I. INTRODUCTION

1.1 Background

The tropical forest is a unique ecosystem that lies around the equator with considerable temperature, humidity, and average annual rainfall (Alikodra, 2020). Tropical rainforest ecosystems can control soil erosion and flooding, absorb various pollutants, stabilize the microclimate, and play an important role in regulating global climate. In many developing countries, however, forest is perceived to be a source of readily income and exploiting through deforestation and land clearing (Alikodra, 2020).

Lowland tropical forests that dominates Sumatran landscapes posseses high biodiversity (Suwardi *et al.*, 2013). In addition to its biodiversity, Indonesian tropical forest stores huge amount of carbon stock and play an important role in maintaining the stability of global climate. Chemically, vegetation community in forest absorb carbon through photosynthesis and store it within vegetation biomass, litter, necromass, and soil organic matter. Information regarding aboveground biomass is required to estimate ecosystem productivity, carbon stock, nutrient distribution, and fuel accumulation (Suryandari *et al.*, 2019).

The largest carbon stocks are stored in unspoiled forests with a diverse long-lived plant species and accumulated litter. Deforestation significantly contributes to climate change or global warming, responsible for approximately 20-25% of global carbondioxide ($CO_{2)}$. At the United Nations Climate Change Conference's Conference of the Parties 13 in Bali in December 2007, the expansion of the carbon

market for CO_2 mitigation was agreed upon, as was the plan of reducing emissions from deforestation and forest degradation (REDD). Carbon dioxide is absorbed through photosynthesis and stored within carbon pockets in the roots, stems, and leaves before being released back into the atmosphere as carbohydrates (Yastori *et al.*, 2007).

Research on the potential carbon stocks was previously conducted at sub-montane forest stands in Mount Halimun Salak National Park (Arifanti *et al.*, 2014). It concluded that the sub-montane forest in Mount Halimun Salak National Park is still intact, indicated bt its carbon storage at aboveground measured at 139.326 tonC/ha, below ground at 39.011 tonC/ha, understorey at 1.971 tonC/ha, and necromass at 5.77 tonC/ha. The average standing biomass and carbon stock in this primary forest are respectively 364.503 ton/ha and 185.177 ton/ha.

Another study was also conducted at the roadside of Lore Lindu National Park (Sedjarawan *et al.*, 2014). It measured the aboveground tree biomass at observation plot of 10 m away from the roadside reached 711 ton/ha and the observation plot of 100 m away from roadside measured at 256 ton/ha. The aboveground tree carbon in the observation plot 10 m away on the roadside of Lore Lindu National Park was 355.6 ton/ha and the observation at plot 100 m away from the edge of Lore Lindu National Park was 128.0 ton/ha.

Another study estimated carbon stocks at lowland tropical forest in Pinang-Pinang forest in West Sumatra by identifying plant species composition and their carbon storage capacity (Suwardi *et al.*, 2013) It identified 155 plant species of 45 families from 852 tree individuals surveyed, all with 8 cm DBH. The study site was

dominated by *Nephelium juglandifolium, Swintonia schwenkii, Syzygium* sp., *Microcos florida, Palaquium* sp., *Cleistanthus glandulosus, Hopea dryobalanoides, Mastixia trichotoma, Calophyllum ssoulattri,* and *Shorea maxiwelliana.* Tree biomass was measured at 482.75 tons/ha, while carbon stock was assessed to be 241.38 tons/ha. Large trees with 100 cm or more DBH contributed 26.62% to the carbon stocks in the study site.

Bukit Barisan Selatan National Park (BBSNP), one of protected area in Sumatra and consist of tropical forest area, has importants function as habitat for wildlife as well as stabilizing the global climate by storing carbon. Way Canguk Research Station (hereinafter WCRS) is a research station collaboratively managed by the Wildlife Conservation Society-Indonesia Program (WCS-IP) and Bukit Barisan Selatan National Park Office. There is approximately 800-900 ha in WCRS designated as research area. This research area comprises only 0.22% of the total 313.572,48 ha of BBSNP area (Taman Nasional Bukit Barisan Selatan, 2015).

The level of stability and resilience of a forest ecosystem can be assessed from two perpective; species diversity (Kasim and Hamid, 2015) and carbon stock (Yastori *et al.*, 2016). Therefore, WCRS has commited to carry out a routine on the dynamics of plant community since 1997. The WCRS has made estimated on carbon stock from biomass data collected at 100 permanent plots showed declination from 1.715 Mg (megagram, 1 Mg = 106 gram) in 1997 to 1.684 Mg in 2017. Similarly, the estimated biomass density slightly went down from 343 Mg/ha in 1997 to 337 Mg/ha in 2017, hence the total carbon stock assessed respectively as 168 Mg/ha in 1997 to 165 Mg/ha in 2017 (Utoyo *et al.*, 2020). This estimation, however, is not final, as it

only counted trees more than 10 cm DBH into the general allometric equation develop by Brown (1997). Hence, further studies that include more parameters into the assessment are welcome.

The use of species-specific equations is more preferable in estimating aboveground biomass due to the extent of differences of tree architectures and wood density when estimating the above-ground biomass of a forest, the use of species-speciic equations are preferred because trees of different species may differ greatly in tree architecture and woody density (Kattering *et al.*, 2001),. Therefore, this study affords to obtain more accurate assessment on biomass estimation and carbon stock by developing allometric equation developed recently for that purpose (Chave *et al.*, 2014). This equation adds parameters for wood density and tree height which previously exclude. The amount of aboveground biomass is specifically calculated from the tree, sapling, understorey, and litter. Moreover, plant species diversity is also monitored in this study to give update on floral biodiversity, in WCRS of BBSNP.

1.2 Research Questions

Accoeding to what detailed in the background section above, two problems are formulated ass bellow:

1. How diverse the trees and saplings in Way Canguk Research Station?
2. What is the total aboveground carbon stock in Way Canguk Research Station?

1.3 Research Objectives

1. To determine the species diversity of trees and saplings in Way Canguk Research Station.
2. To estimate the total aboveground carbon stock at Way Canguk Research Station.

1.4 Research Benefits

1. Updating species diversity that comprise the tree and sapling strata in Way Canguk Research Station.
2. Provide more accurated assessment on aboveground carbon stock from trees, saplings, understorey, and litter in Way Canguk Research Station.
3. Improving the knowledge of those who read this study, particularly regarding plant ecology, vegetation analysis, biomass, and carbon stock estimation, as well as serving as reference for further researches.