Review Article

FACTORS INFLUENCING FARMER ADOPTION IN PROBLEMATIC SOIL RECLAMATION PRACTICES:A COMPREHENSIVE REVIEW

ABSTRACT

Soil degradation, particularly in the form of salinity, alkalinity, and acidity, presents a critical challenge to agricultural productivity and food security in India, especially in the Bhal region of Gujarat. Despite the availability of various soil reclamation techniques, the adoption of these practices among farmers is inconsistent, hindered by socio-economic, technological and administrative barriers. This review synthesizes current literature to explore key factors influencing the adoption of soil reclamation practices and identifies effective strategies for enhancing farmer engagement in these vital interventions. Key factors such as access to irrigation, farmer knowledge and awareness, socio-economic status, risk orientation and extension participation play pivotal roles in adoption rates. Barriers include high economic costs, limited technological knowledge, inadequate administrative support and socio-cultural resistance to change.Addressing these challenges through coordinated efforts among policymakers, researchers and local communities is crucial for promoting sustainable agricultural practices and enhancing farmer livelihoods in degraded areas. Future research should focus on long-term impacts and the integrating of innovative technologies to ensure a resilient farming system.

Key words:*Soil degradation, Reclamation practices,Farmeradoption,Socio-economic factors and Agricultural sustainability*

1. INTRODUCTION

Soil erosion is a major environmental and agricultural problem facing humanity (Blanco and Lal, 2008; Hurni, 1988). Soil degradation, particularly in the form of salinity, alkalinity and acidity, poses a significant threat to agricultural productivity and food security in India. The *Bhal* region of Gujarat, with its diverse agricultural landscape, faces acute challenges in soil health, exacerbated by irrigation projects such as the Narmada Canal. As agriculture employs over 54.60 percent of the rural population in India, enhancing soil reclamation practices is essential for sustaining productivity and improving farmers' livelihoods.

Despite the availability of various reclamation techniques, the adoption of these practices among farmers remains inconsistent. Research indicates that socio-economic factors, such as education level, access to resources and environmental awareness, significantly influence farmers' decisions to implement soil reclamation strategies. Additionally, barriers such as high input costs, limited knowledge and inadequate administrative support further hinder adoption efforts [18-20].

This review aims to explore the key factors influencing farmer adoption of problematic soil reclamation practices and identify effective strategies for enhancing engagement in these vital interventions. These factors encompass socio-economic and cultural aspects as well as institutional, technical, and environmental influences. Socio-economic elements, including education, income

levels, and resource availability, combined with institutional support such as extension services and government policies, significantly impact farmers' decision-making. Additionally, farmers' perceptions of the affordability, long-term advantages, and practicality of implementing these practices often play a pivotal role in determining adoption rates. This review synthesizes existing research to uncover the barriers and facilitators influencing the adoption of sustainable soil reclamation techniques. It aims to highlight opportunities for improving their uptake among farmers. The insights derived from this analysis can support policy makers, researchers, and practitioners in developing tailored interventions that meet farmers' specific needs, ultimately contributing to the global pursuit of sustainable agriculture.

2. LITERATURE REVIEW

Soil degradation is a pressing global issue that threatens agricultural productivity and food security. Numerous studies have explored the relationship between soil health and farming practices, revealing that farmers often face significant challenges in adopting effective soil reclamation techniques.

A study conducted in Tanzania identified age, sex, educational status of the heads of families, and ownership of land to have significant positive effects on soil and water conservation practices. However, non-farm income and the distance from farmland to home were found to have significant negative effects on soil and water conservation measures (Ashoori *et al.*, 2016). The soil and water conservation (SWC) measures could reduce surface runoff and soil loss and had a positive effect on land productivity. The conservation of essential plant nutrients, organic matter, and moisture by SWC measures improves crop yield (Vancampenhout *et al*., 2006; Adeboye *et al*., 2017).

Jara-Rojas *et al.* (2012) explain that the size of farms and land ownership are important variables associated with the adoption of soil and water conservation measures. Noorjehan (2015) stated that the majority (76.00%) of farmers had a medium level of overall adoption of recommended reclamation practices for sodic soil, followed by 13.00% and 11.00% of farmers who had low and high levels of overall adoption of these practices, respectively.

Ingale *et al.* (2017) observed that more than half (57.00%) of farmers had a low level of adoption of recommended soil reclamation practices for salt-affected tracts of the Purna Valley, followed by 31.00% and 12.00% who had medium and high levels of adoption, respectively.

Sighal and Vatta (2017) pointed out that nearly half (48.30%) of farmers had a medium level of adoption of improved agricultural production technologies, followed by 35.80% and 15.80% from the high and low levels of adoption categories, respectively.

Sivanarayana and Lalitha (2019) indicated that nearly half (46.40%) of farmers were from the medium level adoption category, followed by 39.20% and 14.40% who had low and high levels of adoption, respectively.

Yarazari*et al.* (2019) disclosed that more than two-fifths (42.67%) of farmers had a medium level of adoption regarding saline soil management practices, followed by 36.00% and 21.33% who had low and high levels of adoption, respectively.

Lotha and Jha (2022) reported that more than three-fifths (61.67%) of farmers were from the medium level of technology adoption category, followed by 23.33% and 15.00% who had high and low levels of technology adoption, respectively.

2.1 FACTORS INFLUENCING FARMER Several key factors influence farmers' adoption of soil reclamation practices. Socio-economic factors such as income levels, education, and family background play a crucial role. Additionally, psychological factors such as risk orientation and farmers' attitudes toward innovation can either facilitate or hinder their willingness to adopt new practices.

Irrigation Facilities/Water Availability

Access to reliable irrigation is crucial for soil reclamation. Farmers with better irrigation infrastructure are more likely to adopt reclamation practices like salt leaching or chemical amendments, as water availability helps reduce soil salinity and alkalinity (Reddy *et al.,* 2022).

- **Knowledge and Awareness**

Farmer awareness and understanding of soil reclamation techniques play a significant role. Extension services and educational programs that inform farmers about appropriate practices, such as gypsum application or planting salt-tolerant crops, significantly increase adoption rates. Studies show that farmers with higher technical knowledge are more likely to adopt scientifically proven methods(Luangduangsitthidetha*et al.,* 2019).

- **Socio-Economic Status**

Wealthier farmers or those with larger land holdings have more resources to invest in costly reclamation practices like land grading or advanced drainage systems. Conversely, economically disadvantaged farmers may struggle to implement costly or labor-intensive reclamation techniques.

- **Risk Orientation and Innovation Proneness**
  Farmers with a higher willingness to take risks or those open to innovations are more likely to experiment with new soil reclamation techniques. This includes adopting new crop varieties, chemical treatments, or even modern drainage systems.
- **Extension Participation**

Farmers who engage in agricultural extension programs or training sessions are more likely to adopt reclamation practices. These programs help disseminate crucial information, foster positive attitudes, and demonstrate the practical benefits of soil reclamation.

- **Land Ownership and Size**

Land ownership encourages farmers to invest in long-term improvements like soil reclamation. Those with secure land tenure are more likely to adopt sustainable practices since they stand to benefit from the long-term productivity of their land (Sighal and Vatta, 2017; Sivanarayana and Lalitha, 2019).

2.2 BARRIERS AND CONSTRAINTS TO ADOPTION

The adoption of soil reclamation practices by farmers is often hindered by a variety of barriers and constraints. These obstacles can be broadly categorized into economic, technological, administrative and socio-cultural factors.

- **Economic Constraints**

High initial costs for adopting soil reclamation practices, such as purchasing chemical amendments like gypsum, implementing drainage systems or improving irrigation, act as significant barriers for many farmers, especially smallholders. Limited financial resources prevent farmers from investing in necessary infrastructure, machinery, and inputs. Additionally, the high cost of organic matter and other soil-enhancing inputs exacerbates the economic burden. Lack of access to affordable credit further limits farmers' ability to adopt new technologies or practices(Chavai*et al.,*2012;Yarazari, 2022).

- **Technological Barriers**

A lack of knowledge and awareness regarding proper soil reclamation techniques is a major technological barrier. Farmers in regions like the *Bhal* area may not have access to adequate extension services that provide training on sustainable reclamation practices. In addition, the complexity of certain technologies or practices, such as precision farming tools or GIS mapping for salt-affected soils, can discourage adoption, especially in rural areas with limited technical expertise. The availability and quality of soil testing services are also often inadequate, preventing farmers from identifying the most suitable reclamation practices for their land(Tiwari, 2022).

- **Administrative and Policy-Related Barriers**

Government support, subsidies and incentives for soil reclamation practices are often insufficient or poorly implemented. Bureaucratic red tape, delayed subsidies and a lack of clear guidelines on accessing government schemes create administrative obstacles. Additionally, insufficient collaboration between government agencies, local authorities and farmers can lead to miscommunication and delays in the implementation of essential reclamation projects. Farmers may also face difficulty accessing land tenure security, which discourages long-term investment in soil improvement.

- **Socio-Cultural Factors**

Traditional farming practices and resistance to change often pose socio-cultural barriers to the adoption of innovative soil reclamation techniques. Farmers may be reluctant to shift from conventional methods to more modern approaches due to deep-rooted cultural practices, mistrust in new technologies or skepticism about the potential benefits of soil reclamation. Social norms and community influence also play a role, as farmers may hesitate to adopt practices that are not widely accepted by their peers.

- **Lack of Infrastructure and Institutional Support**

Poor infrastructure, including inadequate roads and transportation systems, limits the delivery of essential inputs for soil reclamation, such as organic matter or chemical amendments. Furthermore, the lack of proper irrigation and drainage infrastructure makes it challenging for farmers to effectively implement reclamation strategies. Institutional support in the form of extension services, research dissemination and on-the-ground technical assistance is often limited, especially in remote areas (Singh *et al.,* 2013).

2.3 STRATEGIES TO IMPROVE ADOPTION RATES

- **Financial Incentives and Support Programs**: Offer subsidies, grants, or low-interest loans to reduce the cost of implementing soil reclamation practices.
- **Capacity Building and Extension Services**: Provide training and educational programs for farmers, focusing on new soil reclamation techniques through field demonstrations and peer learning.
- **Access to Technological Innovations**: Introduce affordable soil testing kits, mobile applications and improved irrigation systems to assist farmers in managing problematic soils effectively.
- **Policy and Institutional Reforms**: Strengthen policies that support sustainable soil management, streamline access to reclamation programs and encourage farmer cooperatives for collective action.
- **Improved Infrastructure Development**: Invest in rural infrastructure like irrigation, transportation and soil testing facilities to make reclamation efforts more accessible.
- **Community-Based Approaches**: Promote community-led reclamation efforts, social mobilization and local leader participation to foster collective responsibility for soil health.

3. CONCLUSION

In conclusion, the adoption of soil reclamation practices in problematic regions like *Bhal* is essential for ensuring agricultural sustainability and improving the livelihoods of farmers. This review has highlighted the critical factors influencing adoption, including access to irrigation, extension services and socio-economic characteristics. Despite these insights, significant barriers-ranging from economic constraints to a lack of knowledge-continue to hinder widespread adoption. Addressing these challenges will require coordinated efforts between policymakers, researchers and local communities. Moving forward, the focus should be on developing scalable, low-cost solutions and strengthening policy frameworks to encourage adoption. Future research must also explore the long-term impacts of reclamation practices and the integration of innovative technologies. By promoting sustainable soil management practices, we can pave the way for more resilient agricultural systems and enhanced farmer well-being.

4. ROAD AHEAD

- **Advancing Climate-Smart Technologies**: Future efforts should focus on developing and implementing affordable, climate-smart solutions tailored to address soil degradation issues like salinity. These technologies need to be scalable and easily accessible, particularly for smallholder farmers.
- **Strengthening Policy Support**: Governments should prioritize policies that offer financial incentives, such as subsidies and grants for soil reclamation efforts. Additionally, policies must streamline access to reclamation programs and strengthen agricultural extension services, ensuring farmers receive timely guidance and support.
- **Enhancing Community Involvement**: Promote the establishment of farmer cooperatives and encourage local leadership in soil reclamation efforts. Community-driven approaches can help scale best practices and create a culture of shared responsibility for soil health, leading to more sustainable long-term adoption.
- **Conducting Longitudinal Studies**: More long-term studies are needed to evaluate the sustained impacts of soil reclamation practices on both agricultural productivity and environmental sustainability. This research will provide deeper insights into the effectiveness of various interventions over time.
- **Exploring Socio-Economic Factors**: Further investigation into socio-economic barriers to adoption, such as land tenure issues, access to markets, and gender-specific challenges, is crucial. Understanding these dynamics will help design more inclusive and equitable reclamation strategies.
- **Innovating Cost-Benefit Analyses**: Conducting detailed cost-benefit analyses will be essential in evaluating the financial viability of soil reclamation for smallholder farmers. These analyses can guide future policy and financial decisions to make these practices more economically feasible.

REFERENCES

1. Adeboye, O. B., Schultz, B., Adekalu, K. O., Prasad, K. (2017). Soil Water Storage, Yield, Water Productivity and Transpiration Efficiency of Soybeans (GlyxineMaxL. Merr) as Affected by Soil Surface Management in Ile-Ife, Nigeria. *Int. Soil Water Conserv. Res.,* 5: 141-150.
2. Ashoori, D., Bagheri, A., Allahyari, M. S. and Al-Rimawl, A. S. (2016). An Examination of Soil and Water Conservation Practices in the Paddy Fields of Guilan Province, Iran. *Ann. Braz. Acad. Sci.,* 88(2): 959-971.
3. Blanco, H.andLal,R.(2008). *Princip. Soil Conserv. Manag.* Co- lumbus OH,USA:TheOhioStateUniversity.
4. Chavai, A. M., Barange, P. K. and Pawar, Y. B. (2012). Adoption of Salt Affected Soil Reclamation Practices by the Farmers of Maharashtra. *J. Agric. Res. Technol.*, 37(3): 429-432.
5. Hurni,H.(1988).DegradationandConservationoftheResourcesintheEthiopianHighlands. *Mount. Res. Dev.*, 8(2/3): 123-130.
6. Ingale, S. M., Kale, N. M., Jangwad, N. P., Bhopale, P. P. And Mankar, D. M. (2017). Knowledge and Adoption of Recommended Soil Reclamation Practices for Salt Affected Soils by the Farmers in Purna Valley. *Int. J. Appl. Nat. Sci.*, 6(4): 71-78.
7. Lotha, B. and Jha, K. K. (2022). Imperatives of Technology Adoption among Farmers Growing Horticultural Crops in Wokha District of Nagaland. *Indian Res. J. Ext. Educ.*, 1-5.

8. Luangduangsitthidetha, O., Limnirankulb, B. and Kramol, P. (2019). Farmers' Knowledge and Perceptions of Sustainable Soil Conservation Practices in Paklay District, Sayabouly Province, Lao PDR. *Kasetsart J. Soc. Sci.*, 40: 650-656.
9. Noorjehan, A. K. A. H. (2015). Awareness, Knowledge and Adoption of Reclamation Practices in Sodic Soil of Tiruchirappalli District in Tamil Nadu. *Madras Agric. J.*, 102(1-3): 92-97.
10. Reddy, S. K., Pradhan, K. and Saha, S. (2022). Exploring the Level of Livelihood Security of Farmers Adopted Integrated Farming System in West Bengal. *Indian Res. J. Ext. Educ.*, 22(4): 140-146.
11. Singh, Y. P., Dubey, U. C., Singh, S. and Dubey, S. K. (2013). Interventions of Sodic Soil Reclamation Technologies and Constraints in Their Adoption. *Indian Res. J. Ext. Educ.*, 13(2): 36-40.
12. Singhal, S. and Vatta, L. (2017). Factors Influencing Adoption of Improved Agricultural Technologies. *Indian J. Family Community Stud.*, 1(1): 13-16.
13. Sivanarayana, G. and Lalitha, A. (2019). Adoption Behaviour of Krishna District Farmers Towards Soil Health Cards. *J. Res. ANGRAU*, 47(3): 51-54.
14. Tiwari, A. (2022). Constraints Faced by Farmers in Adoption of Improved Practices of Wheat Cultivation in District Kanpur Dehat (Uttar Pradesh). *The Pharma Innov. J.*, 11(6): 2393-2395.
15. Vancampenhout, K., Nyssen, J., Gebremichael, D., Deckers, J., Poesen, J., Haile, M. and Moeyersons, J. (2006). Stone Bunds for Soil Conservation in the Northern Ethiopian Highlands: Impacts on Soil Fertility and Crop Yield. *Soil Tillage Res.*, 90: 1-15.
16. Yarazari, S. P. (2022). Constraints in Adoption of Saline Soil Management Practices by the Farmers of Belagavi District. *Mysore J. Agric. Sci.*, 56(1): 320-326.
17. Yarazari, S. P., Devegowda, S. R., Shelar, R. and Sachin, V. R. (2019). Adoption of Saline Soils Management Practices by the Farmers. *Int. J. Chem. Stud.*, 7(4): 1433-1435.
18. Bewket W. Soil and water conservation intervention with conventional technologies in northwestern highlands of Ethiopia: Acceptance and adoption by farmers. Land use policy. 2007 Apr 1;24(2):404-16.
19. Vanclay F, Lawrence G. Farmer rationality and the adoption of environmentally sound practices; a critique of the assumptions of traditional agricultural extension. European Journal of Agricultural Education and Extension. 1994 Apr 1;1(1):59-90.
20. Chinnappa B. An economic analysis of land reclamation technologies for amelioration of irrigation-induced soil degradation. Agricultural Economics Research Review. 2005;18(1):103-16.