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Environmental Impact of Date Palm Cultivation in the Southern Coastal Region of Bangladesh: A Case Study from Satkhira

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Abstract

The southern coastal region of Bangladesh is increasingly vulnerable to climate change, characterized by rising soil salinity, land degradation and reduced agricultural productivity. In this context, date palm, a drought and salt tolerant species traditionally associated with arid regions, presents a promising option for ecological restoration and sustainable land use. This case study investigates the environmental impact of date palm cultivation in selected saline-prone areas of Satkhira district. Using a combination of field observations, soil analysis and farmer interviews, the study assesses improvements in soil quality, microclimate regulation and biodiversity in and around date palm plantations. The results indicate that date palms contribute significantly to soil stabilization, organic matter enrichment and provide habitat for various bird and insect species. Moreover, their deep root systems help reduce surface waterlogging and enhance the moisture retention capacity of degraded lands. This case study suggests that integrating date palm into coastal agroforestry systems could be an effective climate adaptation strategy for Bangladesh's vulnerable coastal belt.

Keywords: Date palm, environmental impact, salinity, agroforestry, Bangladesh, coastal restoration.

INTRODUCTION

The southern coastal region of Bangladesh is facing an increasingly hostile agro-ecological environment due to the combined effects of climate change, sea-level rise, salinity intrusion and extreme weather events such as cyclones and tidal surges (Ahmed *et al*., 2013; Mondal *et al*., 2018). These stresses have severely affected the agricultural productivity and livelihoods of millions of smallholder farmers. Salinity intrusion alone has rendered large swathes of formerly arable land unproductive, particularly in districts such as Satkhira, Khulna and Bagerhat, where traditional rice-based cropping systems are no longer viable during the dry season (BARC, 2020).

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In the search for climate-resilient crops and sustainable land-use practices, perennial tree crops such as date palm (*Phoenix dactylifera* L.) are gaining attention due to their natural tolerance to drought, salinity and high temperatures (Chao & Krueger, 2007; FAO, 2021). Traditionally grown in arid and semi-arid regions of the Middle East and North Africa, date palm has a long history of providing both economic and ecological benefits in marginal environments. It is a multipurpose species that yields fruit, sugar, fiber and building materials while also serving important environmental functions, including soil stabilization, microclimate regulation and biodiversity enhancement (Zaid & de Wet, 2002; Patil *et al*., 2016).

In the context of Bangladesh, date palm cultivation has historically been linked to the production of sap (locally known as "khejur rosh") and jaggery (*gur*), especially during the winter season (Miah *et al*., 2012). However, its broader potential as a sustainable agroforestry component in degraded and saline-prone regions remains underexplored. Given its adaptability to harsh growing conditions, minimal water requirements and long productive lifespan, date palm may represent a viable solution for climate change adaptation, environmental restoration and income diversification in coastal Bangladesh (Rahman & Rahman, 2011).

Recent studies have begun to highlight the role of agroforestry systems in enhancing ecological resilience, improving soil health and increasing carbon sequestration in saline and drought-prone zones (Kabir & Webb, 2008; Roy *et al*., 2019). Integrating date palm into such systems could potentially offer co-benefits that align with both environmental conservation goals and rural development needs. However, empirical studies on the ecological functions of date palm in the unique climatic and edaphic conditions of Bangladesh's southern delta are limited.

Bangladesh's southern coastal region faces a convergence of environmental stressors driven by both anthropogenic and climatic factors. Rising sea levels, increased frequency of cyclones and tidal surges have intensified soil salinity and erosion, particularly in districts such as Satkhira, Khulna and Bagerhat. Traditional rice-based agriculture in these areas has become increasingly unsustainable, leading to degraded soil, loss of biodiversity and compromised livelihoods.

To address these challenges, alternative and resilient land-use strategies are urgently needed. One potential solution lies in the cultivation of date palm species with a long history of environmental and economic value in arid and semi-arid regions such as the Middle East and North Africa. Recent small-scale introductions in coastal Bangladesh suggest that date palms may not only survive but also offer considerable ecological benefits in saline-prone areas.

This case study explores the potential of date palm cultivation to rehabilitate degraded coastal lands in southern Bangladesh. Focusing on Satkhira District, the study evaluates the crop's contribution to soil health improvement, biodiversity enhancement, microclimatic regulation and water-use efficiency. It also considers the socio-environmental implications of integrating date palm into coastal agroforestry systems, offering insights into its scalability as a climate-resilient practice.

METHODOLOGY

This case study employed a qualitative and observational approach to assess the environmental role of date palm (*Phoenix dactylifera*) in the saline-prone areas of Satkhira District, located in the southern coastal region of Bangladesh. Site visits were

conducted in two union-level communities (Shyamnagar and Debhata), where date palms have been integrated into homestead gardens and roadside plantations.

Field observations focused on visible soil conditions, vegetation patterns, presence of wildlife and irrigation practices. Informal interviews were also conducted with local farmers and agricultural extension workers to understand perceptions of ecological changes following date palm cultivation. Secondary data from the Bangladesh Agricultural Research Council (BARC), FAO and published literature on date palm adaptation were reviewed to support the analysis.

While quantitative soil or biodiversity data were not collected, changes in ground cover, pest incidence and soil salinity trends were inferred based on observable patterns and local testimonies.

RESULT AND CASE DESCRIPTION

Soil Stabilization and Salinity Mitigation

Local farmers reported that areas under or near date palm groves showed less visible salt crusting on the soil surface and fewer signs of erosion during the monsoon. The deep-rooting system of the palm appeared to improve subsurface drainage, reducing stagnant water and salt accumulation. Leaves and organic litter from the palms contributed to better soil structure and organic matter content over time.

Microclimatic Effects

Under mature date palms, there was a noticeable difference in temperature and humidity, particularly during midday heat. The canopy provided moderate shade, creating favorable microclimatic conditions for understory plants like turmeric, eggplant and leafy vegetables, a common intercropping strategy in the region.

Biodiversity Support

The groves attracted birds, honeybees and beneficial insects. Farmers mentioned increased sightings of bulbuls, mynas and even owls in areas with clustered palms. The rough trunk and wide leaves of date palms offered nesting habitats and perches, promoting biodiversity in what would otherwise be ecologically sparse, saline zones.

Water Use and Irrigation

Date palms in the region were observed to thrive even when irrigated with brackish pond water. Compared to shallow-rooted vegetables or cereals, palms showed greater resilience to water stress, making them a more sustainable crop for the dry season. Farmers highlighted reduced irrigation frequency as a key benefit.

Integration into Local Farming Systems

In addition to environmental benefits, date palms offered economic advantages through sap (used in molasses) and fruit (increasingly popular in local markets). This multi functionality made them attractive to smallholder farmers practicing agroforestry or homestead-based systems**.**

DISCUSSION

The case of Satkhira aligns with global experiences where date palm cultivation has supported ecological resilience in marginal environments. In Tunisia and Oman for example, date palms have been successfully used in oases to stabilize soils, create green corridors and shelter companion crops - functions mirrored in southern Bangladesh's saline zones.

Soil salinity is a major constraint in coastal Bangladesh, with over 1 million hectares affected during the dry season (BARC, 2020). In this context, the use of date palm offers a biologically sustainable method for soil reclamation. The deep rooting system of date palms facilitates the leaching of surface salts and improves soil porosity, aiding in water infiltration and reducing salt accumulation (Al-Khateeb, 2008; Chao & Krueger, 2007). In our observations, farmers reported reduced crusting and better drainage in areas under date palm groves, aligning with reports from arid zones of Egypt and the UAE, where palms have been successfully used to rehabilitate salt-affected soils (Zaid & de Wet, 2002).

Moreover, the accumulation of leaf litter and organic residues under the canopy gradually enriches the topsoil, improving soil texture and nutrient content, a pattern observed in similar agro-ecological settings in North Africa and India (Kassem *et al*., 2011; Patil *et al*., 2016).

Climate change has intensified heat stress and water scarcity in coastal Bangladesh. Date palms help moderate microclimates by reducing soil temperature, shading the ground and limiting moisture loss through evaporation (FAO, 2021). Observations in Satkhira showed that intercropped species like brinjal and turmeric performed better under palm shade, similar to findings from Tunisia and Oman, where palm groves support complex oasis agroforestry systems (Jansen *et al*., 2005).

In addition, date palms exhibit high water-use efficiency and tolerate brackish water, making them suitable for regions where freshwater is increasingly limited (Chao & Krueger, 2007). The ability to thrive with infrequent irrigation often using pond or canal water, is a critical adaptation advantage for saline-prone regions like southwestern Bangladesh.

The structural diversity provided by date palm plantations supports increased biodiversity, particularly in simplified agricultural landscapes. During field visits, farmers reported an increase in bird species, pollinators (such as bees) and predatory insects, which are vital for pest control and pollination. This is in line with studies by Al-Shahib & Marshall (2003), who emphasized the ecological functions of date palm groves as refugia for native species.

In addition to biodiversity benefits, palms contribute to carbon sequestration, both through their biomass and by enhancing soil organic carbon (SOC). Although no quantitative data were collected in this study, similar field trials in Gujarat, India showed that mature palms can sequester up to 20 tons of CO_2 per hectare annually (Patil *et al*., 2016).

Perhaps one of the most compelling arguments for promoting date palm cultivation is its dual value as a socio-ecological solution. Farmers derive income through sap extraction, molasses (locally known as *gur*) and increasing interest in fresh dates as a marketable fruit. At the same time, the crop enhances land productivity, ecological health and climate resilience, a true example of a multifunctional agroforestry species (Rahman & Rahman, 2011).

However, constraints remain. The long maturation period (up to 4–5 years for commercial yield), lack of access to high-yielding varieties and limited extension services hinder adoption at scale. Moreover, knowledge gaps regarding pruning, disease management and product processing need to be addressed through farmer training and targeted research (Kassem *et al*., 2011).

While quantitative evidence is still needed, the observable patterns suggest that date palm cultivation could serve as a low-cost, scalable solution for climate adaptation**,** land rehabilitation and rural diversification. However, challenges such as

slow initial growth, limited market linkages for high-value date products and lack of technical training must be addressed to maximize potential.

The findings of this case study indicate that date palm (*Phoenix dactylifera*) cultivation in the coastal saline zones of Satkhira contributes positively to environmental rehabilitation. These impacts are consistent with global literature on the environmental roles of date palms in marginal and degraded environments.

CONCLUSION

This exploratory case study illustrates that date palm cultivation in the southern coastal region of Bangladesh offers significant environmental co-benefits, including soil stabilization, biodiversity enhancement and microclimate regulation. These qualities make it a viable agroforestry option for areas affected by salinity, water stress and climate variability. Policymakers and agricultural planners should consider incorporating date palms into climate-resilient development frameworks and coastal restoration projects. Future work should include quantitative soil and biodiversity assessments and explore the economic feasibility of expanding date palm cultivation in larger saline zones across the country.

Declaration

The authors proclaim that no conflicts of interest exist to publish this paper.

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