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Adoption of Soil Health Card by Farmers in Haryana: Perceptions, Challenges and Way Forward

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HIGHLIGHTS

- Farmers believed that adopting the soil health card tailored fertilizer doses could lead to reduction in crop yield.
- Farmers perceived the annual lease land system as a severe constraint in getting soil health card.
- Further reduction in the per-bag quantity of urea could lead to an overall increase in its consumption.
- Regular visits of mobile soil testing vans in field could increase the adoption of soil health card.

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ABSTRACT

The Soil Health Card (SHC) program aims to enhance soil health by providing farmers with detailed information about the nutrient status of their soil. This study investigated farmers' perceptions, challenges, and potential pathways to enhance the adoption of SHC recommendations in Haryana. The analysis was based on primary data collected through face-to-face interviews with SHC adopters and non-adopters, utilizing a pre-tested semi-structured schedule in 2024. The findings revealed that farmers' perceptions of the benefits of the SHC remained low. The perceived constraints in obtaining SHC scored higher than those associated with implementing its recommendations. The study identified the annual lease land system as a key factor driving the indiscriminate use of fertilizers in the state. Although the recent reduction in the per-bag quantity of urea decreased usage in Haryana, any further reduction in bag weight might result in increased fertilizer consumption. The study recommended the use of mobile soil testing vans and timely delivery of soil health cards to promote greater adoption.

INTRODUCTION

Haryana has been an early adopter of chemical fertilizer based green revolution technology. Presently, the state has become second leading user of chemical fertilizers. However, the actual usage of fertilizers in the state deviates significantly from the recommended levels, with farmers reportedly applying excessive doses of nitrogenous fertilizers (Chand & Pavithra, 2015; Bora, 2022). While this practice may offer short-term benefits, the indiscriminate and high use of chemical fertilizers has raised significant challenges for the long-term sustainability of agriculture in Haryana (Veluguri et al., 2019). Overexploitation of soil and unbalanced fertilizer use have led to nutrient deficiencies and declining soil fertility, particularly in areas of intensive farming (Rani, 2019; Ohlan, 2021a).

India's National Mission on Sustainable Agriculture (NMSA), a component of the National Action Plan on Climate Change (NAPCC), emphasizes improving soil health, which aligns with the United Nations' Sustainable Development Goal 15 (SDG#15): Life on Land (Keesstra et al., 2018). SDG 15 recognizes agriculture as a critical economic resource and advocates for protecting land from degradation. In line with this goal, the Government of India (GoI)

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launched the Soil Health Card Scheme (SHCS) in 2015 to promote agricultural sustainability through better soil nutrient management. This scheme enables farmers to have their soil tested by certified agencies, which then provide a Soil Health Card (SHC). The SHC offers detailed information on the nutrient status of their soil and provides crop-specific fertilizer recommendations to ensure rationale use of inputs. It aims to promote sustainable agricultural practices by facilitating balanced use of fertilizers (Purakayastha et al., 2019).

The theoretical justification behind the SHCS draws from regenerative economics, which emphasizes sustainable practices (Dominati et al., 2019). However, the adoption of SHC recommendations depends heavily on farmers' perceptions and the challenges they face. These challenges vary by region, making it crucial to examine the specific factors affecting adoption in Haryana. Additionally, the GoI has recently changed the packaging of urea (nitrogenous fertilizer) by reducing its per-bag quantity from 50 kilogram (kg) to 45 kg. The objective of this ad hoc quantitative policy measure is to promote balanced use of fertilizer. It is, therefore, instructive to know the implication of this change in packaging of urea for fertilizer consumption in the state. A review of existing literature reveals a knowledge gap: while farmers are aware of this soil health testing scheme, little attention has been paid to analyze the constraints faced by farmers in Haryana, particularly regarding non-users of the SHC and tenant farmers. Additionally, the likely impact of recent measure for balanced use of fertilizer through reduction in per-bag quantity of urea is yet to be assessed in the state. This study seeks to address these gaps by exploring farmers' perceptions toward the SHC in Haryana and identifying the barriers to adopting its recommendations. The novel findings contribute to scientific knowledge to enhance the uptake of SHC practices. Additionally, the study offers valuable feedback to stakeholders, aiding in the more effective implementation of this policy.

METHODOLOGY

This study used a mixed-methods approach, combining quantitative surveys with qualitative interviews. The data for this study were collected through a farm-level field survey conducted in the Yamunanagar, Karnal, Kurukshetra, Rewari, Mahendragarh and Sirsa districts of Haryana in 2024-25. These districts were chosen based on their specialization in different crops grown in the state. This comprehensive study covers six main crops grown in Haryana, namely wheat, paddy, mustard, sugarcane, bajra, and cotton. These crops accounted for 85.12 per cent of gross area sown in the state in 2022-23. Given the large size of the population, applying Cochran (Potapov et al., 2022) sampling formula, at a 95 per cent level of confidence and a 5 per cent level of margin, the representative sample size was 396 respondents. Preliminary information on adopter of SHC was obtained from nearby soil health testing labs. A purposive sampling approach was adopted for choosing the sites for the survey. One block having high presence of adopters of SHC was marked from each district. By using the same method, three villages were selected from every block. A list of all farmers adopting SHC was prepared for every selected village. From each village, 11 SHC adopters were selected randomly. To isolate the impact of difference in soil fertility on use of fertilizer, the 11 farmers in each control group were selected from the nearby farms of farmers of experimental group by preparing a separate list and then choosing randomly.

Farmers were individually interviewed using a face to face method applying a pre-tested and semi-structured schedule. Participation in the survey was voluntary based on consent of farmers. Farmers' perception on utility, challenges and way forward in adopting SHC was sought using the five points Likert's scale with responses ranged from one (strongly disagree) to five (strongly agree). Additionally, the opinion of fertilizer retailers on changes in farmers' fertilizer purchasing patterns, due to the reduction in per-bag urea quantity, was gathered through qualitative personal interviews. In doing so, one fertilizer retailer was randomly selected from each district included in the study. The statistical techniques including, mean score (arithmetic mean), percentage (hundred times of mean score divided by highest potential value of scale), standard deviation, and standard error (standard deviation divided by square root of sample size) were applied to analyze the primary data.

RESULTS

Farmers' perceptions towards soil health card

Table 1 presents empirical estimates of farmers' perception regarding utility of SHC, analyzed using arithmetic mean, percentage, standard deviation, and standard error. For most items, the standard deviation was less than one, indicating consistency in farmers' responses. Additionally, the low standard error values, ranging from 0.03 to 0.07, suggested that the sample was representative of the broader population.

The results reported in Table 1 reveal that the mean scores of various items varied across several aspects of SHC. The highest perception was regarding the potential adverse impact of adopting recommended doses of fertilizers on crop yield (MS: 3.61), with a high percentage of 72.22. This was followed by farmers' perceptions of the sample collection method and the reliability of SHC information, with mean scores of 3.58 and 3.52, respectively. Other items with mean scores above three included the usefulness of SHC in the judicious use of fertilizers (MS: 3.40), improving soil sustainability (MS: 3.38), reducing the cost of fertilization (MS: 3.37), the validity of information reported in SHC (MS: 3.35), and managing micronutrients (MS: 3.14).

On contrary, farmers' perception was lowest (MS: 2.09) regarding its usefulness in restoring fertility of problematic soil. Notably, farmers had a low perception even about purpose of SHC (MS: 2.98). Similarly, their perceptions of the ease of adopting recommendations provided in SHC (MS: 2.45) and its usefulness in addressing problem of macronutrient deficiency in soil (MS: 2.95) were relatively low.

Implication of reduction in per-bag quantity of urea on fertilizer consumption

A four-point scale was used for assessing the likely impact of reducing per-bag urea quantity on fertilizer consumption, with responses as follows: one (no purchase of extra urea), two (purchase of extra urea, but less than the amount needed to

Table 1. Farmers' perceptions about soil health card

S.No.	Perception	MS	Percentage	SD	SE
1	SHC intends to help farmers	2.98	59.60	1.03	0.05
2	Soil samples collecting methods are scientific	3.58	71.62	1.20	0.06
3	SHC information is reliable	3.52	70.30	0.91	0.05
4	Recommendation given in SHC is simple to adopt	2.45	49.04	0.89	0.04
5	Macronutrient management is possible with SHC	2.95	59.04	1.25	0.06
6	Micronutrient management is possible with SHC	3.14	62.78	1.17	0.06
7	SHC is useful to reduce cost of fertilization	3.37	67.47	1.33	0.07
8	SHC helps to improve soil sustainability	3.38	67.63	0.88	0.04
9	SHC is useful in restoring fertility of problematic soil	2.09	41.87	0.70	0.04
10	Validity of SHC is temporary	3.35	66.97	0.91	0.05
11	SHC helps to check the indiscriminate use of fertilizers	3.40	67.98	0.65	0.03
12	SCH tailored doses of fertilizers reduces the crop yield	3.61	72.22	0.85	0.04

MS = Mean Score, SD = Standard Deviation, SE = Standard Error.
The perceptions reported in Table 1 are adapted from Ravikishore et al., (2021); Singh et al., (2023).

compensate for the original quantity), three (purchase of extra urea to maintain the original quantity), and four (purchase of extra urea exceeding the amount required to restore the original quantity). Table 2 gives estimates of farmers' preferences on additional use of fertilizer resulting from a reduction in urea bag weight. The average response (MS: 1.79) value was found to be lowest regarding farmers' choice of purchase of an extra quantity of urea in response of existing reduction in its per-bag quantity from 50 kg to 45 kg. Similarly, their likelihood of purchasing an extra dose of other fertilizers was also found to be low (MS: 1.84). On the other hand, the mean value (MS: 3.46) was highest in the context of their potential choice in response of any further reduction in per bag urea quantity by GoI. A total of 86.43 per cent of farmers expressed approval for purchasing additional urea if the government further reduces the per-bag quantity. The value of standard deviation (SD: 0.90) was lowest and less than unity for this item.

Pattern of adoption of soil health card

Farmers' response to the statements concerning pattern of adoption of SHC is quantified in Table 3. The mean scores for all three items assessing the adoption pattern of SHC recommendations indicate a relatively low level of adoption. For instance, the mean score for adopting SHC-tailored recommendations is 1.58, which corresponds to 31.52 per cent of the scale. Moreover, the majority of farmers have not obtained SHC for all their plots of land. Similarly, they do not regularly acquire SHC for the same piece of land.

Constraints in adoption of soil health card

Table 4 provides empirical estimates for major constraints in acquiring soil health card and adopting its recommendations. The mean response score ranged between 4.26, for leasehold land system, and 1.89 for potential increase in cost of fertilization. A total of 80.20 per cent farmers agreed with the statement that the ongoing tenant and land owner relationship does not provide assurance for getting same land for next year. On an average, the mean score of perceived constraints in getting SHC was higher than those of implementing its recommendations. The value of standard deviation for all items was found below unity. The value of SE was also low, indicating the validity of results. More specifically, farmers refuted concerns about the high cost of obtaining a SHC (MS: 2.26), limited access to soil health testing laboratories (MS: 2.26), increased

Table 2. Preferences regarding use of fertilizer

S.No.	Statement	MS	Percentage	SD	SE
1	You purchase an extra quantity of urea after reduction in per-bag urea quantity from 50 kg to 45 kg	1.79	44.82	1.00	0.05
2	You use an extra dose of other fertilizers after reduction in weight of urea bag	1.84	46.02	0.93	0.05
3	You would like to purchase an extra quantity of urea if government further reduces 45 kg to 40 kg per-bag urea quantity	3.46	86.43	0.90	0.05

Note: MS = Mean Score, SD = Standard Deviation, SE = Standard Error.

Table 3. Pattern of adoption of soil health card

S.No.	Item	MS	Percentage	SD	SE
1	You have gotten SCH for all pieces of land	2.22	44.34	1.21	0.09
2	You regularly obtain SHC after every 3 years	2.17	43.33	1.12	0.08
3	You have fully adopted SHC tailored recommendations	1.58	31.52	0.80	0.06

Note: MS = Mean Score, SD = Standard Deviation, SE = Standard Error.
The statements presented in Table 3 are adapted from Madhuri et al. (2024).

Table 4. Constraints in adoption of soil health card

S.No.	Constraint	MS	Percentage	SD	SE
a	Perceived constraint in getting SHC				
1	Leasehold land system	4.26	85.10	0.67	0.03
2	Lack of assurance for getting same land for next year	4.01	80.20	0.87	0.04
3	High cost of getting SHC	2.26	45.25	0.65	0.03
4	Soil health testing laboratory is far away from village	2.57	43.03	0.57	0.03
5	Soil health report does not received timely	3.63	72.53	0.48	0.02
b	Perceived constraint in adopting SHC recommendation				
6	Adverse impact on crop yield	3.74	74.75	0.66	0.03
7	Increase in cost of fertilization	1.89	43.79	0.51	0.02
8	Adequate quantity of required fertilizer was not available	3.68	73.69	0.80	0.04
9	Lack of understanding of tailored recommendations	2.07	41.41	0.66	0.03
10	Inadequate follow-up by extension agency	3.69	73.84	0.46	0.02

Note: MS = Mean Score, SD = Standard Deviation, SE = Standard Error.
The constraint items given in Table 4 are adapted from Ravikishore et al., (2021); Singh et al., (2023).

Table 5. Pathways for improving the adoption of soil health card

S.No.	Measure	MS	Percentage	SD	SE
1	Distribution of hard copies of SHC to farmers without any initiative on their part	3.48	69.60	1.07	0.05
2	Regular visits of mobile soil testing van	3.13	62.53	1.15	0.06
3	Quick distribution of soil health cards	3.27	65.40	1.20	0.06
4	Organizing regular awareness camps by extension agency	3.42	68.33	0.93	0.05
5	Regularly conducting demonstrations	3.04	60.86	1.12	0.06
6	Follow up on use of SHC tailored recommendations	3.26	65.10	1.12	0.06

Note: MS = Mean Score, SD = Standard Deviation, SE = Standard Error.

fertilization costs (MS: 2.26), and a lack of understanding of tailored recommendations (MS: 2.07).

The way forward

Table 5 presents quantitative values of statements regarding farmers' perception about potential way forward for improving the adoption of soil health card. The mean value of all items representing suggestions for improving the adoption of SHC was above three. The data reported in Table 5 revealed that 69.6 per cent of the surveyed farmers seen distribution of hard copies of SHC to all farmers without any initiative on their part as a potential remedy for increasing its adoption. Likewise, 68.33 per cent farmers approved the statement regarding organizing regular awareness camps by extension agencies.

DISCUSSION

The majority of farmers are uncertain whether the SHC is truly intended to promote the balanced use of fertilizers. Many of them view the SHC merely as a tool for assessing soil quality for benefit of health of consumers of farm produce, rather than as a comprehensive guide to improve soil fertility and optimize fertilizer use (Ohlan, 2021b). They do not perceive that SHC is indented to farmers' welfare. A common quote from the majority of farmers in response to a question regarding the purpose of this scheme is stated below:

My land is fertile, and its produce is good for human consumption

Farmers express that the recommendations provided in the SHC are not always easy to implement. For instance, the recommended quantity of Diammonium Phosphate (DAP) fertilizer required for sowing rabbi crops (e.g., wheat and mustard) is sometimes unavailable in the market, leading to an overuse of urea. Similarly, farmers are uncertain whether the fertility of problematic soils can be restored by following the SHC recommendations. In such cases, they often prefer traditional practices such as green manuring, organic manuring, crop rotation, or even taking a crop holiday (Purakayastha et al., 2019). Several farmers agreed that adoption of recommendations given in SHC led to a reduction in cost of fertilization. However, a few farmers have expressed concerns regarding an additional cost of purchasing micronutrients.

In contrast, the majority of farmers believe that adopting the recommended doses of fertilizers can potentially reduce their crop yield. This finding highlights the fact that farmers viewed the additional use of urea as a means to increase crop yield. Farmers in Australia shared a similar perception (Bennett et al., 2014). This perception has made them hesitant to adopt the SHC, as they are concerned about risking lower productivity. Farmers have perceived the SHC primarily as a tool for micronutrient management rather than for macronutrient management. They also recognize that the nutrient status of the soil is dynamic and therefore understood that the results reported in the SHC are only valid for a limited period.

Regarding the reduction in per-bag quantity of urea, farmers do not agree with the notion that they have purchased additional quantities of urea or any other fertilizer to compensate for this reduction. This may be due to the high prevalence of small and resource-poor marginal farmers in the state (Ohlan, 2021c). Additionally, there is a lack of efficient substitutes for urea in the market (Reddy et al., 2024). According to farmers and supported by fertilizer retailers, for most major crops grown in Haryana (e.g., wheat, rice, sugarcane, cotton), farmers typically apply urea by

the number of bags rather than by weight in kilograms. Farmers largely determined urea application based on crop health (Aryal et al., 2021). Consequently, farmers strongly argued that any further reduction in the per-bag quantity of urea would require them to use an additional bag per acre, which would ultimately increase overall consumption.

The finding did not support the hypothesis that farmers fully and sustainably adopted recommendations of the soil health card. The primary obstacle farmers faced in obtaining SHC is the annual leasehold land system. This system discourages tenant farmers from prioritizing soil health, as farming leases were largely informal and provided no assurance of accessing the same land the following year. Consequently, tenant farmers are less motivated to invest in long-term aspects of soil health. Farmers need to prioritize sustainable soil management over immediate returns from leased lands. While farmers perceived a potential increase in fertilization costs as a minor issue, they reported significant delays in receiving SHCs after submitting soil samples. This finding regarding delay in issuing SHC aligns with that reported in Kaur et al., (2020) and Madhuri et al., (2024) concerning farmers in Punjab and Andhra Pradesh, respectively. However, the costs associated with obtaining a SHC and the distance to soil health laboratories are not considered major barriers to soil testing. This may be attributed to the recent increase in the number of soil health testing laboratories in the state.

The major constraint confronted by farmers in adopting SHC-tailored recommendations is the potential adverse impact on crop yield. As noted above, farmers perceived the unavailability of required fertilizers as a major issue contributing to unbalanced fertilization. Adopting SHC recommendations is not seen as increasing fertilization costs, nor was understanding these recommendations reported as a significant challenge, possibly due to the rising education levels in the state. However, inadequate follow-up by extension agencies was identified as a barrier to the sustainable adoption of SHC recommendations. This finding aligns with the observations of Patel et al*.,* (2023) concerning cereal cultivators in Bihar.

To improve SHC adoption, the majority of farmers expressed that the government should take full responsibility for conducting soil testing, suggesting this be implemented through regular visits by mobile soil testing vans. This finding supports the results reported in Singh et al., (2023). Apart from this, farmers expected timely distribution of soil health cards. Likewise, farmers supported the usefulness of organizing more awareness programs on the importance of micronutrients and balanced use of fertilizers in maintaining soil fertility and health. They emphasized that non-government organizations and government organizations like farm science centers should conduct demonstrations on successful adoption of SCH. These trainings should be followed up by extension experts to monitor the progress of the adoption of recommended use of fertilizers. Future research could focus on assessing the implications of the SHCS for horticultural crops in the state, including fruits, vegetables, flowers, spices, ornamental plants, and medicinal herbs.

CONCLUSION

It was found that the majority of farmers in Haryana have a limited perception of the potential benefits of adopting SHC. The annual lease land system was perceived as a considerable constraint in adopting soil health card in the state. Farmers expressed concerns that the adoption of SHC recommendations may reduce crop yields. Additionally, the study established that the existing reduction in the per-bag quantity of urea by the GoI has succeeded in promoting judicious fertilizer use. However, any further reduction may risk imbalanced fertilizer practices, as farmers may offset the lower quantity per bag by increasing the number of bags applied per acre. These findings carry important implications for extension services aiming to improve SHC adoption rates.

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REFERENCES

Aryal, J. P., Sapkota, T. B., Krupnik, T. J., Rahut, D. B., Jat, M. L., & Stirling, C. M. (2021). Factors affecting farmers' use of organic and inorganic fertilizers in South Asia. *Environmental Science and Pollution Research*, *28*(37), 51480–51496. https://doi.org/10.1007/s11356-021-13975-7

Bennett, J. M., & Cattle, S. R. (2014). Adoption of soil health improvement strategies by Australian farmers: II. Impediments and incentives. *The Journal of Agricultural Education and Extension, 20*(1), 107–131. https://doi.org/10.1080/1389224X.2013.783494

Bora, K. (2022). Spatial patterns of fertilizer use and imbalances: Evidence from rice cultivation in India. *Environmental Challenges, 7*, 100452. https://doi.org/10.1016/j.envc.2022.100452

Chand, R., & Pavithra, S. (2015). Fertiliser use and imbalance in India. *Economic and Political Weekly, 50*(44), 98–104. https://www.epw.in/journal/2015/44/special-articles/fertiliser-use-and-imbalance-india.html

Dominati, E. J., Maseyk, F. J., Mackay, A. D., & Rendel, J. M. (2019). Farming in a changing environment: Increasing biodiversity on farm for the supply of multiple ecosystem services. *Science of the Total Environment, 662*, 703–713. https://doi.org/10.1016/j.scitotenv.2019.01.268

Kaur, S., Kaur, P., & Kumar, P. (2020). Farmers' knowledge of soil health card and constraints in its use. Indian Journal of Extension Education, *56*(1), 28–32. https://epubs.icar.org.in/ejournal/index.php/ijee/article/view/107801

Keesstra, S., Mol, G., de Leeuw, J., Okx, J., de Cleen, M., & Visser, S. (2018). Soil-related sustainable development goals: Four concepts to make land degradation neutrality and restoration work. *Land*, *7*(4), 133. https://doi.org/10.3390/land7040133

Madhuri C. R., Naik, A., Kumar, A., & Padhy, C. (2024). Perception and adoption of soil health card by paddy growers of North Coastal Andhra Pradesh. *Indian Journal of Extension Education*, *60*(4), 24–29. https://doi.org/10.48165/IJEE.2024.60405

Ohlan, R. (2021a). Farm reforms, protests and by-election in Haryana, *Economic and Political Weekly*, *56*(21), 21–23. https://www.epw.in/journal/2021/21/commentary/farm-reforms-protests-and-election-haryana.html

Ohlan, R. (2021b). Managing quality of cereal grains. *Economic and Political Weekly, 56*(16), 4-5. https://www.epw.in/journal/2021/16/letters/managing-quality-cereal-grains.html

Ohlan, R. (2021c). Economic viability of destroying crops. *Economic and Political Weekly, 56*(10), 5. https://www.epw.in/journal/2021/10/letters/economic-viability-destroying-crops.html

Patel, D. K., Kumar, A., & Dwivedi, S. (2023). Farmers' challenges in adopting soil health card recommendations in Saharsa, Bihar. *Indian Journal of Extension Education*, *59*(4), 154–156. https://doi.org/10.48165/IJEE.2023.59431

Potapov, P., Turubanova, S., Hansen, M. C., Tyukavina, A., Zalles, V., Khan, A., & Cortez, J. (2022). Global maps of cropland extent and change show accelerated cropland expansion in the twenty-first century. *Nature Food, 3*(1), 19-28. https://doi.org/10.1038/s43016-021-00429-z

Purakayastha, T. J., Pathak, H., Kumari, S., Biswas, S., Chakrabarty, B., Padaria, R. N., & Singh, A. (2019). Soil health card development for efficient soil management in Haryana,India. *Soil and Tillage Research*, *191*, 294-305. https://doi.org/10.1016/j.still.2018.12.024

Rani, S. (2019). Assessment of the consequences of changing cropping pattern on land and water productivity: A case study of Haryana state, India. *Agricultural Research, 8*(2), 252–261. https://doi.org/10.1007/s40003-018-0388-5

Ravikishore, M., Johnson, M., & Supriya, P. (2021). Perception and adoption of soil health card (SHCS) recommendations by the farmers in Anantapuram district. *Indian Journal of Extension Education, 57*(1), 170–175. https://doi.org/10.5958/2454-552X.2021.00018.9

Reddy, K. S., Shivay, Y. S., Kumar, D., Pooniya, V., Prasanna, R., Shrivastava, M., & Baral, K. (2024). Relative performance of urea and nano-urea in conjunction with zinc fertilization on growth, productivity, and nitrogen use efficiency in spring wheat. *Journal of Soil Science and Plant Nutrition, 24*, 3593–3609. https://doi.org/10.1007/s42729-024-01780-3

Singh, B. P., Kumar, V., Chander, M., Reddy, M. B., Singh, M., Suman, R. S., & Yadav, V. (2023). Impact of soil health card scheme on soil fertility and crop production among the adopted farmers. *Indian Journal of Extension Education, 59*(1), 122–126. http://doi.org/10.48165/IJEE.2023.59125

Veluguri, D., Ramanjaneyulu, G. V., & Jaacks, L. (2019). Statewise report cards on ecological sustainability of agriculture in India. *Economic and Political Weekly, IV*(26&27), 19–27. https://www.epw.in/journal/2019/26-27/review-rural-affairs/statewise-report-cards-ecological-sustainability.html