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Intercropping System: A Climate Smart Approach to Resource Conservation

*Dibyabharati Naik
M.Sc. Scholar, Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar, Odisha, India
*Corresponding Author's email: dibyabharati963@gmail.com

Agricultural sustainability faces significant threats from climate change, including elevated temperatures, unpredictable precipitation, increased frequency of severe weather occurrences, and growing strain on natural resources. Climate-smart agriculture (CSA) addresses these concerns by prioritizing productivity enhancement, resilience building, and greenhouse gas emission reduction. The practice of intercropping—growing two or more crops together in the same field simultaneously—is acknowledged as a valuable resource preservation technique within CSA. This paper examines how intercropping contributes to enhanced resource-use efficiency, improved soil health, water preservation, weed control, and pest and disease regulation. Processes including biological nitrogen fixation, hydraulic lift, enhanced canopy coverage, and crop diversification lead to increased productivity and system resilience. Studies from various agro-ecological zones in India, especially Odisha, reveal the economic and environmental benefits of intercropping compared to monocropping. Although challenges exist regarding management intricacy and mechanization, intercropping continues to be a sustainable and climate-adaptive agricultural approach. Appropriate crop selection, spatial design, and institutional backing can promote its wider adoption.

Introduction

Food security and the livelihoods of farmers are seriously threatened by agriculture's extreme vulnerability to climate change. Crop productivity and stability have been negatively impacted by rising temperatures, erratic rainfall, protracted droughts, floods, and an increase in pests and diseases. Declining soil fertility, inefficient resource use, and environmental degradation are the outcomes of conventional agricultural techniques, which are typified by monocropping and large external inputs. Climate-smart agriculture (CSA), an integrated strategy that seeks to sustainably boost agricultural output, improve resilience to climate variability, and lower greenhouse gas emissions, has grown in significance as a response to these issues. Intercropping has become one of the most promising low-input, eco-friendly CSA techniques. Intercropping encourages the effective use of resources like land, water, light, and nutrients through crop diversification and complementary interactions among component crops.

Intercropping as a Respource Conservation Technology

The term "intercropping" describes the planned spatial and temporal arrangements of two or more crops grown concurrently on the same plot of land during the same growing season. Intercropping can be divided into four categories based on how the crops are arranged: row, mixed, strip, and relay. By generating higher combined yields from the same area than solitary cropping, intercropping improves land-use efficiency from the standpoint of resource conservation. While replacement series intercropping partially replaces one crop with another to maintain the total plant population, additive series intercropping keeps the entire population of the main crop while adding an intercrop. When properly maintained, both systems lead to increased resource-use efficiency. Additionally, intercropping boosts the cropping system's biodiversity, which improves ecological stability and lessens susceptibility to climatic pressures. Diverse crop combinations improve yield stability by mitigating the effects of weather extremes.

Resource Conservation Methods in Intercropping

Efficiency of Nutrient Use: Improved nutrient dynamics is one of the most significant resource conservation strategies in intercropping. Through symbiotic relationships with Rhizobium bacteria, leguminous crops including groundnuts (Arachis hypogaea), cowpeas (Vigna unguiculata), and pigeonpeas (Cajanus cajan) fix atmospheric nitrogen. Either during crop growth or following residue breakdown, the fixed nitrogen improves soil fertility and becomes accessible to related non-legume crops. This increases system output overall and lessens reliance for artificial nitrogen fertilizers.

Conserving Water: By increasing canopy coverage and diversifying root systems, intercropping improves water-use efficiency. Through a mechanism called hydraulic lift Deep-rooted crops have the ability to transmit moisture to higher soil levels from deeper soil layers. This increases the availability of moisture for intercrops with shallow roots. Furthermore, increased organic matter content and soil structure promote infiltration while lowering runoff and soil erosion.

Management of Weeds: In intercropping systems, higher crop density and quicker canopy closure limit the amount of light and space available for weed growth. Additionally, some intercrops release biochemical chemicals that inhibit weed germination and growth, a phenomenon known as allelopathic effects. This lowers weed pressure and minimizes the need for chemical herbicides.

Management of Pests and Diseases: In intercropping, crop variety breaks the life cycles of pests and slows the spread of disease. Intercropping hinders the spread of diseases by decreasing continuous host availability, confuses pest host recognition, and helps natural enemies. This promotes ecological balance by lowering the prevalence of pests and diseases as well as the use of pesticides.

Intercropping Indices

Several indices, including Land Equivalent Ratio (LER), Competition Ratio (CR), Aggressivity, and Relative Crowding Coefficient (RCC), are used to evaluate the performance of intercropping systems. The yield benefit of intercropping over solitary cropping is indicated by an LER value larger than one. These indices offer a scientific foundation for choosing appropriate crop combinations and aid in measuring the level of complementarity and competition between component crops.

Research Reports

The benefits of intercropping systems have been shown in a number of Indian research. Sweet corn-based intercropping systems yielded higher net returns and benefit-cost ratios than solitary cropping, according to experiments carried out at Odisha University of Agriculture and Technology, Bhubaneswar. Higher pod equivalent production and improved competition indices were seen when groundnuts and finger millet were interplanted in the proper row proportions under rainfed conditions. In the North Eastern Ghat Zone of Odisha, intercropping turmeric with okra was more profitable than growing just turmeric. Across many agro-ecological locations, intercropping systems based on maize and soybeans also demonstrated increased productivity, water productivity, and economic benefits. These results demonstrate how intercropping can improve farm income and resource efficiency in a variety of climatic settings.

Innovative Approaches in Intercropping for Climate-Smart Agriculture

In order to further improve resource efficiency and climate resilience, recent developments in agricultural science highlight the merging of conventional intercropping techniques with contemporary technologies. Precision intercropping is one such cutting-edge method in which site-specific soil and climate data are used to optimize row proportions and spatial crop groupings. By finding appropriate crop combinations and planting geometry, precision instruments like GPS-guided sowing, soil sensors, and decision-support systems lessen competition and increase complementarity among component crops. Climate-resilient functional intercropping is another new idea in which crops are chosen for their ecological roles in addition to their production. For instance, water extraction from various soil strata is improved when shallow-rooted short-duration crops are combined with deep-rooted drought-tolerant crops.

In a similar vein, adding floral intercrops like sunflower or marigold enhances ecosystem services and lessens reliance on pesticides by supporting pollinators and natural enemies. Carbon-smart intercropping is becoming more popular as a climate change mitigation tactic. Soil organic carbon sequestration is improved by increased biomass output and residue integration in intercropping systems. Intercropping with legumes further lowers the need for synthetic nitrogen fertilizer, improving soil health and reducing greenhouse gas emissions. Additionally, new approaches to encouraging the adoption of intercropping include digital extension and participatory research models. Real-time decision-making and location-specific recommendations are made possible by mobile-based advising services, the integration of climate forecasts, and farmer field schools. These developments close the gap between field-level acceptance and research.

Challenges in Adoption of Intercropping

Intercropping has a number of drawbacks despite its benefits. These include more complicated crop management, challenges with mechanization, problems with irrigation and fertilizer management, greater labor demands, and a dearth of location-specific solutions. Large-scale adoption is further hampered by market limitations and low farmer awareness. Promoting intercropping systems requires addressing these issues through research, extension, and policy assistance.

Conclusion

An efficient climate-smart farming technique that increases output, preserves natural resources, and strengthens system resilience in the face of shifting climate circumstances is intercropping. Intercropping helps improve soil health, reduce weeds, and manage ecological pests by encouraging the effective use of land, water, and nutrients. Its advantages over solitary cropping methods in terms of the economy and environment are amply demonstrated by research. Intercropping can significantly contribute to the development of sustainable and climate-resilient agriculture with the right crop combinations, better management techniques, and institutional support.

References

1. Dash, T., Sahoo, S. C., & Mohanty, M. (2025). Response of sweet corn to intercropping and fertility levels. *International Journal of Plant & Soil Science*, 37(7), 352–357.
2. Debata, D. K., & Das, L. K. (2024). Response of spacing and row proportions of turmeric + okra intercropping system in Odisha. *Journal of Experimental Agriculture International*, 46(5), 584–589.
3. Lenka, S., Swain, S. K., & Pradhan, K. C. (2021). Performance of groundnut-based intercropping systems with millets under rainfed conditions. *Legume Research*, 44, 1–7.
4. Mishra, P. J., Behera, B., Swain, D., Mishra, A., Subudhi, C. R., & Mishra, P. K. (2017). Productivity and profitability of maize + vegetable intercropping systems. *Indian Journal of Soil Conservation*, 45(2), 136–140.
5. Ramana Rao, K. V., Rajwade, Y. A., Verma, N. S., Yadav, D., & Nangia, V. (2023). Techno-economic feasibility of soybean-based cropping systems under varying climates. *Journal of Agrometeorology*, 25(2), 300–304.