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Awareness of farmers regarding Integrated Nutrient Management (INM) practices in Rice-Wheat Cropping System (RWCS)

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Abstract

Rice-Wheat Cropping System (RWCS) is an important cropping system of Haryana. Over the decades, its intensification into a monocropping system has resulted in various issues, including soil health deterioration. Indiscriminate use of chemical fertilizers, especially nitrogen is said to be the major cause. A sustainable solution for this is integrated nutrient management (INM). The present study was conducted to ascertain farmers' awareness about INM practices in RWCS during 2021-22 in Haryana using the ex-post facto research design. The total sample size for the study was 120. It could be concluded that two-third of respondents (66.67%) belonged to medium category of awareness, while 21.67 percent of the respondents had high awareness and about 11.66 percent of the respondents had low awareness about recommended INM practices in RWCS. The correlational analysis between awareness and independent variables revealed that age, education, land holding, farming experience, social participation, farm power, mass media exposure, extension contact and risk orientation were significantly correlated with awareness indicating their role in raising awareness of the INM practices.

Keywords: RWCS, INM, awareness, correlation, practices

Introduction

The Rice-Wheat Cropping System (RWCS) is the backbone of food security in India. Both rice and wheat crops are fertilizer intensive to achieve good productivity. Intensive cultivation of rice and wheat, coupled with disproportionate use of chemical fertilizers and restricted use of organic manures and bio-fertilizers has caused environmental imbalance, and has made the soils nutrients deficient. In addition, the soil health has deteriorated, resulting in decline in crop response to the recommended dose of nitrogen (N) fertilizer (Singh *et al.* 2010) ^[10]. The RWCS is very dominant in Panipat, Karnal and Kurukshetra districts of Haryana with high cropping intensity of 198.17, 199.17 and 196 percent, respectively. The total consumption of fertilizers (N+P+K) in Karnal district was 121.36 thousand tonnes during 2018-19 (N-80.29 percent, P-17.34 percent and K-2.36 percent). The total fertilizers (N+P+K) consumption in Panipat district during 2018-19 was 54.96 thousand tonnes with 82.60 percent, 13.70 percent and 2.30 percent proportions of N, P and K, respectively (Anonymous, 2018-19) ^[1]. During 2019-20, the total fertilizer (N+P+K) consumption in Kurukshetra district was 84.72 thousand tonnes with consumption proportion of N, P & K was 80.20 percent, 16.70 percent and 2.20 percent respectively (Anonymous, 2019-20) ^[2]. This clearly indicated that the RWCS is a highly fertilizer intensive cropping system and it has resulted in decline in soil productivity.

Intensification of crops and high productivity pursuits has

caused depletion of both macro and micro nutrients. In Haryana gap between addition and removal of nutrients is increasing every year for the nutrients like potassium (K), sulphur (S), manganese (Mn), iron (Fe) and copper (Cu). This calls for suitable interventions to add these nutrients to soil from all available organic, inorganic and biological sources in order to maximize the production on sustainable basis. Apart from depletion of nutrients from soil, problem of imbalanced use of fertilizers continues on enormous scale despite so many awareness programmes/campaigns about this issue. The nutrient use ratio of 4:2:1 (N:P:K) is the recommended proportion for balanced fertilizer use in case of rice and wheat. However, N:P:K ratio during 2014-15 was 6.7:2.4:1 at national level and 27.7:6.1:1 in Haryana (Pavithra, 2021) ^[8].

The only way to narrow down this gap of nutrient consumption and removal is the adoption of Integrated Nutrient Management (INM). INM involves use of organic manure, crop residue management, green manuring and use of bio-fertilizers with balanced use of fertilizers based on soil test report. Apart from reducing cost of cultivation, INM increases soil productivity, water holding capacity and fertilizer use efficiency. Since, there is no single source that is sufficient to supply all the required plant nutrients it is recommended to adopt an integrated approach to nutrient management.

Integrated Nutrient Management (INM) or Integrated Nutrient Supply System (INSS) aims at making efficient use of chemical fertilizers in conjunction with organic manures.

Long term fertilizer experiments involving intensive cereal-based cropping systems revealed a declining trend in productivity even with the application of recommended levels of N, P and K fertilizers. The crop productivity increases from the combined application of chemical fertilizers and organic manures. The basic concept of INM system is to maintain plant nutrients supply to achieve a given level of crop production by optimizing the benefits from all possible sources of plant nutrients in an integrated manner, appropriate to each cropping system and farming situation (Mahajan and Sharma, 2005)^[6].

Studying farmers' awareness about integrated nutrient management (INM) practices in RWCS is crucial to ensure sustainability of the cropping system as well as the agro-ecology. Understanding farmers' awareness towards INM practices helps identify gaps in training, guide effective extension services, and tailor policies to support adoption of these practices. Enhanced awareness and implementation of INM can lead to better resource management, increased productivity, and long-term food security, benefiting both farmers and the broader ecosystem.

Methodology

The study was conducted using the ex-post facto research design. A multistage sampling was done to derive the sample for this study. Three districts of Haryana state *viz.*, Panipat, Karnal and Kurukshetra, were purposively selected as these districts had maximum cropping intensity of RWCS in Haryana in North-Eastern Agro-Climatic Zone. Again, two blocks from each of the three districts were selected randomly *viz.*, Sanauli Khurd and Ishrana from Panipat district, Karnal and Nilokheri from Karnal district and Shahbad and Ladwa from Kurukshetra district were selected randomly. A list of rice and wheat growers was prepared with the help of Agricultural Development Officers (ADOs), Scientists of Krishi Vigyan Kendras (KVKs), and sarpanches of selected villages. Ten farmers from each village were selected randomly for personal interview from the prepared list, making the total sample size of 120 for the study.

The independent variables such as age, education, family size, family type, occupation of respondent, caste, land holding/ farm size, farming experience, social participation, farm power, mass media exposure, extension contacts and risk orientation were included in investigation. In present study awareness level of respondent farmers was assessed by asking general questions about different agronomic practices related to INM with 'Yes' or 'No' scoring as one and zero respectively. The scores obtained under various questions were summed up and then respondent farmers were classified into three categories *i.e.*, 'low' ($\bar{x} - SD$), 'medium' ($\bar{x} \pm SD$) and 'high' ($\bar{x} + SD$) by using mean score (\bar{x}) and standard deviation (SD) as checks.

Results and Discussion

Awareness of respondents towards various INM practices

It could be concluded from Table 1 that cent percent of the farmers were aware about the balanced use of fertilizers, time and application of manures, organic manures and their positive effect on soil health. This could be attributed to the fact that balanced use of fertilizers and use of organic

manures is not a new concept to the farmers. It has been a part of indigenous technical knowledge (ITKs). Farmers were aware that they have to use balanced doses of fertilizers but seldom used it as they were more concerned about yield for income. The concept of organic manures in the form of farm yard manure (FYM) or compost and their role in soil health improvement was also known to many but again seldom used as it increased the cost of cultivation. Farmers (100%) also were aware about the fact that INM increases the organic matter in soil for similar reasons. Majority (94.16%) of the farmers were aware that the INM was key to sustainable agriculture and INM sustained the soil health (90.00%). INM takes an integrated approach to providing nutrients to soil for crop growth. The region earlier had a diversified cropping system in which farmers were aware about this before shifting to intensified system. However, the knowledge as carried over. There was regular use of green manuring during fallow summer season to improve soil health.

More than four fifth (83.33%) of the farmers were aware about the essential role of organic matter in maintaining soil fertility and crop yield. Organic manures such as FYM or compost were in use before but the need for productivity has resulted in their replacement by fast nutrient releasing chemical fertilizers. Majority (82.50%) of the farmers were aware about the crop residue management and its role in maintaining soil health. The recent years, a major problem of residue burning has been reduced in the study area due to concerted efforts of the authorities and stringent action against the practice. The farmers have shifted to use of happy seeder, bailing and other methods of sustainable residue management. As mentioned earlier, many farmers resorted to growing dhaincha as summer crop and later incorporating it soil for better soil health. Thus, its awareness was also high as 72.50 percent of the farmers knew about this practice and its beneficial effects. Soil health card (SHC) was a novel idea of the government to mitigate excess application of fertilizers by recommending doses based on the soil of the farm. Though many farmers had been issued SHC, they were still not able to calculate the required dose of fertilizers to be applied. Therefore, its awareness was only 67.50 percent. Stubble burning was a cultural practices since many decades and farmers reluctant to try other sustainable methods as they did not know its effect on soil health, thus its awareness was only about 45.00 percent. The awareness of use of biofertilizers like Rhizobium, Azotobacter, Azospirillum, PSB *etc.* was only 45.00 percent as many farmers just resorted to applying chemical fertilizers for quick response from the crop.

The use of chemical fertilizers is so widespread in the study region that many farmers were unaware of INM and even if they were aware they preferred yield over environmental balance. Therefore, the awareness about the use of INM and if it improved the yield was low (40.00%) as many farmers still perceived that INM resulted in lower yields. As stated earlier, many farmers (62.50%) were not aware how to use SHC for calculating doses of fertilizers and hence did not know about its use in supplying nutrients to soil and reducing overall cost of cultivation (63.34%). As disproportionate fertilizer application is the norm in the state, the exact NPK in different fertilizers were not known by majority of the farmers (71.67%). Farmers applied

chemical fertilizers even during harvesting season hoping for better yield. Though the INM is a cost-effective practice, many farmers perceived that integrated use of both natural and chemical fertilizers would increase the cost of cultivation in the form of labour for its application and capital investment. Therefore, its awareness was low

(26.66%). Majority of the farmers lacked awareness of essential micronutrients (75.84%) and primary and secondary nutrients (91.67%) as they only knew about N, P, K and few other nutrients and felt these concepts as too technical to understand. That was the reason for its low awareness.

Table 1: Awareness of respondents towards INM practices in RWCS

(n=120)

S. No.	Particular	Frequency (%)		Rank
		Aware	Not Aware	
1.	Are you aware that Soil Health Card (SHC) provides information regarding the status of available nutrients in soil?	81 (67.50)	39 (32.50)	XI
2.	Are you aware that SHC helps to check the excessive use of fertilizers?	45 (37.50)	75 (62.50)	XV
3.	Are you aware that SHC helps farmers in reducing expenditure by supplying required nutrients in the soil?	44 (36.66)	76 (63.34)	XVI
4.	Are you aware of primary and secondary nutrients?	10 (8.33)	110 (91.67)	XX
5.	Are you aware of importance of essential micronutrients?	29 (24.16)	91 (75.84)	XIX
6.	Are you aware about percentage content of NPK in different fertilizers?	34 (28.33)	86 (71.67)	XVII
7.	Are you aware about balanced use of fertilizers?	120 (100)	-	I
8.	Are you aware of time and method of application of manures and fertilizers?	120 (100)	-	I
9.	Are you aware of organic manures and fertilizers?	120 (100)	-	I
10.	Are you aware that use of organic manures and fertilizers improve soil health?	120 (100)	-	I
11.	Are you aware that organic matter is essential for maintaining soil fertility and crop yield?	100 (83.33)	20 (16.67)	VIII
12.	Are you aware of benefits of incorporation of green manure crops in soil?	87 (72.50)	33 (27.50)	X
13.	Are you aware of burning of crop residue in field affects the soil health?	54 (45.00)	66 (55.00)	XII
14.	Are you aware about bio-fertilizers and their benefits, <i>i.e.</i> , Rhizobium, Azotobacter, Azospirillum, PSB, <i>etc.</i> ?	54 (45.00)	66 (55.00)	XII
15.	Are you aware that INM increases the organic matter?	120 (100)	-	I
16.	Are you aware that INM sustains the soil health?	108 (90.00)	12 (10.00)	VII
17.	Are you aware that INM increases the crop yield?	48 (40.00)	72 (60.00)	XIV
18.	Are you aware that INM is cost effective practice?	32 (26.66)	88 (73.34)	XVIII
19.	Are you aware that crop residue management practices improves the soil physical, chemical properties and biological activities?	99 (82.50)	21 (17.50)	IX
20.	Are you aware that INM is key to sustainable agriculture?	113 (94.16)	7 (5.84)	VI

Data in Table 2 highlights that about two-third of respondents (66.67%) were in medium category of awareness, followed by 21.67 percent respondents in high category and 11.66 percent of respondents in low category of awareness towards INM practices in RWCS. Similar findings were reported by Kaur (2019) [4]. Probable reason may be that higher social participation, mass media exposure, frequent contacts with extension personnel helped in gaining information and awareness about recommended practices or new technologies. The present study found that

about two-third farmers were having membership of at least one social institution, more than 85.00 percent farmers had medium to high level of mass media exposure and extension contacts, which helps directly in channelization of information and new recommendation practices. These findings were partially supported by findings of Rohila *et al.* (2017) [9]. Probable reason for respondents having low awareness is low level of education of few respondents and complexity to understand this kind of information. These findings are supported by Madhu (2019) [5].

Table 2: Overall Awareness level of respondents towards INM practices in RWCS

(n=120)			
Category	Range	Frequency	Percentage
Low	≤ 10.13	14	11.66
Medium	10.14-15.50	80	66.67
High	>15.50	26	21.67

Factors affecting awareness level of the farmers

The correlation analysis given in Table 3 revealed that among the 13 independent variables, age was found negatively significant with farmers’ level of awareness towards INM practices under RWCS. Education, land holding, farming experience, social participation, farm power, extension contacts, mass media exposure and risk orientation were found positively and significantly correlated with awareness level of respondent farmers at significant level of one percent, while farming experience was found significant at the five percent level of significance. Analysis also showed that family size, family size, occupation and caste were non-significant with farmers’ awareness level of INM practices. These findings were partially supported by findings Naik *et al.* (2009) [7] and Rohila *et al.* (2017) [9].

The probable reason that age was negatively correlated as respondent at young age was possessing high education and as education level increases, awareness and knowledge of complex practices increases which leads to better adoption. Young, educated and large land holding farmers leaned towards high risk bearing abilities and could try to adopt new practices in their farm. Social participation, mass media exposure and extension contact played an important role in flow of information from one person to another person and create awareness and knowledge about new technologies or practices available in market. Hence, these were found to be highly correlated with awareness.

Table 3: Pearson correlation between farmers’ awareness level and selected independent variables

S. No.	Independent variables	Correlation coefficient (r)
1.	Age	-0.293**
2.	Education	0.239**
3.	Family type	0.056 ^{NS}
4.	Family size	0.061 ^{NS}
5.	Occupation	0.071 ^{NS}
6.	Caste	0.110 ^{NS}
7.	Land holding	0.331**
8.	Farming experience	0.220*
9.	Social participation	0.458**
10.	Farm power	0.325**
11.	Mass media exposure	0.381**
12.	Extension contacts	0.492**
13.	Risk orientation	0.497**

** : Significant at the 0.01 level

* : Significant at the 0.05 level

^{NS} : Non-significant

Conclusion

RWCS is a fertilizer intensive cropping system. The disproportionate use of chemical fertilizers has led to various issues in the system. The solution lies in INM. The results of the present study conclude that majority of the farmers had medium level of awareness of INM practices. It

clearly indicates the need to raise awareness and adoption of INM practices by farmers for system’s sustainability. Increasing the awareness by trainings and use of biofertilizers by subsidizing them is a solution. The various independent variables could be manipulated for its use in increasing the awareness of the farmers in the study area. This will lead to overall sustainability of rice-wheat cropping system.

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