Research Article

Indian Journal of Extension Education
Vol. 58, No. 3 (July–September), 2022, (83-87)

ISSN 0537-1996 *(Print)*
ISSN 2454-552X *(Online)*

Comparing the Nutrient Management Pattern in Soybean and Rice based Cropping Systems by Soil Health Card holders and Non-holders

Meenal Dubey[1], Kallely C. Shinogi[2]*, H. K. Awasthi[3] and M. A. Khan[4]

[1]Research Scholar, [3&4]Professor, Department of Agricultural Extension, College of Agriculture, IGKV, Raipur, Chhattisgarh, India
[2]Scientist, ICAR-Indian Institute of Soil Science, Bhopal, Madhya Pradesh, India
*Corresponding author email id: shinojikallely@gmail.com

ARTICLE INFO

Keywords: Soil health, Nutrient management, Soil health card, Productivity, Adoption

http://doi.org/10.48165/IJEE.2022.58318

ABSTRACT

The paper discusses about the importance of Soil Health Card (SHC) based nutrient management based on a study carried out during 2017-18 on 100 SHC beneficiary farmers and 50 SHC non-beneficiary farmers of Madhya Pradesh. Significant differences between the beneficiary and non-beneficiary farmers of soil health card in the nutrient use pattern in soybean and rice-based cropping systems were found. Majority of the SHC beneficiaries failed to adopt the fertilizer nutrients as per recommendation. Major reasons identified behind this negative trend were difficulty in understanding the SHC information without the help of an agricultural/ extension officer and lack of knowledge about the importance of SHC &benefits associated with adopting soil test based nutrient management. Further, the positive correlation of micro and secondary nutrients application with the yield and income from the adopters' farm fields reaffirms the key role scientific nutrient management plays in improving agriculture based rural economies. More efforts from the promoting agencies required to convince farmers to adopt SHC based nutrient recommendation.

INTRODUCTION

Soil is an important land resource that supports agriculture and the basis of sustenance for diverse life forms on earth. To sustain the life of its dependents, soils also need to be healthy. Unhealthy soils that do not hold enough moisture and nutrients often fail to support proper growth and development in crop plants. These soils in general need more external inputs but generate less crop yield per unit of input as they use inputs inefficiently. Moreover, soils with poor health are highly susceptible to further degradation and their productivity potential gets weakened with time (Katyal et al., 2016). In a scenario where 33 per cent of the world soils are reportedly degraded due to various reasons, lots of efforts are required to achieve the target of 60 per cent increase in global agricultural production by 2050, to meet the global food requirement (FAO, 2015). An assessment of degraded lands in India showed nearly 120.72M ha of arable land and open forest under the degraded and waste land category with ≥14 M ha degraded and waste land in Rajasthan, Uttar Pradesh and Madhya Pradesh each (ICAR and NAAS, 2010). To make the land-based livelihoods sustainable and ensure food security for the future generations, the first and foremost step in the country needs to be the management of its soil resources that includes rejuvenation of degraded and wastelands (Aulakh & Sidhu, 2015).

Realising the importance of soil health for ensuring enough food for the growing population of the country, the government of India launched a soil health management programme in the year 2015 under the National Mission for Sustainable Agriculture (NMSA). The programme emphasized sustainable soil health management promoting judicious application of fertilizers and manures through issuing soil health cards (SHCs) to all farmers of the country in every three years (GoI, 2016). Scientific use of chemical fertilizers through SHCs expected to economize the fertilizer use in the country by reducing their consumption in the areas where soil

Received 19-05-2022; Accepted 27-05-2022

fertility is built up and increasing their use in the areas where it is required. That in turn ensures enhanced productivity sustainably (Acharya & Srivastava, 2017). The government of India data (https://soilhealth.dac.gov.in/) show distribution of nearly 10,73,89,421 SHCs to the farmers of different states in the first phase of the programme.

Generating nearly 163,89,077 SHCs, Uttar Pradesh ranked on the top of SHC distribution in the first phase of the Scheme, followed by Maharashtra (40,70,904) and Madhya Pradesh (38,78,333). Studies on impact of SHC in different parts of Madhya Pradesh conveyed an increased awareness among framers about the importance of scientific application of manures and fertilizers for different crops (Niranjan et al., 2018; Ghaswa et al., 2019). Several SHC beneficiaries in Madhya Pradesh adopted SHC based nutrient management and benefitted in terms of yield and income (Singh et al., 2019). However, not many studies are available on the changing trend in the use of plant nutrients with the introduction of SHC. This paper analyzed the impact of SHCs on the fertilizer use behaviour of farmers as well as crop productivity in central India.

METHODOLOGY

The study was conducted in the Raisen district of Madhya Pradesh during 2017-18. An ex-post-facto research design was adopted for the study. Raisen district was selected for the study considering its good performance in distributing SHCs to a large number of farmers within the time frame in the cycle-I of the SHC scheme i.e., 2015-16 and 2016-17. (https://soilhealth.dac.gov.in/PublicReports/ProgressReportDistrictWise). Two blocks of the district viz., Sanchi and Gairatganj were selected purposively as the implementing agency of SHC scheme in the district, Krishi Vigyan Kendra (KVK), Raisen, distributed SHCs mainly in these two blocks, in the first phase. Further, to constitute the sample size of one hundred SHC beneficiary and fifty SHC non-beneficiary farmers, fifty SHC beneficiaries and twenty five SHC non-beneficiaries were randomly selected from each of the two blocks. Data collection was carried out through personal interview of the respondents with the help of a semi structured and pre-tested schedule. Nutrient management pattern of respondents was assessed on a three-point scale from 0 to 2. No adoption, Partial adoption and Full adoption were scored 0, 1, 2, respectively. If the farmer applied the recommended fertilizer(s) in more or less equal dose as per SHC it was considered as 'full adoption' whereas, if he/she applied it in a relatively lower or higher dose than recommended it was considered as 'partial adoption' and 'no adoption' if he/she failed to adopt the SHC recommendation. Level of adoption of fertilizer products was calculated using Adoption Quotient explained by Singh (1981) with slight modification.

To analyze the constraints, a list of constraints faced by the SHC beneficiary farmers in different parts of the country were prepared from the available literature and seven statements were selected based on judges rating. Farmers were asked to rank those statements based on their experience and their responses were analyzed using Garrets ranking technique. Other statistical tools used for data analysis were descriptive statistics, and non-parametric tests like Mann-Whitney U test and Spearman's rank correlation.

RESULTS AND DISCUSSION

Crop diversity and cropping pattern

The study confirmed crop diversity in the farmlands of both groups of respondents. Major crops grown in the study area on commercial basis during *kharif* season were soybean and rice whereas, that of *rabi* season were wheat and gram. However, farmers also integrated many other crops like maize, pigeonpea, green gram and different vegetable crops in their farming system mainly for family food requirement. These crops had been commercially cultivated by nearly 10 per cent of the SHC beneficiary and 24 per cent of the SHC non-beneficiary farmers. Majority of the farmers were practising monocropping of soybean and rice (52% of SHC beneficiary and 62% of the non-beneficiary farmers) in the *kharif* season. However, the *rabi* crop wheat had been cultivated as a monocrop in hardly 14 per cent of SHC beneficiary and 26 per cent of the non-beneficiary farm fields. Multiple cropping of commercial crops such as soybean and rice in the *kharif* season was identified as regular practice in 31 per cent SHC beneficiary farm fields. Whereas, multiple cropping of wheat, gram, and lentil in the *rabi* season was practiced by both SHC beneficiary (69%) and non-beneficiary (34%) farmers.

Nutrient management practices, productivity and profitability

Analysis to identify discrepancies in the nutrient management pattern of the SHC beneficiary and non-beneficiary farmers showed significant differences between the two groups of farmers in the adoption of nutrients in their farmlands (Table 1). Higher mean ranks of SHC beneficiaries for NPK (83.75), MSN (88.46) and FYM (82.46) than SHC non-beneficiaries indicate that the nutrient management practices of SHC beneficiaries were much improved and balanced compared to SHC non-beneficiaries. Further analysis to understand the adoption pattern of different nutrients by the two groups of respondents showed the entire group of SHC beneficiary as well as non-beneficiary farmers adopted NPK nutrients but, in varying doses. However, hardly 2 per cent of the SHC non-beneficiaries adopted micro and secondary nutrients. Also, FYM application was not adopted in 24 per cent of the non-beneficiary farmlands. Use of different manures (pre-digested or semi digested) in agriculture limited to nearly 60 per cent farm fields in Madhya Pradesh (Motiwale et al., 2020).

Table 1. Comparison of two groups for the nutrient management pattern

Nutrients	Mean Rank		Mann-Whitney	*p* value
	SHC beneficiary	SHC non-beneficiary	U	
Major nutrients (NPK)	83.75	59.00	1675.00	< 0.001
Micro & secondary nutrients (MSN)	88.46	50.10	1230.00	< 0.001
Farmyard manure (FYM)	82.46	61.59	1804.50	0.001

For the SHC beneficiaries, as there were prescribed doses of fertilizer nutrients based on the soil test values of their farmlands, analysis was done to understand the trend of nutrient use in terms of manures and fertilizers. Results (Table 2) showed that all the SHC beneficiaries were adopters of NPK fertilizer products such as urea, DAP/SSP and MOP but, majority of them were only partial adopters. The higher mean AQ value for the K fertilizer MOP compared to N and P fertilizers (Urea, DAP, SSP) conveyed its increased use. Findings of the study on impact of SHC scheme carried out by the National Institute of Agricultural Extension Management (MANEGE) supported these results as they reported a twenty per cent increase in the use of K fertilizers along with a slight decline in the use of N fertilizers (9%) and P fertilizers (7%) among the paddy framers of the country due to SHC scheme (PIB, 2021). According to fertilizer statistics of FAI (2020), consumption of N and P fertilizer products were more in Madhya Pradesh agriculture than K fertilizer. In the case of other nutrient products, many farmers failed to adopt micro and secondary nutrient fertilizers (40%) and FYM (13%) recommended in their SHCs. Studies on adoption of SHC based nutrient recommendation in Andhra Pradesh also confirmed many SHC beneficiary farmers as partial adopters and fertilizer dose is mostly based on their own perception (Chowdary & Theodore, 2016). Majority of this group of adopters applied fertilizer nutrients in higher doses than recommended expecting a higher yield performance (Chowdary et al., 2018). One of the main reasons behind the non-adoption of micronutrients by a lion share of SHC beneficiary farmers in the country was reported to be low awareness and knowledge about the benefits of micronutrients (Kumar & Rani, 2018).

The correlation analysis (Table 3) revealed that application of micro and secondary nutrients had positive correlation with average crop yield and income of SHC beneficiary farmers., this practice showed positive correlation even with the average crop yield of SHC non-beneficiary farmers. Increase in the net farm income with the adoption of SHC based nutrient application from the farm fields of Madhya Pradesh was earlier reported by Singh et al., (2019). Though application of FYM did not show any significant correlation with crop yield the practice showed moderate correlation with the net income of the SHC beneficiary farmers. Positive impact of using straight fertilizers on the net farm income, if they were applied based on the soil test value was reported by Jayalakshmi et al., (2021). Possible reason for the positive impact of FYM on net farm income here might be due to the application of this locally available-low cost input in a required/higher dose with a proportional decrease in the dose of fertilizer nutrients.

Multiple cropping of rice and soybean in kharif season along with wheat and gram in rabi season were mostly adopted by the SHC beneficiary farmers. The average yield of crops from the system were 36.6 q ha^{-1} for rice, 2.5 q ha^{-1} for soybean, 37.4 q ha^{-1} for wheat and 14.2 q ha^{-1} for gram crops. From the rice based cropping systems, average yields obtained from SHC beneficiary and non-beneficiary farm fields for rice crop were 33.2 q ha^{-1} and 30.2 q ha^{-1}, 30.8 q $ha^{-1}$and 26.6 q ha^{-1} for wheat crop, and 15.4 q ha^{-1} and 13.8 qha^{-1} for gram crops. Average yield of soybean, wheat and gram crops for the SHC beneficiary farmers from soybean based cropping systems were 2.84 q ha^{-1}, 28.9 q ha^{-1} and 10.9 q ha^{-1} respectively and for the non-beneficiary farmers yield values of these crops were 1.55 q ha^{-1}, 24.9 q ha^{-1} and 7.4 q ha^{-1} respectively. Possible reasons for the lower yield from the soybean crop could be erratic rainfall and outbreak of yellow mosaic virus along with pest attack occurred in the state widely during the study period as well as in the previous two kharif seasons (Srivastava et al., 2021). Farmers cultivated mostly the soybean varieties JS 93-05 and JS 95-60 and both of these varieties are reportedly susceptible to the yellow mosaic virus disease (JNKVV, n.d).

Constraints associated with the Use of SHC

The Garret's ranking analysis showed the most prominent constraint faced by the SHC beneficiary farmers of the study area as 'difficulty in understanding the information given in SHC without the assistance of an agricultural/extension officer' (Table 4). lack of knowledge about what is SHC and its use even after receiving the

Table 2. Extent of adoption of SHC based nutrient doses through fertilizers

Recommended Fertilizers in SHC	Full adoption (%)	Partial adoption (%)	No adoption (%)	Mean AQ (%)
Farmyard manure	29	58	13	58.0
Urea	4	96	–	52.0
Di Ammonium Phosphate (DAP)/ Single Super Phosphate (SSP)	13	87	–	53.8
Muriate of Potash (MOP)	22	77	1	60.5
Zinc fertilizer	30	30	40	45.0
Sulphur fertilizer	30	30	40	45.0

Table 3. Correlation between nutrient use and average yields from cropping systems

Nutrients	Spearman's rho			
	Average system yield		Net Income	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
NPK nutrients	0.0	-0.137	0.0	0.134
Micro & secondary nutrients	0.505**	0.337*	0.290**	0.176
Farmyard manure	0.159	0.301	0.282**	0.081

*Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level

Table 4. Ranking of constraints associated with SHC use through Garret's ranking

S.No.	Constraints	Mean Score	Rank
1.	Difficulty in understanding the SHC information without the helpof an agricultural/extension officer	45.24	I
2.	Unavailability of recommended quantity of FYM for farming	16.35	III
3.	Lack of trust in the information given in SHC	9.33	VI
4.	High cost of fertilizers recommended in SHC	7.02	VII
5.	Unavailability of SHC before the crop season	15.57	IV
6.	Lack of knowledge about the importance of SHC and the benefits associated with adopting the soil test based nutrient management even after receiving the card	22.2	II
7.	Other personal constraints associated with illiteracy/low education	10.95	V

card and unavailability of recommended quantity of FYM for farming were also ranked among the top three constraints associated with the use of SHC. Other researchers have also reported similar issues faced by the farmers while adopting the SHC based nutrient recommendations in different parts of the country (Ghaswa et al., 2019; Gogoi et al., 2021; Senthamizhselvan et al., 2022). This calls for the need for more extensive efforts from the promoting agencies of SHC such as government and other extension agencies to enhance the knowledge level of farming community about the use as well as benefits associated with SHC through different capacity building programmes. Thus, farmers could develop more understanding about this innovative technology and that in turn lead to its proper adoption.

CONCLUSION

Significant differences observed in the nutrient use between the SHC beneficiary and non-beneficiary farmers confirm the effectiveness of SHC in generating awareness among the farmers about soil test based fertilizer use. However, many factors prevent the diffusion of the technology deep into the farming community such as difficulty in understanding SHC and lack of knowledge about scientific nutrient management. Correlation of application of micro & secondary nutrients with yield and net income of SHC beneficiary farmers is a visible result of this innovative tool. This study has revealed that the SHC scheme can have higher impact in the judicious use of plant nutrients through fertilizers and manures, if the farmers become successful in properly interpreting the information given in their SHCs as well as the direct and indirect benefits of SHC based nutrient management. This innovation may take lot more years to penetrate into the farming systems if the promoters fail to impart need based training/awareness programmes through targeted approach.

REFERENCES

Acharya, C. L., & Srivastava, S. (2017). Soil Health Card. *NAAS NEWS, 17*(2), 11-14. Available online: http://naasindia.org/page_details.php?pid=7

Aulakh, M. S., & Sidhu, G. S. (2015). Soil degradation in India: Causes, major threats, and management options. In: MARCO Symposium 2015 - Next Challenges of Agro-Environmental research in Monsoon Asia. pp. 151-156. National Institute for Agro-Environmental Sciences (NIAES), Tsukuba, Japan. Available: https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2_m_s_aulakh.pdf

Chowdary, K. R., & Theodore, R. K. (2016). Soil health card adoption behaviour among beneficiaryes of Bhoochetana project in Andhra Pradesh. *Journal of Extension Education, 28*(1), 5588-5597.

Chowdary, K. R., Prasababu, G., & Theodore, R. K. (2018). Soil health card adoption behaviour of farmers in Andhra Pradesh state of India. *International Journal of Current Microbiology and Applied Sciences,7*, 4028-4035.

FAI. (2020). *Fertiliser Statistics 2019-20*. The Fertiliser Association of India, New Delhi.

FAO. (2015). Soil is a non-renewable resource: Its preservation is essential for food security and our sustainable future. IYS Fact Sheets, Food and Agriculture Organization, Rome, Available: www.fao.org/fileadmin/user_upload/soils-2015/docs/EN/IYS_fact_sheets_preservation_en_PRINT.pdf

Ghaswa, R., Tripathy, S., & Sharma, B. (2019). Knowledge, adoption and constraints of soil health card based fertilizer application in Ratlam district, M.P. *Indian Journal of Extension Education, 55*(2), 94-96.

Gogoi, P., Barman, U., Sharma, R., & Deka, N. (2021). Socio economic factors affecting the use of soil health card in Assam Factors influencing the soil health card use in Assam. *International Journal of Current Microbiology and Applied Sciences, 10*(3), 419-426.

GoI (2016). National Mission for Sustainable Agriculture (NMSA): Operational guidelines. Department of Agriculture, Cooperation and Farmers Welfare, Government of India. Available: https://nmsa.dac.gov.in/pdfDoc/SHM_Guidelines472016.pdf

ICAR & NAAS. (2010). *Degraded and Wastelands of India, Status and Spatial Distribution*, pp 24-27, Indian Council of Agricultural Research and National Academy of Agricultural Science, New Delhi. Available: https://icar.org.in/files/Degraded-and-Wastelands.pdf

Jayalakshmi, M., Prasadbabu, G., Chaithanya, B. H., Bindhupraveena, R., & Srinivas, T. (2021). Impact of soil test based fertilizer application on yield, soil health and economics in Rice. *Indian Journal of Extension Education, 57*(4), 147-149.

JNKVV. (n.d). Soybean. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur. Available: http://jnkvv.org/Departments/Dep_DRS_Soybean.aspx

Katyal, J. C., Datta, S. P., & Golui, D. (2016). Global review on state of soil health. *Soil Health: Concept, Status and Monitoring*, pp 1-33. Katyal, J. C., Chaudhari, S. K., Dwivedi, B. S., Biswas, D. R., Rattan, R. K. & Majumdar, K. (Eds). Indian Society of Soil Science, New Delhi.

Kumar, D. V., & Rani, A. J. (2018). Adoption behaviour of paddy farmers on SHC recommendations. *Journal of Extension Education, 30*(3), 6113-6118.

Motiwale, V., Sharma, A., Gurjar, R. S., Thakur, D., & Pathak, K. N. (2020). Adoption of organic farming practices by farmers in Indore district of Madhya Pradesh. *International Journal of Current Microbiology and Applied Sciences, 11*, 2961-2964.

Niranjan, H. K., Chouhan, R. S., Sharma, H. O., & Rathi, D. (2018). Awareness and performance of soil health card scheme in central India. *Journal of Crop and Weed, 14*(1), 99-103.

PIB (2021). Implementation of soil health card scheme. Press Information Bureau, Government of Indian. Available: https://pib.gov.in/PressReleasePage.aspx?PRID=1697516

Senthamizhselvan, D., Kumaravel, K. S., & Baskar, D. C. (2022). Impact of soil health card on consumption and yield of paddy in Karaikal district for sustainable agriculture. *The Pharma Innovation Journal*, *11*(1), 544-546.

Singh, A. K. (1981). Study of some agro-economic, socio-psychological and extension-communication variables related with the level of fertilizer use of the farmers. Ph.D. Thesis, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidhyalaya, West Bengal.

Singh, S. K., Kumar, R., & Kushwah, R. J. (2019). Economic effect of soil health card scheme on farmer's income: A case study of Gwalior, Madhya Pradesh. *Indian Journal of Extension Education*, *55*(3), 39-42.

Srivastava, A. K., Marabi, R. S., Bal, L. M., & Yogranjan. (2021). Weather based rules for yellow mosaic disease prediction on soybean in Madhya Pradesh. *Indian Journal of Biochemistry & Biophysics*, *58*, 486-497.