



## Assessing the Potential of Prambanan Biodiversity Park for Sustainable Food Resources and Agriculture in Kemudo, Klaten, Central Java

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### Abstract

Prambanan Biodiversity Park (TKP), situated in Kemudo, Klaten, Central Java, is an important natural reserve dedicated for preservation of local biodiversity and environmental protection by PT.Sarihusada Generasi Mahardhika. This research investigates the park's potential in providing food resources and supporting agricultural practices for nearby communities. Assessment of plant species is conducted to evaluate the park's biodiversity, including surveys, species identification, mapping. The collected data provides an overview of the park's biodiversity and serves as a baseline for further analysis. The analysis focuses on identifying plant species within the park that hold potential value for food resources and agriculture. This includes studying ecological relationships between species and plants that contribute to pest control in agricultural systems. To understand the local community's perspectives and practices related to food and agriculture, interviews, focus group discussions are conducted, exploring their traditional knowledge and utilization of biodiversity for sustenance and farming. The research finds several potential benefits of utilizing TKP for food resources and agriculture. The diverse flora of the park offers a variety of edible plants, such as *Moringa oleifera* and fruit-based species, which can enhance local diets and provide nutritional diversity. Furthermore, traditional plants like *mojo* hold potential as natural pesticides, contributing to pest control in agricultural fields. Integration of biodiversity into local food systems may require capacity building and awareness programs to promote sustainable harvesting and cultivation practices. The research recommends the development of conservation strategies and policies focused on sustainable practices, community participation, and educational initiatives to maximize the potential benefits for local food security and agriculture. This research drive conservation strategies that protect biodiversity and enhance the well-being of the local community. TKP emerges as an invaluable resource capable of supplying essential food provisions and supporting eco-friendly agricultural practices for neighboring communities, thereby emphasizing the criticality of interweaving biodiversity preservation within the framework of local food systems.

**Keywords:** agriculture, biodiversity park, conservation, food resources, sustainability

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## **Introduction**

Indonesia, which is a mega-biodiversity country, is facing a significant challenge with one of the highest rates of species extinction. This disconcerting trend is principally propelled by the rampant destruction of forests, the unlawful pursuit of endangered animals through poaching and trafficking within illegal markets. The lack of awareness and indifference among people contribute to weak societal control, further worsening the condition. Ironically, contemporary attitudes seem to overlook the fundamental advantages that biodiversity confers upon both individual lives and the preservation of culture and the economy, both historically and for posterity (Nugraha *et al.*, 2022).

Indonesia stands as a recognized hotspot for biodiversity. However, these very hotspots harbor rare flora and fauna imperiled by factors such as forest degradation, deforestation, and shifts in land use. Consequently, urgent measures to conserve biodiversity emerge as imperative. The pivotal role of biodiversity in upholding the equilibrium of natural resources remains paramount. Conservation is closely tied to managing diversity, with the concept involving preservation, protection, and limited utilization of natural resources (Bimantio *et al.*, 2023a).

Biodiversity is an urgent topic in forest and area management in Indonesia. Natural systems provide more impact on the balance of the ecosystem from upstream to downstream. The current trajectory of biodiversity management reflects developmental trends, with the conservation of natural resources emerging as a particular emphasis (Nugraha, Putra, Bimantio, Ferhat, & Zakaria, 2022). Biodiversity parks in Indonesia are divided based on their management rights, namely biodiversity parks managed by the state and biodiversity parks managed by the private sector. Each locality, facilitated through the Environment and Forestry Service (DLHK), is mandated to establish and carry out biodiversity parks as a form of state-endorsed management. Simultaneously, management by the private sector is facilitated through initiatives like the Company Performance Rating Assessment Program in Environmental Management (PROPER), where the existence

and management of a biodiversity park stand as imperative requisites for attaining green and gold PROPER ratings (Ferhat *et al.*, 2021).

As the global population grows and the pressure on natural resources intensifies, securing sustainable food resources and enhancing agricultural practices become necessary. The Prambanan Biodiversity Park (TKP), established in 2022 by PT. Sarihusada Generasi Mahardhika in Kemudo, Klaten, Central Java, stands as a testament to this imperative. Dedicated to conserving local biodiversity and safeguarding the environment, TKP signifies an indispensable repository of diverse ecosystems and copious plant species, holding significant promise for scientific inquiry, conservation endeavors, and potential benefits for neighboring communities (Bimantio *et al.*, 2021).

Studies by Bimantio *et al.* (2021) highlight the development of biodiversity parks in Wonosobo, Central Java, serving as repositories for plant collections, facilitating plant breeding, supporting animal habitats, nurturing local genetic resources, and functioning as educational and research hubs, in addition to serving as green open spaces. Putra *et al.* (2021) in his book define biodiversity park in Klaten Central Java is able to provide animals and vegetation define the biodiversity park in Klaten, Central Java, as a conducive environment enabling the sustenance and proliferation of both fauna and flora due to the provision of an enabling spatial context. The ripple effects of the park's existence necessitate a careful examination of its impacts, encompassing ecological ramifications as a support system for local animal life and its broader societal implications. These impacts can be categorized into ecological and social spheres.

This research aims to explore the potential of TKP in providing food resources and supporting agricultural practices for the local communities. The paper will assess the park's biodiversity, including surveys, species identification, and mapping. Furthermore, interviews and focus group discussions will be conducted to unravel the local community's perspectives and practices related to food and agriculture. The ensuing findings aspire to offer insights into the prospective benefits of leveraging TKP for food resources and

agriculture, accompanied by recommendations for conservation strategies and policies.

The surveys aim to capture the diversity of plant species within the park, including both native and introduced species. The data accrued through these surveys are anticipated to furnish valuable insights into the flora present within TKP, significantly contributing to the comprehension of its overall biodiversity.

Biodiversity conservation plays a crucial role in maintaining ecosystem health and resilience. It provides a wide range of ecosystem services, including food production, water purification, climate regulation, and pest control. Preserving biodiversity is essential for sustaining human well-being and ensuring the long-term survival of ecosystems.

Building upon prior research by Bimantio et al. (2022), TKP is segmented into two sections: an inner block integrated within the factory premises and an outer block situated outside the factory enclosure. The garden inside the factory is well-maintained, featuring various main crops like mahogany, almond tree, palm, and *pucuk merah*. However, access to this inner area is limited as it is situated within the factory grounds, which are not accessible for public due to the production of baby milk that requires a contamination-free environment. Consequently, only plants that do not produce flowers or fruit, thus avoiding potential insect-related product contamination, are allowed in this inner section. On the other hand, the outer block situated outside the factory is currently neglected and needs extensive land clearing. The fragmented nature of this outer area which is lacking continuity results in certain portions encroaching upon lands owned by local residents. This necessitates effective collaboration and communication to ensure smooth development of TKP without causing future issues. Presently, the outer block lacks information about the Biodiversity Park, and its infrastructure and vegetation are limited and lack diversity. Situated strategically along the north side of the National Road connecting D.I. Yogyakarta and Central Java provinces, this location, while offering accessibility, also poses the risk of air and sound pollution. Moreover, community involvement in park management remains nascent, making educational initiatives indispensable to foster

understanding and formulate development plans.

Beyond its role in providing food resources, TKP harbors potential in supporting agricultural practices through the integration of traditional knowledge and biodiversity-centric approaches. This research undertakes an exploration of the local community's viewpoints and practices pertaining to food and agriculture, shedding light on their indigenous wisdom and utilization of biodiversity in sustaining dietary needs and agricultural pursuits.

## Methodology

Between December 2021 and June 2022, a comprehensive assessment of the biodiversity within TKP was executed. This assessment involved multifaceted methodologies, including surveys, species identification, and mapping, which collectively generated a dataset providing an overarching perspective of the park's biodiversity. This dataset was pivotal in establishing a foundational baseline for subsequent in-depth analyses.

Field surveys are conducted within TKP to identify and record the plant species present in the park. The plants carefully observe and documented for further analysis. Notably, tree monitoring practices were innovatively integrated with technological tools to expedite data collection and facilitate the estimation of carbon absorption. Specifically, the incorporation of smartphone-integrated applications such as *Jejakin* augmented the process of monitoring trees within biodiversity parks. This integration not only digitized tree monitoring practices but also enhanced the efficiency of data retrieval, consequently streamlining reporting mechanisms (Nugraha, Putra, Bimantio, Ferhat, Zakaria, et al., 2022).

Based on the data collected during the biodiversity assessment, the plant species were examined to identify those with potential value for food resources. Plants with high nutritional value and culinary versatility were considered as potential food resources.

To understand the local community's perspectives and practices, interviews and focus group discussions are conducted. Local farmers, agricultural practitioners, and

community members are engaged in conversations to gather information about their traditional knowledge, farming techniques, and the utilization of biodiversity in their agricultural practices. The interviews and focus group discussions within 20 people in Kemudo Village aim to capture the wealth of traditional knowledge and practices that have been passed down through generations. This knowledge often includes sustainable farming methods, pest control techniques, and the utilization of specific plant species for soil fertility enhancement and crop protection.

## Results and Discussion

The surveys conducted within TKP reveal a various diversity of plant species, including trees, shrubs, herbs, and grasses. The park harbors a variety of endemic and rare species, contributing to its conservation significance. The park's rich biodiversity provides a variety of edible plants that can enhance local diets and improve nutritional diversity. Moreover, certain identified plant species exhibit inherent properties as natural pesticides, presenting a sustainable alternative

for pest management within agricultural landscapes.

Prambanan Biodiversity Park has 2 areas that are used as biodiversity parks, namely the inner area which is one with the factory area and the outer area which is outside the factory fence. The inner area is unique in the types of plants planted generally as carbon sinks, shade plants, ornamental plants, and perennials that do not produce flowers. This is intended so as not to invite insects and other animals which can be a source of contaminants from factory-produced products. An initial study recording and inventorying plant species within TKP unveiled 50 flora species, totaling 902 individuals, as shown on pareto diagram in figure 1. Predominant species in the inner area encompass palms (*Roystonea regia*), glodokan (*Longifrom monoon*), and *pucuk merah* (*Syzygium myrtifolium*). In contrast, the outer area boasts an abundance of fruit trees, perennials, and grasses. This section, due to its proximity to local residents' agricultural land, holds potential as suitable agricultural commodity territory. Notable species prevalent in the outdoor areas include mango (*Mangifera indica*), cassava (*Manihot esculenta*), and sengon (*Albizia chinensis*) (Bimantio et al., 2023b).

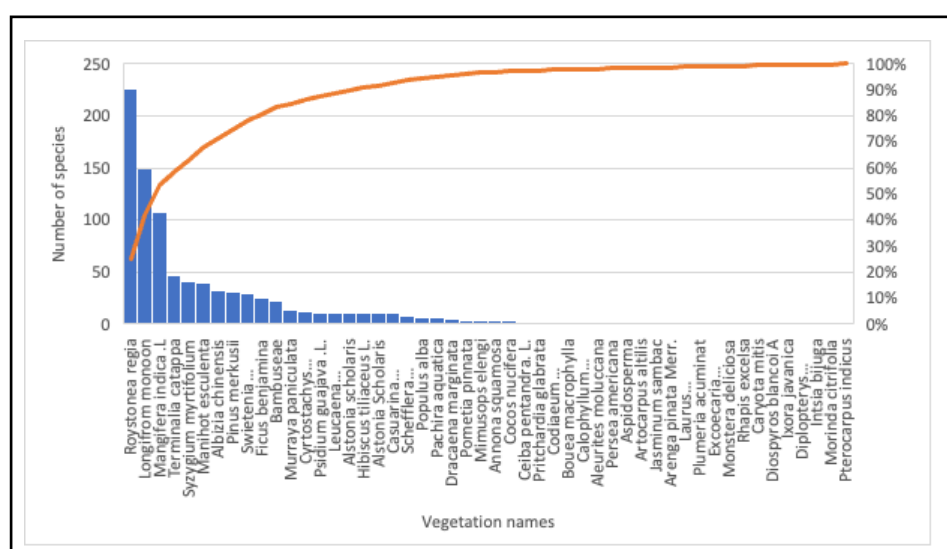


Figure 1. Pareto Diagram of All Plants found in Prambanan Biodiversity Park

Amidst the diverse array of plants within TKP, certain species stand out as key contributors to both nutrition and environmental conservation. Mango (*Mangifera indica*), renowned for its luscious

and vitamin-rich fruits, represents a harmonious blend of taste and nutrition. Similarly, cassava (*Manihot esculenta*) emerges as a resilient staple, offering a reliable source of carbohydrates, particularly in

challenging growth conditions, benefiting communities. Beyond their taste profiles, plants like guava (*Psidium guajava*) with high vitamin C and dietary fiber content play pivotal roles in boosting immune systems and digestive health. Moringa (*Moringa oleifera*), often termed the "miracle tree," encapsulates an array of vital nutrients within its leaves, serving as a potent tool against malnutrition, particularly in regions grappling with dietary deficiencies. Avocado (*Persea americana*), renowned for its nutrient-rich composition and culinary adaptability, embodies the fusion of taste and nutrition, contributing to healthier diets and livelihoods. These plants collectively highlight the intricate interplay between sustainable agricultural practices, nutritional enhancement, and resilient ecosystems. Recognizing their potential and nurturing them conscientiously can pave the way for a balanced and nourishing future, benefitting both humanity and the planet (Idhayanti et al., 2022; Llauradó Maury et al., 2020; McMullin et al., 2019).

Among the diverse assembly of plants within TKP, several species emerge as promising contributors to agricultural enrichment, each presenting unique benefits and applications. *Moringa oleifera*, commonly known as the "Miracle Tree," is one of the edible plant species found in TKP. Renowned for its exceptional nutritional profile, its leaves, pods, and seeds encompass a wealth of vitamins, minerals, and antioxidants. The versatile utilization of *Moringa oleifera* extends from fresh consumption of its leaves to their incorporation in diverse culinary preparations like soups, stews, and salads. Moreover, the seeds can be processed to extract oil used in both cooking and skincare products, amplifying its multifaceted significance (Awi et al., 2022; Jusnita & Tridharma, 2019; Z. Suhaemi et al., 2021). The integration of *Moringa oleifera* into local diets holds immense promise in addressing nutritional deficiencies, particularly in regions with limited access to diverse and nutrient-rich foods. Its cultivation and utilization can significantly bolster food security initiatives and combat malnutrition-related health concerns (Marhaeni, 2021).

*Manihot esculenta*, commonly known as Cassava, emerges as a prominent staple crop celebrated for its adaptability to adverse

environmental conditions. Its resilience renders it invaluable in areas where cultivating traditional crops might pose challenges (Setiawan & Sebayang, 2023). Similarly, species such as *Leucaena leucocephala* and *Casuarina equisetifolia* (Australian Pine) exhibit nitrogen-fixing capabilities, presenting promise in enhancing soil fertility and augmenting agricultural yields (Kumar et al., 2023).

Beyond these, *Bambuseae* (Bamboo) showcases its potential as a multipurpose resource in agriculture. Its rapid growth and versatility position it as a formidable candidate for soil erosion control, construction material, and the production of edible bamboo shoots, thereby bolstering both ecological integrity and local economies. Additionally, *Moringa oleifera* (Moringa), known for its nutrient-rich leaves, can complement livestock feed systems and contribute to enhanced soil health, underscoring its significance as an agricultural asset.

The integration of such diverse plants into agricultural systems calls for a nuanced understanding of their ecological compatibility and optimal cultivation practices. This underscores the importance of considering local environmental conditions and the broader agricultural landscape when harnessing these plant species for maximum benefit. Through judicious cultivation and informed management, these plant species hold the potential to enrich and transform agricultural practices, reinforcing the vital interplay between nature and human sustenance.

An exemplary instance of traditional agricultural knowledge pertains to the utilization of the mojo plant for pest control, representing a native plant species found within TKP. Mojo, scientifically known as *Eupatorium odoratum*, boasts inherent properties as a natural insect repellent. Farmers, drawing upon traditional wisdom, have long utilized this plant to effectively manage pests within their agricultural fields (Taufieq et al., 2019). By strategically planting mojo around their crops, farmers can curtail reliance on chemical pesticides, thereby mitigating the environmental footprint and potential health hazards associated with pesticide application. This age-old practice illuminates the remarkable potential of

biodiversity in fostering sustainable pest control practices within agricultural systems.

In carrying out the form of monitoring and evaluation, it must not be separated from The Result Chain, where the concept is the basic data used for the assessment process, Activities conducted for monitoring and evaluation encompass various forms, such as public discussions and documentation. Public discussions, including Focus Group Discussions (FGDs) or panel discussions, involve diverse stakeholders like village governments, district and provincial ministries, NGOs, and community representatives. Additionally, documentation in forms like Logical Frameworks, S Curves, and monthly activity reports ensures the continuity and documentation of program progression (Ferhat et al., 2021).

Interviews and focus group discussions with local community members indicate a strong reliance on traditional knowledge and practices related to food and agriculture. The community recognizes the potential of biodiversity in enhancing local diets and agricultural practices. Traditional plants with medicinal properties and nutritional value are valued for their contribution to health and well-being. The integration of biodiversity into local food systems necessitates the formulation of conservation strategies and policies, focusing on sustainable harvesting and cultivation practices, community involvement, and educational initiatives. Capacity-building initiatives are pivotal in enhancing the community's adeptness in harnessing biodiversity for food resources and agriculture.

Building upon the research findings, several recommendations can be proposed to optimize TKP's potential for food resources and agriculture while concurrently conserving biodiversity and prioritizing the local community's well-being.

1. **Promotion of Sustainable Practices:** Ensuring the long-term viability of utilizing TKP for food resources and agriculture mandates the promotion of sustainable harvesting and cultivation practices. This involves implementing responsible harvesting guidelines for edible plants, advocating regenerative agricultural techniques, and endorsing organic fertilizers and natural pest control methods.

2. **Community Engagement and Participation:** Engaging the local community in decision-making processes and conservation endeavors is imperative for the success of TKP's utilization. Fostering community participation can be achieved through the establishment of community-led organizations, offering training and capacity-building programs, and supporting local initiatives that champion biodiversity conservation and sustainable farming practices.
3. **Educational Initiatives:** Implementing educational programs in schools, organizing workshops, and conducting awareness campaigns play a crucial role in disseminating knowledge about biodiversity conservation's significance. These initiatives can also highlight the potential benefits of leveraging TKP for food security and sustainable agriculture, ensuring wider community understanding and support.

By aligning with these recommendations, TKP can serve as a model for sustainable agriculture and biodiversity conservation, nurturing a symbiotic relationship between nature, food security, and community well-being.

Governmental support and policy integration are pivotal for the successful integration of Prambanan Biodiversity Park (TKP) into local food systems. Formulating policy frameworks that incentivize sustainable practices, safeguard biodiversity, and bolster the livelihoods of local communities is imperative. These policies can encompass creating market opportunities for sustainably harvested and cultivated products, offering financial incentives for conservation initiatives, and embedding biodiversity preservation within land-use planning and agricultural policies.

Moreover, the presence of protection, education, innovation, and biodiversity education programs aligns with the company's objective to achieve green PROPER status. The PROPER initiative not only augments the company's standing as one deeply committed to biodiversity protection but also underscores real dedication by supporting educational facilities that contribute to the welfare of the surrounding community (Ferhat et al., 2023).

The existence of a biodiversity park, like TKP, can exert positive impacts on environmental and community management. These impacts manifest in several ways: Firstly, it enhances comprehension regarding biodiversity parks through dedicated biodiversity monitoring. Secondly, it facilitates employment opportunities for the working-age population through infrastructure development and the daily management of biodiversity parks via tourism awareness groups. Thirdly, it stimulates new economic growth, consequently elevating incomes. Lastly, it fosters collaborations among stakeholders with a shared commitment to safeguarding flora and fauna ecosystems, leveraging specific biodiversity park landmarks as tourist attractions (Ferhat et al., 2022).

The diverse flora of TKP offers a wide range of plant species that hold potential value as food resources for the local communities. This research explores some of the edible plants found within the park and their potential contributions to local diets and nutritional diversity.

Food security is a global concern, particularly in regions where communities rely heavily on agriculture for their sustenance. Enhancing agricultural practices and diversifying food resources are key strategies for improving food security. Incorporating biodiversity into agricultural systems can contribute to sustainable food production and help mitigate the negative impacts of climate change.

The findings derived from this research reinforce the critical significance of safeguarding biodiversity and incorporating it into local food systems to enhance the well-being of the community and ensure food security. TKP, serving as an exemplary model, encapsulates the essence of biodiversity conservation while supporting sustainable agriculture and fostering community development.

## Conclusions and Suggestions

The Prambanan Biodiversity Park (TKP) stands as a potential source of invaluable food resources and a bastion for sustainable agricultural practices beneficial to nearby communities. The comprehensive assessment

of TKP's biodiversity underscores a rich assortment of plant species holding significant promise for food resources and agricultural applications. Furthermore, delving into the local community's perspectives and practices illuminates their reliance on traditional knowledge and the utilization of biodiversity for sustenance and farming.

Realizing the maximum potential benefits of TKP for bolstering food security and advancing agriculture necessitates the development of robust conservation strategies and policies. These strategies should center on advocating sustainable practices, fostering active community involvement, and spearheading educational initiatives. By seamlessly integrating biodiversity conservation into local food systems, TKP can effectively contribute to the well-being of the local community while safeguarding and preserving the area's diverse biodiversity.

The research findings underscore the pivotal role of recognizing the latent potential inherent in natural reserves like TKP. Such reserves play a crucial role in bolstering local food security, championing sustainable agricultural practices, and advocating for the integration of biodiversity conservation into societal norms and policies.

Conservation strategies must prioritize preserving TKP's biodiversity to ensure the enduring availability of invaluable plant species. Collaboration among PT.Sarihusada Generasi Mahardhika, the local community, and pertinent stakeholders stands as a cornerstone in effectively implementing these strategies, fostering a collective effort towards sustainable conservation and community well-being.

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