Soil-health management in nutrient-deficient soils: A case study of Indian farmers

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ABSTRACT

The present study was carried out in two agro-climatic zones of the state of Haryana in India, viz. north-eastern zone and south-western zone with the objective that how farmers approach soil-health management in nutrientdeficient soils. The outcomes have been visualised in this paper after conducting a field survey during 2018–19 of 240 farmers, who were interviewed with a well-structured interview schedule. The study found that respondents' awareness level was good about the Integrated Nutrient Management (INM), had a rich knowledge about Integrated Farming System (IFS) and were well aware about organic farming. Major constraints faced by the respondents in INM, IFS and organic farming were 'high fertilizer cost and manures are bulky to handle', 'high rate of interest on borrowings and initial cost of production' and 'prices are not remunerative', respectively. The study concluded that there was a gap in awareness level of soil health management practices among the farmers. Hence, there is an immense need to motivate and encourage the farmers.

Keywords: Awareness level, IFS, INM, Organic farming, Soil health

India is one of the major agricultural production based economies, where nation's 58% population relies on agriculture for liveliness. A heavy pressure on India's land resources is exerted due to the modern economic and trade liberalization. Therefore, the joint effect of obtaining food demand under finite cultivable area and healthy agricultural produce have become a prerequisite forcing factor for India to expand our potential for opting traditional agriculture, the efficient farming approach endorse by governments, agribusiness groups everywhere in the world and organic agriculture which is an integrated-production management structure supportive to health, environment and sustainability. Future strategies for increasing agricultural production will have to focus on using available natural resources more efficiently, effectively and sustainably than in the past. Since there is no scope to increase the net cultivable land, intensive cropping through integrated soil fertility and nutrient management could be one of the important means to further increase of crop production (FAO 2004). Thus, optimum allocation of available resources is important to reduce the risk related to land sustainability. To mitigate the continuous increase in demand for stability of income and food, IFS seem to be the possible solution. The IFS provides an excellent opportunity to increase the yield (Ravisankar *et al.* 2007, Rathore and Bhatt 2008).

Growth of population and changes in dietary conditions will bring worldwide food demand to remarkable levels in the coming decades. To hold this momentum, food production will have to increase 60% by 2050 (FAO 2013). India's population is projected to continue growing for several decades to around 1.5 billion in 2030 and approaching 1.66 billion in 2050. Whereas, natural resources are deteriorating and degrading at a very fast rate due to unmindful agricultural intensification, imbalanced use of fertilizers, overuse and inefficient use of irrigation water and deforestation. Therefore, there is immense need of soil health management practices to enhance the production and productivity through sustainable use of natural resources and keeping the soil healthy (Patel *et al.* 2017).

MATERIALS AND METHODS

The study was conducted in Haryana which is divided into two agroclimatic zones such as North-Eastern Zone and South-Western Zone. From each zone two districts were selected purposively, viz. Kurukshetra and Karnal from North-Eastern Zone and Bhiwani and Rewari from South-Western Zone having highest degraded soil. Further, two

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blocks Thanesar and Babain from Kurukshetra; Karnal and Indri from Karnal; Siwani and Kairu from Bhiwani; and Khol and Bawal from Rewari were selected purposively having highest nutrient deficiency. Thirty respondents were selected randomly from each block. Thus, a total of 240 farmers were interviewed for this study during 2018–19.

To validate the theoretical models and ideas, primary data can be gathered in three different ways: survey methods, observational procedures and by conducting experiments. In survey methods, information is gathered by asking individuals questions they are thought to have the option to reply. Questioning can be possible through personal interviews, telephone interviews, as well as mail questionnaires. In present study, the data was collected with a well-structured and pre-tested interview schedule. The responses were taken on three-point continuum scale in case of awareness (not aware, aware and fully aware) and constraints (not so serious, serious and very serious). Frequency, percentage, mean, rank, correlation coefficient, regression coefficients and chi-square values were calculated for the analysis and interpretation of data.

RESULTS AND DISCUSSION

Farmers' awareness towards different soil health management practices: Data (Table 1) show that awareness level was good about 'INM increase the crop yield' ranked 1st position with weighted mean score of 2.10, awareness level of INM sustain the soil health and organic manures and fertilizers were ranked 2nd with weighted mean score of 2.01 followed by balanced use of fertilizers ranked 3rd with weighted mean score of 1.99. Whereas, awareness level in case of 'essential micronutrients' was lowest with weighted mean score of 1.33. To maintain the good health

of soil while confirming higher crop productivity, awareness level must be amplified among the farmers through trainings and awareness campaigns by local authorities because INM advocates the connective use of both organic as well inorganic sources of nutrients. The findings are in line with those reported by Farouque (2007) and Mahajan *et al.* (2007).

It is clear from data (Table 2) that farmers had rich knowledge about IFS and it was found that IFS help them in increasing the production ranked 1st with highest weighted mean score of 1.92. IFS maintain soil health properly (Singh *et al.* 2014), IFS give the income round the year (Kumar *et al.* 2013) and IFS help to generate the employment throughout the year (Dasgupta *et al.* 2015), all thrice were equally ranked at lowest position with weighted mean score of 1.79. Majority of farmers in India belongs to small and marginal land holding categories (Sahu *et al.* 2019) and therefore IFS may be adopted as an alternative. The agroforestry based integrated farming system is suitable for improving economic condition, employment opportunities, productivity and nutritional security (Harsh and Tewari 2007). So, there is an immense need to arouse the interest as well as awareness regarding the IFS. These results are in agreement with those reported by Rai *et al.* (2013).

Data (Table 3) show that most of respondents were aware about organic farming with organic farming reduces input cost ranked at 1st position with weighted mean score of 2.38 and closely followed by organic farming enhances food quality' ranked at 2nd position with weighted mean score of 2.36. While, awareness about 'organic farming allows soil carbon sequestration (Dhyani *et al.* 2016, Ajit *et al.* 2017) ranked lowest with weighted mean score of 1.47. The farmers' awareness level needs to enhance so that

Table 1   Awareness towards INM

Statement	Fully aware (%)	Aware (%)	Not aware (%)	Total weighted score	Weighted mean score	Rank order
Balanced use of fertilizers	38 (15.84)	161 (67.08)	41 (17.08)	477	1.99	III
Time and method of use of FYM and fertilizers	34 (14.17)	156 (65.00)	50 (20.83)	464	1.93	IV
Organic manures and fertilizers	41 (17.08)	161 (67.08)	38 (15.84)	483	2.01	II
Aware from biofertilizers	24 (10.00)	48 (20.00)	168 (70.00)	336	1.40	VII
Primary and secondary nutrients	24 (10.00)	34 (14.17)	182 (75.83)	322	1.34	VIII
Essential micronutrients	24 (10.00)	31 (12.92)	185 (77.08)	319	1.33	IX
INM increase the organic matter	55 (22.92)	96 (40.00)	89 (37.08)	446	1.86	V
INM sustain the soil health	67 (27.92)	108 (45.00)	65 (27.08)	482	2.01	II
INM increase the crop yield	72 (30.00)	120 (50.00)	48 (20.00)	504	2.10	I
Percentage of NPK in different fertilizers	31 (12.92)	96 (40.00)	113 (47.08)	398	1.66	VI

Figures in parenthesis are the per cent (n=240)

Table 2   Awareness towards IFS

Statement	Fully aware (%)	Aware (%)	Not aware (%)	Total weighted score	Weighted mean score	Rank order
IFS helps to increase the production	68 (28.33)	85 (35.42)	87 (36.25)	461	1.92	I
IFS helps to reduce the cost of production	69 (28.75)	79 (32.92)	92 (38.33)	457	1.90	II
IFS maintain soil health properly	49 (20.42)	92 (38.33)	99 (41.25)	430	1.79	V
IFS increase the total farm income	47 (19.58)	104 (43.34)	89 (37.08)	438	1.83	IV
Effective use of farm resources under IFS	62 (25.83)	88 (36.67)	90 (37.50)	452	1.88	III
IFS help to generate the employment throughout the year	38 (15.84)	113 (47.08)	89 (37.08)	429	1.79	V
IFS gives the income round the year	40 (16.67)	110 (45.83)	90 (37.50)	430	1.79	V

Figures in parenthesis are the per cent (n=240).

Table 3   Awareness towards organic farming

Statement	Fully aware (%)	Aware (%)	Not aware (%)	Total weighted score	Weighted mean score	Rank order
Organic farming reduces input cost	99 (41.25)	132 (55.00)	9 (3.75)	570	2.38	I
Organic farming sustaining soil health	72 (30.00)	160 (66.67)	8 (3.33)	544	2.27	IV
Organic farming and soil carbon sequestration	20 (8.33)	72 (30.00)	148 (61.67)	352	1.47	VIII
Organic farming is pollution-free approach	85 (35.42)	147 (61.25)	8 (3.33)	557	2.32	III
Organic farming enhances food quality	97 (40.42)	133 (55.42)	10 (4.16)	567	2.36	II
Organic products are good in nutritive value	73 (30.42)	154 (64.16)	13 (5.42)	540	2.25	V
Better returns organic than old farming	63 (26.25)	157 (65.42)	20 (8.33)	523	2.18	VI
Organic farming with conservation technique	52 (21.67)	150 (62.50)	38 (15.83)	494	2.06	VII

Figures in parenthesis are the per cent (n=240).

they can be encouraged to adopt organic farming. Rohilla (2018) also reported similar findings.

Constraints perceived in adoption of soil health management practices by farmers: The data indicates that the major constraints reported by respondents in INM were 'high fertilizer cost' and 'manures are bulky to handle' jointly at 1st position with weighted mean score of 2.13 followed by 'lack of knowledge about essential nutrients' ranked 2nd with weighted mean score of 2.08. While lack of knowledge about trash composting (sugarcane) was ranked lowest and it was not so serious constraint. Therefore, it is suggested that improving the methods, doses, scheduling of fertilizer application and protecting nutrient losses by various measures can seems the fertilizer cost lower. *In-situ* green manuring and improving the manure nutrient percentage by proper composting can overcome the problem of handling of bulky manures. The results of study are in line with Pandey and Singh (2012).

The data shows that out of the total constraints related to IFS, high rate of interest on borrowings, high initial cost of production and non-availability of subsidy/credit in time were found as very serious constraints jointly at 1st rank with weighted mean score of 2.25 followed by 'non-availability of quality planting materials/breeds/species' with weighted mean score of 2.02. Therefore it is recommended to the farmers that start the farming system model at small scale land unit area first, and implement it to large scale later on as possible to overcome the problems related to borrowings, cost, and subsidies etc. it is also required from the government side to easily provide the credit and subsidies to boost the IFM system. These findings were in line with the findings of Pushpa (2010) and Pandey *et al.* (2019). The data shows that the major constraints reported by respondents were price is not remunerative, lack of training and visit programme on organic farming and small and fragmented size of holding ranked 1st, 2nd and 3rd positions with weighted mean scores of 2.06, 1.99 and 1.94, respectively. While non-availability of relevant literature was not so serious constraint reported by respondents and ranked lowest with weighted mean score of 1.35 (Namdev *et al.* 2011). Therefore, it is suggested to strengthen the organic produce market and provides the training and visit progamme on organic farming to mitigate these constraints. The number of certifying agencies should be increased. The results of study are in line with Pandey and Singh (2012) and Midame (2020).

Association between farmers' profile and awareness: The awareness levels of farmers towards INM, IFS and organic farming is presented in Fig 1. Data clearly depicts that 52.90% farmers were aware about INM and 63.75% farmers were aware about organic farming, whereas 45.40% were not aware about IFS. The study revealed significant association between different personality traits like education (χ^2=11.37) socio-economic status (χ^2=38.99), agrochemicals (χ^2=10.71)
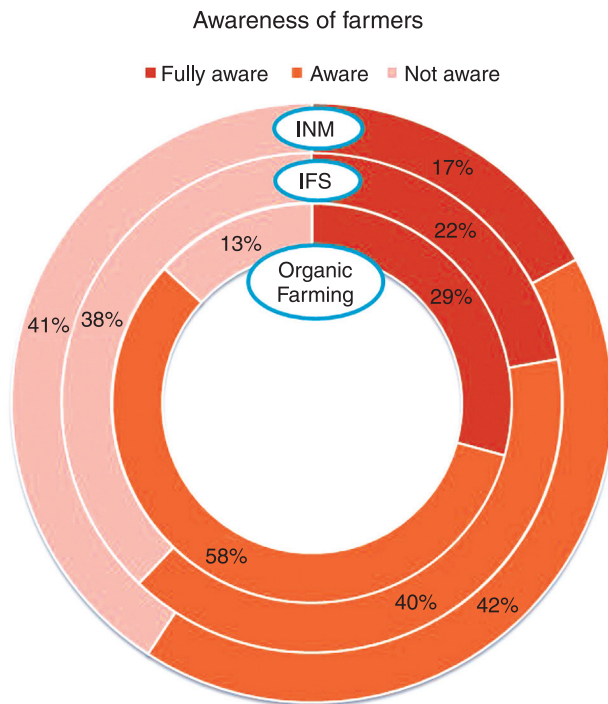
pre-requisites for management of soil health.

Fig 1 Awareness levels of farmers towards INM, IFS and organic farming.

and soil-health card (χ^2=11.76) with the awareness towards INM. The data presented a significant association between personality traits like socio-economic status (χ^2=12.21) and soil-health card (χ^2=14.80) with the awareness towards IFS. There is significant association between traits like farm inputs (χ^2=10.96), irrigation (χ^2=8.66) and mass-media exposure (χ^2=10.38) with the awareness towards organic farming. However, remaining traits like age, caste, land holding, farm equipment, crop rotation, cropping pattern and extension contacts did not show any significant association with the awareness in adoption of soil health management practices.

The study revealed that there was a gap in awareness level of soil health management practices (SHMPs). Hence, there is an immense need to motivate and encourage the farmers by organizing continuous trainings, lectures, campaigns and demonstrations. These practices can motivate and encourage them to adopt skill oriented techniques in conjugation with subsidies from central and state government agencies. In addition, a well-structured and sound national level planning can definitely enhance the farmer's awareness level regarding SHMPs, so that they could be able to achieve the target of sustainable agriculture while sustaining the natural resources. The government should emphasize on the problems perceived in adoption of SHMPs by farmers. Therefore, more efficient and effective action plans must be formulated and implemented at grass root level by the government to ensure the availability of organic manure and microbes, amendments and equipment to boost the soil health. and also needs to provide the subsidies, support price to encourage organic farming and provision of financial help at reasonable interest rate that are considered to be the

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