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RESEARCH ARTICLE :

Effect of degree of attributes on rate of adoption of farm technology in desert tract of Rajasthan

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SUMMARY : This study was conducted in the desert tract of Rajasthan of during the year 2012-13. To know the causes and motives behind the adoption or non-adoption of the technology base among our diverse farming community. The result revealed that accessibility and cost effectiveness and among the potential causes of non-adoption of recommended production technologies and that very encouraging level of the factors *viz.*, attitude towards innovative farm institute commercialization index and surplus income leads to a high rates of adoption. Out of 160 farmers 42.62 per cent were found to have high rate of technology adoption in various crops whereas, 34.08 and 23.30 per cent farmers had adopted medium and low level of technology. Result highlighted that technology adoption level was highest in fertilizer technology upto 59.17 per cent and only farmers used it upto low level in fertilizer and number of irrigation, respectively. It was also found that maximum farmers were having very encouraging (favorable) levels of attitude towards, Innovative farm, surplus income, commercialization, index farm size, economic information and extension linkage. Had obtained high level of technology. The results further indicated that 'lack of knowledge about chemical weed control', 'weed control through weedicides is technically complex method ', 'lack of knowledge about chemical and quantity in plant protection measures and for seed treatment', labour charges costly were the main constraints as perceived by the respondents in adoption of farm technology.

KEY WORDS :
Commercialization index, Cost effectiveness, Erratic rainfall, Food security, Innovative institute, Peak season

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BACKGROUND AND OBJECTIVES

Out of 323 million hectares of the geographical area in India, 123.6 million hectare is cultivated. Out of this 123.6 million, only 40 per cent of the land has fully or partially assured irrigation. The other 60 per cent is either rain-fed or non-cultivable. Hot arid regions of the country is spread over nearly 31.7 million hectare land area of which 41.5 per cent is arable and 19 per cent is cultural wasteland. The hot arid regions are found mainly in North-West and southern part of the country. The major parts of the country under hot arid conditions are Western Rajasthan (19.62 million ha), North-Western Gujarat (6.2 M ha), South-Western Punjab (1.45 M ha), South-western Haryana (1.28 M. ha), Andhra Pradesh (2.16 M ha), Karnataka (0.86 M ha), and Maharashtra (0.13 M ha). The hot arid regions of the country are characterized by hostile agro-climate and fragil eco-system.

The hot arid zones are characterized by an annual rainfall between 100-500 mm with a co-efficient of variation (CV) varying from 40-70 per cent low and erratic rainfall combined with extremes of temperature (450-500 cal/ cm^2/day); low relative humidity; high potential evapo-transpiration value ranging from 1600 mm in eastern part and 1800 mm in western part of the region (Yadava and Soni, 2008). Despite the various bio-physical constraints, the hot arid areas like Bikaner, Jaisalmer and Churu districts of western Rajasthan offers very good opportunities for cultivation of arid legume crops. Squeezing natural resources (mainly land) coupled with increasing demand for food and food security has only way out in vertical expansion in the agricultural production, which requires a location and product specified. Technology interventions at field level, and thereby to its traditional agriculture on modern lines progressively. Besides enhancing production, these interventions are expected not only to stimulate a definite shift in cultural practices on farm and farm plan say the farming on the while but may encourage a shift in investment layout, farm inventory and farm plan-say the farming on the while (Ramrati, 1964).

India an agriculture predominant nation, where is sector contributes about 1/4th of its GDP and where more than 60 per cent production drive their livelihood form this sector, faces a challenge in terms of ensuring food security to its alarmingly increasing population and therefore, is hell-bent ever modernizing its agriculture industry through proper blending of technologies adoptable Indian context. But given the poor socio-economic status our almost all the farmers the transformation rate is disappointing, which is feared to continue until a proper extension work method with some incentives to farmers to transform themselves are not assured. Studies have revealed that either the poor attitude towards poor access to all these technologies is the two general causes of non-adoption (Joshi and Lal, 1977). So in order to address these, massive efforts are required to come out of this message systematically, but prior to this the existing technology adoption behaviour and underlying motives of our farmers needs to be studied so that a proper and scientific action plan can be formulated. With this objective in mind the present study has been carried out in the desert area (less irrigated) situation where the effective agricultural extension service is yet to take off at desired norms with following objectives.

- To study rate of adoption of technology group in different selected crop by the farmer.
- To study the existing adoption behaviour of farmers among various technologies.
- To identify socio-economic cum behavioral variables of farmers upon their rate of technology adoption.
- To enlist the major constraints faced by the farmers in adoption of various technological group of selected crops.

Arid zone is endowed with harsh adverse climatic conditions with very limited irrigation water, erratic rains, fragil eco-system etc. under these situations farming is a challenging task. The Zone Ic (Hyper Arid Partially Irrigated Western Plain) with its head quarter at Agricultural Research Station, Bikaner was carved out by bifurcating the NARP Zone Ia, which alone comprised about 33 per cent of the geographical area of the state and was considered unwidely from management point of view. In order to manage developmental activities and speed up need- based research for command and non command area of *Indira Gandhi Nahar Priyojana* in Bikaner and Jaisalmer districts and three tehsils of Churu district, this zone was created. The Zone with 7.71 m ha area (about 22.5 % of total geographical land of Rajasthan) is the largest agro- climatic zone categorized agroclimatically as Zone Ic. Desert and sand dunes occupy major portion of the area of this Zone. Soils are windblown, Aeolian, loamy fine to coarse sand in texture. Livestock and arid legume crops production are the backbone of rural economy in this zone.

RESOURCES AND METHODS

Rajasthan state comprises of ten agro climatic zones. Out of these ten agro-climatic zones. The zone Ic was selected purposely for the study. The zone is comprises of three districts *i.e.* Bikaner, Churu and Jaiselmer out of these, two districts Bikaner and Churu was selected randomly. From the selected districts 50 per cent Panchayat Samities were this selected randomly (Four Panchayat Samities were selected out of eight Panchayat Samities). Two gram Panchayat were selected from each Panchayat Samities hence, 8 gram panchayat were selected randomly. Two villages were randomly selected from each gram panchayat (8 villages). A list of all the farmers who were growing all the five crops; bajra, moth, guar, groundnut and vegetables crops (under less irrigated

farming situations) since last 5 years was prepared from each selected villages. From the list of farmers so prepared 40 per cent respondents were selected randomly, making a total sample of 160 respondents for the study with noticeable diverse socio-economic status were sampled out.

Selection of farmers and villages :

Farmers and villages were selected keeping in mind the diversity of their socio-economic status and the distance from any Agricultural Technology Information Centre (ATIC), like KVK, ARS, ATC and Govt. farms etc. Also it was hypothesized that type and nature of crop does have an impact on the adoption of particular, technology in production of that particular crop, therefore only those farmers were selected which cropping pattern would operation maximum increase to either of the five purposively selected crops *viz.*, Bajra, Clusterbean, Mothbean, Groundnut and Vegetable in the year of 2012-13

Selection of crop :

Following five distinct crops were selected based on the assumptions that farmers would adopt different levels of technology in different crops due to their different nature, type and importance for farmer and depend up on the availability of resources.

Pearlmillet :

Pearlmillet being more a staple crop than commercial is of prime importance for ordinary farmer and therefore will not compromise (in terms of adoption/ implementation of avoidable and accessible technologies) for quality and optimum production.

Clusterbean :

A fodder, commercial and well known industrial crop raised with available resources and natural rainfed and with less possible inputs in the sampled area it is grown mainly for domestic consumption and now considered as cash crop therefore, bears more market value. So farmer is more expected to choose lower cost technology which ensure them high returns on low cost basis.

Mothbean :

A fodder crop being raised with least possible inputs in the sampled area during rainy season for domestic consumption like *Dal, Mangodi, Papad*, namkeen and other confectionary items .Farmers are least interest to choose expensive technologies in this crop throw canal.

Peanut :

A main oilseed, commercial and provide dry fodder to live stock and more income generated crop of the area. Farmers are expected to adopt all those valuable technologies/like HYV seeds, early maturing and disease resistance varieties and alike which ensure them high returns farmers preferred this crop in IGNP command area having limited irrigation water.

Vegetable, Pumpkin, tinda, bottle guard, brinjal, chilli, tomato and cabbage and spinach fenugreek etc.

Due to importance of vegetable and having nutrional value and commercial crop and regular income generator. Farmers are expected to adopt all those available technologies *viz.*, hybrid seeds, early maturing and disease and pest resistant and having good keeping quality varieties and a like which ensure these maximum returns per unit of land and time.

Selection of variables :

Eleven characteristics (variables) having an impact on adoption behaviour, as identified after discussion/ interview with farmers and extension workers and results of previous studies, were selected to know extent of underlying motives for adoption or non-adoption of technologies. The lower level of these variables for any farmer has a discouraging effect on his adoption behaviour and vice versa, therefore, the farmers were scored against each variable and were accordingly sub-grouped in these categories *viz.*, (i) very encouraging (ii) encouraging and (iii) discouraging.

Analytical tools :

Simple percentages and averages were used to drive results. Average rate of adoption was calculated as follows :

$$R_A\,(\%) = \sum_{i=1}^{n} [(A_L/R_L)*100]$$

where,

R_A = Average rate of adoption

A_L = Actual level of technology used as seed rate, doses of NPK and pesticides etc. by the n^{th} farmer.

R_L = Recommended level of above technologies used by the n^{th} farmer.

On account of wide range of rate of adoption,

farmers were categories as 'High' (those having rate of adoption between 75% and above) and 'medium' having rate of adoption between 40-75 per cent and low having below 40 per cer, respectively.

OBSERVATIONS AND ANALYSIS

As mentioned earlier, it was assumed that importance, nature and type of crop were having an effect on rate of adoption of technology in that crop. In this context Table 1 evaluates the rate of technology adopted in selected crops.

It is evident from the table that 42.62 per cent farmers were having high rate of technology adoption of about 83.10 per cent in an average crop whereas 34.08 and 23.30 per cent farmers adopted medium and low level of technology of about 55.75 and 35.10 per cent, respectively.

It is also evident that rate of technology adoption of sampled farmers is as low as 29.72 per cent in clusterbean and as high as 86.32 per cent in groundnut. Farmers seem to have more tendencies towards in terms of technology adoption followed by vegetables. Clusterbean and mothbean. Since 52.75 per cent farmers have high rate of technology adoption in vegetable than comparatively less number of farmers (47.75%, 46.25%, 42.63% and 23.75%) in Pearlsmillet clusterbean, peanut and mothbean, whereas only 14.75 per cent have low rate of technology adoption in vegetablesas compared to 37.50, 23.40, 21.50 and 19.28 per cent farmers in mothbean, clusterbean, pearlmillet and Peanut, respectively. It can thus concluded that farmer prefer to adopt new and productive technologies in the crops bearing more impotence for then hereby supporting our assumption that impotence and nature of crops does have an impact on the rate of adoption of technology. Hussan *et al.* (2009) also reported more or less similar finding in their study.

Table 2 enlists the constituent technology of a crop on one side and the distribution of farmers according to their rate of technology adoption in different technology group. It was found that technology adoption level was highest in fertilization technology where about 59.17 per cent farmers used it upto high level and only 12.50 per cent farmers used it upto low level in fertilization and number of irrigation, respectively. The highest number of farmers were having low rate of technology adoption, recorded in case of FYM where about 51.25 per cent farmers used FYM/compost manures upto only low (0-40%) level as compared to 13.75 per cent who used it by high (70-100%) level. Satisfactory number of farmers having high rate of technology adoption was also recorded in seed rate (55.63%) and number of irrigation (47.50%) and plant production measures(46.25 %) whereas in case of area under HYV seeds and spacing and method of sowing, maximum farmers had low to medium level of technology. The similar results have also reported by Joshi and Lal (1977) and Hussain *et al.* (2009) and Singh *et al.* (2010) From the Table 2 it can be realized that number of farmers having high rate of technology adoption is more in the easily accessible and less expensive technology like fertilization, seed rate, number of irrigation and plant protection measures. It can thus be generalized that accessibility and cost effectiveness are among the potential causes of non-adoption of recommended production technology in the sampled area.

Socio-economic cum behavioural status has been found to have a definite impact on farmers technology adoption level, so the Table 3 was designed to reflect the impact of different socio-economic cum behavioural variables of farmers upon their rates of technology adoption. The characters (variables) thus identified are farm size, educational status of farm family head. Surplus income per annum from all sources which could be reinvested in farming business after meeting other priority expenditures, commercialization index (*i.e.* percentage of marketed surplus to total production of any crops),

Table 1 : Crop-wise distribution of farmers in various technology groups

Crop	High		Medium		Low	
	% farmers	Average rate of adoption	% farmers	Average rate of adoption	% farmers	Average rate of adoption
Pearls millet	47.75	84.34	30.75	58.78	21.50	39.24
Cluster bean	46.25	82.25	30.35	48.75	23.40	29.72
Moth bean	23.75	78.64	38.75	48.09	37.50	37.84
Peanut	42.63	86.32	38.09	59.75	19.28	34.50
Vegetables	52.75	83.98	32.50	63.40	14.75	34.82
Average	42.62	83.10	34.08	55.75	23.30	35.10

farming experience, attitude towards agriculture technology information centres, Govt. farms, agriculture universities etc. and distance from each centres. Commercialization index was included as one of the attribute as commercial farmers believed that more technology means more production and more production means more income, whereas non-commercial farmers did believe on traditional technology to yield them enough upto subsistence level. Similarly, farming experience is a practical tool with farmers to distinguish between traditional and modern technology and therefore, is a significant factor to weigh against the adoption level thereof. The table thus provide us with a lot of information regarding the interplay of rate of technology adoption and the hypothetically casual factors *viz.*, education, farm size, attitude, economic motivationn, risk orientation, credit behavioural and soon. The results in the table favour the hypothesis/assumption that very encouraging (VE) levels of factors *viz.*, Education, attitude towards innovative institute, income, farm size, economic motivation, extension linkage, distance from innovative institute and education lead to a high rates of adoption, however, a discouraging levels (D) of any factor might negate the effects of very encouraging levels of other factors on adoption level e.g., as in Table 3 only 9 per cent farmers having high attitude do not have high adoption levels, may be because that they might not have enough surplus income to invest in new technology. It is evident from the table that maximum (89.93, 63.12, 79.0, 62.0, 61.16, 60.72, 59.63, 57.45%, 49.25 %) of farmers having very encouraging levels of attitude towards innovative institute, surplus income, commercialization index farm size, economic motivation, extension linkage, distance from innovative institute education and nsk-orientation have attained high level of technology adoption, whereas (77.72, 78.57, 69.0, 72.86, 81.28, 87.64, 70.20, 72.87 and 79.55%) farmers were having discouraging levels of these factors have attained medium to low levels of technology.

It is even clear that considerable percentage of farmers (50% and more) with medium level status in all factors have attained high rates of adoption, which indicates that farmers do adopt to the level they are access too, so adoption behaviour of any farmer can thus be stated to be a function effect of various inherent characters which need to be identified and then addressed by the Govt. through proper extension network. The findings corroborating with the findings of Abid Hussain *et al*. (2009).

Table 3 and Fig.1 reveals that the response of adoption behaviour of farmers to average level of all the 11 attributes. It is clear that high technology group curve bends down as the attributes move from very encouraging level to discouraging level, and similarly, low technology group moves upwards as they move from very encouraging level to discouraging level. Indicating

Table 2 : Technology wise distribution of farmers in various technology groups **(n = 160)**

Sr. No.	Intervention technology	High		Medium		Low	
		Number	(75-100%)	Number	(40-75%)	Number	Below 40%
1.	Area under HYV	29	18.12	52	32.50	79	49.38
2.	Seed rate	89	55.63	57	35.62	14	8.75
3.	Spacing and method of sowing	39	24.37	70	43.75	51	31.88
4.	Seed treatment	69	43.12	67	41.88	24	15.00
5.	Compost manures						
	F.Y.M.	22	13.75	56	35.00	82	51.25
	Fertilizers						
	Nitrogenous	132	82.50	22	13.75	06	3.75
	Phosphorus	85	53.13	53	33.12	22	13.75
	Potashic	67	41.88	61	38.12	32	20.00
6.	Use of herbicide and weed management	45	28.12	43	26.88	72	45.00
7.	Number of irrigation	76	47.50	64	40.00	20	12.50
8.	Plant protection measures	74	46.25	43	26.87	43	26.88
9.	Post harvest practices	53	33.12	36	22.50	71	44.38
	Total	780	487.49	624	389.99	516	322.52
	Average	65	40.62	52	32.50	43	26.88

proportionality between technology adoption level of the farmers and their attributes *i.e.* their socio-economic cum attitudinal status. This findings is in conformity with the findings of Joshi and Lal (1977); Sharma and Sharma (2007) and Hussain *et al.* (2009).

Major constraints faced by the farmers:

It is evident from Table 4 that the major problems perceived by the farmers in adoption of various technology group of *Kharif* crops in the sample area. Data in Table 4 reveals that most of the farmers did not adopt whole technology about the chemical weed control and p.p. measures due to lack of knowledge about chemical weed control (98.75%) and ranked Ist followed by weed control through weedicide is technically complex method (95.62%), lack of knowledge about use of chemical quantity of plant protection measures (89.37%), lack of knowledge about the advantages of seed treatment and chemical and their quantity (86.25%) and stood rank II, III and IV, respectively. Another impotent contents perceived by the respondents farmers were *i.e.* labour charge costly (81.25 %) non-availability FYM and

Table 3 : Distribution of farmers in various technology groups according to different degrees of various attributes

Sr. No.	Attributes	Degree	Size		High	Medium	Low
			N	%			
1.	Farm size	VE	62	38.75	62.00	25.00	13.00
		E	72	45.0	53..00	21.00	26.00
		D	26	37.50	31.00	41.50	27.50
2.	Education	VE	24	15.00	57.45	17.71	24.84
		E	50	31.25	54.14	15.21	30.65
		D	86	53.75	29.80	43.10	27.10
3.	Surplus income	VE	20	12.50	79.00	11.00	10.00
		E	49	30.62	61.52	31.23	7.25
		D	91	56.88	21.43	38.64	39.93
4.	Commercialization index	VE	36	22.50	63.12	27.75	9.13
		E	29	18.12	50.00	26.00	24.00
		D	95	59.38	27.13	38.89	33.98
5.	Farming experience	VE	113	70.63	49.02	31.65	23.19
		E	33	20.62	32.76	39.36	27.88
		D	14	8.75	21.00	39.00	40.00
6.	Attitude to wards innovative	VE	22	13.75	89.93	9.03	1.04
	farm institute	E	52	32.50	70.00	21.00	9.00
		D	86	53.75	22.47	43.16	34.37
7.	Distance from innovative farm	VE	56	35.00	59.63	28.51	11.86
	institute	E	66	41.25	43.42	37.47	19.11
		D	38	23.75	12.36	7.42	80.22
8.	Extension linkage	VE	21	13.12	60.72	28.54	10.74
		E	84	52.50	36.83	48.96	14.21
		D	55	34.38	18.72	12.48	68.80
9.	Economic motivation	VE	48	30.00	61.16	19.12	19.72
		E	40	25.00	32.86	40.00	9.86
		D	72	45.00	50.14	25.00	47.86
10.	Risk orientation	VE	49	30.63	49.25	40.12	10.63
		E	37	23.12	82.50	11.54	5.96
		D	74	46.25	20.45	38.64	40.91
11.	Credit behaviour	VE	27	16.88	30.62	27.20	43.60
		E	36	22.50	36.40	42.50	37.50
		D	97	60.60	30.00	30.00	40.00

% represent percentage to total respondents, VE=Very encouraging, (E)=Encouraging, (D) = Discouraging

Table 4 : Reasons responsible for low rate of adoption of farm technology

Sr. No.	Reasons	No. of farmers	Percentage of farmers	Rank order
1.	Lack of knowledge about HYV seeds	82	51.25	XV
2.	Non-availability of pure seed in market	54	33.75	XXIV
3.	Non-availability of agril. inputs at peak season	72	45.0	XVIII
4.	High cost of required inputs	69	43.12	XIX
5.	Lack of knowledge about chemical and quantity for seed treatment	138	86.25	IV
6.	Lack of knowledge about the advantages of seed treatment	138	86.25	IV
7.	Lack of knowledge about recommended quantity and method of application of fertilizer	106	66.25	IX
8.	Non-availability of FYM and compost manures	127	79.37	VI
9.	Scarcity of moisture in the soil for application of fertilizer	59	36.87	XXIV
10.	Lack of knowledge about use of chemical and quantity in PP measures	143	89.37	III
11.	Lack of operational skills in PP measures	98	61.25	XII
12.	pesticides shows the harmful residual effect on main crops	104	65.0	X
13.	Weed control through weedicides is technically complex method.	153	95.62	II
14.	Use of weedicides put on adverse effect on the main crop	101	63.12	XI
15.	In accessibility to fumigants	108	67.50	VIII
16.	Lack of technical know how about soil treatment	80	50.00	XVII
17.	Lack of irrigation facilities, low and erratic rainfall	125	78.12	VII
18.	Do not believe in soil treatment	68	42.50	X
19.	Lack of knowledge about chemical weed control	158	98.75	I
20.	Labour charge costly	139	81.25	V
21.	Poor soil select for legume crops cultivation	92	57.50	XIV
22.	High cost of packing material	67	41.87	XXI
23.	High transportation charges	81	50.62	XVI
24.	Damage vegetable during transport	60	37.50	XXIII
25.	Un-remunerative market rate	64	70.07	XXII
26.	Fluctuating market prices	97	60.25	XII
27.	Lack of finance for tube-well and equipments etc.	53	33.12	XXVI

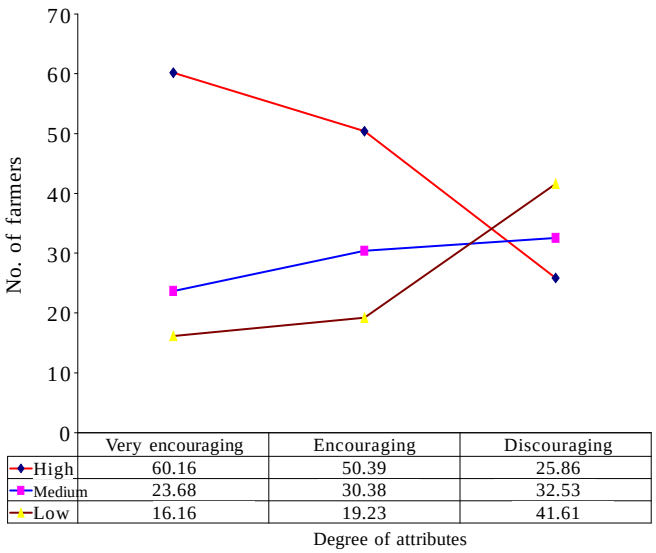

Fig. 1 : Effect of degree of attributes on adoption behaviour

compost manures (79.50%) and lack of knowledge about recommended quantity and method of application of fertilizer (66.25%) and awarded rank V, VI, VIII and IXth, respectively.

Regarding chemical used, pesticides shows the harmful residual effect on main crops (65.0%), use of weedicides put on adverse effect on main crops (63.12%), lack of operational skill in plant protection equipments (61.25%), lack of technical know how about the soil treatment (50.00%) and do not believe in soil treatment (42.50%). Regarding fertilizers application major constraints and scarcity of moisture in the soil for application of fertilizers (36.87%). In respect to other major constraints regarding marketing and seed input availability, irrigation management and other situational constraints were *i.e.* labour charges costly (81.25%), lack of irrigation facilities, low and erratic rainfall

(78.12%), fluctuating market prices (60.25%), poor soil select for legume crop cultivation (57.50%), lack of knowledge about HYV seeds (51.25%), high transportation charges (50.62%), non-availability of agri inputs at peak season (45.0%), high cost of required inputs (43.12%), high cost of packing material (41.87%), un-remunerative market rate (40.0%), damage of vegetable during transportation (37.50%), non-availability of pure seed in market (33.75%) and lack of finance for tube well and equipments etc. are the problems which are responsible in non-adoption of technology and ranked accordingly. Similarly findings reported by Kumar and Sharma (2009) and Singh *et al.* (2013).

Conclusion :

It can be concluded that major technological interventions have a key role to play in improving the efficiency of farmers and farming business, but the extent of the adoptability of these technologies has been the major concern on farmers part. On account of poor access to these technologies in terms of cost effectiveness and availability farmers rate of adoption has been very low as it was found that considerable percentage of farmers with medium levels of education, surplus income, economic motivation, extension linkages, attitude towards innovative institutes and distance from innovative institutes etc. have attained high rates of adoption, which indicates that farmers do adapt to technologies as per their accessibility.

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