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CONSERVATION, UTILIZATION OF LOCAL PLANT SPECIES, AND CULTIVATION AS THE EFFORTS OF CONTROLLING SALT AND SULFUR LEVELS AT THE BORDER OF BALURAN NATIONAL PARK, SITUBONDO REGENCY, EAST JAVA

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ABSTRACT

The diversity of plant species functions as a shelterbelt, to prevent saltwater intrusion and avoid sulfur from the crater of Mount Ijen through the Banyuputih River in Situbondo Regency. The Situbondo-Banyuwangi area is strategic (Pantura), passing through the Baluran National Park, so it is essential to maintain biodiversity and water ecosystems. Mangroves, beach vegetation, cultivated plants, and forest vegetation are indicators of environmental protection and conservation. This study aims to reveal the diversity of flora species on the border of Baluran National Park, Banyuputih sub-district, Situbondo Regency, which is allegedly contaminated with salt material from the sea and sulfur from the crater of Mount Ijen. An interview was conducted to determine the function of flora, location elevation, water pH, and well depth. The results of the biodiversity survey were then collected and diagnosed, and the scientific name was then determined. Potential species diversity at the border from an altitude of 5 m above sea level (asl) – 62 m asl included 17 families and 29 species. The data on biodiversity, location elevation, water well depth, and pH indicate low sulfur and salt content; therefore, water resources can be used sustainably by the living things surround them.

Keywords: Banyuputih, the potential of flora, water sources

INTRODUCTION

Situbondo Regency is administratively located in the northern part of the Madura Strait, east of the Bali Strait, south of Banyuwangi and Bondowoso regencies, and in the western part of Probolinggo district. The total area of 163,850 ha consists of 17 sub-districts including Arjasa, Banyuputih, Banyuglugur and Jangkar. There are sand beaches to mangrove forests in the north with community life activities as farmers and fishermen. The biodiversity of mangroves and beaches includes *tanjang*, *api-api*, *sentigi*, *bakau* (*Rhizophora* sp.), *bogem*, cemara laut (sea pine), *kijaran*, kambil (coconut), and mimba (neem) (Batoro & Wiyono, 2020), while the diversity of mangrove forests in the Papua New Guinea region includes 37 species (Percival & Womersley, 1975).

Situbondo Regency is generally inhabited by the people of Madura and Java, who use their life wisely and sustainably. Local wisdom is human behavior passed down from one generation to the next by word of mouth (Hoffman & Gallaher, 2007; Sutikno *et al.*, 2018). Meanwhile, the relationship between people's lives is related to using and managing natural plant resources in the environment, which is called ethnobotany (Cotton, 1986).

Mount Ijen is a volcanic mountain with high sulfur content, located between Banyuwangi and Bondowoso regencies, has an altitude of 2,386 m above sea level. Banyuputih River in the Banyuputih sub-district is one of the rivers that carry elements of sulfur (sulfur and calcium) brought from the top of the crater of Mount Ijen. It is a problem that must be overcome since it might interfere with human health and other organisms. In the northern part of the Situbondo Regency, a sea requires flora types to cope with seawater and wind intrusion (Percival & Womersley, 1975; Harahap & Setiawan, 2017; Batoro *et al.*, 2018; Batoro & Wiyono, 2020).

The need for water resources, flora, and the environment are the primary needs of human life, so they need attention. The community in the Banyuputih sub-district, Situbondo Regency, is affected by disturbances in salt and sulfur levels (Wiyono *et al.*, 2017; Wiyono & Batoro, 2020). Estimating water depth can be done directly or by the geoelectric method (Wiyono & Batoro, 2020). This research is expected to reveal the potential of flora species diversity related to saltwater and sulfide intrusion from the Ijen crater in Banyuputih district, Situbondo.

MATERIALS AND METHODS

This study was conducted through surveys and direct observations on the western border of the Baluran National Park Forest, Situbondo Regency, in April-September 2021. The survey was conducted in several villages in the Banyuputih sub-district, which borders the Baluran National Park (Figure 1A). Plant specimens were collected and dried, preserved, and processed at the Biology Herbarium, Universitas Brawijaya Malang (HBUR). The listed plants' identification, characterization, and nomenclature were based on a book entitled "Flora Jawa dan Flora Malesiana" (Backer & Van den Brink, 1968; Percival & Womersley, 1975; Aksornkooe *et al.*, 1992; Harris & Harris, 2003). The calculation of water depth was measured directly and through interviews (Hoffman & Galaher, 2007), while the analysis of water pH was carried out with pH meter paper, and location elevation was carried out using GPS.



Fig. 1A : Map of Situbondo Regency and surrounding area (the star)

RESULTS AND DISCUSSION

Most of the people living along the border are the Madurese, indicated by the dialect of the language. In general, the people live by farming, fishing (Figure 3B),

raising cattle and sheep (Figure 2A). In their daily lives, the people of Banyuputih use groundwater, while agricultural management uses river water.

The initial survey points were carried out in the forest area of Baluran National Park and Perhutani production forest with an altitude of 62 m above sea level; S07 47'17.25" and E114 18'31.76" at 32°C ambient temperature. The diversity of production forests is dominated by kayu jati (*Tectona grandis*), while local species include *biduri*, *kijaran*, mimba (neem), *kerinyu*, kasia, babul (*Acacia arabica*) which are exotic plant species originating from Africa.

Biduri, *widuri*, crown flower (*Calotropis gigantea*) are widely distributed in the village area of Blangguan, Banyuputih sub-district with a village elevation of 53 m above sea level, S07 47'32.48" and E114 17'45.20", while the depth of the well water is 20-24 meters. Species diversity includes mimba or neem, kelor or moringa, asam jawa or tamarind (*Tamarindus indica*), *kijaran*, and kasia or babul (*Acacia arabica*). The diversity of cultivated plants includes jagung (corn), padi (rice), tebu (sugar cane), lombok riwit (hot chili), rumput gajah (elephant grass), pisang, plantain (*Musa paradisiaca*), and mangga or mango (*Mangifera indica*). According to Mr. Bambang Trisna and Mr. Hendra, the sap of *biduri* or crown flower (*Calotropis gigantea*) can be used as a toothache medicine but affects porous teeth (Figure 2B). The latex from this plant has been used in Africa as an arrow poison. The group *Calotropis* spp. is a poisonous plant because it contains calotoxin, calotropone, and calactin. Compound calotropone displayed inhibitory effects towards chronic myelogenous leukemia K562 and human gastric cancer SGC-7901 cell lines (Nian Wang, 2008). The fruit, young tamarind or leaves asam jawa (*Tamarindus indica*), can be used for drinks and treating cold. Young mimba or neem leaves (*Azadirachta indica*) are used to treat various diseases, including headaches and Covid-19. The community uses neem, kasia or babul, and *kijaran* leaves to feed for cattle (*Bos sondaicus*) and goats. It can be indicated by a large number of cattle in the area (Figure 2A).



Fig. 2A : Cattle. B. *Biduri*, C. kasia or babul (*Acacia arabica*)

In the coastal area of TPI Pondok Rindu, there are fishermen and a fish market with a height of 5 m above sea

level, S07 44'53. E.114 17'43.60 (Fig. 3A,B). The diversity of plant species is generally in the range. However, according

to some residents, on the east side of TPI, there are tanjang (*Bruguiera gymnorhiza*), api-api (*Avicenia marina*), and sentigi. According to Mr. Mahfud and Mr. Uci, the residents of Sumber Anyar village located 1 km from the beach, the well water is clear, 4 meters deep, not salty, and has a pH of 7. Meanwhile, the leading agricultural cultivations are mbako, tobacco (*Nicotiana tabacum*), kambil, coconut (*Cocos nucifera*), kijaran (*Lannea coromandelica*) as a fence,

and mimba (neem) leaves as medicine. One of the informants, Mr. Jenan said that in Sidodadi hamlet, Sumber Anyar village, the water well depth is 3–4 m; at an altitude of 8 m above sea level, S07 45'31.33" and E114 11'50.86" with a water pH of 6.5 – 7. The existence of a pond adjacent to the village housing causes the well water to become salty. It is related to the diversity of flora and it requires attention from related parties.



Fig. 3A : Mimba (*Azadirachta indica*), B. Fishermen

According to Mr. Mide from Ranurejo village, Banyuputih sub-district is 3 km from the beach at an altitude of 21 m above sea level; S07 46'01.43" and E114 17'30.04, has a water well depth of 12 m. The important biodiversity includes biduri or crown flower (*Calotropis gigantea*), kijaran (*Lannea coromandelica*), mimba or neem (*Azadirachta indica*), kambil or coconut (*Cocos nucifera*), jagung or corn (*Zea mays*) (Table 1). Mimba, neem (*Azadirachta indica*) (Figure 3A) is said by the community to have a curing power of various diseases, including Covid-19.

This species can be regarded as a valuable plant source to rationalize its use in traditional medicine and modern drug development (Van Der Nat *et al.*, 1991). Kijaran (*Lannea coromandelica* (Houtt.)) is used by local people for shade and road dividers or fences because it is easy to grow through cuttings and is used for animal feed. Kijaran (*Lannea coromandelica* (Houtt.) Merr.) synonym *Odina gummifera* Blume, *Lannea grandis* Engler was collected by Teijsmann JE with specimen no: K000695336.

Table 1 : Diversity of important cultivated plant species in the border village of Baluran National Park

No	Local name	Scientific name	Familia	Habitus
1	Mangga, mango	<i>Mangifera indica</i>	Anacardiaceae	Tree
2	Kambil, coconut	<i>Cocos nucifera</i>	Arecaceae	Tree
3	Kates, papaya	<i>Carica papaya</i>	Caricaceae	Tree
4	Pohong, cassava	<i>Monihot esculenta</i>	Euphorbiaceae	Shrub
5	Asam jawa, tamarind	<i>Tamarindus indica</i>	Fabaceae	Tree
7	Gamal	<i>Gliricidia sepium</i>	Fabaceae	Tree-shrub
8	Kaliandra	<i>Calliandra haematocephala</i>	Fabaceae	Shrub
9	Kayu jati, teak	<i>Tectonagrandis</i>	Lamiaceae	Tree/ <i>Perhutani</i>
10	Kapuk randu	<i>Ceiba petandra</i>	Malvaceae	Tree
11	Pisang, plantain	<i>Musa paradisiaca</i>	Musaceae	Tree
12	Padi, rice	<i>Oryzasativa</i>	Poaceae	Grass
13	Jagung, corn	<i>Zea mays</i>	Poaceae	Grass
14	Tebu, sugarcane	<i>Saccharum officinarum</i>	Poaceae	Grass
15	Rumput gajah, elephant grass	<i>Pennisetum purpureun</i>	Poaceae	Grass
16	Mbako, tobacco	<i>Nicotiana tabacum</i>	Solanaceae	Shrub

Table 2 : Diversity of important local plants in the border village of Baluran National Park

No	Local name	Scientific name	Familia	Habitus
1	Kijaran	<i>Lannea coromandelica</i>	Anacardiaceae	Tree
2	Biduri	<i>Calotropis gigantea</i>	Asclepiadaceae	Shrub
3	Kerinyu	<i>Eupatorium odoratum</i>	Asteraceae	Shrub
4	Ketapang	<i>Terminalia catappa</i>	Combretaceae	Tree
5	Babul, kasia	<i>Acacia arabica</i>	Fabaceae	Tree
6	Toro	<i>Leucaena glauca</i>	Fabaceae	Tree
7	Tom	<i>Indigofera sumatrana</i>	Fabaceae	Shrub
8	Keben	<i>Barringtonia asiatica</i>	Lecythidaceae	Tree
9	Waru	<i>Hibiscus tiliaceus</i>	Malvaceae	Tree
10	Mimba	<i>Azadirachta indica</i>	Meliaceae	Tree
11	Kelor	<i>Moringa oleifera</i>	Moringaceae	Tree
12	Alang-alang	<i>Imperata cylindrica</i>	Poaceae	Grass
13	Bambu, bamboo	<i>Dendrocalamus asper</i>	Poaceae	Tree

Kasia, babul (*Acacia arabica* (Lam.) Willd), whose synonym is *Acacia nilotica* (L.) Dellile is a family of Leguminosae subfamily Mimosoideae, and the Madurese local name is Kasia (Table 2). This exotic species originates from northern Africa and Arabia and is scattered among Perhutani, dominating Baluran National Park and in the rural border areas of Situbondo. *Acacia arabica* has been effective against various diseases, including diabetes, skin disease, and, most concerning, cancer. The fresh plants' parts of *Acacia arabica* are considered as astringent, demulcent, aphrodisiac, anthelmintic, antimicrobial, antidiarrhoeal, with good nutritional value in the Indian traditional medicine system (Rajvaidhya *et al.*, 2012).

The higher the location has the impact on the depth of the water well. According to Wiyono & Batoro (2020), rock properties can affect groundwater depth. It is evidenced in the village of Blangguan, with an altitude of 52 m above sea level, which has a water well depth of about 24 meters. The growth of padi or rice (*Oryza sativa*) and jagung or corn (*Zea mays*) cultivation indicates that the area has negligible sulfur content. According to Batoro & Wiyono (2020), around the Banyuputih River, with low sulfur content and pH, it is suitable for tebu or sugarcane (*Saccharum officinarum*) cultivation but not suitable for jagung or corn (*Zea mays*) and padi or rice (*Oryza sativa*) cultivation. The diversity of wild and cultivated plants and environmental factors such as soil and river flow in the border area of Baluran National Park can indicate the impact of sulfur infiltration, salt content so that it can provide information and contribute to people's lives.

CONCLUSION

The diversity of cultivated and local plant species on the border of Baluran National Park, Banyuputih sub-district, Situbondo Regency was numerous. There are 29 species, 13 familia, while the dangerous exotic species kasia or babul (*Acacia arabica*) and local species as medicinal ingredients are three types, namely mimba or neem (*Azadirachta indica*), kijaran (*Lannea coromandelica*), and biduri or crown flower (*Calotropis gigantea*). The depth of groundwater depends on the location's altitude; the closer to the sea, the less depth it is. Seawater intrusion depends on soil factors, mangrove biodiversity, while the sulfur content in the border area of Baluran National Park is low; this indicates the growth of maize and rice plants that thrive.

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