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# Reassessing the Benefits and Costs of Universitas Indonesia's Urban Forest Zonation

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**Abstract.** Universitas Indonesia's urban forest is part of Universitas Indonesia's campus area and had been so for 30 years. It was found that Universitas Indonesia's urban forest was divided into 3 zones: *Wales Barat*, *Wales Timur*, and *Vegetasi Asli* (consisted of trees from Jakarta and West Java). The zoning was based on the imaginary line which was the formed vegetation zone found by Alfred Russel Wallace and functioned as a facility for germplasm collection and conservation. Over a while, Universitas Indonesia's urban forest has experienced secondary succession, including the elimination of dead trees, species enrichment throughout replanting, and invasive (fast-growing) species dispersion. Those conditions have changed the structure of vegetation in UI's urban forest. Reassessing the zonation of UI's urban forest is important. The reassessment was carried out by data inventory of replanting from 1988 to 2018 and the use of periodic inventory data. The reassessment result showed that the zonation of UI's urban forest being a facility for germplasm collection and conservation is not changed (has not been altered).

## 1. Introduction

The history of the Universitas Indonesia's urban forest began in 1988. Rector of University of Indonesia, Prof. Dr. Sujudi, through the Decree of the Rector of UI number 084 / SK / R / UI / 1988, stipulates that the greening land of new campus of Universitas Indonesia is the area and development of UI urban forests [1]. Urban Forests within the new campus of Universitas Indonesia (UI), besides being able to collect and conserve the germplasm, also has function as water catchment area for the Ciliwung watershed. The development budget and development of urban forests in the new campus of Universitas Indonesia Depok sourced from various related institutions, both regional and central and other non-binding sources.

From the Rector's decision, it was later made a derivative in the form of the Master Plan for the Construction of Urban Forests at the Universitas Indonesia - Depok Campus 1988 to 1999. This Master Plan Book is one of the initial documents that can be a reference for the development of University of Indonesia's urban forest. The document states that UI urban forests are divided into several zones based on the origin of plants. Western Indonesian plants can be found in West Wales zone, otherwise, eastern



Indonesian plants entering the East Wales zone. The other zone is Original Vegetation which contains native plants of Depok - Jakarta and buffer zones and cast green open academic areas.

After the period of urban forest development, in 14 July 1999, the Governor of DKI Jakarta, Sutiyoso, decided to issue letter number 3487/1999 concerning the Establishment of the Universitas Indonesia's Forest of +55.4 hectares including + 9 hectares of reservoirs as a conservation forest for the municipality South Jakarta [2]. The decree issued primarily to improve environmental quality in the urban areas of DKI Jakarta. DKI Jakarta requires elements of reforestation to regulate water systems, control air pollution, habitat for flora and fauna, health and sports facilities, germplasm conservation, container sanctuary (birds), and tourism facilities for education and counseling, windbreaks and other natural disturbances and aesthetics (comfort and beauty of the environment).

After around 30 years from the construction and development of urban forests, many activities in urban forests have been done, especially the planting of species enrichment plants from the sponsors of both government agencies and companies that contribute their crops (even some up to post-planting maintenance). Starting from the Ministry of Forestry through its BPDAS, Jakarta Forest Service, TNI to companies such as Mobil oil, BNI, Pertamina, Antam, CIMB Niaga, Ritz Carlton and many more.

Nowadays, early plants in the form of plant species for rehabilitation, pioneer / fast growing (which are mostly Leguminosae) rubber and invasive plants that are easy to grow in urban forests are already aging. Trees especially for those which are directly adjacent to areas with dense activities (roadsides, public areas, and education areas) begin to cause problems. Some trees are also documented as being affected by diseases, termites, fungi and also not resistant to extreme weather (strong winds, storms) and irregular growth (sloping), disrupting assets and buildings began to become a concern. The tree has risks of broken branches, branches, and stems, even falling from its base.

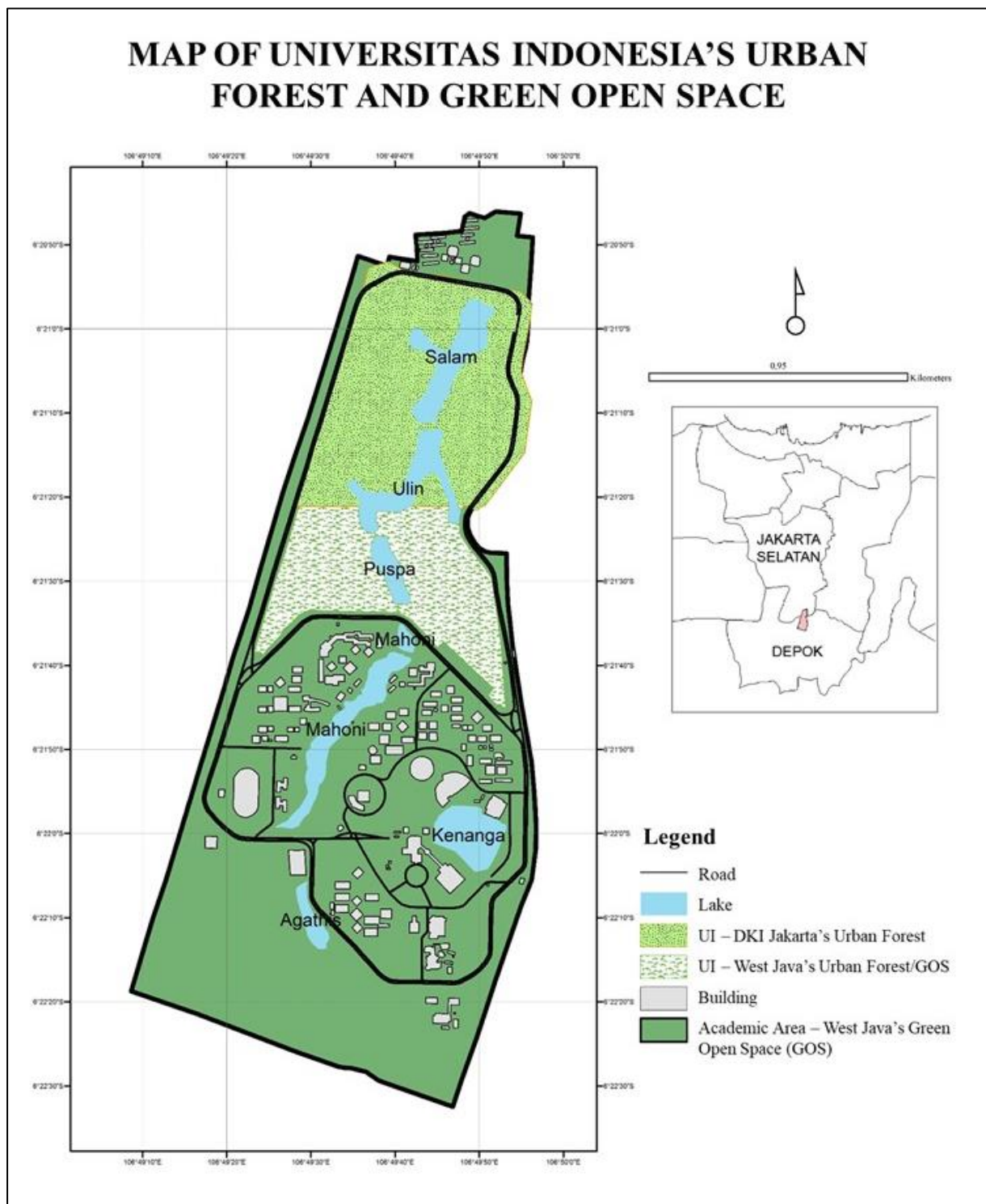
## 2. Theory

Definition of urban forests according to FAO is networks or systems consisting of all forests, tree groups, and each tree located in urban and suburban areas; include forests, road trees, trees in parks and gardens, and trees in abandoned corners [3]. Urban forests are the backbone of green infrastructure, bridging rural and urban areas and improving the city's environmental footprint. Effective planning and management urban trees and forest will provide benefits and also a cost for the urban people [4]. The function of trees in urban forests is explained by an infographic issued by FAO, as follows:

- Can reduce air temperature between 2 ° - 8 °C
- City pollution filters and absorbers
- Regulates water flow and improves water quality
- Climate change mitigation
- Can be used for firewood
- Producing fruit, seeds, and leaves that can be utilized further
- Improve physical and mental health
- Around the building, trees can reduce ac usage by up to 30%
- Increase city biodiversity
- Increase property value by up to 20%

In the UI's urban forest, one of its primary functions is for collection and conservation of germplasm, including trees. Increasing the collection and conservation of germplasm in Universitas Indonesia also directly supports the improvement of city biodiversity, especially Depok and Jakarta.

In Indonesia, urban forests regulation refers to Government Regulation number 63 of 2002 [5]. The aim is to preserve, harmonize and balance urban ecosystems which include environmental, social and cultural elements. In this regulation, it is also stated that Urban Forests are part of the Green Open Space. In the 2010-2014 Integrative Research Plan issued by the Ministry of Forestry in 2010 stated that in order to improve the functioning of urban ecosystems in the structure of urban ecosystems, it is necessary to enrich the species and replacement of plants in a green open space and urban forest [6].



**Figure 1.** Map of geographical location that refers to the history of the development of the Urban Forest and Green Open Spaces (RTH) of the UI campus.

The diversity of species will increase economic value in isolation as in an article written by Pearce & Moran (1994) IUCN's Economic Value of Biodiversity - The World Conservation Union. It stated that research and technology continued to grow over time, where currently there may be many specific

species of benefits that are not directly known to humans [7]. If the species needed at one time were extinct, it would result in enormous losses for humans at that time.



**Figure 2.** Wallace line in Indonesia.

Alfred Rusell Wallace, a British researcher in his book "Malay Archipelago," has long been (in 1890) researching this species diversity [8]. His dedicated research and exploration produced his fundamental work, the Wallace line in Indonesia. This line is a false line that divides the diversity of species that exist in Western and Eastern Indonesia. It is what inspires UI to perpetuate its name as a boundary zone that divides the urban forest area.

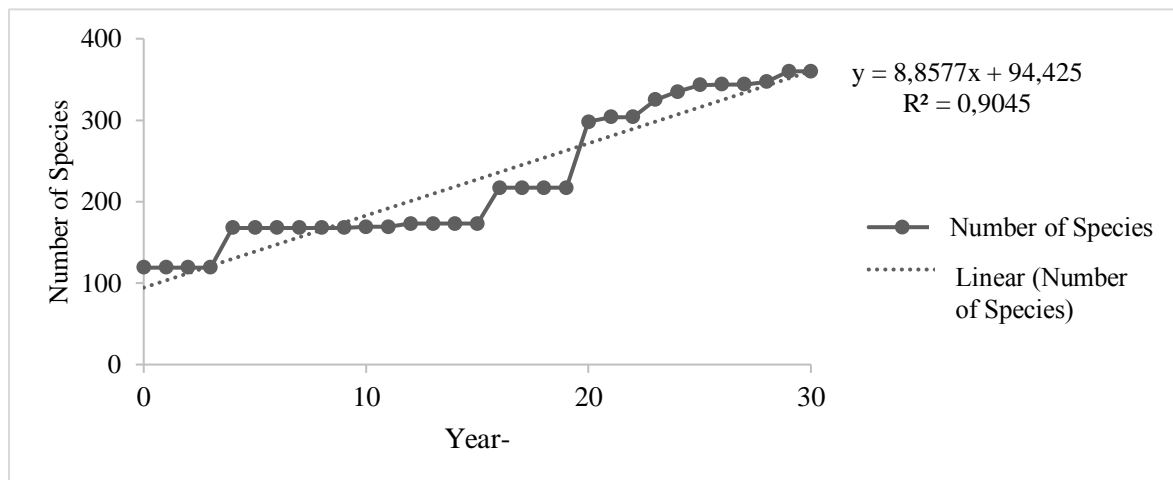
### 3. Methods

This study aim is to find out how far the structural changes in the number of stands in the field, starting with the recapitulation of existing plant, and planting data in 1988 to planting in 2018. Planting data was obtained by collecting internal documents in the form of planting reports which were recapitulated and compared with current data. Regression analysis was performed to compare the species of plant data variation in 1988 with 2018 (30 years)

Benefit data was obtained from the increase/decrease that occurs in all species of plants recorded. Whereas for the existing cost, it is by carrying out data collection on each activity carried out on maintenance activities and incidents that occur as a result of the typical variation in each zone in the UI.

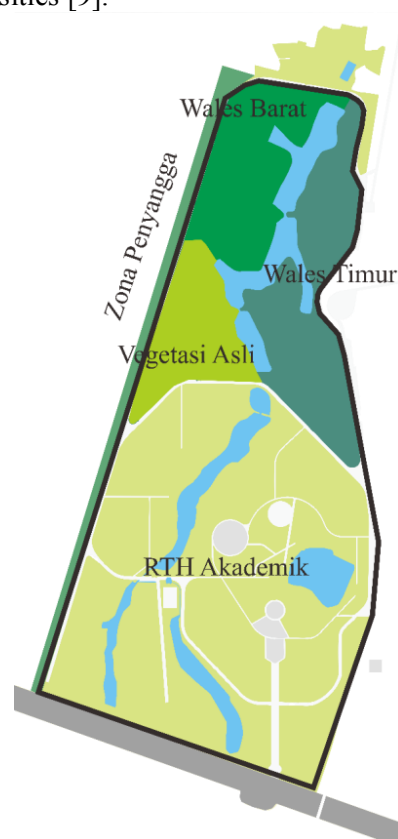
### 4. Analysis and Discussion

There is an increasing rate of species of plants from 1988 to 2018. From the graph below, it can be seen that there is an increase in the number of species of plants in urban forests and green open space UI. From 1988 there were 119 species of plants recorded until 2018 which reached around 360 species of trees. The annual increase is known from the equation  $y = 8.8577x + 94.425$ . This shows that from the UI side it is very committed to realizing the achievement of improved germplasm collection and conservation.



**Figure 3.** Graph of Regression of Number of Tree Species in Urban Forests and Green Open Spaces UI

Tree maintenance and pruning were recorded in the last few years at UI. Pradipta et al, 2018 stated that around 500 to 600 trees were trimmed and eliminated from 2015 to 2017 in RTH UI and especially in areas that had high activity densities [9].



**Figure 4.** Plan zoning in urban forests and green open spaces on the UI campus

This is done to reduce the incidence of incidents caused by fallen trees, broken branches, branches, or stems. From the study, there was a 47% decrease in the incidence of incidents. This high-intensity intensity of tree cutting and pruning activities has caused an increase in costs incurred by UI, especially

for workers, equipment and supplies, fuel, supervision, assistance and OHS training for officers [10] [11].

The loss of trees is usually associated also with the increase in the heat of an urban environment [12] [13]. In Jakarta, Pradipta 2018 conducted a study, on tree correlation and temperature around buildings. From the study, in the range of 0, 3 and 6 meters from the building surrounding the tree shade, information was obtained that the current temperature did not correlate significantly from the shaded area (near the park) or not (near the building) [14]. In law No. 32 of 2009 concerning Protection and Management of the Environment, it is stated that human safety is a top priority in the form of environmental management [15]. So pruning in order to prevent incidents around the dense area of activity can still be tolerated.

## 5. Conclusion

From the results of the observations obtained information that there is an increase in the species of plants in all zoning in the UI urban forest. This happens because planting and enrichment are routinely carried out by UI every year. Almost every year the species of plants in UI are increasing, although there is a reduction in tree elimination activities that endanger the safety of people and assets around, especially for academic green open areas. In the urban forest area itself (the zone of West Wales, East Wales, and Original Vegetation) there is almost no activity that creates a potential reduction in the number of tree species.

Competition between existing tree species, adaptability of the species of plants introduced, weeds and plant diseases, and the health of trees pose a serious threat to the diversity of plant species in the urban forest of UI. This is a particular challenge for UI, especially the cost of carrying out environmental engineering and specialized care for certain species that are considered important (further research is needed), given the form of urban forest management and its budget, in large part, originating from non-binding budgets. The significant cost is precisely in the green open space in the academic area which is directly adjacent to the activities of the UI academic community and other vital assets.. So here, for the green space in UI's academic area, tree planting that is highly susceptible or endangered should be carried out (need further research for this survey) and prefer tree species that have been proven to have a substantial direct impact on surrounding humans and are resilient facing extreme weather, disease pests and a tense environment. Another thing to note is the boundary and status of a zone or area in the updated UI according to the times and to guarantee the diversity of species and functions of the ecosystem in the long run.

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