bihar	Ranchi	6	68	10	70	4	62	12	65
4	Chattisgarh	Raipur	30	72	18	80	26	58	22	72
5	Gujarat	Banaskantha	52	66	18	82	32	48	18	82
6	Karnataka	Chitradurga	12	56	12	96	8	44	6	85
7	Madya Pradesh	Indore	70	82	45	70	68	72	50	70
8	Maharashtra	Solapur	72	78	35	76	70	72	32	74
9	Orissa	Pulbhani	10	30	2	50	6	18	2	60
10	Punjab	Relmajra	58	68	28	72	62	54	18	90
11	Tamil Nadu	Madurai	42	48	16	70	22	36	20	64
12	Uttar Pradesh	Agra	20	60	46	76	18	48	46	88
13	Uttar Pradesh	Mirzapur	16	30	10	72	10	22	6	68

MRD Watersheds

S. No.	State	Watershed location	Watershed development programme villages				Non-watershed villages			
			Seed	Fertilizer	Plant protection	Weeding	Seed	Fertilizer	Plant protection	Weeding
15	Karnataka	Gollahally	18	60	36	88	22	52	30	88
16	Maharashtra	Kolhapur	22	58	20	72	18	50	8	66
17	Orissa	Koraput	18	52	20	72	16	40	15	64
18	Punjab	Hoshiarpur	32	72	52	78	30	38	45	82
19	Rajasthan	Bhilwara	25	50	12	68	18	48	7	76
20	Tamil Nadu	Coimbatore	16	52	6	66	14	38	5	70

ICAR Watersheds

21	Haryana	Bhiwani	25	60	15	88	16	60	15	78
22	Karnataka	Bellary	10	62	12	80	6	52	5	69
23	Karnataka	Bijapur	12	58	8	80	7	52	4	71
24	Karnataka	Kolar	8	49	6	82	6	43	6	80
25	Maharashtra	A'nagar	33	68	12	88	20	45	8	78
26	Rajasthan	Kota	25	60	9	85	14	44	5	76
27	Uttar Pradesh	Jhansi	26	69	22	86	15	56	12	75

International Agency supported Watersheds

28	Haryana	Adilabad	22	60	16	87	9	49	6	75
29	Karnataka	Maheswaram	23	62	17	82	20	52	12	78
30	Karnataka	Junagadh	52	72	48	95	41	66	18	76
31	Karnataka	Tiptur	28	62	16	82	15	50	10	78
32	Tamil Nadu	Ramanatha puram	4	33	3	48	2	21	0	50

NGO Watersheds

33	Andhra Pradesh	Anantapur	23	70	22	91	13	38	13	81
34	Maharashtra	Ralegon Siddhi	50	68	56	100	30	45	17	75
35	Tamil Nadu	Dharma puri	8	30	6	81	8	28	7	75
36	Uttar Pradesh	Faizabad	8	60	32	85	9	70	12	80
37	West Bengal	Purulia	10	38	12	75	10	35	5	63

It is clear from the results of Table 2 that the percentage of area covered under different components of technology is quite close to the percentage of farmers adopting the technology. Therefore the extent of area under adoption of technology varied from location to location and also under two different situations (watershed and non-watershed). The trend as in case of percentage of farmers who adopted emerged in case of extent of area under adoption of improved technology also. The trend was also more or less in case of watershed area vis-à-vis non-watershed area. The adoption of improved seed in commercial crops was more as compared to pulse / grain crops. However, adoption of area with improved varieties of sorghum at different locations in Vertisols was also more. Improved varieties of soybean have become more popular in Madhya Pradesh due to higher productivity and income. Similarly fertilizers were also applied by a majority of farmers. However, the area covered under fertilizers was also less in non-watershed areas compared to watershed areas. Plant protection measures have gained momentum even in non-watershed areas in case of commercial and hybrid varieties. Thus farmers turned towards adoption of larger area for income. However, adoption rate in relation to area was also low at all locations compared to watershed area.

Improved weeding was widely accepted by the farmers for all line sowing crops in all regions, as it is not a totally cash input. The near saturation level of adoption was found except in minor millets / coarse grain crops / minor pulse crops because family labour with the addition of labour on exchange / wage basis could complete the weeding operation.

It is clear from the adoption of four technologies by a number of farmers and the extent of area under adoption was certainly higher in watershed area compared to non-watershed areas in arid / semi-arid regions in India. However, adoption was low / slow in arid regions compared to semi-arid regions. The adoption levels depend on rainfall and its distribution, marketing ability of crops, type of soil, socio-economic conditions of farmers. Generally adoption rate is higher in Vertisols compared to Alfisols / Aridisols due to obvious reasons.

Constraints in Adoption

Among the four components of technology, the adoption of improved seed was low, as there were many seed varieties on par with latest varieties under marginal / normal conditions where the risk of adoption / crop failure is low. Improved seed requires better agro-climate / favourable conditions for higher productivity. Hence the majority of farmers are adopting improved but locally available seeds whereas some farmers go for hybrid varieties. Hence the adoption rate varied. However, the major constraint for non-adoption by a majority of farmers at different locations was climatic factors including rainfall, which is not under anyone's control. The second reason reported was not only

cost the but also non-availability at the right time. The third reason was reported to be the economic condition of farmers who cannot spend on fertilizers / plant protection chemicals due to uncertainty.

In case of fertilizers, the price was reported to be a major constraint, as the prices of fertilizers have been increasing steeply while prices of output of dryland crops have been more or less stagnant during the past ten years. Hence farmers suggested having rationale in price fixing for fertilizers and agricultural produce which has not been there for the past 10 years.

The adoption of plant protection chemicals has been gaining momentum but it has caught the attention of farmers for all crops due to lack of knowledge, no action against dealers for supplying spurious chemicals etc. Farmers reported that Government should stipulate strict regulation in fixing prices, sale etc. in addition to popularizing through proper education / extension methods.

A majority of farmers do not adopt the new technology as a package. An investigation to identify the constraints to adoption of different components of the technology revealed that these ranged from reasons such as lack of awareness of the practice to rational reasons as such the risk involved in switching over to improved technology. However, economic factors seem to dominate the spectrum of constraints.

Conclusion

Thus, it can be concluded that the fear of loss due to failure of rains / monsoon was attributed to be the major constraint in adoption of improved seed and fertilizers in addition to lack of awareness on improved seed and plant protection measures among farmers. The economic factor also plays a major role. These constraints, individually or in combination were found to be responsible for non-adoption of technology by farmers.