Constraint analysis of the farmers in the adoption of integrated nutrient management (INM) technologies in potato-based cropping system in Punjab

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ABSTRACT

Integrated nutrient management (INM) has evolved as one of the most important means to handle and sustain the agricultural output and improve the farmers' productivity through its various components. The present study was conducted to analyse various constraints faced by the farmers who were following potato-based cropping system in three agro-climatic zones of Punjab. A total of 180 farmers were included comprising sixty farmers from each agro-climatic zone. Collection of data was done with the help of interview schedule consisting of statements to identify the constraints being faced by the farmers. Findings of the study showed that constraints for adoption of INM technologies were much inclined towards the production constraint although there was no loss in yield of the crops by following INM practices. Other constraints faced by the farmers were of economic and organizational in nature. Farmer field school can be organized on INM in specific crops at village level and farmers' participatory research can be initiated for developing INM package for different cropping systems.

Keywords: Potato; constraints; adoption; INM; organic sources; chemical fertilizers

INTRODUCTION

Agricultural production holds the key to peace, progress and prosperity of the nation. It is a soil-based industry that extracts nutrients from the soil. The nutrient status of soil is also a key element in agriculture. Both the over and underuse of chemical fertilizers and their poor management lead to the deterioration of soil environment which in turn leads to decrease in soil productivity. The overuse of chemical fertilizers disrupts the natural environment and agricultural system to greater extent. So integrated nutrient management (INM) has vast scope to sustain soil health and good yield. It is introduced as a system to handle and sustain the agricultural output and improve the farmers' productivity through its various components. INM is basically the maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired productivity through the optimization of the benefits from fertilizers, organic manures, green manures, biofertilizers, non-conventional sources and crop residues. INM aims at maximization of the use efficiency and minimization of the avoidable losses of nutrients from all the sources such that triple objective of maximization of crop yields, sustenance of soil, water and air quality and improvement of socio-economic conditions of farming community is accomplished (Trehan et al 2008). The soils of Punjab are deficient both in macro and micronutrients. The intensive agricultural practices in past three to four decades have put a tremendous pressure on the soil of the state and resulted in steady decline in its fertility. Initially it contributed to increase in productivity in Punjab but now it has become a vicious circle of high use of chemical fertilizers and decreasing soil fertility (Gulati et al 2017). So INM has vast scope to sustain soil health and good yield in Punjab. Constraints play a vital role in the adoption of any innovation. The constraints in the adoption of any agricultural innovation include nature of technology, the way in which it is conveyed to the farmer and attitude and perception that the farmer has about the technology. To obtain better results of any type of services, it is very essential to minimize the constraints. INM is an advanced crop production system that seeks to both increase agricultural production and safeguard the environment

for future generations. For sustainable crop production it is essential to identify the constraints that most of the farmers in a community face about practicing INM technologies. The present study was undertaken to analyze the constraints faced by the farmers in the adoption of INM technologies in potato-based cropping system in Punjab.

METHODOLOGY

In the present study the variable constraint was operationalized as the difficulties foreseen or faced by the farmers in the adoption of recommended INM technologies such as less net return by using organic manures, unavailability of seeds of green manuring crops, unawareness of ill-effects of overuse of chemical fertilizers and weak linkages with extension personnel. It was measured on a three point continuum viz most severe, severe and not severe and were scored as 3, 2 and 1 respectively. The data were collected from the farmers cultivating potato which were widespread in the three agro-climatic zones of Punjab state viz sub-mountain undulating zone, central plain zone and western zone. Taking into consideration the highest yield of potato production from each agro-climatic zone, three districts Hoshiarpur, Jalandhar and Bathinda were selected. From these selected districts one block was selected randomly and from each selected block two villages were selected by applying simple random sampling technique. Thus a total of six villages from three blocks were selected. A complete enumeration of farmers following the selected cropping pattern was carried. For each village, thirty respondents were selected randomly following the lottery method thereby resulting in the selection of a total of 180 respondents from the study area.

Data were collected with the help of interview schedule which consisted of items pertaining to five categories of the constraints being faced by the farmers. The ease or difficulty of introduction of any idea depends basically on the nature of the 'new' in the new product. The constraints in the adoption of any agricultural innovation include nature of technology, the way in which it is conveyed to the farmer and attitude and perception that the farmer has about the technology. To obtain better results of any type of services, it is very essential to know and minimize the constraints. So to know about the hurdles which affect the rate of adoption of INM practices, five broad classes of constraints viz economic, institutional/regulatory, behavioural, organizational and production constraints were made. Economic constraint can be defined as profitability in economic terms on long term basis. According to Rogers, among the five attributes of technology, profitability is the most important attribute. So economic constraint is studied to know various problems faced by the farmers including the items relating to economic aspect. The innovations are adopted only if they have direct commercial value or they can maintain long term productivity on the farm (Rogers 1983). Institutional/regulatory constraint can be defined as the availability of products or incentives awarded by the government to speed up the rate of adoption of innovation. Various organic components like seeds of green manure crops and biofertilizers are unavailable in cooperative societies of the villages. Contrary to it, inorganic fertilizers are made available at subsidized rates by government which influences the use of chemical fertilizers. This hinders the adoption of INM practices among the farmers. The predispositions of individual influence their behavior towards adoption of any innovation. Behavioral constraint is defined as the unawareness and insecurity of the farmers in using the biofertilizers. Farmers perceive that observable health of the crop is more in using chemical fertilizers as organic manures have low nutrient status as compared to inorganic sources. So these behavioral aspects of farmers hinder the adoption of INM practices. Organizational constraint can be defined as the lacunas regarding the skills in using various practices of INM and weak extension linkages of farmers. These lacunas become the major hurdles in the adoption of INM practices. Innovations which can maintain long term productivity on the farm (Rogers 1983) can be adopted with greater speed. On the other hand if the technology is not being consistent with farmers need and not compatible to their environment it is not adopted with the same speed eg recycling of crop residue is an integral part of INM practices but due to short time slot between two main crops farmers ignore the sowing of green manure crops. In other words we can say this practice is not compatible with their crop rotation. With the help of interview schedule all these constraints were discussed with farmers and the responses regarding these constraints were recorded on three point continuum viz most severe, severe and not severe. A particular score was assigned to the response of individual farmer as 3 for most severe, 2 for severe and 1 for not severe. Thus the total score of individual farmer was summed up and ranking was done by calculating mean score.

RESULTS and DISCUSSION

Constraint refers as a situation or circumstances which impede or restrict the activity or the performance of an individual. In this study it was operationalized as the constraints faced by the farmers which hinder them to adopt INM technologies. Characteristic of a technology is a precondition of adopting it. There are five attributes of innovations by which an innovation can be described and show the individual's perception of innovation. These five attributes namely relative advantage, compatibility, complexity, trialability and observability affect the rate of adoption but the most important attribute is profitability in economic terms and compatibility with previously introduced ideas or innovations. For sustainable crop production it is essential to identify the constraints that most of the farmers in a community face about practicing INM technologies. So in this context, the major constraints namely economic constraints, institutional/regulatory constraints, behavioral constraints, organizational constraints and production constraints were identified. The responses of farmers were sought for these constraints on three point scale viz most severe, severe and not severe. The frequencies of the constraints were summed up separately and mean scores were calculated. Later on ranks were assigned according to the descending order of mean scores of the constraints (Table 1).

Economic constraints: Adoption will be limited if the new technology has little financial benefits on long term basis. The data indicate that less net return by using organic manures as compared to inorganic fertilizers was perceived as the major constraint by majority of the respondents (rank I; mean score 2.96). High cost in availing organic manures ranked second (mean score 2.86). The farmers felt that organic manures such as FYM, poultry manure and vermicompost were available at high prices which was not affordable for small or marginal farmers. Bhushan et al (2017) also found that high cost of organic inputs was the major constraint for the respondents in the adoption of organic farming. Though less net return by using organic manure was considered to be the top most constraint, the uncertainty in returns and yields of crops by using recommended doses of fertilizers was ranked third (mean score 2.71). Farmers used overdose of chemical fertilizers as they perceived that they could get higher yield at higher doses of chemical fertilizers. But according to the package of Punjab Agricultural University, there is no effect on yield by applying chemical fertilizers more than recommended dose. Labour is an important component since it affects the cultivation process like application of chemical fertilizers and manures. The problem of labour ranked at fourth place (mean score 2.64). Aparna and Thomas (2017) stated that lack of availability cum high wages were the major constraints in adoption of organic plant protection practices. Fertilizers are available at subsidized rates which affects the use of organic sources in various crops. Farmers prefer inorganic fertilizers over organic sources due to their lower prices as compared to organic manures. The constraint ranked fifth with mean score of 2.42. Mwangi and Kariuki (2015) stated that farmers with large size farms adopt a new technology as they can afford to devote part of their land to try new technology unlike those with less farm size. Unavailability of land for practicing INM practices was ranked sixth with mean score of 2.28. Since good number of farmers under study belonged to the category of semi-medium (5-10 acres) farmers, they stated that they did not possess enough land for practicing the new technologies like INM as this technology had lower yield and net profit was reduced in initial years.

Institutional/regulatory constraints: Incentives are awarded to speed up the rate of adoption of an innovation. These are direct or indirect payments in cash or in kind given to an individual in order to encourage some overt behavioral change (Rogers 1983). No incentivising of INM practices was perceived as the major constraint and was positioned at first rank (mean score 2.85). These findings are in line with those of Purohit and Dodiya (2014) who found that lack of subsidies on biofertilizers was the major hurdle in adoption of biofertilizers in agriculture. On the other hand inorganic sources are highly subsidized. Availability of subsidy support to inorganic fertilizers was ranked second (mean score 2.73). The per unit fertilizer consumption in the Punjab state is highest among all the states of India but prohibitive steps are not taken by the government in efficient way to control the overuse of fertilizers. Farmers had lack of knowledge and proper guidance about the use of biofertilizers hence this constraint was ranked third with mean score of 2.68 whereas unavailability of seeds of green manuring crops in the cooperative societies or other seed sources ranked fourth (mean score 2.56). Mohanty et al (2013) reported that non-availability of disease free seeds is the major problem in adoption of vegetable production technologies. Majority (60%) of the respondents were educated up to matriculation.

Table 1. Ranking of constraints expressed by the respondents based on their mean scores (n= 180)

Constraints	Mean score	Rank
Economic constraints		
High cost involved in availing required organic manures	2.86	II
The uncertainty in returns and yields of crops by using recommended doses of fertilizers	2.71	III
Inorganic fertilizers application is cheaper than organic manures as they are subsidized	2.42	V
Net return is less by using organic manures as compared to inorganic fertilizers	2.96	I
Labour is unavailable and wages are also high for manuring	2.64	IV
Being a small farmer the applicability of INM technologies on own field is not feasible	2.28	VI
Institutional/regulatory constraints		
No incentivizing of INM practices	2.85	I
Availability of subsidy support for inorganic fertilizers	2.73	II
Prohibitive steps not taken by government for overuse of fertilizers	2.68	III
Unavailability of seeds of green manuring crops in the cooperative societies/other seed sources	2.56	IV
Difficulty in interpretation of soil testing report	2.49	V
Fertilizers and biofertilizers are unavailable at times	2.35	VII
Available biofertilizers may be adulterated	2.43	VI
Behavioral constraints		
Unawareness of ill-effects of overuse of chemical fertilizers	2.92	I
The observable health of the crop is more in over application of urea	2.43	V
Lack of observable results of using of biofertilizers	2.86	II
Non-acceptability of fertilizer doses recommended by PAU	2.52	IV
Organic manures have low nutrient status as compared to inorganic	2.29	VI
Insecurity as other farmers in peer group use the overdoses of fertilizers	2.58	III
Organizational constraints		
Lack of skill of using the PAU Leaf Colour Chart (LCC)	2.42	VIII
Lack of information about balanced fertilization	2.69	IV
Poor access to organic sources of nutrient management	2.73	III
No knowledge of INM practices	2.65	V
Weak linkages with extension personnel for seeking advice regarding use of INM technologies	2.98	I
Lack of knowledge to take soil samples for testing	2.55	VII
Lack of knowledge from where soil should be sampled	2.63	VI
Soil testing laboratory is far away from farmers' fields	2.82	II
Production constraints		
Late decomposition of organic manures	2.97	I
Ignorance of growing green manures due to short time slot between two main crops	2.83	II
Residues of green manure and previous crops interfere with tillage operations	2.61	III
Improper sowing of seed with Happy seeder	2.38	IV
Overall constraints		
Economic constraints	2.64	III
Institutional/regulatory constraints	2.58	V
Behavioural constraints	2.60	IV
Organizational constraints	2.68	II
Production constraints	2.69	I

They had not much difficulty in interpreting the soil testing report so this constraint was positioned at fifth place with mean score of 2.49. Respondents were not using any biofertilizer in any crop so they did not have awareness about the adulteration of biofertilizers. It was positioned at sixth place with the mean score of 2.43 while the unavailability of biofertilizers (mean score 2.35) ranked seventh.

Behavioral constraints: An individual gains awareness knowledge through behavior that must be initiated. The predisposition of individual influences the behavior towards adoption of any innovation. The unawareness of ill-effects of overuse of chemical fertilizers ranked first (mean score 2.92). Due to low participation in extension activities farmers were not aware about the ill-effects of overuse of chemical fertilizers. Farmers were of the opinion that by using chemical fertilizers the health of the crop is improved which was not comparable to the use of organic sources. Lack of observable results of using of biofertilizers ranked second (mean score 2.86) whereas insecurity as other farmers in peer group used the over doses of fertilizers ranked third (mean score 2.58). Farmers applied overdoses of chemical fertilizers in various crops to get the benefit of higher yield at higher doses of fertilizers. Farmers perceived that by the application of recommended doses of Punjab Agricultural University (PAU), higher yield was not attained. It was ranked fourth (mean score 2.52). They perceived that the observable health of the crop was more in over application of urea. This was positioned at fifth place with mean score of 2.43. Farmers were also of the view that organic manures had low nutrient status as compared to inorganics which was positioned at sixth place (mean score 2.29).

Organizational constraints: Farmers face many problems in the adoption of nutrient management technologies like skill of using new practices, poor access to sources, weak linkages with extension personnel, soil testing etc. The weak linkage with extension personnel for seeking advice regarding the use of INM technologies ranked first with mean of score 2.98. The level of extension contacts of majority of the farmers was medium and their participation in extension activities was low. Soil testing is a prerequisite for the application of chemical fertilizers in various crops. PAU gives soil test-based recommendations for the use of chemical fertilizers in various crops. Majority of the farmers did not go for soil testing at least once in a year. According to them distance of soil testing laboratory was far from their fields. It was ranked second with mean score of 2.82. In the use of organic sources, FYM and green manuring were only two components popular among the farmers. Farmers had poor access to other organic sources of nutrient management. Thus it was ranked third with 2.73 mean score while lack of information about balanced fertilization (mean score 2.69) ranked fourth. To get higher yield farmers were using double the recommended dose of chemical fertilizers. They did not have knowledge of benefits of INM practices on yield and soil health and ranked it at fifth place with mean score of 2.65. As discussed above, the soil testing laboratories were far from the farmers fields so they did not exactly know from where soil should be sampled. This was also a major hurdle in the adoption of recommended doses of fertilizers and was ranked sixth (mean score 2.63) while lack of knowledge about collection of sample for soil testing (mean score 2.55) ranked seventh. Leaf colour chart (LCC) is an important tool for the application of need-based urea in various crops but majority of the farmers did not have the skill of using it. This constraint was positioned at eighth place with mean score of 2.42.

Production constraints: Under production constraints, the late decomposition of organic manures was ranked first (men score 2.97). Organic manures took long time to decompose and problem of timely preparation of the fields for the next crop existed (Mahajan and Gupta 2009). Farmers ignored the growing of green manures due to short time slot between two main crops and was positioned second with mean score of 2.83. The farmers stated that residues of green manure and previous crops interfered with tillage operations in the succeeding crop which was ranked third (mean score 2.61). Recycling of crop residue is an integral part of INM. PAU has developed to sow the crop in the presence of residues of preceding crop. But in the discussion with farmers it was concluded that there was improper sowing of seed with Happy seeder and this constraint was positioned at last rank with 2.38 mean score.

Overall analysis of the different constraints faced by the respondents: The production constraint was the most expressed constraint positioned at first with the mean score of 2.69. Organic sources are the important component of INM technologies. Lack of knowledge and skills for using any technology also hinders its adoption among the farmers. So organizational constraint with its various components like no knowledge of INM, lack of skill of using PAU LCC, weak linkages, lack of knowledge to take sample and from where soil should be sampled was ranked second with mean score of 2.68. On the other side various economic factors like high cost availed in organic manures, cheaper inorganic fertilizers and less net return in using organic manures hindered the adoption of organic sources in INM. So economic constraint was ranked at third place with mean score

of 2.64. Farmers' behavior towards any technology was influenced by various factors. It was positioned at fourth place with mean score of 2.60. Incentives given directly or indirectly speed up the rate of adoption of any technology. No incentivizing of INM practices, unavailability of seeds of green manure crops, unavailability of biofertilizers at times are the various components of institutional constraints which were positioned at fifth place with mean score of 2.58.

CONCLUSION

It was concluded that the topmost constraint faced by the farmers was production constraint by using organic sources. Therefore demonstrations should be laid down for introduction of green manure crops and biofertilizers to increase the production of crop. Under organizational constraints there was need to make the farmers aware about the use of INM practices through awareness programmes. Popular articles and new articles on INM should be published in various farm magazines and newspapers. To address the economic constraints appraisal of farmers for adoption of INM practices was required. Unawareness and insecurity in using organic sources and pressure of peer groups were the major behavioral constraints faced by majority of the farmers. This calls for the organization of farmers' field schools on INM in specific crops at village level. The organic sources like seeds of green manure crops and biofertilizers were not available in cooperative societies. The seed village programmes can be encouraged for growing green manure crops so that seed availability at farmers' level is ensured. So it is suggested that government agencies should ensure the availability of these components to increase the adoption of INM practices.

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