Vol XXI
No. 1

JANUARY-
MARCH
1966

ISSN 0019-5014

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

TECHNOLOGICAL CHANGE IN AGRICULTURE : STUDY OF SOURCES OF ITS DIFFUSION, EFFICACY OF THESE SOURCES AND THE ECONOMIC FACTORS AFFECTING THE ADOPTION OF IMPROVED PRACTICES

R. S. SAVALE*

Assistant Professor of Agricultural Economics
College of Agriculture, Dhulia

INTRODUCTION

Change in technology in agriculture results in greater production. Innovations may be factor-saving, factor-using and output-increasing. In agriculture, innovations which increase output to a considerable extent but do not demand large increase in factor-use are expected to be accepted readily. Schumpeterian theory considers that "the innovations come in swarms and that their application follows similar pattern." It is however observed that the adoption process is not so simple and involves several considerations. Acceptance of any new technology is a process composed of learning, deciding and acting over a period of time. The adoption of new technique is not a result of a single decision to act but a series of actions and thought processes.

These actions can be divided into five stages.

(i) The awareness stage (securing of initial knowledge about the practice);
(ii) The interest stage (obtaining ideas and information leading to acceptance of the practice as a "good idea for most farms");
(iii) The education stage (deciding that the practice is worthwhile for one's own farm);
(iv) The trial stage (adoption on a trial basis); and
(v) The adoption stage (adoption of the practice completely on one's farm);

A large number of farmers progressing upto the third stage finds it difficult to enter the fourth and final stage for many reasons. The farmers in the last two stages may sometimes revert to old practices for economic reasons.

PROBLEM

Farmers adopting improved techniques secure increased returns for almost every new technique. The practices recommended under new techniques are tested before-hand both at the experiment stations and on farms of selected farmers in the locality. Even with these pre-requisites the farmers do not accept and adopt all the recommended practices readily. They adopt new technology after giving considerable thought to the matter. It naturally takes some time in accepting the changed practice. The decision is influenced by economic, social and personal considerations. It is hypothesized that the economic considerations

* The views expressed by the author are in his personal capacity.
The work is based on a research project which was to be submitted to Poona University for the Ph. D. thesis by the author, under the guidance of Prof. V. M. Dandekar, Gokhale Institute of Politics and Economics, Poona-4.

weigh heavily amongst these three. It was therefore proposed to study (i) the extent of adoption of selected agricultural practices; (ii) various sources of information and their efficacy in inducing the farmers to adopt new technology; (iii) the reasons for non-acceptance of the selected improved techniques; and (iv) the association of selected economic and other characteristics of the farmers with the adoption of improved technology.

Design of the Study and the Sources of Data

The study was taken up in the year 1959-60 and was restricted to selected self-cultivating owners and tenant-cum-owner families from Haveli, Purandhar, Bhor and Velhe talukas of Poona district in Maharashtra. To start with, it was decided to study 300 randomly selected cultivators from ten villages from the above four talukas. It was however observed that 40 cultivators of the lot refused to give information even after two to three visits while the data collected from seventeen cultivators could not provide necessary details. The data were collected in a prescribed pre-tested proforma and the analysis was finally done for the data from 243 cultivators.

EXTENT OF ADOPTION OF SELECTED FARM PRACTICES

The selected farmers were asked about the adoption of twenty selected farm practices. As shown in Table I, these practices were selected as (a) generally applicable to all farms in the locality, (b) practices which have been recommended by the Department of Agriculture in the State for at least five years, and (c) practices whose adoption could be rather easily determined in response to one or two questions. Practices which were not applicable to a particular farm, for example, use of oil engine for pumping water, use of improved poultry breeds, etc., for those who have either no irrigation facility or who did not keep poultry on religious grounds, were marked as "not applicable."

Out of twenty total practices, ten involved primarily improvements in existing techniques not involving many changes in the type of materials, equipment or techniques, or the practices recommended for over 10 to 15 years. The remaining ten practices were of the innovations type in farming, which required the new type of materials, equipment or techniques. Table I indicates the extent of adoption of the selected practices. Adoption in this case does not necessarily mean that the cultivator has brought his whole farm or concerned area under the improved practice, but carried on the recommended practice beyond the trial stage. The technological change of "raising improved poultry breed" received the least response amongst the selected recommendations. Only 10.65 per cent of the selected cultivators adopted this practice. On the contrary as many as 85.89 per cent cultivators adopted the "rotation practices." The results indicate that in the case of first ten practices, involving mostly improvements in existing operations for several years, the percentage of farmers adopting individual practice varied from 41.10 to 85.89 thus having a range of about 44. In case of innovations, this percentage was comparativey low ranging from 10.65 to 64.93. The range in acceptance of innovation was 54, which is comparatively wider. In seven out of ten practices in the first group, the adoption was by over 60 per cent of farmers while in the second group the adoption was by less than 50 per cent of farmers in 50 per cent of practices.

TABLE I—PERCENTAGE OF SAMPLE FARMERS ADOPTING SPECIFIC IMPROVED AGRICULTURAL PRACTICES

Sr. No.	Type of practice	Number for which practice is applicable	Total number of farmers who adopted the practice	Percentage adopting the practice
1	2	3	4	5
1.	Use of improved implements	243	182	74.89
2.	Plowing immediatcly after harvest	243	142	58.36
3.	Use of improved seed for sowing	241	150	61.65
4.	Seed treatment before sowing	243	115	47.26
5.	Selection of seed before sowing	240	206	84.66
6.	Cultivation across the slope	243	155	63.70
7.	Preparation and use of compost	243	100	41.10
8.	Rotation of crops	243	209	85.89
9.	Use of irrigation	217	152	70.04
10.	Use of iron mhot or oil engine	124	89	71.77
11.	Dibbling or transplanting in straight line ..	243	96	39.43
12.	Use of insecticides and fungicides	243	128	52.60
13.	Use of green manuring crops	243	114	46.85
14.	Catch crops on bunds	243	140	57.54
15.	Use of fertilizers	243	158	64.93
16.	Artificial insemination of cattle	93	49	52.07
17.	Castration of bulls by Burdizo Castrator ..	238	105	44.11
18.	Use of improved breed of cattle	204	30	14.70
19.	Use of improved poultry birds	122	13	10.65
20.	Membership of a co-operative society ..	243	132	54.25

SOURCES OF INFORMATION AND MEDIA AS AGENTS OF DIFFUSION OF FARM TECHNOLOGY

Farmers get information about the new techniques by various sources. The type of contacts for obtaining the most information were classified under four categories, *viz.*, (a) Mass Media like press and radio broadcasting; (b) Extension agency in agriculture; (c) Other farmers; and (d) Commercial agents of fertilizers, implements, etc.

Each of the above sources has proved its utility and efficacy in diffusion of farm technology in various stages of adoption as indicated in various studies in other countries like the United States of America and Europe. It was therefore decided to study the order of response for obtaining most information about diffusion of farm technology under the Indian conditions. Table II provides information about first, second and other responses regarding contacts for most informtaion about new technology in farming. Dissemination of information by extension agency and radio broadcasting and publication of literature under mass media is a planned and intended function for each of which independent administrative set-up has been provided, but sources like other farmers and commercial agents of implements, insecticides and fertilizers, act in an informal manner. It may be by chance meeting of individuals or sometimes through advertisement and demonstrations that the commercial agents pass on the information to the farmers.

TABLE II—DISTRIBUTION OF FIRST, SECOND AND OTHER RESPONSES REGARDING CONTACTS FOR MOST INFORMATION ABOUT NEW TECHNOLOGY IN FARMING

Type of contact for information	Order of response for obtaining most information about new technology in farming							
	All responses		First response		Second response		Other responses	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1	2	3	4	5	6	7	8	9
1. Mass media	3	0.05	—		3	0.14	—	
Literature	2		—		2		—	
Radio program	1		—		1		—	
2. Extension agencies in agriculture	1,016	15.47	822	37.59	174	7.96	20	0.91
Gramsevak (Village level worker)	665		615		49		1	
Agricultural assistants	80		49		27		4	
Development staff	143		81		57		5	
Other Government servants ..	26		7		13		6	
Demonstration centers ..	4		4		—		—	
Government farm	10		9		1		1	
Development board	10		9		—		1	
Exhibition	14		9		5		—	
Publicity van	5		2		3		—	
Gramneta Shibir (Village leader camps)	5		5		—		—	
Co-operative society	54		32		19		3	
3. Other farmers	623	9.50	586	26.79	36	1.65	1	0.05
4. Commercial agents and dealers	10	0.16	8	0.37	2	0.09	—	
Agents	7		7		—		—	
Grosser	3		1		2		—	
5. Do not know	4,909	74.82	771	35.25	1972	90.16	2,166	99.04
Total farmers reporting ..	243		243		243		243	
Total responses	6,561		2,187		2,187		2,187	

Mass Media

Mass media have proved to be the most usefu source of initial information in U.S.A. Farm magazines, farm newspapers, radio and television supply lot of information as observed by Beal and Rogers,[1] Copp[2] and the Foundation for Research on Human Behaviour.[3] The present study, however, does not substantiate the views expressed by the above workers. Mass media have proved to be of l ttle use either as a source of init al information or even in later stages of adoption process. This can be attribu ed to the fact that a large percentage of Indian farmers is illiterate, which prevents effective use of literature and even radio broadcasting. Secondly, there was lack of suitable literature useful for common

1. A. M. Beal and E. M. Rogers, "Informational Sources in the Adoption of New Fabrics," *Journal of Home Economics*, October, 1957, pp. 630-634.
2. J. H. Copp, M. L. Sill and E. J. Brown, "The Function of Information Source in the Farm Practice Adoption Process," *Rural Sociology*, June, 1958, pp. 146-157.
3. The Foundation for Research on Human Behaviour : The Adoption of New Products Process and Influence, Ann Arbor Brown and Brumfield, Inc., 1959.

agriculturists. There was hardly any radio set owned by individuals and those owned by *Gram Panchayats* had limited patronization. All India Radio used to broadcast only about an hour's programme every day for villagers and special agricultural programmes on every alternate day for cultivators. In the immediate future mass media as a source of initial information may prove to be effective as in other countries as the level of literacy and standard of literature and radio programme improves.

Extension Agencies in Agriculture

Extension agencies in agriculture are organized groups, which are designed to disseminate information and render several other services to farmers. They included village level workers, agricultural assistants, research centers, agricultural schools and colleges and staff working under the Development Department. Studies by Beal, Copp, the Foundation for Research on Human Behaviour mentioned earlier and also by Lionberger[4] indicate that these agencies are most used at the evaluation and trial stages. The present study indicates that this group was useful in almost all stages in influencing the cultivators for the adoption of new technology. The investigation revealed that 37.59 per cent of farmers reported the extension agency as responsible for the first response.

Among the extension agencies in agriculture, village level workers, specially appointed for propaganda work in extension organization, ranked first in diffusion of information in awareness, interest and the trial stage. Next to them stood the development staff, who included generally the supervisory staff. They were more useful in the interest and evaluation stage. Agricultural assistants in the districts, who were the only source of dissemination of agricultural information before the commencement of community projects, ranked third under the agricultural extension agencies. They used to concentrate only on extension of a selected agricultural improvement. They proved useful in awareness, interest, evaluation and trial stages. The co-operative societies both at the village level and taluka place were useful in diffusion process during all the stages. As large as 74 per cent of total selected cultivators expressed that they did not know the source of information for the selected practices. As regards first response for getting most information, 35.25 per cent of the selected cultivators could not point out the source of their first response. This proportion was a high as 90.16 per cent for source of second response and 99.04 per cent for the third response. This indicates that the extension service has to make a long headway and that the sources for getting effective information were limited.

Other Farmers

Other farmers include generally the progressive cultivators in the locality who are innovators or early adopters. They are also the first to take up any new practice. Unless this group accepts the new technology, try it on their farms and convince themselves and others in the locality, majority of cultivators in the locality do not come forward to accept it. These farmers are associated with formal and informal organizations and are also leaders in the community or village. The extension agency therefore concentrates more on this group which

4. H. F. Lionberger: Information Seeking Habits and Characteristics of Farm Operators, Missouri Agricultural Experiment Station Research Bulletin, 581, Columbia, April, 1955.

makes their work easy. Studies carried out by Beal and Rogers, and Copp mentioned earlier and that by Rogers and Beal[5] indicate that "other farmers" are used most at the evaluation and trial stages. When a final decision is to be made it is the "other farmers" who are consulted. This is particularly true for new practices associated with existing farming operations, where professional specialized knowledge is not required. For late adopters they are the only source of information during all stages of adoption.

The present investigation also revealed that other farmers form the second best source of information at all the stages of adoption. For obtaining the most information about new technology in farming, this group contributed 26.79 per cent of the first response, 1.65 per cent of the second response and 0.05 per cent of other responses. They thus ranked second in all categories in the diffusion of agricultural information.

Commercial Agents and Dealers in Farm Implements, Fertilizers, Insecticides, etc.

Agents of firms dealing with the sale of various implements, insecticides and fertilizers, and grossers selling these products also serve as a source of diffusion of agricultural information. Beal, Copp and Lionberger indicate that this source is mostly useful at the trial stage. The present study revealed that like mass media, this source was also poorly developed in this locality. The firms and agents have proved to be of no use in providing new information to farmers. They had no purposeful ideal of dissemination. This source was however useful to innovators and early adopters who tried to seek information at their own accord from this group.

REASONS FOR THE NON-ADOPTION OF SELECTED PRACTICES

It is worthwhile to investigate into the causes of non-adoption of recommended practices. This helps us in finding out some clues for suggesting remedial measures. Reasons based on responses from farmers for the practices both for innovations and other group are discussed below.

Improved Implements

Out of 182 farmers, 74.89 per cent of them used some improved implements. Others could not use them for the following easons : absence of demonstrations (7.78 per cent) ; financial difficulty (5.77 per cent) ; non-availability of implements (5.36 per cent) ; and high cost of implements (4.9 per cent).

Improved Seed

A large proportion, *viz.*, 61.65 per cent of cultivators used improved seeds. A substantial proportion, *viz.*, 27.16 per cent of the cultivators indicated that the supply was inadequate, untimely or sometimes no supply at all of the required seed. Financial difficulties and the high cos of seed was also pointed out by a large portion from this group. The rest 5.85 per cent had doubts in their mind as regards the suitability and superiority of the recommended variety for the locality.

5. E. M. Rogers and G. M. Beal, "The Importance of Personal Influence in the Adoption of Technological Changes," *Social Forces*, May, 1958, pp. 329-335.

Green Manuring

Green manuring was practised by 46.85 per cent of selected cultivators. About 12 per cent of the cultivators expressed lack of technical guidance. The reasons put forward by rest of the non-adopters included lakh of irrigation facilities, scarcity of rains, losing of one crop season, smallness of holding and difficulties in getting the seed.

Fertilizers

Fertilizers were used by 65.02 per cent of selected cultivators. Difficulties of supply was the major cause expressed by 23.86 per cent of the cultivators, while lack of technical guidance was also the reason given by 2.88 per cent of the cultivators.

Insecticides

Insecticides were used by 52.60 per cent of selected cultivators. One out of every three cultivators could not get any guidance and demonstrations for using insecticides. The remaining 14 per cent reported difficulties of supply both of insecticides and appliances for using them. High cost of insecticides and financial difficulties in general were also other reasons given by the cultivators for their non-adoption.

Treatment of Seed before Sowing

Seed treatment was practised by 47.26 per cent of the sample farmers. It was revealed that 32.21 per cent of the farmers could not get necessary details about the type of treatment to be given to seed, nor any demonstrations were arranged for them. The remaining 13.16 per cent indicated difficulties of supply in getting the chemicals.

Castration of Bulls by Burdizo Castrator

Castration of bulls by this method was practised by 44.11 per cent of selected cultivators. Out of the total sample, 32.10 per cent of the cultivators reported that they could not adopt this practice because the dispensary was far away from their place. Other reasons attributed were of minor importance which included lack of technical guidance and purchase of bullocks (which need no further castration).

Raising of Improved Poultry Breeds

Only 10.65 per cent of selected farmers raised improved breeds of poultry. The causes attributed to the low response for raising local poultry breeds were as follows: lack of veterinary aid (14.14 per cent); non-availability of improved breeds and the unsuitability of the improved breed for hatching purpose (6.99 per cent) ; lack of technical guidance (6.18 per cent) ; and high cost of the birds (4.9 per cent). A large portion of population did not take up this practice on religious grounds.

Improved Breed of Cattle

Only 14.70 per cent of the farmers maintained improved breeds of cattle. A main reason attributed to non-adoption was the financial difficulty (28.80 per cent) ; 14.81 per cent of them considered the purchase price of these cattle to be too high ; while 13.59 per cent of them reported the difficulty of fodder supply. A small portion of 10.70 per cent could not get guidance regarding profitability of improved breed and the rest 7 per cent stated that the animals of improved breeds were not readily available.

Artificial Insemination of Cattle

Artificial insemination of cattle was adopted by 52.07 per cent of the selected cultivators. There were no facilities even in nearby village for 34.97 per cent of farmers. A group of farmers (12.75 per cent) had no milch cattle and hence they did not accept this practice. Services of breeding bull were available for 4.94 per cent of selected farms; while the rest 8.64 per cent could not get any guidance in this aspect.

ECONOMIC FACTORS AFFECTING ADOPTION OF TECHNOLOGICAL CHANGES

Uncertainty

Uncertainty about the expected increased returns is due to the lack of information about the technical details of new technology and that of sufficient number of demonstrations on nearby farms to convince the farmers that the additional income by the adoption of new technique will over-weigh the additional costs. It is difficult to contact every individual farmer and still more difficult to arrange demonstration for them. As large as 74.82 per cent of farmers could not be approached by any agency. It is not a single visit by an extension worker or one or two demonstrations but several observations by the farmer himself makes him feel free from the element of uncertainty. The uncertainty regarding prices is also of great importance and did not permit farmers with average means to accept any change in current practices.

Capital Requirements

Technological change involving large investment of capital is not accepted readily and early by a large percentage of farmers, as can be seen in practices like use of improved breed of cattle and poultry, green manuring, use of insecticides and fungicides, etc., where the percentage of adopters ranged from 10 to 52 per cent only.

Income Level or Economic Status of the Farmers

It is natural that the farmers having higher level of income or economic status will be in a position to take more risk and face the uncertainty in a better way. The present study supported this view and indicated that the farmers having irrigation facilities secured income and those following some type of secondary occupation like dairying, poultry farming, service, trade, carpentry, smithy, etc., adopted the new technology much more readily. The hypothesis that (*i*) the

farmers having irrigation facilities and or (*ii*) following some subsidiary business would adopt the improved practices readily has been proved (x^2 (Chi-Square) 12.54 for 3 degree of freedom and x^2 30.08 for 6 degree of freedom respectively).

Expectation of Net Marginal Returns

Expectation of increase in net marginal returns by adopting certain new practice weighs heavily both for early and late adopters. Use of fertilizers and insecticides which shows immediate results and considerable increase over the local practice have been accepted readily and almost within no time as against the preparation and use of compost and improved implements which have taken considerable time for adoption. The majority of sample population have not accepted the preparation and use of compost even after concentrated efforts by the Government agencies for several years.

Suitability of the Practice to the Locality

Some practice is not accepted in all the localities with equal interest. Table III gives the percentage of adopters for various selected practices in four talukas of Poona district. It is observed that the use of improved implements has been accepted to a considerable extent in Haveli but not so in Purandhar, Bhor and Velhe. This is mainly due to the fact that farmers in Haveli taluka grow various irrigated cash crops, which permit economic use of improved implements. In Bhor and Velhe, where paddy is the important crop there is little scope for the use of variety of implements, and in Purandhar irrigation facilities and rainfall are scanty.

TABLE III—TALUKA-WISE ADOPTION OF VARIOUS SELECTED PRACTICES

	Use of the practice	Percentage of adopters in Taluka			
		Haveli	Purandhar	Bhor and Velhe	Total
1.	Improved Implements ..	93	59	51	74
2.	Improved seeds	65	71	55	61
3.	Preparation and use of compost	36	50	33	41
4.	Green manuring	77	10	39	47
5.	Fertilizers	73	58	55	65
6.	Insecticides	43	69	27	53
7.	Seed treatment	45	57	33	47
8.	Castration of bulls by Burdizo Castrator	17	78	48	44
9.	Improved poultry breeds ..	9	7	23	11
10.	Improved cattle	14	11	24	15
11.	Artificial insemination of cattle	100	51	0	52

Consider another improvement, *viz.*, use of green manuring. In Haveli use of canal water permits intensive cropping of vegetables and sugarcane. There is shortage of manures, and green manuring is both convenient and economical. In Bhor and Velhe area the rainfall is sure and comparatively more, which also permits to grow green manuring crops during the period of raising of rice seed-

lings. It can be buried before transplanting of seedlings. On the other hand, in Purandhar, the rainfall and general cropping pattern did not allow extension of this practice on a measurable scale.

Distance of Locality from Marketing and Educational Centers

Farmers located near the district place get advantage of marketing the farm produce at profitable rates and can also procure farm and household requisites timely and at cheaper rates. They are well informed by their constant visits to the district place and come in contact with extension agencies at higher level. This leads to quicker adoption of any practice by a larger number. Table III indicates that the average number of adopters in case of ten practices in Haveli was to the extent of 56.7 per cent as against 44.2 and 34.00 per cent respectively in the other areas located away from Poona city.

Size of Holding and Tenancy

Factors like size of holdings and tenancy were also studied to see whether there is any relationship between the above with the adoption of practices. The results were not statistically significant indicating that the tenant and owner cultivators adopted the new practice with almost the same speed. This may be due to the State legislation protecting the rights of individual tenants. The farmers having different size of holdings did not show any material difference in adoption. This is in contrast to the results of studies carried out in other countries.

CONCLUSION

The investigations of the problem revealed that a large number of farmers could not adopt new technology because several of them could not be contacted by any agency. The demonstrations arranged were also out of their reach. The financial position of the farming class in general is sub-normal. Even though care was taken while sampling to exclude very poor farmers who would refuse to accept any improvement only on financial grounds, it is observed that the financial position of farmers did affect largely the adoption of some practices. A large number of practices recommended did not promise attractive returns over local practices. The new practice should therefore be both output-raising and factor-saving. If it is factor-using the difference between marginal returns and marginal cost needs to be quite substantial so as to attract even the most reluctant cultivators to adopt the new technology. This is true even for output-raising technologies. The problem of supplies is of great importance in inducing farmers to accept new technology. The majority of them did not know the source from which to get the required supplies and the procedure to be followed in that respect. Non-availability and inadequacy of supply and untimely nature of supplies did affect adoption to a considerable extent. It is necessary to develop suitable agencies at village level to tackle the problem of supplies effectively. It will be worthwhile to concentrate the efforts with a view to promote extension of irrigation activities and also to induce farmers to take some subsidiary industry like dairy, poultry, service, trade, etc., in addition to farming. The efforts will have to be made by the Government to provide necessary guidance and facilities in both these aspects.