

Inventory of Native, Introduced and Invasive Vegetation in Tree-Pole Regeneration in Laweyan Village, Surakarta

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ABSTRACT

The existence of invasive foreign plants is a threat to the global ecosystem. Its rapid growth often causes this plant to destroy the original habitat in an area. This research aims to identify tree-pole regeneration species in Laweyan Village. This research was carried out by direct observation using a sampling method with a plot measuring 10 x 10 meters and analyzed descriptively. Based on the results of research conducted in Laweyan Village, it was found that there were 38 species of pole and tree regeneration vegetation which were divided into 3 types based on their origin, namely native, introduced and invasive species. There were 19 species of native plants, 15 species of introduced plants, and 4 species of invasive plants. Meanwhile, based on their function, plants are divided into three, namely fruit plants, shade plants and ornamental plants. The plants that dominate based on their function are fruit plants, totaling 16 types.

KEYWORDS

Invasive plants
Biodiversity
Lamtoro
Ecosystem
Vegetation

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1. Introduction

Indonesia is a megabiodiversity country with a fairly high level of vegetation diversity both in terms of species, genetics and ecosystems. This diversity is considered the backbone of life which has functions and benefits in various aspects, namely social, cultural, economic or ecological (Supriyatna et al., 2022). This diversity of vegetation needs to be cared for so that its sustainability is maintained into the future. Therefore, we need to analyze and explore various factors that can threaten the existence of native vegetation in this country. One of the factors that influences biodiversity and ecosystem function is land change. Land changes can create supporting conditions for the spread of invasive plants. When land changes occur, there is an opportunity for invasive plants to take over native habitats (Rifai et al., 2021). Urbanization and population growth that occur in various cities throughout the world are the cause of significant transformations in the urban environment (Rukmana & Cahyaningias, 2021). Although living in cities has provided great benefits for humans, it also brings various new challenges, especially in the context of environmental sustainability. One of the challenges that is currently of great concern is the spread of invasive foreign plants in urban areas.

Laweyan Village, as a component of the city, is experiencing rapid growth in various aspects, so it is also facing the impact of environmental changes. Apart from the threat from invasive foreign plants, urban conditions are worsened by increasing population growth which is one of the causes of the conversion of agricultural land to non-agricultural land which makes the existence of native plants increasingly threatened due to land transformation (Rohsulina et al, 2020). Invasive foreign plants are plants that come from outside their natural habitat and have the potential to dominate an area, so that surrounding plants cannot grow and develop (Sayfulloh et al., 2020). According to (Yuliana, 2018) the presence of invasive foreign species on plants has a detrimental impact both ecologically and economically. This issue has become an international concern regarding biodiversity conservation, the control and management of which requires enormous costs (Thapa et al., 2018). (Rasyid, A., Suleman & Lilies., dan Achmad, 2020) stated that invasives are a threat that needs attention because they can damage native ecosystems and change nutrient and hydrological cycles.

In recent decades, tree-pole saplings have become one of the invasive alien plants that dominate a number of urban areas around the world. The spread of invasive foreign plants can occur directly or indirectly depending on environmental factors (Sulistiyowati et al., 2021). The main impact that occurs due to the presence of invasive foreign plants is reduced biodiversity (Kodiran et al., 2020). This impact is not only felt on flora, but also on local fauna who depend on these plants as a source of food and shelter. In the context of Laweyan Village, the presence of invasive foreign plants such as tree-pole regeneration is of particular concern. Efforts to understand the distribution and spread of these plants in urban environments are essential, as they can provide insight into the potential ecological and social impacts resulting from their presence. Research on "Inventory and Distribution Patterns of Invasive Alien Plants, Tree-Mass Regeneration in Laweyan Village" aims to identify existing tree-pole regeneration species. Through this research, it is hoped that a better understanding will be gained about the impact of invasive alien plants on the urban environment, as well as the potential risks that may arise. Additionally, the information obtained from this research can be used as a basis for designing effective management strategies, including monitoring efforts, population control, and restoration of affected ecosystems. This is an important step in maintaining the sustainability of the urban environment and the welfare of the people living in Laweyan Village.

2. Method

2.1 Location and Time

This research was conducted in Laweyan Village, Laweyan Surakarta, Central Java. To be precise, there are 30 plots spread across Laweyan Village. This research was conducted in September 2023.

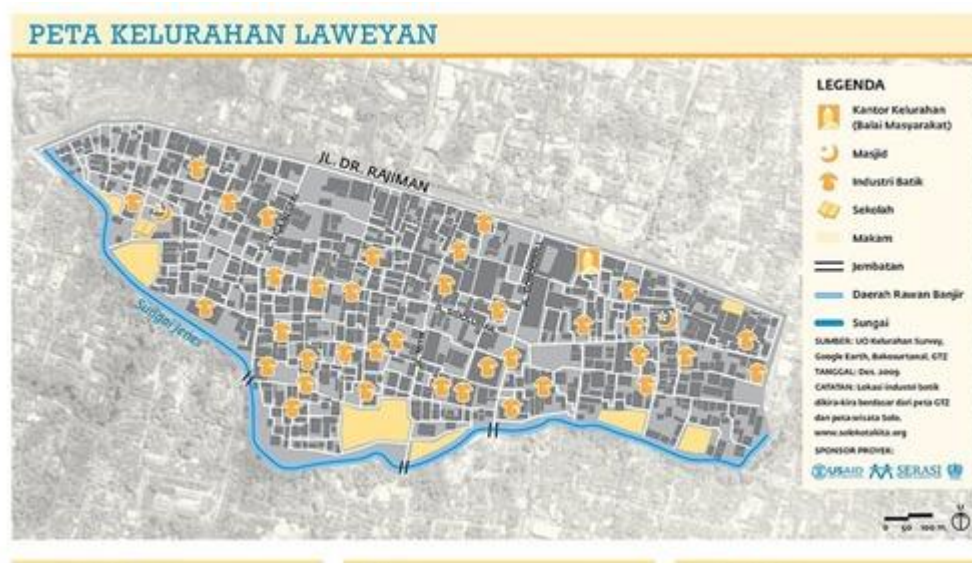


Fig. 1. Map of Research Locations in Laweyan Village, Laweyan, Surakarta

2.2 Data collection method

In this study, plot points were determined using satellite imagery by considering the highest NDVI value because it influences the ability of water absorption and carbon absorption (Awaliyan & Sulistyoadi, 2018). The transect method was used to collect data about the distribution and composition of vegetation in Laweyan Village. Next, the data was taken by analyzing the vegetation on each plot for a plot size of 10 x 10 meters (Febriawan, 2023). The vegetation analyzed was the type of tree and pole regeneration.



Fig. 2. Research Location Points from Sampling Results with Imagery

2.3 Data analysis

This research uses a descriptive method with a quantitative research type (Rukajat, 2018). This research presents a total inventory of vegetation in Laweyan Village and describes it based on species, function and origin. After being classified based on its origin, the impact of invasive alien vegetation will be explained. The vegetation analyzed is the type of tree and pole regeneration. All species are separated based on their origin, namely native, introduced and invasive species. Species in the invasive category are then analyzed for reproductive speed, resistance to the environment, and ability to take over the ecosystem.

3. Results and Discussion

3.1 Inventory of Plants in Laweyan Subdistrict on Replanting Trees and Poles

Table 1. Inventory of Plants in Laweyan Subdistrict on Replanting Trees and Poles

Local Name	Latin Name	Origin	Alien Invasive (V)	Amount	Function
Rambutan	<i>Nephelium lappaceum L.</i>	Indonesia		2	fruit
Kapas Randu	<i>Ceiba pentandra (L.) Gaertn.</i>	Amerika Selatan dan Amerika Tengah		4	leafy
Mangga	<i>Mangifera indica L</i>	India		24	fruit
Sukun	<i>Artocarpus communis Forst</i>	New Guinea		4	fruit

Gelodokan Tiang	<i>Polyalthia Longifolia</i>	India		21	leafy
Angsana	<i>Pterocarpus indicus. Willd</i>	Burma Selatan		1	leafy
Bunga kertas	<i>Bougainvillea glabra Choicy</i>	Amerika Selatan	V	3	Ornamental
Beringin	<i>Ficus benjamina</i>	Indonesia		1	leafy
Melinjo	<i>Gnetum gnemon L.</i>	Malaysia		6	leafy
Kantil	<i>Magnolia alba (D.C.)</i> ×	India		1	leafy
Durian	<i>Durio zibethinus Merr.</i>	Malaysia dan Sumatra, Kalimantan Indonesia		1	fruit
Palem Putri	<i>Veitchia merillii</i>	Filipina		5	ornamental
Salam	<i>Syzygium polyanthum</i>	Indonesia		1	leafy
Matoa	<i>Pometia pinnata Spp.</i>	Papua, Indonesia		2	fruit
Srikaya	<i>Annona squamosa L.</i>	Amerika Selatan		3	fruit
Belimbing Wuluh	<i>Averrhoa bilimbi L</i>	Indonesia		5	fruit
Jambu air	<i>Syzygium aqueum</i>	Indo Cina dan Indonesia		2	fruit
Stone Bambu	<i>Phyllostachys angusta McClure</i>	Tiongkok Timur		6	Ornamental
Sawo	<i>Manilkara zapota</i>	Amerika Tengah dan Meksiko		2	fruit

Ulin Persia	<i>Parrotia persica Mey.</i>	Iran		12	leafy
Kamboja	<i>Plumeria rubra L.</i>	Amerika Tengah		23	Ornamental
Nangka	<i>Artocarpus heterophyllus</i>	India		6	fruit
Lamtoro	<i>Leucaena leucocephala Lam.</i>	Meksiko dan Amerika Tengah	V	8	leafy
Pepaya Jepang	<i>cnidoscolus aconitifolius (mill.) i.m.johnst</i>	Meksiko dan Amerika Tengah	V	2	Ornamental
Jati	<i>Tectona grandis Linn. f.</i>	Burma (Myanmar)		3	leafy
Kelapa Gading	<i>Cocos nucifera L.</i>	Amerika Selatan		1	Ornamental
Alpukat	<i>Persea americana P. Mill.</i>	Amerika Tengah		4	fruit
ketapang kencana	<i>Terminalia paniculate</i>	Afrika Barat		3	Ornamental
Asam Jawa	<i>Tamarindus indica L.</i>	Afrika Timur		2	leafy
Ficus Rubiginosa	<i>Ficus rubiginosa</i>	Australia		1	leafy
Jambu biji	<i>Psidium guajava L.</i>	Karibia, Amerika Tengah, Amerika Selatan		2	fruit
Belimbing bintang	<i>Averrhoa carambola L.</i>	Malaysia		3	fruit
Mengkudu	<i>Morinda citrifolia L.</i>	Asia Tenggara		1	fruit

Kelengkeng	<i>Dimocarpus longan</i>	Myanmar		3	fruit
Kecapi	<i>Sandoricum koetjape Merr.</i>	Indocina dan Semenanjung Malaya	V	1	fruit
Jenitri	<i>Elaeocarpus ganitrus Roxb.</i>	Indonesia		1	leafy
Pohon trumpet	<i>Brugmansia candida (Pers.) Saff.</i>	Peru dan Meksiko		1	Ornamental
Pohon hantap	<i>Sterculia coccinea Jack.</i>	Indonesia		1	leafy

Based on the results of the research that has been carried out, it shows that in table 1 it is known that there are 38 species of pole and tree regeneration vegetation in Laweyan Village. The thirty-eight species are divided into three types based on their origin, namely native, introduced and invasive species. There were 19 species of native plants, 15 species of introduced plants, and 4 species of invasive plants. The results of plant identification in Laweyan Village show diversity. Apart from origin, the plants in Laweyan Village are classified based on their function. Based on their function, the plants in table 1 can be divided into three functions, namely fruit plants, shade plants and ornamental plants (Melanira et al., 2023)

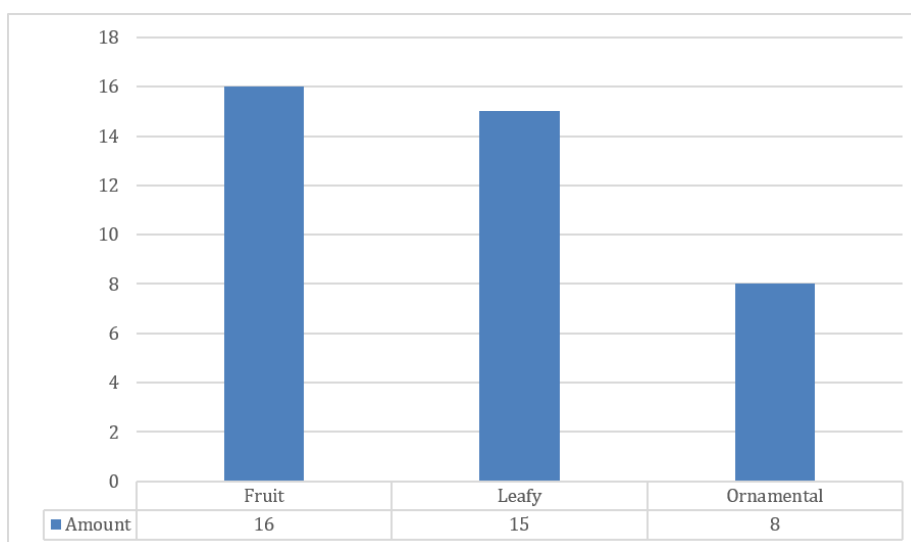


Fig. 3. Comparison of The Amount of Fruit, Leafy and Ornamental Plants

Fruit plants, shade plants and ornamental plants have their respective roles in the ecosystem and daily life. Fruit plants have a very important dual role in the ecosystem. Fruit plants act as producers of nutrient-rich fruits, such as mango, guava and durian, which are vital food sources for humans and animals. However, the benefits of fruit trees are not only that, the flowers that bloom on fruit trees also provide protection for various organisms by providing shelter and a source of nutrition. Apart from that, tall growing fruit trees such as shade trees have a very significant additional role. They

provide protection from excessive sunlight, create a comfortable shady place to rest, and protect against inclement weather such as strong winds and heavy rain.

Shade plants or leafy plants are plants that grow tall and have dense leaves, which function to provide protection from excessive sunlight. They are often used to create shady areas. Apart from that, shade plants can also act as natural shade, helping reduce heat and offering a comfortable place to rest. Some examples of shade plants that are commonly used include acacia trees, teak trees, cypress trees, and various types of palms. Shade plants can also provide ecological benefits by creating habitat for various types of fauna and caring for the soil with strong roots. For example, the acacia tree is an example of a shade tree that carries out this function very well (Nurhaliza et al., 2023).

Ornamental trees are generally planted for aesthetic purposes or functions (Azizah & Utami, 2021). Some types of ornamental trees can even function as air pollution filters, improving the quality of the surrounding air, and creating a more comfortable environment, such as *Sansevieria* (P. Tiara Rosha, 2013). In addition, a variety of ornamental trees support a diverse ecosystem. It should be noted that some trees can have a dual function, such as fruit trees which also act as shade trees or ornamental trees, depending on their management. Therefore, selecting the right tree species must take into account specific needs and objectives in the context of the environment in question. Based on its distribution, it is divided into local and foreign.

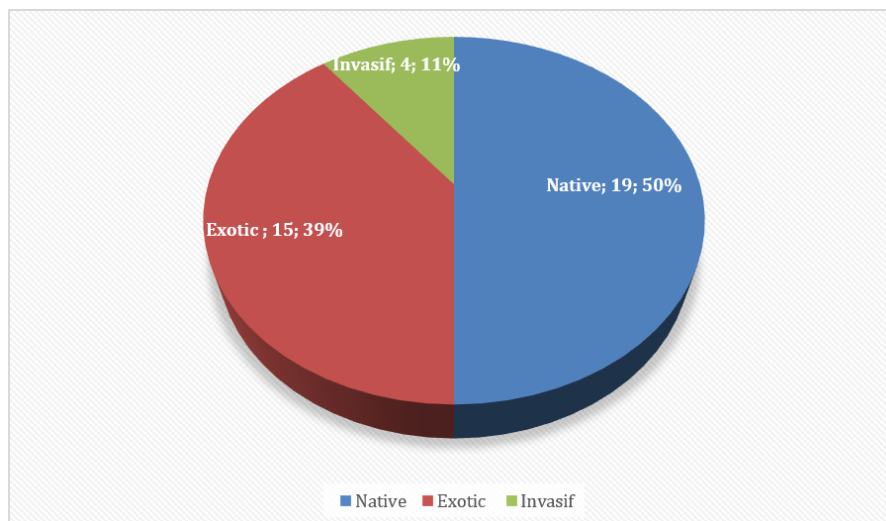


Fig. 4. percentage comparison of the number of native, exotic, and invasive plants

3.2 Native Plants

Native plants are plants that grow and develop in a certain area, and whose distribution cannot be found in other areas (Karyati et al., 2022). They have been around for a long time and play an important role in local ecology and culture. Native plants have adapted to the local environment and often become an integral part of the ecosystem itself. The native species found were *Nephelium lappaceum* L., *Mangifera indica* L., *Artocarpus communis* Forst., *Pterocarpus indicus* Willd., *Ficus benjamina*, *Gnetum gnemon* L., *Durio zibethinus* Merr., *Syzygium polyanthum*, *Pometia pinnata* Spp, *Averrhoa bilimbi* L., *Syzygium aqueum*, *Manilkara zapota*, *Artocarpus heterophyllus*, *Tectona grandis* Linn. f., *Averrhoa carambola* L., *Morinda citrifolia* L., *Dimocarpus longan*, *Elaeocarpus ganitrus* Roxb., and *Sterculia coccinea* Jack. These native vegetation have their respective functions or roles in the environment. Some of them include fruit, shade and ornamental vegetation types. The dominant type of vegetation is fruit vegetation with 12 species. Laweyan Village as an urban area has a cultural tendency to prioritize the function of fruit and ornamental vegetation. Fruit vegetation has a function that is favored by the community, namely producing fruit that can be consumed by the community. Meanwhile, ornamental vegetation is often chosen to add to the aesthetic value of living

spaces with various variations and origins. Unfortunately, shady vegetation is rarely chosen by people due to the problem of unavailability of land.

3.3 Introduced Plants

Introduced or foreign plants is non-native but not invasive, known as non-native or exotic plants, are plants that originate from other regions and are outside their natural distribution area because they were brought intentionally or unintentionally by humans (Wiryoно & Nurliana, 2019). These plants usually come from different geographic regions. They have no natural history in the region and can have ecological impacts, including competition with native or invasive plants. Introduced species are foreign species that do not disturb their new ecosystem and do not have the characteristics of invasive vegetation. The introduced species found in Laweyan Village is *Ceiba pentandra* (L.) Gaertn. originates from South America and Central America; *Polyathia Longifolia* originates from India; *Magnolia × alba* (D.C.) is native to India; *Veitchia merillii* is native to the Philippines; *Annona squamosa* L. originates from South America; *Phyllostachys angusta McClure* is native to Eastern China; *Parrotia persica* Mey originates from Iran; *Plumeria rubra* L. comes from Central America, *Cocos nucifera* L. comes from South America; *Persea americana* P. Mill from Central America; *Terminalia paniculata* from West Africa; *Tamarindus indica* L. originating from East Africa; *Ficus rubiginosa* from Australia; *Psidium guajava* L. from Caribbean, Central America, and South America; *Brugmansia candida* (Pers.) Saff from Peru and Mexico.

Like native vegetation, introduced vegetation has its own function or role in the environment. Some of them include fruit, shade and ornamental vegetation types. The dominant type of vegetation is shade vegetation with 7 species. This may be due to the conditions and needs of the urban area itself. Because Laweyan Village is a densely populated location, there is very little free land for vegetation. This means that the provision of vegetation can only be done along roads and green open space which makes it possible for the case study of Laweyan Village as a burial ground. It is common for vegetation to be planted along roads with the aim of providing shade, this is proven by the large number of shade plants along the roads in Laweyan Village. One of the most commonly found introduced vegetation is the 23-individual glodokan pole, this species has been widely used in Indonesia as shade planted on roadsides. This is because the pole glodokan's ability to adapt in Indonesia is very good, and it has a root structure that does not damage surrounding buildings or roads. The impact of this large amount of introduced vegetation can be in the form of positive and negative impacts. In contrast to invasive plants, introduced plants do not disturb or damage the balance of the ecosystem of the area where they are introduced. So there is no direct negative impact on the ecosystem, the negative impact given by the large number of introduced plants can make local plants unpopular and not the main choice. This can disrupt the sustainability of local plants. Furthermore, the positive impact provided depends on the type and function of the plant. In the Laweyan Village case study, many of the introduced plants are shade plants, so they have positive impacts such as lowering the temperature, helping water absorption, and providing a place to live/habitat for various small animals. Because the characteristics of shade plants have a wide canopy and lots of branches, this allows small animals such as birds and small reptiles to nest.

3.4 Invasive Alien Plants

There were 4 invasive species found, namely *Bougainvillea glabra* Choisy, *Leucaena leucocephala* Lam., *Cnidocolus aconitifolius* (mill.) i.m.johnst, and *Sandoricum koetjape* Merr. Invasive alien plants are non-native plants that grow and spread aggressively in their new environment to the point of causing significant negative impacts (Sitepu, 2020). Invasive plants are definitely foreign plants while foreign plants are not necessarily invasive. They can displace local plants, disrupt natural ecosystems, and damage biodiversity. Therefore, invasive plants can be said to be competitors with other plant species in their survival and growth with abundant nutrients (Ahimbisiwe, 2018). The main characteristic of invasive alien plants is their ability to adapt quickly and spread widely, often without natural control from local pests or predators, they can take resources such as water, nutrients, and sunlight from local plants, causing a decline in local plant populations. This can disrupt food chains, affect local fauna that depend on these plants, and change the

composition of the entire ecosystem. Apart from that, generally invasive foreign plants have a clustered distribution pattern and a small number spread evenly according to environmental factors (Nurlaila et al., 2019). The invasive species with the highest number found was 8.

Lamtoro, whose scientific name is *Leucaena leucocephala Lam.*, is a plant that originates from Mexico and Central America. These plants have the ability to grow and reproduce quickly in new environments, so they can disrupt the balance of the ecosystem, where these plants can take up resources and space needed by native plants. Apart from that, this plant has the ability to spread through seeds and strong rhizome roots, which can grow quickly and cover the surrounding environment. This can cause a decline in native plant populations and change the structure and composition of ecosystems. The distribution pattern of Lamtoro is generally found in groups which are not evenly distributed throughout the landscape.

The next plant species, paper flower, which has the scientific name *Bougainvillea glabra Choisy*, is a plant that originates from South America. The second most abundant plant species found in the Laweyan Village area is 3 species. Paper flowers are long-lasting plants and spread quickly, allowing them to grow quickly in new areas and outcompete native species. The ability to spread rapidly causes the displacement of native plants and disrupts the balance of the local ecosystem. This plant is also known to easily adapt to new environments, allowing this plant to explore new places. A characteristic of paper flower plants is that they have branching spines, which can deter herbivores and provide a competitive advantage over native plants that may be more susceptible to grazing. This characteristic makes paper flower plants difficult to control and remove once they grow well. In its native area, *Bougainvillea glabra Choisy* has natural predators and diseases that help control its population. However, when introduced in new areas, these natural controls are not present so the plant can spread unchecked. The distribution pattern of the *Bougainvillea glabra Choisy* plant can vary depending on environmental conditions. In some areas, this plant can be found in clustered patterns, where there is a high concentration of plants in certain areas. On the other hand, the *Bougainvillea glabra Choisy* plant can also show a random distribution pattern which can occur due to natural dispersal, for example wind or animals spreading plant seeds over a wider area.

The Japanese papaya plant, which has the scientific name *Cnidocolus aconitifolius (mill.) i.m. Johnst.*, is a plant that originates from Mexico and Central America. and is included in the invasive foreign plants found in Laweyan Village, totaling two plants. This plant can produce seeds in large quantities, which can spread easily via wind, water or animals. These seeds have a high viability and can lie dormant in the soil for a long time, making it difficult to control their spread. Apart from that, Japanese papaya plants have the ability to regenerate from stem cuttings. Spinach trees can tolerate a variety of soil types and can grow in both sunny and shady areas. This adaptability allows tree spinach plants to thrive in diverse habitats and outperform native plants in obtaining resources such as water, sunlight and nutrients. Apart from that, spinach tree growth is very fast, reaching a height of up to 6 feet in a few months. This rapid growth allows dense undergrowth to form, further displacing native vegetation. The distribution pattern of tree spinach plants also tends to be clustered, and is often found growing in open areas such as gardens. The lyre, which has the scientific name *Sandoricum koetjape Merr.*, is a plant that originates from Indochina and the Malay Peninsula. and is included in the invasive plant category. There is one plant that was found growing in the Laweyan Village area. In general, this plant has strong stems and wide leaves and can grow up to 2-3 meters. This plant can grow quickly and can cover a large area in a short time. Apart from that, the harp plant has the ability to destroy biodiversity where it invades. These plants inhibit the growth of other plants by taking up nutrient and water resources that would otherwise be available to native plants. So that native plants are unable to compete with lyre plants, which will lead to a decline in biodiversity in the future. The distribution pattern of Japanese papaya plants naturally tends to be clustered.

3.5 Ecological Impacts of Invasive Alien Plants

The existence of invasive species outside their natural environment can be a threat to the continuity of natural processes found in that environment. The presence of invasive foreign plant species can simplify the ecosystem by suppressing the growth of native species and turning it into a

monoculture system. The proliferation of invasive foreign plant species always causes the diversity of native species and natural regeneration processes to decline, decreasing forest productivity and causing environmental degradation. The following are the ecological consequences of invasive alien plants including (a) decreasing biodiversity (b) endangering endangered species and their habitats, (c) the habitat of insects, birds and native wildlife is at risk of being lost. (d) altering natural ecological processes such as succession, (e) increasing the frequency and intensity of natural fires, and (f) disrupting plant-animal associations such as pollination and seed dispersal. According to research conducted by (Kacheche & Mzuza, 2021) the ecological impacts caused also affect changes in biomass and changes in the hydrological cycle. The extraordinary adaptability of invasive plants allows them to spread rapidly and gain a high degree of dominance over other plants (native plants) over large areas, before evolving into harmful species in damaged or modified environments. Because there may be few predators or diseases in their new home, populations may spread uncontrollably, and native plants cannot compete effectively for space and food, they may be driven to extinction.

4. Conclusion

Based on the results of research carried out in the Laweyan Village area, it can be concluded that there were 38 species of pole and tree regeneration vegetation found which were divided into 3 types based on their origin, namely native, introduced and invasive species. There were 19 species of native plants, 15 species of introduced plants, and 4 species of invasive plants. The plants found as a whole have a clustered distribution pattern. Apart from that, generally invasive plants also have the ability to easily adapt to new environments which is supported by strong plant parts such as seeds, roots, stems which have high absorption capacity and fast growth so that they can affect biodiversity, especially local plants which cannot compete with invasive plants. Invasive plants found in Laweyan Village are *Bougainvillea glabra Choisy* (South America), *Leucaena leucocephala Lam.* (Mexico and Central America), *Cnidioscolus aconitifolius (mill.) i.m.johnst* (Central America), and *Sandoricum koetjape Merr.* (Indochina and the Malay Peninsula). Meanwhile, based on their function, plants are divided into three, namely fruit plants, shade plants and ornamental plants. In the Laweyan Village area, the plants that dominate based on their function are shade plants, totaling 7 species. Shade plants dominate in this area because of their role as natural shade, helping reduce heat and offering a comfortable place to rest which is suitable for planting around urban areas. Apart from that, shade plants can also create habitat for various types of fauna and care for the soil with their strong roots.

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