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Cover Photo : A very beautiful colours formed by the canopy of trees in a primary peat swamp forest area of Kerumutan Landscape, Riau, Indonesia (©Rolf M. Jensen)

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GUEST EDITORIAL

Government, the private, and local communities in ecosystem restoration governance and practices

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ABSTRACT

Ecosystem restoration is not only a concern for countries such as Indonesia, but has become a global concern, as the UN has announced the Decade on Ecosystem Restoration for 2021-2030. Ecosystem restoration is an important way of restoring degraded landscapes, ensuring the sustainability of biodiversity, as well as being an effective pathway for reducing emissions. Indonesia has committed to ecosystem restoration through national statutory law since 2004, although it is no longer explicitly listed in the Omnibus Law No. 11 of 2020 and Government Regulation No. 23 of 2021 on Forestry Stewardship. Indonesia has demonstrated good progress in the implementation of ecosystem restoration in several priority provinces coordinated by the Peat and Mangrove Restoration Agency, as well as in initiatives led by the private sector. Although both involved rural communities in restoration activities, I propose here that an innovative ecosystem restoration business model is necessary to make their participation more financially attractive to local communities. This paper provides an analysis of progress and the needs for ecosystem restoration improvement in Indonesia.

ABSTRAK

Restorasi ekosistem saat ini bukan hanya menjadi perhatian negara tertentu seperti Indonesia, tetapi telah menjadi perhatian dunia, sebagaimana UN telah mencanangkan periode restorasi ekosistem tahun 2021-2030. Restorasi ekosistem merupakan hal yang sangat penting untuk pemulihan lanskap yang terdegradasi, menjamin keberlangsungan biodiversitas yang sangat kaya, serta menjadi pathway penurunan emisi sektor berbasis lahan. Indonesia telah menunjukkan komitmen restorasi ekosistem dalam regulasi nasional sejak 2004, walaupun secara eksplisit tidak lagi tercantum dalam Omnibus Law No 11 tahun 2020 dan Peraturan Pemerintah No 23 Tahun 2021 tentang Penyelenggaraan Kehutanan. Indonesia juga telah mendemonstrasikan capaian yang cukup baik pada pelaksanaan restorasi ekosistem di sejumlah provinsi prioritas yang dikoordinasikan oleh BRGM, dan juga inisiatif restorasi ekosistem yang dilakukan oleh sektor swasta. Keduanya memang melibatkan masyarakat dalam pelaksanaan restorasi, namun dipandang perlu untuk menciptakan model bisnis restorasi ekosistem yang inovatif agar lebih atraktif secara finansial bagi kelompok masyarakat. Paper ini akan menganalisis progress dan kebutuhan tersebut untuk kepentingan peningkatan kualitas restorasi ekosistem di Indonesia.

Keywords: *business model, community, ecosystem restoration, private sector*

INTRODUCTION

The UN General Assembly has declared the UN Decade on Ecosystem Restoration to catalyze massive ecosystem restoration efforts on damaged and disturbed ecosystems in 2021-2030 (IUCN, 2021). Forest ecosystem restoration in particular is considered an effective pathway to restoring landscapes and mitigating climate change. It also increases food security, protects biodiversity, and maintains the water balance.

Indonesia has demonstrated significant concern for the restoration of degraded ecosystems and habitats. Indonesia aims to restore all its degraded land, a total of 27.5 million ha, by 2040 through various approaches, assuming no further land is degraded during 2015-2040 (Republic of Indonesia, 2015).

There are critical reasons why ecosystem restoration is important. Firstly, Indonesia has a long history of emergence of degraded land, indicated by the pattern of deforestation and forest degradation from 1990 until today. Deforestation peaked in 1996-2000, when 3.51 million ha were lost, but, fortunately, this continues to decrease to now. From 2017 to 2019, annual deforestation was no more than 0.5 million ha per year (MoEF, 2020). Indonesia's National Forest Monitoring System recorded the average rate of forest degradation from 1990 to 2019 as 211,153 ha per year (Ditjen PKTL, 2020). In addition, the Ministry of Environment and Forestry reported that the total critical land area was 14,006,450 ha in 2018, of which the critical land area inside forest areas was 8.35 million ha and the rest outside forest areas or other land uses area (*Areal Penggunaan Lain* or APL). The largest critical land area is

on Sumatra (4.5 million ha), and the lowest on the Maluku Province (687,496 ha) (KLHK, 2018). This implies not only the need to avoid deforestation and for forest degradation strategies, but also the need to restore those deforested and degraded forest ecosystems.

Secondly, the need for ecosystem restoration arises due to the importance of saving the mega-biodiversity in Indonesia's forest ecosystems, particularly characterized by extremely high endemism. Indonesia consists of 13 land-based ecosystems and six aquatic ecosystems (including both freshwater and marine ecosystems). Within these 19 ecosystems, there are 74 systems of vegetation (MoEF, 2020a). In addition, Indonesia is home to 1,605 species of birds, 723 species of reptiles, 385 species of amphibians, 720 species of mammals, 1,248 species of freshwater fish, 197,964 species of invertebrates, 5,137 species of arthropods, and 151,847 species of insects, including 30,000 Hymenoptera (wasps, bees and ants). There are also 91,251 species of spore-based plants. Within the spermatophytes (plants that produce seeds), there are 120 species of vascular plants that produce exposed seeds (gymnosperms) and an estimated 30,000 to 40,000 species of flowering plants (angiosperms), of which only 19,112 species have been identified so far (Bappenas, 2016). Indonesia's tropical peat ecosystems contain rich and distinctive flora and fauna, with high ecological value. Of the 258,650 species of trees recorded in the world, about 13-15% (about 35,000-40,000 species) are found in Indonesia's peat ecosystems (Osaki, et al, 2016). Some 35 species of mammals, 150 species of birds, and 34 species of fish are also found in peatlands. Many species are endemic and have been on the IUCN Red List since 2012, including the False Gharial, Thomas's Langur, Orangutan, Sumatran Tiger, and Sun Bear (WWF, 2009).

Thirdly, climate change mitigation pathways through enhancing the forest carbon stock from restoration ecosystem contributes to 21% of total pantropical mitigation potential (Griscom, et al., 2020). Although forest restoration may involve trade-offs with alternative land uses, it can incur high costs of establishment, and is more expensive than Avoided Forest Conversion, as with most forest pathways, both forest restoration and reforestation provide well-demonstrated co-benefits, including biodiversity habitat, air filtration, water filtration, flood control, and enhanced soil fertility (Griscom et al, 2017).

Forest restoration in Indonesia has become a national policy priority. However, progress so far has not met government targets. Therefore, it is very important to revisit the role of the government, the private sector, local communities, and other entities in accelerating ecosystem restoration in Indonesia.

EXISTING CONCEPT OF ECOSYSTEM RESTORATION

Ecosystem restoration is intended as an effort to restore the structure, productivity, and diversity of forest species to their initial conditions so that the processes and functions of the forest ecology will be the same or close to their initial conditions (Rochmayanto, et al., 2020). This definition is in line with ITTO & IUCN (2005), who underline forest restoration as a process aiming to restore the ability of forest ecosystems that have been degraded or deforested to support or maintain forest ecological processes and their rich biodiversity and to improve human well-being. When ecosystem degradation can be reversed and the sustainability of historical conditions is still possible to improve through management actions, standard approaches can be used to restore the ecosystem. However, if assessment of the degradation level shows that the ecosystem cannot be restored, then the management option to build a new ecosystem can be considered (Hulvey et al., 2013).

Stanturf, et al. (2017), explained more detail and promoted the mechanism and trajectory of change in ecosystem as illustrated by Figure 1. Successful ecosystem restoration must include the starting point and desired endpoint. Historical ecosystem conditions or existing reference ecosystem can be a guide for targetted ecosystem in the future. It is possible to use different trajectory to get an expected endpoint fit with existing social footprint. A diversity of new forest and non-forest habitats may best be suited to meet multiple social needs.

Strategies for ecosystem restoration do not only consider hydrological, edaphic, and vegetative components, but also social-economic perspectives on the landscape. Currently, `strategies of forest ecosystem restoration can be viewed from several perspectives based on scale of restoration, intensity of vegetative interventions, and strata of restoration. (Rochmayanto, et al., 2020; Rochmayanto et al., 2021). Scale of restoration refers to restoration activities focused on particular units of the ecosystem area. Intensiveness of intervention refers to the extent of the intervention of revegetation activities in restoring the forest. The strata of restoration draws level of ecosystem restoration activities both on physical activities and other non-vegetative approaches based on the destruction level of the ecosystem.

Scale of restoration is divided into two types, namely large-scale and mosaic restoration (IUCN & WRI, 2014). Large-scale restoration involves several unit areas of contiguous degraded land or fragmented land, or the adjacent land uses area. Mosaic restoration describes restoration activities in a particular land use area only, such as agriculture land, agroforestry system, improvement of denuded areas, ecological corridors,

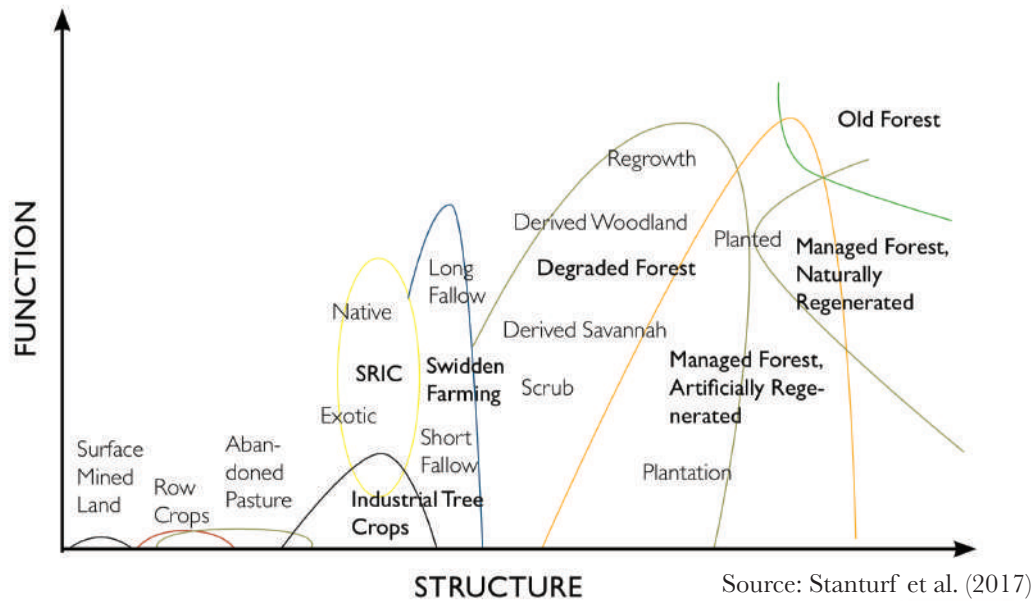


Figure 1. Conceptual model of land use condition based on vegetation structure and ecosystem function

forest area, and planting riparian zones to control water flow.

Concerning intensity of vegetative intervention, ecosystem restoration in principle can be achieved through four main approaches: natural succession, supporting natural succession, enrichment, and planting (JICA, 2014). Selection of approach depends on the terms and conditions that are appropriate, and can be used in combination in one area as needed to adjust to the site characteristics. The last perspective is the level of restoration that reflects the level of ecosystem recovery activities required as a logical consequence of the severity of degradation. This restoration level does not only involve revegetation actions, but also civil and technical engineering. For example, the following strata of ecosystem restoration have been introduced by Suryadiputra et al. (2018), among other: back filling, rewetting, drying, firebreaks, canal blocking, and topsoil introduction.

In addition, forest ecosystem restoration needs to assess the social footprint of the targeted restoration area. Social footprint refers to the extent local communities depend on the targeted restoration area. Historical land use and household economic dependency on such areas can be used as social footprint indicators. Such indicators need to be used in line with biophysical indicators of the targeted area. Biophysical assessment variables include geographical condition, hydrology, geology, land cover and land cover change. Designing any restoration ecosystem strategy must involve combining those variables with the social footprint identification results.

Restoration does not just focus on planting-related activities, such as species selection or plant autecology and phenology. Forest ecosystem recovery through natural succession is a high priority. Therefore, restoring

soil and hydrological conditions, as well as protection of the restoration site against land degradation drivers are crucial components of restoration activities. In the context of forest and land degradation, MoEF (2020) officially noted that the causes of deforestation and forest degradation comprise, among other factors, intensive logging of natural forests in timber concessions, conversion of forest areas for other sectors (agricultural expansion, estate crops, mining, plantations, and transmigration), unsustainable forest management, illegal logging, encroachment, and fires. This is in line with scholarly analyses of the drivers of deforestation in Indonesia that include both direct and underlying causes. Most of deforestation is driven by expansion of crop plantation, agriculture (small and commercial scale), industrial plantation, and mining, and includes structural factors, market failure, and unsecure property rights (Rowling, 2020; Austin et al., 2019; Motel et.al., 2011).

AN UPDATE OF ECOSYSTEM RESTORATION WITHIN NATIONAL FRAMEWORK

At the global level, Indonesia has committed to actively restoring degraded ecosystems, for example, ratification of the three Rio conventions related with the issue of land degradation and habitat loss: Law No. 6 of 1994 ratifying the United Nations Framework Convention on Climate Change (UNFCCC), Law No. 5 of 1994 ratifying the Convention on Biological Diversity (CBD), and Presidential Decrees. Number 135 of 1998 ratified the United Nations Convention to Combat Desertification (UNCCD).

Ecosystem restoration has been included in the Indonesian regulatory system since 2004, on the Minister of Forestry Regulation No. 159 / 2004 concerning

Ecosystem Restoration in Production Forest Areas. This regulation was followed by Minister of Forestry Regulation No. 18 of 2004 regulating Criteria for Production Forests that Can Be Granted Business Permits for Utilization of Timber Forest Products in Natural Forests with Ecosystem Restoration Activities. By 2007, ecosystem restoration was appointed in a higher regulatory system, namely Government Regulation No. 6 / 2007 Jo Government Regulation No. 3 / 2008 concerning Forest Management and Preparation of Forest Management Plans and Forest Utilization. The Government Regulation strengthens the implementation of restoration ecosystem mechanism that is made in the business permit scheme for the use of ecosystem restoration timber forest products.

The issuance of Government Regulation No. 23/2021 on Forestry Stewardship as a derivative of Omnibus Law No. 11 / 2020 led to the end of the Government Regulation No. 6/2007. Unfortunately, although the new Government Regulation is quite comprehensive, the term “ecosystem restoration” is no longer included. This raises the question of whether ecosystem restoration is still in the regulatory system in Indonesia.

There are two interpretations of this issue. The first interpretation is that ecosystem restoration was removed from Omnibus Law No. 11 of 2020 and then placed (implicitly) in one of its derivative forestry regulations (Government Regulation No. 23/2021) through the forests use in environmental service businesses. One of these forest services is carbon sequestration, as has been implemented by several companies holding ecosystem restoration concession permits. Another interpretation is that the current ecosystem restoration terminology no longer exists in the Indonesian regulatory system, because in Government Regulation No 23/2021, the business of utilizing timber forest products is separated and is not the same as the business of utilizing environmental services. Ecosystem restoration permit is part of the use of wood forest product, previously known as the business permit for the use of wood forest products from ecosystem restoration (IUPHHK-RE) (Susteyo, 2021).

Even so, to date, restoration ecosystem-related programmes and interventions have been widely initiated, for example:

a. Ecosystem restoration focused on peatlands. Indonesia, as stated in the Nationally Determined Contribution (NDC) (a commitment documents submitted to the UNFCCC outlines Indonesia's transition to low-emissions and climate-resilient future), set a peat restoration target of 2.5 million ha (including 684,638 ha in protected peat ecosystems, 1,410,943 ha in cultivated peat ecosystems, and 396,943 ha in community cultivated peat ecosystems) (KLHK, 2018). Priority areas covered seven fire-prone provinces (Riau, South Sumatra,

Jambi, Central Kalimantan, West Kalimantan, South Kalimantan, and Papua), through rewetting, revegetation, and rural livelihood revitalization activities.

- b. By 2020, forest ecosystem restoration commitments were extended not only in peat ecosystems, but also in mangroves ecosystems. This was followed by the enactment of Presidential Regulation No. 120/2020 concerning the Peat and Mangrove Restoration Agency (*Badan Restorasi Gambut dan Mangrove, BRGM*). The peat restoration target was extended by 1.2 million ha, and the mangrove restoration target was 600,000 ha in nine priority provinces.
- c. Forest and land rehabilitation involving central and local governments, concession permit holders, NGOs, and local communities. During 2015-2019, the programme rehabilitated 995,253 ha, with an average productivity of around 200,000 ha/year. In addition, the civil-technical rehabilitation built 35,743 units of soil and water conservation infrastructure during the same period (Rochmayanto et al., 2020).

Along with submission of Updated NDC by 2021, Indonesia also submitted the Long-Term Strategy for Low Carbon and Climate Resilience 2050 (LTS-LCCR) to the UNFCCC. The LTS-LCCR document (as mandated by Act 4.19) described the Government's vision of climate change efforts and its proposed actions up to 2050. It was not a mandatory commitment and non-legally binding so far, but it can be tracked and reported. Indonesia expects to accelerate GHG emission reduction towards Net Sink FOLU, as outlined in the LTS-LCCR document. The Net Sink FOLU is a long-term vision in the LTS document towards net zero emission, where the FOLU emission path is expected to reach a net sink by 2030. Three out of seven main programmes towards Net Sink FOLU by 2030 imply restoration activities: (1) increasing the capacity of natural forests for carbon sequestration (through reducing degradation and increasing regeneration), (2) restoration and improvement of peat water systems, and (3) forest restoration and rehabilitation (plant enrichment/increased carbon sequestration). Based on the LCCP scenario (Low Carbon Compatible with Paris Agreement), the targets for improving peat management and peat water management are 0.95 million ha by 2030 and a further 1.05 million ha by 2050. Furthermore, targets for peat restoration are 2.7 million ha by 2030 and 4.22 million ha by 2050.

EXTENDING RESTORATION PRACTICES TO THE PRIVATE SECTOR AND LOCAL COMMUNITIES

Although ecosystem restoration is no longer explicitly stated in the Indonesia's Government Regulations, restoration ecosystem practices have been regularly incorporated into the management of protected forest and production forests . Companies receiving an ecosystem restoration business permit can target such practices for multiple services, including carbon sequestration.

To date, 16 restoration management units operate within a total area of 622,861 ha. These ecosystem restoration management units are found across five ecosystem types:, 24% in lowland forest , 14% in highland forest , 2% in mangroves , 59% in peatlands, and 1% in swamp (Ekonomi Bisnis, 2021). In addition, three of the companies have successfully provided a carbon conservation service: PT Ekosistem Khatulistiwa Lestari which manages 14,080 ha of forest in Kubu Raya - West Kalimantan, PT Rimba Makmur Utama which manages 157,875 ha of concessions in Katingan and Mentaya - Central Kalimantan, and PT Rimba Raya Conservation of 36,935.77 ha in Seruyan, Central Kalimantan.

Ecosystem restoration activities are currently also expanding to other forest concession companies beyond ecosystem restoration permit holders, such as Industrial Plantation Forest concessions and Production Natural Forest concessions. Asia Pulp and Paper (APP) Sinar Mas is one example of the private sector's forest conservation policy. Ecosystem restoration has been adopted as part of APP's best management practices inside and outside its forest concession areas. There are at least four forest ecosystem restoration sites on private sector initiatives, specifically from APP Sinar Mas experience: concession area, degraded HCV and HCS area to be restored, the peak of peat dome, retirement area, and buffer zone.

This private sector progress complements and expands forest ecosystem restoration facilitated by the government. The Government of Indonesia coordinated by the Peat and Mangrove Restoration Agency has overseen interventions on 52,987 ha of peat ecosystem in 2020, developed 20,851 peat rewetting infrastructure units (boreholes, canal blocking, and backfilling), revegetated 1,187 ha, and delivered 1,174 packages of livelihoods revitalization and productive economic assistance. The Ministry of Environment and Forestry also reported that during 2015-2021, the government carried out large-scale land restoration on a total area of 4.69 million ha, including peat and mangroves (KLHK, 2021). These restoration progress were intended to increase the productivity of both forests and degraded land.

The Peat and Mangrove Restoration Agency actively involve local government and diverse local parties in

restoration planning and implementation, as well as in the monitoring and evaluation processes. The Provincial Peat Restoration Team (*Tim Restorasi Gambut Daerah*) is established as an ad hoc institution led by the Governor and integrating several related institutions such as the Provincial Planning Agency, Forestry Office, Environment Office, Plantation Office, and Public Works Office. Some provinces also include academicians, adat representatives, NGOs, army, and judiciary office. In implementing restoration activities, they directly involve village communities and farmer groups as field implementers (Pantau Gambut, 2018).

The progress of peat restoration by both public and private initiatives demonstrates that both have played an active role in ecosystem restoration in Indonesia. However, the overall target that must be achieved is still large and requires more involvement of other parties. Until now, community participation in ecosystem restoration has only been seen to have a role in implementation in the field. Local communities have not yet been included in the initiation and planning of ecosystem restoration in their village areas.

One pilot initiative to encourage villagers in protecting and restoring peat ecosystem is through the Peat Care Village programme (*Desa Peduli Gambut*). The basic principle of the Peat Care Village is a framework for coordinating various village and regional development programmes/activities. It enables various local technical and socio-economic issues to be recognised and incorporated in planning as well as in execution of programmes: local wisdom and knowledge, disaster prevention response, formation of rural areas, spatial planning of villages and rural areas, identification of conflicts, regional clarity, legalization of rights and access, hydrology and land management, institutions and cooperation, economic empowerment. Through this programme, the goal is to significantly increase the number of participating villages (BRG, 2021).

Table 1. DPG built in Indonesia in 2020

No	Province	Number of village
1	Riau	64
2	Jambi	14
3	South Sumatera	32
4	West Kalimantan	37
5	Central Kalimantan	77
6	South Kalimantan	6
7	Papua	2

Source: BRG, 2021

FUTURE CHALLENGES

The inclusion of private sector and, increasingly, communities in ecosystem restoration has been widely

reported. However, ecosystem restoration has not been a completely profitable business model for communities. The big future challenges are to ensure the sustainable financing for community participation and a productive empowerment model for restoration and the economy.

The key to tapping into both public and private sector funding opportunities for forest landscape restoration in particular lies in making it financially and economically attractive alongside the delivery of vital public goods and services. In light of economic liberalisation, private sector funding, including Payments for Ecosystem Services (PES), provides a lucrative opportunity for financing restoration activities. In terms of public funding, it will be increasingly important to mainstream forest landscape restoration into other programmes, including poverty reduction programmes (Mansourian et al., 2005). Lessons from other community financing models and empowerment approaches can be adopted for a successful community-based restoration model in Indonesia. These include outgrower schemes, PES, and Bio-rights.

1. Private For-Profit Sources: Outgrower Schemes

Outgrower schemes could be one option in promoting ecosystem restoration work through community participation. In an outgrower scheme, a company provides marketing and production services to farmers to grow trees on their land under specific agreements. Mansourian et al., (2005) reported that in 2002, around 12,000 smallholder tree growers were involved in outgrower schemes in South Africa on about 27,000 ha . The scheme also provides companies with positive publicity at a time when the distribution of land rights in South Africa is under critical review. Although community motivations are mostly focussed on cash income at harvest, the trees may also be seen as a route to carbon sequestration, as it is the non-wood forest product that is the main source of income for smallholders.

2. Payments for Ecosystem Services

One example of PES in action through ecosystem restoration is the Pimampiro Payment for Watershed Services Scheme, Ecuador (Mansourian, et al., 2005). Under a pioneering project for Ecuador, landowners in the Paluarco river sub-watershed are being paid to manage the forest in the watershed to protect water sources. In 2001, the municipality approved an ordinance that established the pilot project Water Regulation for the Payment of Environmental Services for Forest and Paramo Conservation. A fund was created to channel payments from beneficiaries (mostly domestic water users) to those providing good water quality through maintenance of forest cover upstream.

3. Bio-rights

Bio-rights were promoted by Eijk & Kumar (2008) as a type of microfinance model. As such, the aim was to

combine poverty alleviation and conservation efforts through the provision of microcredit for sustainable development. This approach supports local people to be actively involved in environmental restoration and conservation efforts.

- Phase 1 is the allocation of a financial loan to the community that can be used to develop activities to create sustainable income.
- Phase 2 is the repayment of loan not in the form of money, but in the form of environmental restoration, protection, and conservation services, which in this case is forest ecosystem restoration.
- Stage 3 is if the environmental recovery, protection, and conservation activities in stage 2 are deemed successful, then the loan will be converted into a pure grant, which can then be forwarded to other community members for further sustainable development activities.

CONCLUSION

Ecosystem restoration has been widely tackled in Indonesia, driven by both the government and the private sector. Although currently ecosystem restoration does not exist implicitly in Law and Government Regulation No. 23 of 2021, the practice of ecosystem restoration has become a recognized part of forest management in Indonesia. Efforts to mainstream ecosystem restoration must continue by creating new and feasible conservation business models and encouraging productive community empowerment.

Good progress has been made by the government in expanding the role of the private sector and the local community in implementing ecosystem restoration. However, the role of the community needs to be improved so that it is not only a supporting unit for the implementation of restoration, but also seen as the main instigator. Innovative business models need to be piloted and strengthened to make ecosystem restoration financially attractive for community groups.

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NEWS, NOTES, & EVENTS

Think Globally, Act Locally – publishing amidst global summits

Dolly Priatna and Kathryn A. Monk (Eds.)

We are very pleased to present InJAST Volume 2 Number 2 October 2021 at this exciting time for national and global focus on applied environmental studies. This latest edition contains reviews and research articles such as “Traditional knowledge of biodiversity in the community surrounding Giam Siak Kecil-Bukit Batu Biosphere Reserve, Riau, Indonesia” and “Overview and evaluation of Indonesia's water resources management policies for food security”. In addition, our guest editorial explores the topic of “Government, private, and local communities in ecosystem restoration governance and practices”. This editorial reminds us all that we are now in the first year of the UN Decade on Ecosystem Restoration (2021-2030), which challenges everyone to massively scale up restoration efforts focussed on our degraded ecosystems.

Environmental studies have never been of such importance nor received as much attention as they are at this time. This fourth issue of our journal is published in the midst of two major global environmental agendas, with both significantly affected by the on-going global covid-19 pandemic. The biggest biodiversity conference in a decade, the UN Biodiversity Conference of the Parties (CBD COP15), was originally scheduled to take place on 15-28 October 2020, in Kunming, China. After several postponements, it is now taking place in two parts. The first part was the High-Level Summit, in virtual format, on 11-15 October 2021. The second part will be a face-to-face meeting in Kunming, China, on 25 April-8 May 2022. Inger Andersen, Under-Secretary-General of the United Nations and Executive Director of the UN Environment Programme, said in her speech on 12 October that :

COP15 is our chance to shift our course. Together with COP26 on climate, it is our chance to agree on the pathway to the world we want. Because in delivering on biodiversity, we deliver on climate, on pollution, on the UN Decade of Ecosystem Restoration, and on the food and energy system transformation. So, let us ensure that this COP will be remembered as the moment we finally set our societies and economies on the path to rebuilding the biodiversity upon which we all rely.

The first part of CBD CoP15 closed with the adoption of the Kunming Declaration, where all parties committed to develop, adopt, and implement an effective post-2020 global biodiversity framework that would biodiversity put on a path to recovery by 2030 at the latest, towards the full realization of the 2050 Vision of “Living in Harmony with Nature.”

Following this successful part one of CBD CoP15, the

26th UN Climate Change Conference of the Parties (COP26) was held in Glasgow, UK, on 31 October – 12 November 2021, bringing 192 parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change, specifically to

1. Secure global net zero by mid-century and keep 1.5oC within reach.
2. Adapt to protect communities and natural habitats.
3. Mobilise finance.
4. Work together to deliver.

Unlike CoP15, this was a summit and so all Heads of State were expected to attend. The debate rages as to whether they have succeeded in pushing forward the operationalisation of the Paris Agreement in any really effective way. We know that if they have not, our children and grandchildren across the globe will hold us all to account for failing them.

Indonesia ratified the Paris Agreement through the Law No. 16/2016 concerning the Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change and has established a Road Map for Climate Change Adaptation until 2030, which is outlined in Indonesia's Updated NDC (Nationally Determined Contribution). Indonesia has a high commitment to climate change adaptation., and on day 1 of CoP26 itself, Indonesian President Joko Widodo signed a declaration with more than 100 other countries leaders committing to work “collectively to halt and reverse forest loss and land degradation by 2030 while delivering sustainable development and promoting an inclusive rural transformation”. Furthermore, to phase out its coal-fired power plants by the 2040s, as part of another pledge signed at COP26 by 23 countries, Indonesia plans to start with decommissioning a quarter of its coal capacity by 2030, much more ambitious than its initial plan to decommission 1.1 GW of coal power by 2030. Indonesia also hopes that the outcome of COP26 has included a strong agreement between countries on the Global Goal on Adaptation (GGA), as a pivotal component of the Paris Agreement enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change by increasing the quantity, quality, and predictability of funding for adaptation. This includes increasing the accessibility of funding for local action. As a large developing country, with the fourth largest population in the world, of course Indonesia requires large resources. Several things related to policies, programmes, guidelines, tools, and actions in

terms of climate change adaptation have been prepared to show that Indonesia leads by example. In this regard, Indonesia has launched an initiative called the "Indonesia FoLU Net-sink 2030", an implementation, mitigation, and climate adaptation agenda designed to relate to forests and land, including forestry activities and community participation in customary forests and mangroves. In accordance with the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) 2050, Indonesia will increase its ambition on GHG reduction, with plans to peak GHG emissions, with a net sink in the FoLU sector by 2030. The FoLU sector is one of the largest emitters in Indonesia, along with energy, waste, industry, and agriculture. CoP26 saw strenuous debate and negotiation around the necessary means of implementation of key actions to operationalise the Paris Agreement. We will see similar efforts associated with CBD CoP15's landmark post 2020 global biodiversity framework, which is due to be adopted at part two of CBD CoP15 in May 2022, following further formal negotiations in January 2022. Means of implementation in line with the CBD and its two protocols, as well as appropriate mechanisms for monitoring, reporting and review, may well see as many debates and challenges as we have just seen in Glasgow, even though the Kunming Declaration gives clear political direction for those negotiations for a successful post-2020 framework: the mainstreaming of biodiversity across all decision-making; phasing out and redirection of harmful subsidies; strengthen the rule of law; recognizing the full and effective participation of indigenous peoples and local communities and ensuring an effective mechanism to monitor and review progress, among others.

For Indonesia, the post 2020 global biodiversity framework will become the standard of survival, to

strengthen and augment the frameworks and agreements to counter climate change. As home to more than more than 300,000 wildlife species or 17% of the world's wildlife in 19 types of ecosystems with 74 habitat types, including the third largest tropical rainforest in the world (94.1 million hectares), and the world's largest tropical peatlands (14.9 million hectares) and mangrove forests (3.31 million hectares), Indonesia strongly supports the negotiations on the biodiversity framework. Indonesia already pursues three pillars in accordance with the objectives of the CBD, namely conservation, sustainable use, and access, as well as fair and balanced distribution of genetic resources.

We reflect further of course that we are all, both personally and societally, in a hugely different place from where we were at the start of 2020. The Covid pandemic, so obviously a global tragedy, has changed many people's behavioural patterns and our subsequent impact of nature and the environment. It has in so many ways heightened people's awareness and understanding of nature and environmental issues, and the relationships between unsustainable production and consumption and the nature and climate change crises. A plethora of new research is emerging on these interdisciplinary questions, and we look forward to submissions tackling these questions in future editions of InJAST.

Finally, as Editors-in-Chief, we have been working hard to improve and expand our peer review community, as well as the processes of online submission, reviewing and publishing. We are delighted to be presenting Volume 2 No 2 of InJAST and we encourage our colleagues from all sectors to submit their papers for the next issue. In particular, we remind potential authors that we accept a range of article types and encourage you to contact us to discuss ideas for special issues.

InJAST's website and online submission portal is:

<https://journal.unpak.ac.id/index.php/InJAST/index>

Submissions can also be directed to the Chief Editors at: injast@unpak.ac.id

Comments on InJAST's website, reporting portal issues and other issues, should be addressed to the Editorial Manager at: editor_injast@unpak.ac.id

NOTES

Pandemic meets pollution: Poor air quality increases deaths by COVID-19

We study the impact of short-term exposure to ambient air pollution on the spread and severity of COVID-19 in Germany. We combine data at the county-by-day level on confirmed cases and deaths with information on local air quality and weather conditions. Following Deryugina et al. (2019), we instrument short-term variation in local concentrations of particulate matter (PM10) by region-specific daily

variation in wind directions. We find significant positive effects of PM10 concentration on death numbers from four days before to ten days after the onset of symptoms. Specifically, for elderly patients (80+ years) an increase in ambient PM10 concentration by one standard deviation between two and four days after developing symptoms increases the number of deaths by 19 percent of a standard deviation. In addition, higher levels air pollution raise the number of confirmed cases of COVID-19 for all age groups. The timing of effects surrounding the onset of illness suggests that air

pollution affects the severity of already-realized infections. We discuss the implications of our results for immediate policy levers to reduce the exposure and level of ambient air pollution, as well as for cost-benefit considerations of policies aiming at sustainable longer-term reductions of pollution levels.

Ispording & Pestel (2021). Pandemic meets pollution: Poor air quality increases deaths by COVID-19. *Journal of Environmental Economics and Management* 108:102448.

Palm oil and the politics of deforestation in Indonesia

This paper studies the interactions between political and economic incentives to foster forest conversion in Indonesian districts. Using a district-level panel data set from 2001 to 2016, we analyze variation in remotely sensed forest losses as well as measures of land-use licensing. We link these outcomes to political incentives arising before idiosyncratically-timed local mayoral elections as well as to price exposure measures based on oil palm soil suitability combined with global price variations for palm oil. Empirical results document increases of about 4% in deforestation in the year prior to local mayoral elections on average. Additionally, palm oil plays a crucial role in driving deforestation dynamics. Deforestation rates increase by 7% in places that experience a one standard deviation increase in local price exposure, but no upcoming elections. These effects are amplified to almost 19% larger forest losses in places that experience pre-election years and a standard deviation higher palm oil price exposure at the same time. We thus find clear evidence for economic and political incentives reinforcing each other as drivers of forest loss and land conversion for oil palm cultivation.

Cisneros, Kis-Katos & Nuryartono (2021). Palm oil and the politics of deforestation in Indonesia. *Journal of Environmental Economics & Management* 108:102453.

Sustainable wastewater management in Indonesia's fish processing industry

The government of Indonesia has pledged to meet ambitious greenhouse gas mitigation goals in its Nationally Determined Contribution as well as reduce water pollution through its water management policies. A set of technologies could conceivably help achieving these goals simultaneously. However, the installation and widespread application of these technologies will require knowledge on how governance affects the implementation of existing policies as well as cooperation across sectors, administrative levels, and stakeholders. This paper integrates key governance variables--involving enforcement capacity, institutional coordination and multi-actor networks--into an analysis

of the potential impacts on greenhouse gases and chemical oxygen demand in seven wastewater treatment scenarios for the fish processing industry in Indonesia. The analysis demonstrates that there is an increase of 24% in both CH₄ and CO₂ emissions between 2015 and 2030 in the business-as-usual scenario due to growth in production volumes. Interestingly, in scenarios focusing only on strengthening capacities to enforce national water policies, expected total greenhouse gas emissions are about five times higher than in the business-as-usual in 2030; this is due to growth in CH₄ emissions during the handling and landfilling of sludge, as well as in CO₂ generated from the electricity required for wastewater treatment. In the scenarios where there is significant cooperation across sectors, administrative levels, and stakeholders to integrate climate and water goals, both estimated chemical oxygen demand and CH₄ emissions are considerably lower than in the business-as-usual and the national water policy scenarios.

Gomez-Sanabria et al. (2020). Sustainable wastewater management in Indonesia's fish processing industry: Bringing governance into scenario analysis. *Journal of Environmental Management* 275:111241.

Challenges of soil erosion and sludge management for sustainable development

Most developing countries, particularly Indonesia, will be facing problems of sludge pressure in the next decades due to the increase in practices of legal and illegal logging as well as land and water demands. Consequently, they will also be facing the challenges of soil erosion and sludge management due to increased quantities of sludge coming from several potential sources, such as activated sludge, chemical sludge, fecal sludge and solid wastes as well as erosion and sedimentation. Although the government of Indonesia has enacted laws and policies to speed up the implementation of the programs and activities related to sludge management, the detailed practice concepts in implementing the programs need to be identified. Discussion of role-sharing amongst the related government agencies, private institutions and other stakeholders is urgent for clarifying the participation of each party in the next years to come. This paper proposes a management approach and level of responsibilities in sludge management. Implementation of zero ΔQ , zero ΔS and zero ΔP policies needs to be adopted by local and central governments. Application of sludge on the agricultural lands and other uses will promote sustainable development.

Fulazzaky & Gany (2009). Challenges of soil erosion and sludge management for sustainable development in Indonesia. *Journal of Environmental Management* 90 (8):2387-2392.

Enhancing voluntary participation in community collaborative forest management

This paper examines voluntary participation in community forest management, and characterizes how more participation may be induced. We implemented a survey of 571 respondents and conducted a case study in Central Java, Indonesia. The study's novelty lies in categorizing the degrees of participation into three levels and in identifying how socio-economic factors affect people's participation at each level. The analysis finds that voluntary participation responds to key determinants, such as education and income, in a different direction, depending on each of the three levels. However, the publicly organized programs, such as information provision of benefit sharing, are effective, irrespective of the levels of participation. Overall, the results suggest a possibility of further success and corrective measures to enhance the participation in community forest management.

Lestari, Kotani & Kakinaka (2015). Enhancing voluntary participation in community collaborative forest management: A case of Central Java, Indonesia. *Journal of Environmental Management* 150:299-309.

Multiple Carrying Capacities from a management-oriented perspective

This article describes how the concept of Tourism Carrying Capacity (*TCC*) has shifted from a uni-dimensional approach to incorporating environmental, social and political aspects. This shift is demonstrated by a study of a large, internationally popular protected area used by trekkers, the Mt. Everest Region, where qualitative data collected from visitors was combined with environmental modeling using a participatory framework. Tourist satisfaction showed positive margins for further tourist industry expansion, but current environmental conditions limit growth and further development. Space and time dimensions were also considered. We observed that the limits on growth and further development can be manipulated, with a certain degree of flexibility, through investments and regulatory measures. We hypothesized that *TCC* can play an important role in the management of protected areas only if it is viewed as a systematic, strategic policy tool within a planning process rather than as a unique, intrinsic number that is not modifiable. We conclude that to translate the strategy into action using standard measures, further investigation is needed to balance the various *TCC* components as a part of a decision-making framework that includes the integration of different cultural approaches and policy needs.

Salerno et al. (2013). Multiple Carrying Capacities from a management-oriented perspective to

operationalize sustainable tourism in protected areas. *Journal of Environmental Management* 128:116-125.

Are corporate environmental activities to meet SDGs simply greenwashing?

The purpose of this study is to address the criticism that corporate environmental activities to meet the UN sustainable development goals (SDGs) are simply greenwashing. To this end, we clarify whether and why corporate environmental activities are effective in achieving SDGs from the stakeholder management perspective. Using data on Vietnamese companies, we first empirically clarify the influence of stakeholder pressure on a company's environmental management control system (EMCS) implementation as a comprehensive approach to environmental activities and maintaining a proactive attitude toward the SDGs. Second, we examine the influence of EMCS implementation on environmental performance with or without proactive attitudes. The main findings are as follows. Companies implementing EMCSs normally improve their environmental performance, and pressure from final consumers and the government is a precondition for this accomplishment. However, if these companies incorporate the SDGs into their business targets, they can actually improve their environmental performance somewhat further, and government pressure plays an important role in this additional accomplishment. Therefore, corporate environmental activities to meet the SDGs work better than existing activities in Vietnam, refuting the criticism of greenwashing. Importantly, the Vietnamese government as a powerful stakeholder has proactively promoted domestic structural change to achieve the SDGs and has enacted many policies to encourage companies to be proactive in their environmental activities.

Nishitani et al. (2021). Are corporate environmental activities to meet sustainable development goals (SDGs) simply greenwashing? An empirical study of environmental management control systems in Vietnamese companies from the stakeholder management perspective. *Journal of Environmental Management* 296:113364.

Estimating the impacts of financing support policies

This study develops a hybrid energy agent-based model that integrates the input-output analysis, environmental factors and socioeconomic characteristics of rural and urban households in Indonesia. We use the model to estimate the effects of four solar energy policy interventions on photovoltaic (PV) investments, government expenditure, economic outputs, CO₂e emissions and the uses of steel, aluminium, concrete and energy. The results of our analysis call for the abolition

of the PV donor gift policy, the improvement of production efficiency in the PV industry and the establishment of after-sales services and rural financing institutions. A 100 W peak (Wp) PV under this recommendation would be affordable for 80.6% of rural households that are projected to be without access to electricity in 2029. Net metering is the most effective policy for encouraging urban people to invest in PV in a situation where fossil energy prices are increasing and PV prices are declining. A donor gift policy may induce USD 51.9 new economic outputs for every Wp of PV operating to capacity in 2029, but would require a subsidy of USD 18.6/Wp. The recommended policies do not require subsidies and reduce CO_{2eq} emissions and the consumption of aluminium, energy, steel and concrete by between 83.1% and 89.7% more than the existing policy. Several policy implications are discussed in response to these findings. As a contribution to energy modelling literature, the model can be used for other developing countries by merely changing its data.

Irsyad & Nepal (2019). Estimating the impacts of financing support policies towards photovoltaic market in Indonesia: A social-energy-economy-environment model simulation. *Journal of Environmental Management* 230:464-473.

Effectiveness of community-based mangrove management

Community-Based Mangrove Management (CBMM) is implemented with different approaches and outcomes. This study examined the effectiveness of various CBMM practices to achieve sustainable management of mangrove resources. We analyzed local mangrove resource management strategies in four coastal villages (e.g. Sriwulan, Bedono, Timbulsloko, and Surodadi) on Central Java, Indonesia. Local data on institutions, socio-economic conditions and mangrove resources utilization was collected through participatory resource mapping and interviews with 16 key actors and 500 households. The main differences in CBMM-practices that affect the outcomes in each village were the type of community participation, the level of organizational and economic assistance from external institutions, the magnitude of the rehabilitation project, the time selected for rehabilitation and the maintenance strategies applied in each village. Surodadi achieved most in terms of both efficient resource utilization and local livelihood improvement. Bedono's management strategy was most effective in extending and maintaining the rehabilitated mangrove areas but less in terms of livelihood support while the strategy applied in Timbulsloko resulted in higher resource utilization compared to Surodadi. Sriwulan failed on most criteria. This study suggests that combining the management strategies practiced in Bedono and Surodadi and adding external scientific and

technological assistance, income diversification, institutional reinforcement and continuous monitoring of the functioning of local institutions can improve the CBMM performance to sustainably manage mangrove resources and improve livelihoods.

Damastuti & de Groot (2017). Effectiveness of community-based mangrove management for sustainable resource use and livelihood support: A case study of four villages in Central Java, Indonesia. *Journal of Environmental Management* 203(1):510-521.

Sustainable irrigation in Indonesia

This study employs Ostrom's Design Principles to examine the robustness of institutional arrangements employed by water user associations to manage access to water resources in Southeast Sulawesi Province, Indonesia. The outcome is a set of eight propositions which, if implemented, can be predicted to significantly improve water use in Indonesia. Emphasis is placed on the development of institutional arrangements that encourage and empower local action within an agreed system-wide framework so that communities can prosper as pressures and demands for water access increase—a requirement generally applicable to situations found in many other countries.

Ma'mun, Loch & Young (2021). Sustainable irrigation in Indonesia: A case study of Southeast Sulawesi Province. *Land Use Policy* 111:105707.

EVENTS

UN Climate Change Conference 2021/COP26: UK in partnership with Italy - Glasgow 31 Oct-12 Nov 2021

The COP26 summit will bring parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. What do we need to achieve at COP26?

Secure global net zero by mid century and keep 1.5 degrees within reach. Countries are being asked to come forward with ambitious 2030 emissions reductions targets (NDCs) that align with reaching net zero by the middle of the century. To deliver on these stretching targets, countries will need to accelerate the phaseout of coal, encourage investment in renewables, curtail deforestation and speed up the switch to electric vehicles.

Adapt to protect communities and natural habitats. The climate is already changing and it will continue to change even as we reduce emissions, with devastating effects. At COP26 we need to work together to enable and encourage countries affected by climate change to protect and restore ecosystems, build defences, put warning systems in place and make infrastructure and agriculture more

resilient to avoid loss of homes, livelihoods and lives.

Mobilise finance. To realise our first two goals, developed countries must deliver on their promise to raise at least \$100bn in climate finance per year. International financial institutions must play their part and we need to work towards unleashing the trillions in private and public sector finance required to secure global net zero.

Work together to deliver. We can only rise to the challenges of climate change by working together. At COP26 we must finalise the Paris Rulebook (the rules needed to implement the Paris Agreement). And, we have to turn our ambitions into action by accelerating collaboration between governments, businesses and civil society to deliver on our climate goals faster.

<https://ukcop26.org/>

Convention on Biological Diversity – UN Biodiversity Conference (COP15) - 11 - 15 October 2021; Online | 25 April - 8 May 2022; In-person, Kunming, China

Despite on-going efforts, biodiversity is deteriorating worldwide and this decline is projected to worsen with business-as-usual scenarios. The UN Biodiversity Conference will convene governments from around the world to agree to a new set of goals for nature over the next decade through the Convention on Biological Diversity post-2020 framework process. The framework sets out an ambitious plan to implement broad-based action to bring about a transformation in society's relationship with biodiversity and to ensure that, by 2050, the shared vision of living in harmony with nature is fulfilled.

The Conference will also look at the implementation of the protocols of the Convention on Biological Diversity that deal with the fair and equitable sharing of benefits from the use of nature, and the safe transport, handling and labelling of Living Modified Organisms.

The first part of COP-15 will include the opening of the Meetings and will address agenda items that have been identified as essential for the continuation of the operations of the Convention and the Protocols by the Bureau. This will include meetings about administrative matters and technical issues related to CBD programmes.

There will also be a high-level segment on 12 and 13 October 2021. Participants are expected to focus on the development of the post-2020 global biodiversity framework.

All sessions at COP15 will be streamed live at cbd.int/live.

<https://www.unep.org/events/conference/un-biodiversity-conference-cop-15>

7th International Conference on Environmental Pollution, Treatment and Protection (ICEPTP'22): April 10, 2022 - April 12, 2022 | Lisbon, Portugal

The Conference Proceedings will be published with an ISSN and ISBN, indexed in Scopus and Google Scholar, and archived permanently in Portico. The conference aims to become the leading annual conference in fields related to environmental pollution, treatment and protection. The goal of this environment conference 2022 is to gather scholars from all over the world to present advances in the relevant fields and to foster an environment conducive to exchanging ideas and information. This conference will also provide an ideal environment to develop new collaborations and meet experts on the fundamentals, applications, and products of the mentioned fields.

<https://iceptp.com/>

ICENS 2022: International Conference on Environment and Natural Science: January 07-08, 2022 in Singapore, Singapore

The International Research Conference is a federated organization dedicated to bringing together a significant number of diverse scholarly events for presentation within the conference program. Events will run over a span of time during the conference depending on the number and length of the presentations. With its high quality, it provides an exceptional value for students, academics and industry researchers.

International Conference on Environment and Natural Science aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Environment and Natural Science. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Environment and Natural Science.

<https://waset.org/environment-and-natural-science-conference-in-january-2022-in-singapore>

Traditional knowledge of biodiversity in the community surrounding Giam Siak Kecil-Bukit Batu Biosphere Reserve, Riau, Indonesia

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ABSTRACT

The Objective of this study is to analyze the potential for biodiversity and traditional knowledge in the buffer zone of the Giam Siak Kecil-Bukit Batu Biosphere Reserve (GSK-BB). The research was conducted descriptively-quantitatively by analyzing two variables, i.e. biodiversity and community traditional knowledge. Biodiversity monitoring report documents from PT Sakato Pratama (PT SPM) and PT Bukit Batu Hutan Alam (PT BBHA), profiles of Temiang and Sepahat villages, questionnaire data taken from village community representatives, as well as the results of in-depth interviews were used in the analysis. The results show that in the PT SPM area, there are 177 species of plants and 55 species of animals. Meanwhile in the PT BBHA area there are 146 species of plants and 46 species of animals. Based on information from the community of Temiang Village, there are 51 species of plants and 18 species of animals, while according to the people of Sepahat Village, there are 73 species of plants and 83 species of animals. The biodiversity utilized by the community in the two villages consists of 36 species of plants and 15 species of animals, but only three species are wild animals, i.e. sun bear (*Helarctos malayanus*), horseshoe crab (*Limulus sp.*), and seahorse (*Hippocampus sp.*), and one species of plant (rattan, *Calamus sp.*). The rest are cultivated plants and livestock. From the analysis, it can be concluded that the relationship between biodiversity and traditional knowledge in both Temiang and Sepahat Villages is very limited. Awareness of the strategic value of wild plants and wildlife in the buffer zone of the biosphere reserve needs to be increased.

ABSTRAK

Penelitian ini bertujuan untuk menganalisis potensi keanekaragaman hayati dan pengetahuan tradisional di zona penyangga Cagar Biosfer Giam Siak Kecil-Bukit Batu (GSK-BB). Penelitian dilakukan secara deskriptif-kuantitatif dengan menganalisis dua variabel, yaitu keanekaragaman hayati dan pengetahuan tradisional masyarakat. Dokumen laporan monitoring keanekaragaman hayati dari PT Sakato Pratama (PT SPM) dan PT Bukit Batu Hutan Alam (PT BBHA), profil Desa Temiang dan Sepahat, data kuisisioner yang diambil dari perwakilan masyarakat desa, serta hasil wawancara mendalam digunakan dalam analisis. Hasil menunjukkan bahwa di kawasan PT SPM tercatat terdapat 177 jenis tumbuhan dan 55 jenis satwa. Sementara itu di kawasan PT BBHA terdapat 146 jenis tumbuhan dan 46 jenis satwa. Berdasarkan informasi dari masyarakat Desa Temiang terdapat 51 jenis tumbuhan dan 18 jenis satwa, sedangkan menurut masyarakat Desa Sepahat terdapat 73 jenis tumbuhan dan 83 jenis satwa. Keanekaragaman hayati yang dimanfaatkan oleh masyarakat di kedua desa tersebut terdiri atas 36 jenis tumbuhan dan 15 jenis satwa, namun hanya tiga jenis yang merupakan hewan liar, yaitu beruang madu (*Helarctos malayanus*), belangkas (*Limulus sp.*), dan kuda laut (*Hippocampus sp.*), serta satu jenis tumbuhan (rotan, *Calamus sp.*). Selebihnya merupakan tanaman budidaya dan hewan ternak. Dari hasil analisis, dapat ditarik kesimpulan sementara bahwa hubungan keanekaragaman hayati dengan pengetahuan tradisional di kedua desa Temiang dan Sepahat sangat terbatas. Kesadaran tentang nilai strategis tumbuhan dan satwa liar yang ada di kawasan penyangga cagar biosfer perlu ditingkatkan.

Keywords: *biodiversity, biosphere reserve, buffer zone of Giam Siak Kecil-Bukit Batu, traditional knowledge*

INTRODUCTION

UNESCO has denominated the Giam Siak-Kecil Bukit Batu Biosphere Reserve, located in Bengkalis District and Siak District Riau province as the 7th biosphere reserve in Indonesia by 2009. The main purpose of the development of GSK-BB Biosphere Reserve is to support the achievement of sustainable development of landscape, peat swamp forest, lakes and their water system that had been converted into industrial forest, plantation and settlement (Qomar,

2017) Looking at the local community activities who lives around area of GSK-BB Biosphere Reserve, many villagers are still utilizing biodiversity to meet their daily needs through traditional methods such as harvesting forest honey by climbing sialang tree, fishing using bubu or lukah, and various types of biodiversity processed medicines based on community traditional knowledge (Anna, 2013). Utilizing biodiversity, landscape and local culture in tourism is believed to be able to conserve the natural and cultural environment and be able to prosper the community around the region (Yosevita, 2013). The

buffer zone area of the GSK-BB Biosphere Reserve is the focus of this research, involving respondents from Temiang and Sepahat villages located in the buffer zone area. The buffer zone area serves as a protector to the core zone (Cecep, 2018). The selection of this zone due to its opportunity to be further expanded to support biodiversity conservation in the area that will potentially preserve the core zone. Based on the description, this research was conducted to identify the biodiversity and traditional knowledge manageable in the buffer zone area of GSK-BB Biosphere Reserve in Riau.

METHODS

Location

The research was conducted in February-April 2020, in buffer zone area of GSK-BB Biosphere Reserve (Figure 1) which covers the protected area of PT Sakato Pratama Makmur (PT SPM) and PT Bukit Batu Hutan Alam (PT BBHA), as well as two villages in Bandar Laksamana Subdistrict which are both paced in the buffer zone area of GSK-BB Biosphere Reserve. Those two villages are Temiang and Sepahat.

Temiang Village was chosen for several reasons as follow: (a) part of the village area is in the buffer zone of GSK-BB Biosphere Reserve, (b) Its villagers carry out many activities in the buffer zone and core zone area of GSK-BB Biosphere Reserve (rubber plantation, oil palm plantation, agricultural field, and river fishing). Sepahat Village was chosen because: (a) part of the village area is included in the buffer zone of the GSK-BB Biosphere Reserve, (b) The Sepahat village government is

developing coastal tourism, (c) the lack of interaction of Sepahat village communities to the core zone of the GSK-BB Biosphere Reserve. Tools used in data collection phase are stationery, recorder, camera, laptop, questionnaires, and data storage devices.

The research method using descriptive-quantitative method. The aspects studied in this research are:

1. Identify biodiversity potential in GSK-BB buffer zone with document studies, questionnaires and in-depth interviews.
2. Identify traditional knowledge of the community with questionnaires and in-depth interviews

The data and information obtained will be analyzed using quality of diversity of flora and fauna species according to Fandeli (2000). Questionnaire results are processed to find out the level of public knowledge on biodiversity. In-depth interviews conducted with community leaders to enrich information about knowledge of biodiversity utilization by the community.

In obtaining an assessment or scoring, the main component of the assessment is calculated by using the formula: $S = N \times B$

Description:

S = Score/value

N = Number of values of elements on the criteria

B = Value weight

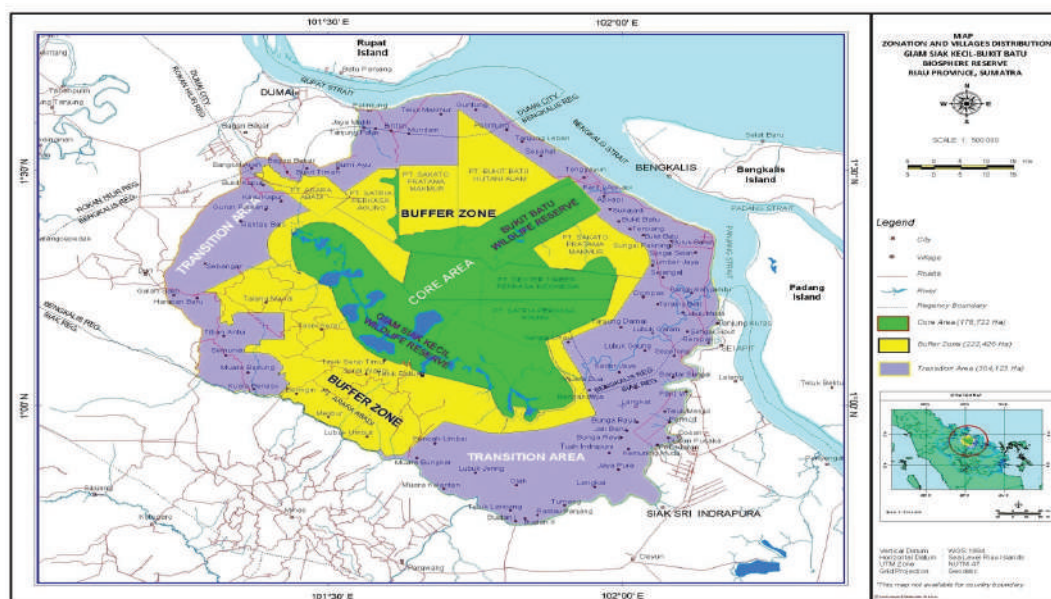


Figure 1. The map of research site map (red boxes in two companies and round red in two villages)

Location

1. Biodiversity analysis in GSKBB buffer zone

The analysis was conducted by collecting data on the company's biodiversity report in 2018 (PT SPM and PT BBHA) and questionnaires and in-depth interviews with the community. The company's biodiversity report data is then processed using assessment guidelines from Fandeli (2000) to obtain information on the quality of flora and fauna diversity in the GSK-BB buffer zone area. The quality of diversity referred to by Fandeli (2000) is related to the diversity of flora and fauna. The high diversity of flora and fauna means that the area has a high tourism potential. Fandeli (2000) makes the diversity quality criteria presented in the Table 1 and Table 2.

Table 1. Criteria for the quality of plant diversity

Scale	Number of species	Category
1	There are ≤ 5 species of plant	Bad
2	There are 6-10 species of plant	Poor
3	There are 11-20 species of plant	Fair
4	There are 21-31 species of plant	Good
5	There are ≥ 31 species of plant	Very Good

Table 2. Criteria for the quality of animal diversity

Scale	Number of species	Category
1	There are 1-2 species of animal	Bad
2	There are 3-5 species of animal	Poor
3	There are 6-10 species of animal	Fair
4	There are 11-15 species of animal	Good
5	There are > 15 species of animal	Very Good

Questionnaires are used to explore people's knowledge about biodiversity in the GSK-BB buffer zone. Questionnaire results are processed to determine the level of public knowledge about biodiversity. In-depth interviews with community leaders to enrich information about people's knowledge of biodiversity.

2. Traditional knowledge analysis

The analysis was conducted by collecting data through questionnaires and in-depth interviews to obtain information on people's knowledge in the utilization of biodiversity (in the form of traditional medicine, cultural works, customary rituals, and artworks) in the region. Questionnaire results are processed to determine the level of knowledge of the community in utilizing biodiversity. In-depth interviews with several community leaders to enrich information about people's knowledge about biodiversity utilization.

RESULTS AND DISCUSSION

The buffer zone areas in this study were areas in-and-around the PT SPM and PT. BBHA concession area, Sepahat village and Temiang village, Bandar Laksamana Subdistrict. The quality of biodiversity in the buffer zone refers to Fandeli (2000) assessment criteria with following results: (a) Area of PT SPM species diversity quality of flora and fauna is very high, with more than 31 species of plants and more than 15 species of animals found (177 species of plants, which are 13 protected status; 55 species of animals, which are 33 protected status); (b) Area of PT BBHA the of species diversity quality of flora and fauna is very high, with more than 31 species of plants and more than 15 species of animals found (146 species of plants, which are 18 protected status; 46 species of animals, which are 21 protected status); (c) In Temiang village the quality of flora and fauna diversity is very high with more than 31 species of plants and more than 15 species of animals found (51 species of plants, 18 species of animals) (d) In the villages of Temiang and Sepahat the quality of flora and fauna diversity is very high with more than 31 species of plants and more than 15 species of animals (73 species of plants, 83 species of animals).

Traditional knowledge of Temiang and Sepahat village communities revolves around the utilization of several species of flora and fauna for the medicine, traditional rituals, handicrafts, and arts. The most widely used species of plants as a medicine mostly cultivated independently or grows naturally in the dwelling / yard and the majority are from the family of Zingiberaceae. Based on the way it is processed, 55% made by general community, not specifically made by village shamans. Supported by the respondent's statement that knowledge of plants and medicinal plants is obtained pass from parents to their generations through observation and practice. The most widely processed and used part of the plant as a medicine is the leaf. The utilization of medicinal plants by the villagers of Temiang is usually to overcome diseases such as: stomach pain or ulcers, colds, to increase stamina and endurance, to increase appetite, fever, cough, abdominal pain, diabetes, cholesterol and gout, and minor injuries.

Animals that are often used as medicine include squirrels, earthworms and aruan/gabus or snakehead fish. Squirrel (*Scandentia sp.*) is the most widely used animal as a medicine to overcome diabetes. The practice of using squirrels that are widely found in the gardens since many diabetics feel positive changes after consuming squirrel meat. The second most used animal as a medicine is earthworms (*Lumbricina sp.*) used for the treatment of asthma which are commonly found in the yard soil. The third most used animal as a medicine is snakehead fish that are found in river or trench areas (*Channa striata*) that are efficacious to treat deep wounds or postoperative wounds (Budi, 2016). Based on data

obtained in Temiang Village, it is known that the most widely used animal parts as medicine are the meat (40%) and the whole body part (30%). Temiang villagers use animals for the treatment of diabetes, shortness of breath, postoperative wounds, weak stamina, fractures and sprains, toothache and ulcers. There is also one species of protected animal used as medicine, although the practice is rare, namely the sun bear (*Helarctos malayanus*) by taking its liver to treat shortness of breath. Sun bear is one of the protected animals listed under Appendix I of CITES (Convention on International Trade in Endangered Species), as well as protected under Government Regulation of the Republic of Indonesia number 7 of 1999, Law number 5 of 1990 (BBKSDA Riau, 2018).

Cultural works produced by the community by utilizing the diversity of plants include: pandanus mats from pandan (*Pndanus sp.*) thorns and lukah / bubu from bamboo used to catch fish, although they have not been managed specifically. There is no group of pandan mat craftsmen or lukah, although the products have reached Malaysia, based on orders by one or two consumers (not produced in large quantities, only by consumer demand). The people of Temiang Village considered the economic potential of the product to be low and not potentially touristy. The most traditional rituals performed by the people of Temiang Village are Tepung Tawar that is carried out during the wedding ceremony; Beliman bath is carried out in every Islamic commemoration day, as well as Kenduri which is carried out to welcome the fasting month of Ramadhan.

Plant species that is usually used in traditional ritual activities are rice, potpourri, fragrant pandanus (*Pandanus amaryllifolius*), glutinous rice (*Oryza glutinosa*), turmeric (*Curcuma longa*) and lime leaves (*Citrus sp.*). For the people of Temiang Village, there is no traditional ritual considered to have economic value and attractions. The most commonly mentioned artwork by the Temiang villagers is the Zapin dance. This Zapin dance is usually performed in large religious celebrations, to welcome large guests as well as at wedding ceremonies. In the implementation of this dance, dancers will wear traditional clothes accompanied by Malay music, kompang and tambourine instrument. Zapin dancers also carried betel leaves (*Piper betle*) and rice (*Oryza sativa*) placed on the treads (plates) used at the beginning and end of the dance.

In Sepahat Village found 36 species of plants that are often used as medicine, mostly from the Zingiberaceae family, with the highest species is turmeric plant (*Curcuma domestica*). Sequentially the most used parts of plants as medicine by Sepahat villagers are: leaves, rhizomes, fruits, stems, bark, leaves and roots, leaves and fruits, jellies, and buds. Explained by Aisha (2015) the high frequency of utilization of leaf parts as medicinal ingredients related to some advantages such as : the huge

number, leaves are easier to obtain compared to other parts and easier to process. Medicinal plants mentioned by Sepahat villagers are used to treat various diseases such as; hemorrhoids, shortness of breath, lumbago, yellow sap, aches and sprains, flatulence, nosebleeds, diarrhea, diabetes, obesity, increase stamina and endurance, repel insects, cure external wounds, increase stamina of postpartum mothers, increase appetite, increase breast milk and dengue fever, expel colds, cholesterol, fever, hypertension, cough and whitish. Sepahat villagers do not put special efforts in preserving the species of plants that are used as medicine. This is due to the large number of plants and they could easily found in plantation areas and community yards. Meanwhile, the type of root plants hooks are getting fewer in the forest area due to the changing function of forests into plantations and also forest fire incident.

The six species of animals most commonly used as medicine are squirrels (*Scandentia sp.*) 25%, snakes (*Serpentes sp.*) 20%, greater coucal (*Centropus sinensis*) 11%, ant-lion (*Myrmeleon formicarius*) 8%, seahorses (*Hippocampus sp.*) 7% and thousand feet (*Myriapoda sp.*) 7%. From the 12 species of animals used as medicine, there are four types of animals which have protected status according to Ministry of Environment and Forestry decree Number P.106 Year 2018, namely lathes, shoehorse crab, sun bears and seahorses. The practice of using these animals as medicine is still common, though the number of these animals found in forest and marine areas already decreasing due to poaching and illegal trading. The most widely used parts of the animal's body as medicine are the meat as much as 67%, the bile 17%, the liver 8% and the egg 8%. Diseases treated by utilizing these animals include: shortness of breath or asthma, eye pain, fever, diabetes, rheumatism, thypoid, sprains and fractures, postoperative wounds, increased fertility and toothache.

The most mentioned cultural work by Sepahat villagers is traditional food and drink (56%). Furthermore, chicken mat pandanus, woven lukah or bubu, woven dishes and baskets and woven climb each showed a value of 11%. Traditional ritual activities that are still carried out include: ritual bath to resist bad luck (water war) 45%, tepung tawar and kenduri 36% which carried out during the wedding ceremony. The most commonly called art activities are Zapin dance (22%), kompang art (19%), art in the form of stage house models and lembayung or roof hats (16%), rhythmic reverse art or Berbalas Pantun (10%), Silat martial art (10%), tambourine instrument art (10%), sekapur sirih dance (6%) and Serampang Dua Belas dance 5%.

CONCLUSION

Biodiversity in the PT SPM found 177 species of plants which 13 of them are protected, 55 species of animals of which 33 are protected status. In PT BBHA

found 146 species of plants which 18 of them are protected, 46 species of animals of which 21 are protected. In the village of Temiang found 51 species of plants which 2 of them are protected, there are 18 species of animals of which 8 are protected. In Sepahat Village found 73 species of plants, 6 of which are protected, there are 83 species of animals and 44 of them are protected.

Traditional knowledge of medicine, cultural works and community artworks in two villages is closely related to biodiversity. Traditional medicine of Temiang villagers utilizes 11 species of plants and 10 species of animals, 3 of which are protected. Traditional medicine of Sepahat villagers utilizes 36 species of plants and 12 species of animals (3 of which are protected). The cultural work in Temiang village utilizes 7 species of plants, while in the artwork Temiang people make use of 2 species of plants. The cultural work in Sepahat Village utilizes 26 species of plants and 1 species of animals. In the artwork, Sepahat villagers make use of 8 species of plants and 2 species of animals.

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Overview and evaluation of the Indonesia's water resources management policies for food security

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ABSTRACT

Water and water resources must be maintained by their functions and benefits to meet the needs of all sectors and future generations. One important part of sustainable water resource management that is of considerable interest to the government is irrigation which aims to achieve food security. Food security in Indonesia Development in the field of food security and poverty alleviation in rural areas is one of the leading sectors in the nine national development priority agendas contained in "Nawa Cita". The development of food security in Indonesia faces many complex problems, such as irrigation infrastructures maintenance, regulations, land use change, population, policy implementation, coordination among stakeholders and also budget issues. The method in this study is a qualitative method through the literature review related to the management of water resources for food security in Indonesia. This paper seeks to evaluate the development irrigation policies as part of sustainable water management that supports food security in Indonesia. Literature sources are 5 main regulations, 5 papers and some government reports. To support increased food security, the direction of the Indonesian Government's policy in strengthening food security from the irrigated agricultural sector is realized through a strategy to increase production capacity and improve irrigation network services. The problem of the availability of irrigation water must be addressed quickly by upstream conservation, maximizing capacity through normalization of existing reservoirs, and continuing to build dams to have water storage containers that can accommodate planting season throughout planting.

ABSTRAK

Air dan sumber daya air harus dijaga fungsi dan manfaatnya untuk memenuhi kebutuhan semua sektor dan generasi mendatang. Salah satu bagian penting dari pengelolaan sumber daya air berkelanjutan yang cukup menarik perhatian pemerintah adalah irigasi yang bertujuan untuk mencapai ketahanan pangan. Di Indonesia, pembangunan di bidang ketahanan pangan dan pengentasan kemiskinan di pedesaan merupakan salah satu sektor unggulan dalam sembilan agenda prioritas pembangunan nasional yang tertuang dalam "Nawa Cita". Pembangunan ketahanan pangan di Indonesia menghadapi banyak masalah yang kompleks, seperti pemeliharaan infrastruktur irigasi, regulasi, perubahan penggunaan lahan, kependudukan, implementasi kebijakan, koordinasi antar pemangku kepentingan dan juga masalah anggaran. Metode dalam penelitian ini adalah metode kualitatif melalui studi pustaka terkait pengelolaan sumber daya air untuk ketahanan pangan di Indonesia. Tulisan ini berupaya mengevaluasi kebijakan pembangunan irigasi sebagai bagian dari pengelolaan air berkelanjutan yang mendukung ketahanan pangan di Indonesia. Sumber literatur adalah lima peraturan utama, lima makalah dan beberapa laporan pemerintah. Untuk mendukung peningkatan ketahanan pangan, arah kebijakan Pemerintah Indonesia dalam memperkuat ketahanan pangan dari sektor pertanian beririgasi diwujudkan melalui strategi peningkatan kapasitas produksi dan peningkatan pelayanan jaringan irigasi. Masalah ketersediaan air irigasi harus segera diatasi dengan konservasi di wilayah hulu, memaksimalkan kapasitas melalui normalisasi waduk yang ada, dan terus membangun bendungan untuk memiliki wadah penampung air yang dapat mencukupi kebutuhan pasokan sepanjang musim tanam.

Keywords: *food security, irrigation, policy, water*

INTRODUCTION

Food is a vital need for humans with rice as a staple food for most of the world community. The demand for import of food from countries producing staple goods is increasing. Data from FAO shows that in 2017 world rice production reached 759.6 million tons or exceeded 0.6 percent from 2016. Most of the increase in rice yields concentrated in Asia, although the rate of production in the region was disrupted by disasters of floods and droughts. In Indonesia, food security is supported by the development of the agricultural sector as a focus in

economic development. The government's attention is devoted to this sector given its role in creating high employment opportunities. Economic development by giving priority to the agricultural sector is a line of wisdom that began to be popular since the early sixties. Before that time (in the forties and fifties), agriculture was considered a passive sector in economic development, as a follower and supporter of a more active and more dynamic sector, namely the industrial sector. The 2020-2024 National Medium Term Development Plan (RPJMN), achievement of water, food and energy

security is one of the national development priorities (GoI, 2020).

Water security determines food security and energy security (Bellfield et al., 2015). The main challenge in managing water resources in Indonesia is the increasing demand for water but with a relatively constant supply, and even in some cases it tends to decrease. This means that the competition for water is getting higher, while the need for water is absolute and cannot be delayed (Euler et al., 2018; Kindu et al., 2017; Bellfield et al., 2015). It needs to be regulated in such a way as to be able to meet the water needs of all parties, because failure or delay in meeting water needs will only cause other bigger problems. Especially for food security, the availability of water with proper and integrated management becomes a separate problem that requires special attention. In the next few years, the world to experience food shortages caused by excessive and uncontrolled water use. Contamination and damage to groundwater sources and irrigation are expected to result in a lack of grain such as rice and wheat (Tripathi & Singal, 2019; Pasandaran & Rosegrant, 1999).

Irrigated paddy fields have a very strategic position because most of the rice production is produced from this area, reaching an area of 6.7 million ha. The large reduction in this area will have a negative impact on national rice production. Rice fields have an important role in determining food security where 90% of rice consumed in Indonesia is self-produced and about 95% of this production is produced from paddy fields (GoI, 2020).

Indonesia has abundant water, but water management issues have an impact on unequal distribution of water between regions, water wastage, weak law enforcement and water pollution (Quincieu, 2015). It must be recognized that irrigation which is traditionally managed by the government is the most inefficient public sector with investment costs that are increasingly expensive and are characterized by transparency and public accountability that are less or nothing at all to their performance. Since the economic crisis, which reached its peak in 1998, damage to irrigation and irrigation networks has increased as a result of low operating and maintenance performance and inadequate rehabilitation funds. The approach to irrigation development in the past, which tended to be centralized and took over the role of the community in the management of irrigation infrastructure, led to increasing dependence on the provision of government funds and had an impact on decreasing community participation in the operation and maintenance of irrigation networks.

Water resources management reform in Indonesia which has been going on since 1997 in the form of a Water Sector Adjustment Program (WATSAOP) has a significant impact on the policies of the Indonesian Government (Quincieu, 2015). In this context, things to

be achieved include; 1) preparation of a water source development policy framework; 2) preparation of the organizational framework and financing of river basin management; 3) institutional arrangements and implementation of water quality management and; 4) institutional arrangements and irrigation management arrangements.

In addition to a decentralization of authority reforms, the paradigm that is to be built is sustainability which is indicated by the existence of environmental insights that do not leave behind social and economic aspects. Water and water resources must be maintained by their functions and benefits to meet the needs of all sectors and future generations. One important part of sustainable water resource management that is of considerable interest to the government is irrigation which aims to achieve food security. Development in the field of food security and poverty alleviation in rural areas is one of the leading sectors in the nine national development priority agendas contained in Nawa Cita (GoI, 2014). To support increased food security, the direction of the Indonesian Government's policy in strengthening food security from the irrigated agricultural sector is realized through a strategy to increase production capacity and improve irrigation network services. This paper seeks to evaluate irrigation development policies as part of sustainable water resource management that supports food security in Indonesia. Also, based on the results of the evaluation, recommendations for improvement in planning water resources are needed for future food security.

METHODS

This paper seeks to examine the condition of irrigations, water, food security and its problems based on literature studies from previous researchers, especially related to implementation of government policies. Many variables of government policies problems such as aspect of regulation, and technical implementation aspect can reflect water resources condition to support food security in Indonesia (Cao *et al.*, 2020; Tripathy & Singal, 2019; Pambudi, 2019). Among these variables, there are several dominant ones. The method used in this study is a qualitative approach through the study of literature related to the management of water resources for food security in Indonesia. This paper seeks to evaluate irrigation policies as part of sustainable water management that supports food security in Indonesia. Literature sources are 5 main regulations, 5 papers and 3 government reports. The results of the study will provide recommendations based on scientific theories and existing regulations, budget and technical aspect to support sustainable food and water security in Indonesia.

RESULTS AND DISCUSSION

Water problems are the problem of ecological balance related to environmental carrying capacity (Pambudi, 2019; Common & Stagl, 2005; Miller & Spoolman, 2015). Ecology is always related to ecosystems, including biotic and abiotic components. Ecology in relation to humans involves economic and environmental factors in an equally important extent (Bellfield et al., 2016; Watson et al., 2014; Common & Stagl 2005).

Food security improvement has been on Indonesia's development national priority for decades (Arif et al., 2020; Bellfield, 2016). Almost every area of food security is covered by Government action plans and policies, although in some cases overlapping. To identify what recommendations will be given in the food and water security, it is necessary to study regulations related to food and water security in Indonesia. There are 5 big regulations related to water resources. Some of the regulations are: a) Basic Law Year 1945 Article 5 Paragraph (2) and Article 33 Paragraph (3) ; b) Law Number 17 Year 2019 about Water Resources; c) Law Number 23 Year 2014 about Local Government; d) Law Number 18 Year 2012 about Food; and; e) Government Regulation No. 37 Year 2012 about Watershed Management.

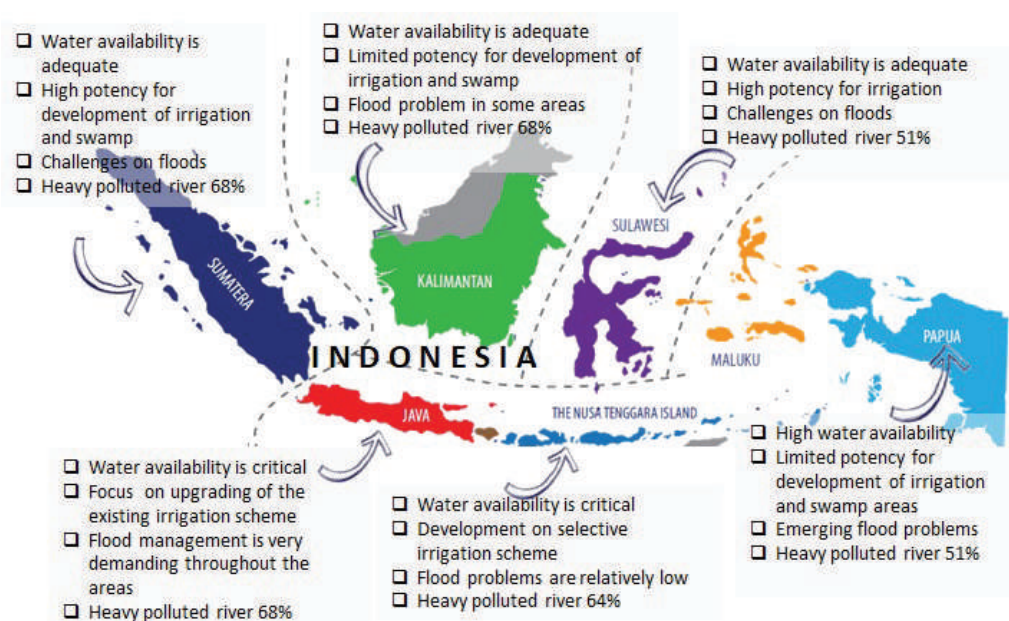
Food security is the fulfillment of human needs related to sufficient, diverse, safe and affordable food (in terms of quality and quantity). (Arif et al., 2020). The definition of "food security" in the Law Number 18 Year 2012 about Food includes the "individual" and "appropriate religious belief" as well as the "culture" of the nation (GoI, 2012a). Those can be assumed as an "enrichment scope" of the previous definition in the Law Number 7 Year 1996 about Food. It was noted that the definition of

"food security" in the Law Number 18 Year 2012 related to Food is substantially in line with the definition of Food and Agriculture Organization or FAO in which "food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

Many studies show that the environment will be greatly affected when there are human activities that are not in accordance with conservation principles (Li *et al.*, 2018). In a broader scope, the problem of coordination and synergy between sectors and regions in watershed management is also a serious threat to environmental problems. (Pambudi, 2019; Asdak, 2006). Apart from that, neglecting the contribution and role of the community is something that must be abandoned if the goal of development is to be more sustainable. For Indonesia, the problem of watershed management is very influential on the condition of water resources in general, which is spread in almost all major islands (Bappenas, 2015).

The picture shows that the problem of water resources in relation to watersheds is related to water quality, quantity, continuity and accessibility (Chandler et al., 2004). Some areas in Indonesia that still have good watershed conditions in general also face a few problems of crises in the quality and quantity of water resources, such as Papua and Kalimantan. However, these areas still face water accessibility problems. This is different from the areas of Java, Bali and Sumatra which have good access to water, but face problems of water availability and quality (Bappenas, 2015)

The difficulty of the availability of irrigation water hinders the government's target to achieve food security.



Source: Bappenas, 2015

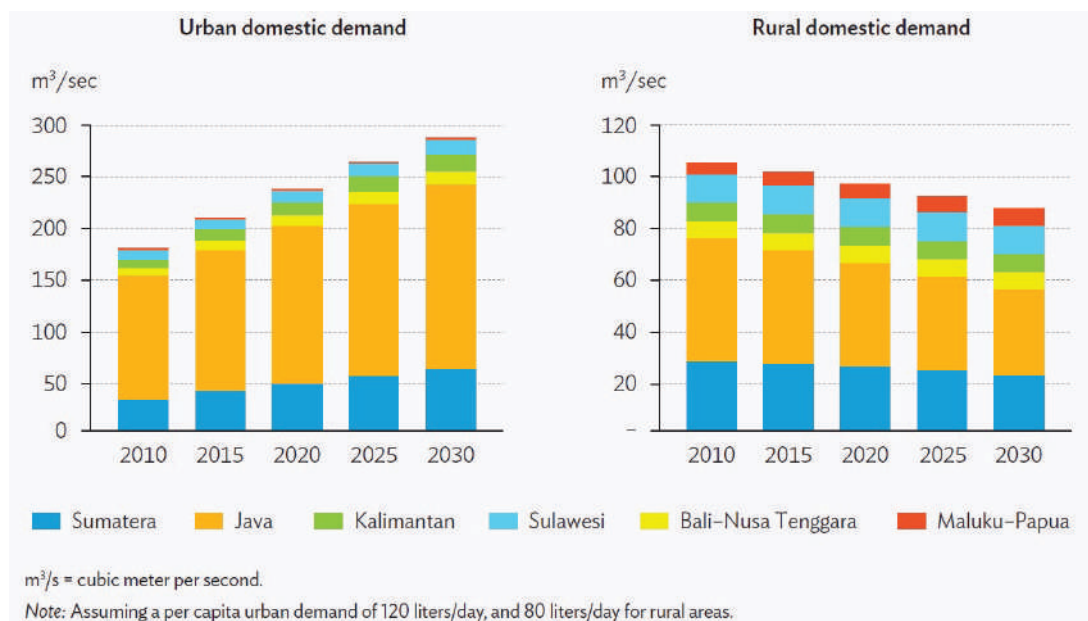
Figure 1. General problems of water resources in the Indonesian Islands region

This condition is exacerbated by the dependence of the food sector fulfilled from Java, even though the water balance conditions have shown that conditions are no longer ideal. The government has a target of 3 (three) planting times to meet food needs, especially rice, domestically and reduce the volume of imports. Sufficient irrigation water can only be achieved if water source problems are upstream, maintenance of irrigation facilities from factors that can reduce water capacity (volume) such as sedimentation, and the construction of new weirs and reservoirs to collect water can be immediately completed.

Irrigation services are an important aspect of an agrarian country such as Indonesia. Good irrigation services will not only improve welfare for farmers' groups, but can also raise the nation's degree with

self-sufficiency. What is currently found is that irrigation services have not been carried out optimally as indicated by the availability of water to drain agricultural land.

The availability of water is the main problem of irrigation and is a problem that arises every year, especially in the dry season. The problem of lack of water generally starts to occur during the Planting Period II (dry season) until it enters the rainy season. The severity of water shortages in each region may vary, but generally it cannot meet the needs for agricultural irrigation or even completely dry out. This problem occurs in each area observed. The decreasing availability of water has resulted in water that can be accommodated and distributed for agricultural irrigation increasingly limited.



Source: Asian Development Bank (2016)

Figure 2. Predicted urban and rural domestic water demand in Indonesia

Problems with Availability of Raw Water

Food is the most important basic human need and its fulfillment is part of human rights guaranteed in the Constitution 1945 (Undang-undang Dasar 1945) of the Republic of Indonesia as a basic component to realize quality human resources (GoI, 2012a; GoI, 1945). Food and agriculture in Indonesia require good irrigation. The first problem related to the availability of water for irrigation is the source of water (Pambudi, 2019; Idris, 2019). Water sources are natural and / or artificial water containers or places which are located on, above or below the surface of the soil. Environmental damage upstream has reduced water supply. The occurrence of environmental damage upstream due to various activities that damage the environment, which causes a decrease in the carrying capacity of the environment for the existence and sustainability of water sources.

Environmental damage, especially the reduction of trees (forests) that are getting worse lately, causes rainwater to not be retained by the environment and becomes a water reserve for the dry season, but is directly channeled downstream to the sea.

Some activities that are identified as damaging the environment of water sources are based on field data, including logging or forest function conversion and group C mining activities (Azadi et al., 2018). Water shortages in the dry season are indicators of the absence of real and sustained efforts by environmental agencies to safeguard and protect sources water. Also related to the excavation of class C mines, it has not been carried out with due regard to environmental conservation so that it affects the sustainability of spring water sources.

Water supply does not increase the number of interested parties. The availability of water for irrigation

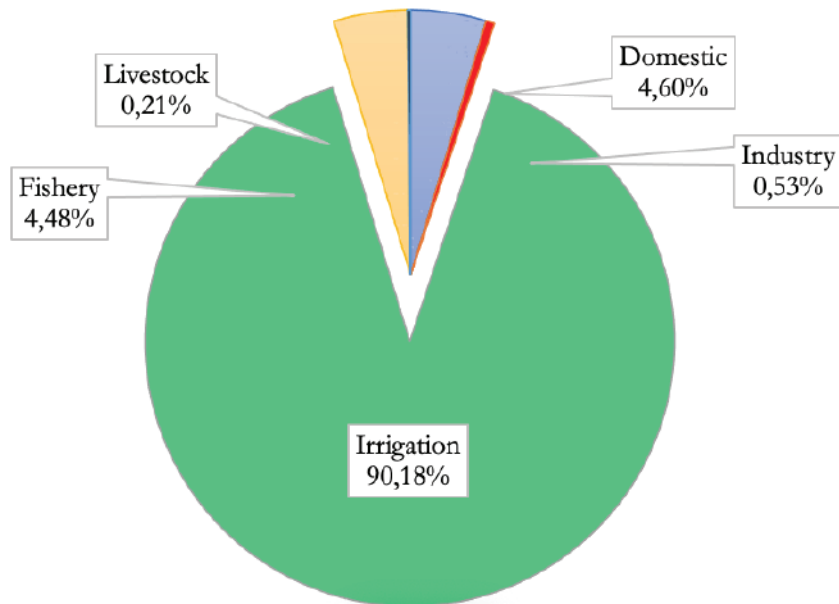
Table 1. Literature review related to water resources / food security

No	Author	Year	Title	Summary	Digital Object Identifier	Analysis Result
1	Andi Setyo Pambudi	2019	Watershed Management in Indonesia : A Regulation, Institution, and Policy Review.	Some sectoral regulations and policies in Indonesia are not aligned with ideal watershed management objectives. This has an impact on the condition of water resources. The problem of integration is still the most difficult part in terms of the number of agencies and overlapping policies that are driven by the goals of achieving the targets of each sector.	https://doi.org/10.36574/jpp.v3i2.74 .	
2	R.F. Lubis, R. Delinom, S.Martosuparno, & H. Bakti	2018	Water-Food Nexus in Citarum Watershed, Indonesia.	The nexus concept, namely the linkage of water, food and energy, has not been fully effective at the site level. This is due to the problem of sectoral egos, overlapping regulations and also problems of understanding differences level due which caused by lack of socialization.	doi:10.1088/1755-1315/118/1/012023	Evaluation of the indonesia's water resources management policies to support food security related to
3	Mohamad Ali Fulazzaky	2014	Challenges of Integrated Water Resources Management in Indonesia.	Indonesia has several problems about water resources, such as vailability of raw water, drought, flood, land use change, stakeholder;s coordination, lack of adequate water storage and climate change	doi:10.3390/w6072000	problems with availability of raw water, problems with infrastructure and governance, issues of interference with other parties and land use change problems.
4	Hidayat Pawitan and Gadis S. Haryani	2011	Water resources, sustainability and societal livelihoods in Indonesia	The availability of water resources related to quality and quantity affects the income of the Indonesian people, whether related to forestry, agriculture and other fields of work. These problems are caused by land use and land cover change, decreased of river debit, water pollution, and overlapping natural resources regulations that have an impact on policy implementation	doi:10.2478/v10104-011-0050-3	
5	S. Soenamo	1993	Is Irrigation Sustainable? The Indonesian Perspective.	Indonesia's irrigation policies are not consider sustainably aspect, such as related to environment protection, pollution, deterioration of the catchment area, and mitigation of population growth	doi:10.4296/cwrij1803281	

Source: Analysis result, 2021

is also influenced by the number of parties interested in water. An example is in Maros Regency, where water from the Bantimurung River cannot meet the needs of irrigation because the PDAM also uses the same water source. Besides that, Bantimurung River water is also used for industrial activities for private companies, namely PT. Bossowa Semen. The Lekopancing Dam has been dominated to meet drinking water needs (PDAM) in the city of Makassar, while agricultural irrigation in

Maros Regency only gets its abundant water, ie if the excess from PDAM water use. The number of parties interested in water has an impact on availability. As a result, in the dry season in Bendung Batubassi (D.I. Bantimurung) there is still water, but it is not sufficient. This results in insufficient water for planting plans, especially in the dry season, so that rice fields can only be planted once (Ombudsman, 2016).



Source: Idris (2019)

Figure 3. Domination of irrigation for water usage of Indonesia's surface water

Problems with Infrastructure and Governance

The second problem relates to the availability of irrigation water and management of weirs and water collection/ collection containers in the form of dams and reservoirs. Some things that need attention, among others: Dam and reservoirs that are in good condition continue to decline while the need increases. Some areas that are potential for agricultural businesses, do not have adequate natural water sources, so they require water sources in the form of reservoirs. One obvious example is in Indramayu District, which is the largest rice-producing area in West Java Province, does not have adequate water storage. Cipancuh Reservoir in this area with an area of 700 Ha can only serve during Planting Period I (rainy season) due to the absence of water supply other than rainwater and the condition of the reservoir experiencing severe siltation. Even if the reservoir is optimized it can irrigate an area of 6,314 ha of rice fields. Whereas the development plan of the Cipanas Dam has yet to be realized. At present the Government is intensifying the construction of new reservoirs. In 2015, the Government built 13 (thirteen) reservoirs namely Keureto Reservoir in Aceh, Seigong Reservoir in Riau Islands, Karian Reservoir in Banten, Logung Reservoir in Central Java, Telaga Waja Reservoir in Bali, Tapin Reservoir in South Kalimantan, Passeloreng Reservoir in South Sulawesi, Lolak Reservoir in North Sulawesi, Raknamo Reservoir in NTT, Rotiklod Reservoir in NTT, Tanju Reservoir in NTB, Mila Reservoir in NTB, and Bintang Bano Reservoir in NTB. However, it is also important to revitalize existing reservoirs but have not provided adequate benefits, such as the Cipancuh Reservoir in Indramayu Regency (Ombudsman, 2016)

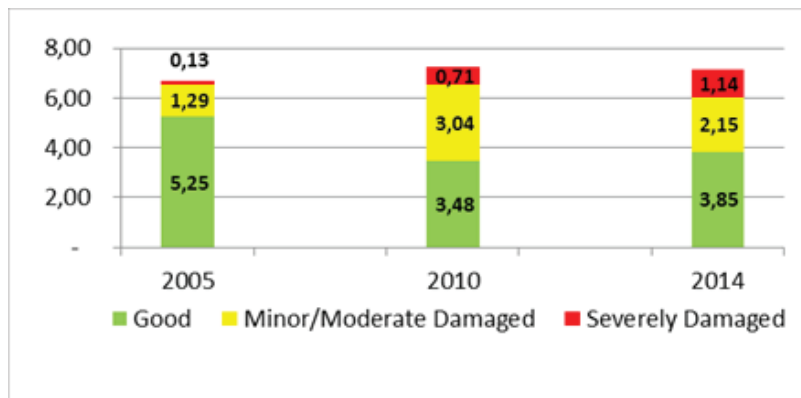
Management of dams and reservoirs in several places has not been found to be optimal. Sedimentation found in several weirs was observed as an indicator that the dam could not accommodate water optimally. So that when the dry season arrives, the water in the dam shrinks in a short time because it does not accommodate the volume optimally.

One of the considerations in Law 17 of 2019 concerning Water Resources states that in the face of an imbalance between the decreasing availability of water and the increasing demand for water, water resources need to be managed by paying attention to social, environmental and economic functions in harmony to create synergy (GoI, 2019). Furthermore, this law try to support inter-regional, inter-sectoral and intergenerational integration in order to meet people's needs for water.

Issues of Interference with Other Parties

The existence of tug-of-war interests in the use of weirs for irrigation purposes and other interests need attention. One interesting example is the use of water in Lekopancing Dam which is monopolized by PDAM Makassar City, while agricultural irrigation can only be used when PDAM needs have been met. In fact, the operation and maintenance of the Lekopancing Dam was still carried out by officers under the Pompengan-Jeneberang River Basin.

Given the many parties that have an interest in water, the mechanism of water management by involving many interests must be a serious concern of the Government. So far, the pattern built by the Government is a pattern of management cooperation, both between the Central



Source: Idris (2019)

Figure 4. Irrigation infrastructure change in Indonesia (Million Ha)

Government and the Regional Government, as well as with business entities. One of the things that need to be considered to build such cooperation is to uphold the principle that such cooperation must not interfere, put aside, let alone negate the people's right to water and be carried out in a participatory and accountable manner.

Land Use Change Problems

Land conversion that is not balanced with good conservation efforts affects the carrying capacity of the land towards environmental resilience (Cumming, 2016; Bonell & Bruijnzeel, 2005). Land-use change can also be interpreted as a change for other uses because of factors such as increasing population needs and increasing demands for a better quality of life. One of the effects of the conversion of paddy fields that are often in the spotlight of the wider community is the disruption of food security. In this connection the impact of the conversion of paddy fields to food problems is more detrimental than the impact of other factors such as drought, floods, and pest/ disease attacks. In the event of droughts, floods and pest / disease attacks, the problem of food caused is temporary, meaning that food problems only arise when the event occurs. However, in the event of land conversion, the problem of food generated is permanent or it will still be felt in the long term even though land conversion has not occurred again.

Regional government regulations greatly impact forest rehabilitation efforts through Forest management Units (KPH) as a result of land use change. In the forestry sector, the regional government law brings about significant changes in forest management processes including forest management, with consequences for institutional arrangements (organization, human resources, infrastructure, budget) and regulatory authority (GoI, 2014b).

Mahaswari et al., 2016 said that the population growth rate which is still high and concentrated in certain areas causes the conversion of cultivated land to non-cultivated land such as road surfaces to be very difficult to control, and even many land uses exceed their

carrying capacity. Deforestation, cultivation of food crops on steep slopes without adequate soil and water conservation are just a few illustrations of the causes of damage to the watershed hydrological system. The damage is characterized by a decrease in the watershed's ability to absorb, store and distribute rainwater during the rainy season. As a result, the addition of recharge in the rainy season is very limited so that the water supply in the dry season is low.

Vegetative conservation of water resources embodied in forest and land rehabilitation policies for restoration of critical land in forest management units (KPH) and watersheds (GoI, 2014a; GoI, 2012b). The above efforts will still face challenges related to the rights and status of critical lands to be planted. In addition, there are still other challenges related to not optimal control of space utilization in the watershed. However, the rate of deforestation in forest areas was successfully reduced. The area of forest and burned land has also been reduced significantly through effective countermeasures. In its development, currently the watershed tends to experience a lot of damage and quality degradation.

CONCLUSION

The big vision for self-sufficiency in food is not an impossible thing to happen if the government is serious to solve the issue regarding the availability of water for agricultural land. In order to realize the government's target of achieving food security, the problem of the availability of irrigation water must be addressed quickly by upstream conservation, maximizing capacity through normalization of existing reservoirs, and continuing to build dams to have water storage containers that can accommodate planting season throughout planting.

RECOMMENDATIONS

1. Conduct Environmental Conservation in Upper Watershed. The carrying capacity of the upstream watershed is very important in its role in water availability. Well-maintained upstream watershed

- will be able to store and provide a source of water that can be used until the dry season. However, forest destruction and the environment reduce the carrying capacity. Therefore, efforts are needed to normalize the upstream and increase its carrying capacity by carrying out conservation.
2. Normalization of Dam. One of the problems with the lack of water availability for planting is the lack of attention to the condition of the dam / reservoir. The amount of sedimentation that reduces the capacity of existing dams / reservoirs is an example of the frequent impacts. Rarely do activities to clean the dam / sedung from sedimentation cause the volume of water that can be accommodated by the dam / reservoir is reduced, besides also because leakage gates and canals and so on. The available water is not optimal. Therefore, dams / ponds need to be immediately and routinely cleaned and renovated. The sedimentation is dredged and the leak is patched so that it can reach its maximum potential in accommodating water to be distributed through irrigation channels to the existing agricultural land.
 3. Extensification of Dam/ Reservoir. In addition to improving the quality of the upstream environment and increasing the maintenance of existing facilities, the construction of dams / reservoirs / reservoirs to accommodate and provide irrigation water needs to be added, especially in areas that become national rice barns. This policy will support efforts to provide water for irrigation. The availability of water in the dry season cannot meet irrigation needs, so water services for agriculture in the dry season cannot be carried out optimally. This is partly due to reduced water resources in the upstream due to environmental damage, the ability of weirs to maintain water volume is not optimal due to sedimentation, and the lack of raw water due to the lack of dams and reservoirs. In some areas, irrigation water must be shared for agriculture, PDAMs and even private companies.
 4. Building a media of technology. Building a media of technology that can monitor the condition of dams / reservoirs and predict and anticipate irrigation water needs quickly. The media is designed to be participatory and user friendly, especially for water officials in the field.
 5. Implementing law enforcement on violations of protected water sources for irrigation. The development of a coordination system related to irrigation requires clear rules regarding law enforcement, both in terms of water regulation, and social justice related to community rights. Regulations related to soil and water conservation as well as water resources are also suggested to be implemented after coordinating with related sectors.
 6. Acceleration of supplying sufficient, safe and affordable bulk water from source to rice field or other food land. Some recommendation that can be implemented are: a) Optimizing water resource from dam; b) Repairing irrigation infrastructures, and distribution system; c) Developing modern distribution network for irrigation community ;d) Developing innovative business/management model for regional water provision (regional water authority); e) Institutional and regulation set-up for irrigation management; f) Improving community awareness on and involvement in water-saving behaviour

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Sustainable traditional market development in Bogor District, West Java, Indonesia

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ABSTRACT

Bogor District (West Java, Indonesia) consists of 40 subdistricts and 483 villages, and because of the development of Metropolitan Jabodetabekpunjur (Jakarta-Bogor-Depok-Tangerang-Bekasi-Puncak-Cianjur), has the potential for rapid growth in traditional markets. The increase of GRDP (Gross Regional Domestic Product) value is indirectly affected by the conditions of economic activity, including market infrastructure and its sustainability. The objectives of this research are to identify potential traditional market development locations (environmental aspect) and development feasibility (economic aspect), and to draw up the concept of distributed market development (social aspect). We used agency and field surveys, observations and interviews, as well as employed qualitative analyses including scoring system, descriptive statistics and strategic decision making. We identified 26 subdistricts' traditional markets and 47 village traditional markets, 12 markets which under category of most feasible markets, 16 feasible markets, and 12 unfeasible markets. The first optimization model is achieved by Kemang subdistrict while the second position is achieved by Dramaga subdistrict and the third position is achieved by Ciawi subdistrict. According to the development plan of Bogor District for 2018-2038, the highest population will be in Gunungputri and the lowest in Cariu, with a predicted demand for 280 markets, which supports the potential development of 202 new markets

ABSTRAK

Kabupaten Bogor (Jawa Barat, Indonesia) terdiri dari 40 kecamatan dan 483 desa, dan karena perkembangan Metropolitan Jabodetabekpunjur (Jakarta-Bogor-Depok-Tangerang-Bekasi-Puncak-Cianjur), memiliki potensi pertumbuhan yang cepat di bidang pasar tradisional. Peningkatan nilai PDRB (Produk Domestik Regional Bruto) secara tidak langsung dipengaruhi oleh kondisi kegiatan ekonomi, termasuk infrastruktur pasar dan keberlanjutannya. Penelitian ini bertujuan untuk mengidentifikasi potensi lokasi pengembangan pasar tradisional (aspek lingkungan) dan kelayakan pengembangan (aspek ekonomi), serta menyusun konsep pengembangan pasar terdistribusi (aspek sosial). Kami menggunakan survei keagenan dan survey lapangan, observasi dan wawancara, serta menggunakan analisis kualitatif termasuk sistem penilaian, statistik deskriptif dan pengambilan keputusan strategis. Kami mengidentifikasi 26 pasar tradisional kecamatan dan 47 pasar tradisional desa, 12 pasar yang termasuk dalam kategori pasar paling layak, 16 pasar layak, dan 12 pasar tidak layak. Model optimasi pertama diraih oleh Kecamatan Kemang sedangkan posisi kedua diraih oleh Kecamatan Dramaga dan posisi ketiga diraih oleh Kecamatan Ciawi. Sesuai rencana pembangunan Kabupaten Bogor 2018-2038, jumlah penduduk tertinggi berada di Gunungputri dan terendah di Cariu, dengan prediksi permintaan 280 pasar, yang mendukung potensi pengembangan 202 pasar baru

Keywords: *development, location, optimization model, sustainability, spatial planning, traditional markets.*

INTRODUCTION

The market (a place where buyers and sellers can meet to facilitate the exchange or transaction of goods and services) has a very close relationship with the economic activities of society, both production, distribution and consumption because markets can be seen as arenas of distribution or exchange of goods. The interests of producers and consumers meet and in turn determine the continuity of the economic activities of their communities. The existence of traditional markets (the places where sellers and buyers meet which is marked by direct buying and selling transactions and usually there is a bargaining process) in Bogor District is one of the economic heart of the community and has been integrated into people's lives. In addition, the market has become an indicator of regional progress because a

market is not just a place for buying and selling but more than that the market is related to the life style and social culture of the community so that the market, especially the people's market, can be a vehicle for economic activity, social interaction, and recreational facilities both the market atmosphere and merchandise products that are distinctively identified by the local wisdom of the community.

One of the potentials that can be the center of economic growth is traditional or people's markets, both at the subdistrict and village level. Developing these markets can help increase the potential for regional economic growth, boosting regional competitiveness, which will in turn encourage the competitiveness of national economy. Market development is a very important part of national development, such facilities

and infrastructure support economic activities and serve to provide services for the flow of goods, particularly in the distribution of goods and services from sources of raw materials to production sites and to their marketing locations, at local, regional, national and international levels. Therefore, the existence of market facilities and infrastructure is very much needed to support the socio-economic activities of the community, both those that already exist and those that are likely to be developed. The existence of the market and distribution of its services in Bogor District must also be able to support high mobility from production centers to the market to increase the geographical coverage of community economic development, as well as support equitable and sustainable economic growth in each district and/or village. The objectives of this study are first to identifying market locations and development and/or market development based on environmental aspects. Secondly, to identifying the feasibility of development and/or market development based on economic aspects, and the third is to develop a concept of market development based on distribution per subdistrict based on social aspects.

The market can be defined as an institution or mechanism where buyers (who need it) and sellers (who produce) meet and jointly exchange goods and services (Campbell, 1990 in KPRI 2015a and KPRI 2015b). The market is a social space in addition to economic space. Factors that affect the popularity of people's markets include the character / culture of consumers. Although information about modern lifestyles is easily obtained, it seems that people still have a culture to keep visiting and shopping at the people's markets. There is a very basic difference between people's markets and modern markets. That difference is that in the market there is still a price bargaining process, whereas in the modern market the price is fixed by the price tag. In the bargaining process there is a personal and emotional closeness between sellers and buyers that is impossible to obtain when shopping in modern markets (Mukhlis, 2007 in KPRI 2015a and KPRI 2015b). Some markets have their own characteristics and this distinguishes one market from another.

The traditional market is also a cultural asset that has an important role in people's lives, especially rural agrarian societies. Sustainable market development need to consider market location and accessibility, market service areas, and market functions and roles. A market should be at a strategic location, this is due to the activities that occur in the market and the importance of the market's role as a component of city, regional and regional services that results in the influence of each supporting element of the city/district's economic activities. Some factors that influence the selection of

market location (Miles, 1999 in KPRI 2015a and KPRI 2015b) are: zoning (land allotment); physical location; utility; transportation; parking; environmental impact; public service; community acceptance/response (including behavior change); demand and supply (population growth, employment and income distribution). Based on Minister of Public Works Decree No. 378/KPTS/1987 concerning Ratification of 33 Indonesian Building Construction Standards can be described as follows: a) place for collecting agricultural products. b) place of distribution of 30 industrial goods. c) a place to exchange goods. d) place for buying and selling goods and services. e) place of trade information. The role of the market is very diverse along with the development of market functions and the development of a variety of activities that occur.

METHODS

Various approaches such as territorial, social characteristic, economic, benefit, local culture, as well as technical were used in this research. Meanwhile, what is meant by technical approach here includes architectural design aspects, market spatial design aspects, environmental aspects, technological aspects, local character aspects, and the future aspects. The study was conducted in in Bogor District (Figure 1).

Data collection methods of baseline data in the context of market location and alternative locations derived from: existing market profiles and alternative development and/or other developments; supporting secondary data relating to the development policies of the people's market; support data in market development based on Indonesian building regulations from the Ministry of Public Works; data and regulations concerning environmental sustainability and market environment management; and with market development and other related data. This study uses secondary and primary data based on the types and sources as follows (Table 1).

Data analysis methods or techniques to answer research questions and formulate problems with stages are: 1) identify the location of development and/or market development based on environmental aspects with descriptive analysis techniques and assessments with weighting or scoring system; 2) identifying the feasibility of development and/or market development based on economic aspects with descriptive statistical analysis; and 3) develop the concept of market development based on distribution per district based on social aspects with analyzing and developing the concept of regional development based on the optimal location choice decision making.

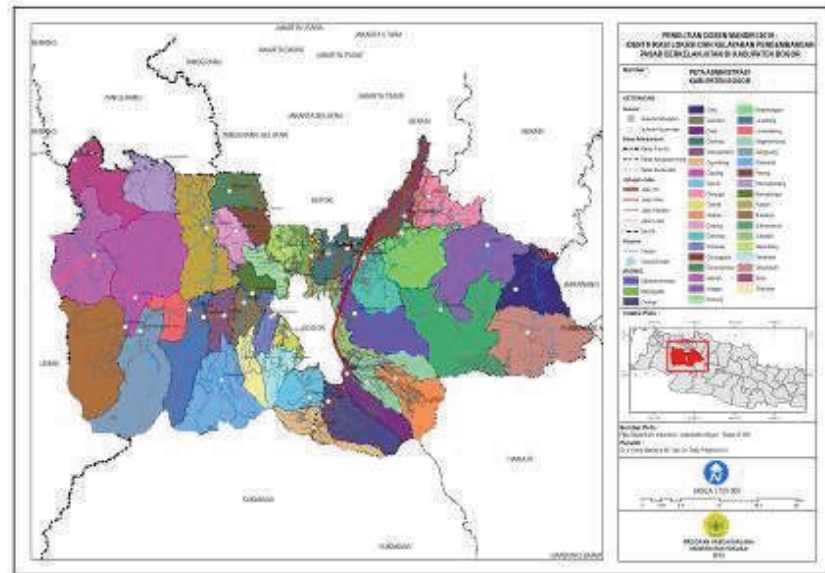


Figure 1. Area of Bogor District with subdistrict boundaries and survey locations

Table 1. Data types and sources

No.	Objectives	Data Types	Data Source
1	Identifying the location of development and / or market development based on environmental aspects	<ul style="list-style-type: none"> •RTRW and RPJMD •Existing land use •Market excise and development plans 	<ul style="list-style-type: none"> •Bappelitbang Kabupaten Bogor •Dinas PU dan Penataan Ruang Bogor •Dinas Lingkungan Hidup Kabupaten Bogor
2	Identify the feasibility of development and / or market development based on economic aspects	<ul style="list-style-type: none"> •RTRW and RPJMD •Existing land use •Market excise and development plans •Market legality 	<ul style="list-style-type: none"> •Bappelitbang Kabupaten Bogor •Dinas PU dan Penataan Ruang Bogor •Dinas Perdagangan dan Perindustrian Kabupaten Bogor
3	Develop concept of market development based on distribution per district based on social aspects	<ul style="list-style-type: none"> •RTRW and RPJMD •Existing land use •Market excise and development plans •Community perceptions and market traders 	<ul style="list-style-type: none"> •Bappelitbang Kabupaten Bogor •Dinas PU dan Penataan Ruang Bogor •Badan Pengelolaan Pendapatan Daerah Kabupaten Bogor

RESULTS AND DISCUSSION

Bogor District has a total area of 2,986.20 km² which consists of 40 Districts and 434 Villages / Kelurahan. The subdistrict that has the largest area is Jasinga with an area of 208.06 km² over about 7.81% of the total area of Bogor District and the smallest one is Ciomas with an area of 16.30 Km² or about 0.61% of the total area of Bogor District. Bogor District is divided into three Development Areas (WP) of: West WP, Central WP and East WP. For more details about the administrative area of each district, administration, distribution of WP and index hierarchy in Bogor District in Table 2.

Identify location of development and/or market development based on environmental aspects in Bogor

District in the existing condition based on its distribution, both traditional and modern markets, where the market is a form of crowd and interaction between people where as one of the places to meet the needs of human life, and there is trade activity. Traditional markets in management are supervised and managed by local governments, whereas for modern markets the management is private, but there are modern markets managed by local governments. Number of companies by form of business entity in Bogor District there are 26 traditional markets in the subdistrict and 47 village traditional markets. This means that not every subdistrict has a traditional subdistrict market. Moreover, the

Table 2. Administrative region size per subdistrict in the District of Bogor

No.	Subdistrict	Size (km ²)	Percentage (%)	No.	Subdistrict	Size (km ²)	Percentage (%)
1	Nanggung	135.25	5.08	21	Tanjungsari	129.98	4.88
2	Leuwiliang	61.77	2.32	22	Jonggol	126.86	4.76
3	Leuwisadeng	32.83	1.23	23	Cileungsi	73.78	2.77
4	Pamijahan	80.88	3.04	24	Klapanunggal	97.64	3.67
5	Cibungbulang	32.66	1.23	25	Gunungputri	56.28	2.11
6	Ciampea	51.06	1.92	26	Citeureup	67.19	2.52
7	Tenjolaya	23.83	0.89	27	Cibinong	43.36	1.63
8	Dramaga	24.37	0.91	28	Bojonggede	29.55	1.11
9	Ciomas	16.3	0.61	29	Tajurhalang	29.28	1.1
10	Tamansari	21.61	0.81	30	Kemang	63.69	2.39
11	Cijeruk	31.66	1.19	31	Rancabungur	21.68	0.81
12	Cigombong	40.42	1.52	32	Parung	73.76	2.77
13	Caringin	57.29	2.15	33	Cisceng	36.78	1.38
14	Ciawi	25.81	0.97	34	Gunungsindur	51.26	1.92
15	Cisarua	63.73	2.39	35	Rumpin	111	4.17
16	Megamendung	39.87	1.5	36	Cigudeg	158.89	5.96
17	Sukaraja	42.97	1.61	37	Sukajaya	76.28	2.86
18	Babakan Madang	98.71	3.71	38	Jasinga	208.06	7.81
19	Sukamakmur	126.78	4.76	39	Tenjolaya	64.44	2.42
20	Cariu	73.66	2.77	40	Parungpanjang	62.59	2.35

Source: Bogor District in Figures (2018)

traditional village market which only has 47 markets out of 434 villages. In addition there are 7 shopping centers, 14 hypermarkets and 763 minimarkets spread across subdistricts. Based on the Number of Trading Facilities by Type in Bogor District, there are several trading facilities, namely Traditional Markets, Local Markets, Regional Markets, Supermarkets /Supermarkets, Hypermarkets, Malls and Shops in Bogor District. There are 713 modern and traditional markets, for modern shops as many as 642 units and traditional and village markets as many as 73 units. the most modern shops are Indomaret (capitalise franchise name) with 356 units and 73 village traditional markets. Subdistricts that have the most modern markets, namely in Gunung Putri Subdistrict As many as 88 units, for the most traditional markets are in Tanjungsari District As many as 4 units. The smallest modern market and traditional market is Sukajaya, which has only 3 market units based on Bogor District BPS data. Identification of conditions and distribution of traditional markets and village markets based on environmental aspects from the field data (primary) and agency (secondary) with the following indicators: 1) RTRW and RPJMD: conformity of regional policies (scale 75-100), 2) existing land use: existing suitability (scale 50-75), and 3) existing market: conformity of market development standards (scale 1-50) with criteria: accessibility, security, safety, health, comfort, aesthetics, and adequacy. Based on the weighting of the criteria above, the worth / best value is between 200-225, worth / good between 150-200 and not worth / bad 75-150. Identification of development

sites and / or market developments based on environmental aspects in Bogor District can be analyzed by weighting as in Table 3.

Identified that based on environmental aspects, the markets in 40 subdistricts in Bogor District consisting of 29 traditional markets and 49 village markets are on average still in good/good categories, while per category is 12 decent/best markets, 16 decent/good markets, and 12 unfavorable/bad markets. Some of the indications of a market that is worthy/best are: traditional markets and the management of district or private or collaboration between them; decent/good markets are: village and traditional markets and district or private administrators; and inappropriate/ugly markets are: village and traditional markets and district government managers. Whereas the criteria for conformity with market development standards with criteria: accessibility, security, safety, health, comfort, aesthetics, and adequacy. Based on the distribution, it can also be identified that the market conditions that are worthy/best are located in the district capital and around the City of Bogor and along the main road / arterial road or collector, while good/decent market conditions are located relatively spread in each subdistrict and market conditions that are unfit/ugly located in subdistricts with low accessibility, so if it is associated with development it is expected to thoroughly consider these various aspects (see Figure 2).

Identifying market development based on economic aspects in Bogor District with Regional Development parameter is the rate of population growth. Bogor District as a residential area which is a buffer zone

Table 3. Market location and market development assessment in Bogor District 2018

No.	Subdistrict	Markets		Weighting			Total	Information
		Traditional	Village	1	2	3		
1	Nanggung (Jl.Raya Ace Tabrani 65)	1 (private)	2	85	65	20	170	decent / best
2	Leuwiliang (Jl.Raya Leuwiliang)	1	-	90	70	40	200	good / good
3	Leuwisadeng (Desa Kalong II)	-	2	75	65	30	170	decent / best
4	Pamijahan (Jl.Raya Gunung Salah Endah)	1 (private)	2	85	60	20	165	decent / best
5	Cibungbulang (Desa Situ Udik)	-	1	75	55	20	150	unfavorable / bad
6	Ciampea (Rancabungur)	1	1	75	55	20	150	unfavorable / bad
7	Tenjo Laya (Tenjolaya)	-	2	85	60	20	165	decent / best
8	Dramaga	1	1	75	65	30	170	decent / best
9	Cisarua (Cisarua)	1	1	75	55	20	150	unfavorable / bad
10	Tamansari (Simagalih)	1 (Govern.)	-	90	75	45	210	good / good
11	Cijeruk (Cijeruk)	1 (Govern.)	-	100	75	50	225	good / good
12	Cigombong (Cigombong)	1 (Govern.)	-	100	75	45	220	good / good
13	Caringin (Jl.Kolonel Bustomi)	1	1	90	75	45	210	good / good
14	Ciawi (Jl.Raya Ciawi)	1 (Govern.)	-	100	75	45	220	good / good
15	Ciseng (Jl.Mad Nur 60)	1 (Govern.)	-	100	75	50	225	good / good
16	Megamendung	-	2	75	65	30	170	decent / best
17	Sukaraja (Cilebut Barat)	1	1	75	55	20	150	unfavorable / bad
18	Babakan Madang(Sentul)	-	1	75	65	30	170	decent / best
19	Sukamakmur	-	1	75	65	30	170	decent / best
20	Cariu	1	-	75	65	30	170	decent / best
21	Tanjungsari	-	4	75	65	30	170	decent / best
22	Jonggol (Cikupa)	1	2	75	65	30	170	decent / best
23	Ciomas (Jl.Raya Ciomas 325)	1 (private)	2	95	70	35	190	decent / best
24	Klapanunggal (Cikaharupan)	-	1	75	55	20	150	unfavorable / bad
25	Gunung Putri	-	2	75	65	30	170	decent / best
26	Ciulengsi	1	1	100	75	45	220	good / good
27	Cibinong	1 (Govern.)	-	100	75	50	225	good / good
28	Bojong Gede (Citayam)	1	1	75	65	30	170	decent / best
29	Tajur Halang	-	1	75	55	20	150	unfavorable / bad
30	Kemang	1 (private)	2	100	75	50	225	decent / best
31	Rancabungur	-	1	75	55	20	150	unfavorable / bad
32	Parung (Jl.Pasar Parung, Waru)	1 (Govern.)	-	100	75	45	220	good / good
33	Citeureup	2 (BOI)	-	100	75	45	220	good / good
34	Gunung Sindur	1	-	75	65	30	170	decent / best
35	Rumpin	1	2	75	55	20	150	unfavorable / bad
36	Cigudeg	1	2	75	55	20	150	unfavorable / bad
37	Sukajaya	-	3	75	55	20	150	unfavorable / bad
38	Jasinga	1	3	75	55	20	150	unfavorable / bad
39	Tenjo (Jl.Abdul Patah)	1	3	75	65	30	170	decent / best
40	Parung Panjang	1	1	75	55	20	150	unfavorable / bad
Total		29	49					

Source: Field survey and market research analysis in Bogor District (2018)

**Figure 2.** A traditional market in Bogor District (Photo : <https://finance.detik.com>)

of Jakarta, has become one of the regions that has a rapid growth rate of modern markets during the period 2010 to 2015. With the largest population in West Java Province, Bogor District which in 2015 reached a population 5,459,668 people, so that it can become a promising region in the regional economic development. The value of the Gross Regional Domestic Product (PDRB) of Bogor District based on current prices (ADHB) according to the business field was dominated by the manufacturing sector from 2013 to 2016. In 2016 the processing industry sector had the highest amount of Rp. 100,528,244.78 million or 55%. While other sectors that have a high number are the car and motorcycle repair sector with a total of Rp. 23,784,157.51 million or 13%, the construction and wholesale trade sector with a total of Rp. 17,028,294.06 million or 9%. For the lowest amount, the procurement of waste management and

recycling waste water sector with a total of Rp. 196.957 million. For more details the contribution of each economic sector based on the value of GRDP in Bogor District. Along with the development of the economy of Bogor District, the GDP value of Bogor District until 2016 reached 184.17 trillion rupiah, aside from being dominated by the manufacturing industry category which was the largest contributor, the second dominance was in the categories: Wholesale and Retail Trade; Car and Motorcycle Repair with a contribution to the economy of Bogor District of 12.91 percent or 23.78 trillion rupiah. From time to time the number of modern markets tends to experience positive growth while traditional markets tend to experience negative growth. the number of modern trade centers in Indonesia, both hypermarkets, supermarkets, minimarkets, to convenience stores (Figure 3).

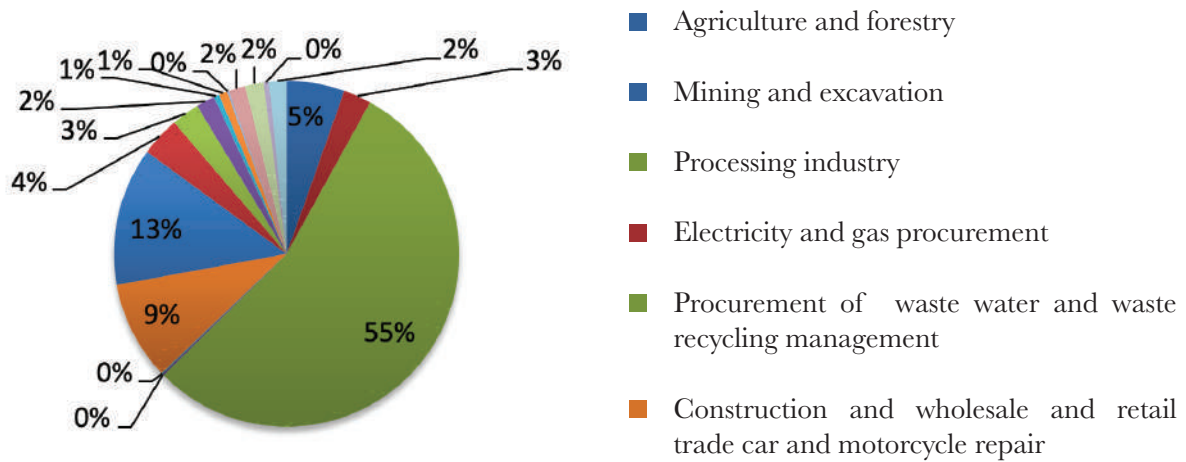


Figure 3. GRDP (Gross Regional Domestic Product) of Bogor District

Based on Spatial Planning (RTRW), Bogor District has issued Regional Regulation (Perda) No. 19/2008 concerning Bogor District Spatial Planning 2005-2025, which explains in detail the function of space in the form of spatial structure and spatial pattern. In this regulation it is mentioned that there are major growth orders that function as systematic centers of growth, where all infrastructure facilities and supporting infrastructure for development must be built in these growth centers. The location of these orders has been determined in the Bogor District 2005-2025 spatial planning document, namely Order I is located in Cibinong, Order II is located in the Districts of Cileungsi and Leuwiliang, and Order III is located in Jasinga District, Parung Panjang subdistrict, Parung, Ciawi, Cigombong and Cariu subdistrict.

function as systematic centers of growth, where all infrastructure facilities and supporting infrastructure for development must be built in these growth centers. The location of these orders has been determined in the Bogor District 2005-2025 spatial planning document, namely Order I is located in Cibinong, Order II is located in the Districts of Cileungsi and Leuwiliang, and Order III is located in Jasinga District, Parung Panjang subdistrict, Parung, Ciawi, Cigombong and Cariu subdistrict.

Based on RTRW Bogor District has issued Regional Regulation (Perda) No. 19/2008 concerning Bogor District Spatial Planning 2005-2025, which explains in detail the function of space in the form of spatial structure and spatial pattern. In this regulation it is mentioned that there are major growth orders that

The optimal location of the Bogor District main market is considering the existing market (assuming) with the assumption that the wholesale market will be built from scratch, all subdistricts in Bogor District have the opportunity to develop the wholesale market, and accommodate the City of Bogor RTRW which will no longer develop the wholesale market in Bogor City, so that the location of the wholesale market will be charged to Bogor District. Whereas the optimal location of the wholesale market by considering the existing market uses the assumption that the wholesale market will be developed from existing markets in Bogor District to

accommodate developed institutions. The area served is seen based on the area of demand and viewed from the area of production and the area of demand. The area of demand is used as a variable because initially the P-Median model is used to meet demand without considering where production is coming from. Because the determination of the location of the wholesale market is considered inadequate when it is only seen from the demand side, the P-Median model is modified by considering the production and demand areas.

Furthermore, seven Bogor District markets selected for analysis are the Cileungsi Market, Cibinong Market, Citeureup Market, Parung Market, Cisarua Market, Leuwiliang Market and Ciawi Market. The selection of the seven markets is assuming that the market has a great opportunity to be developed into a wholesale market in Bogor District because most of it is included in the class I market that serves the regional and surrounding areas and is in a strategic location. The three selected Bogor City markets are quite busy and dynamic markets in the sale of vegetables and fruits, with analysis: distance factor, travel time factor, factors in demand (demand) vegetables and fruits, and factors of production of vegetables and fruits. in determining the location of the bogor district main market based on 40 subdistricts in Bogor District by considering the 6 subdistricts in Bogor

City, using the assumption that the wholesale market will only be built in Bogor District because based on the revised Bogor District RTRW, there is no plan to develop a wholesale market again. in Bogor City, and all subdistricts in Bogor District have the same opportunities for the development of the wholesale market. In this analysis four optimization models are used with different indicators used. The first model used as consideration is the demand (demand) and the closest distance, the second model is the demand (demand) and the fastest travel time, the third model is demand (demand), production and the closest distance, and the fourth model is demand (demand), production and fastest travel time. The results in Table 4.

Based on the calculation results shown in Table 4.2 using the first model that considers demand and the closest distance, the first alternative for the wholesale market location is Dramaga subdistrict with an objective value of 723,134.51. This value shows the minimum total transportation costs in units of tons of kilometers. In this case it is assumed that freight is a function of demand and distance. The second alternative for the wholesale market location is Ciomas subdistrict with an objective value of 732,866.31. While the third alternative for the wholesale market location is the Bojonggede District with an objective value of

Table 4. Optimal location Bogor District main market which calculated based on 40 existing subdistricts in Bogor District by considering six existing subdistricts in Bogor City

No.	Optimization Model	Alternative Location 1		Alternative Location 2		Alternative Location 3	
		Sub-District	Objective Value	Sub-District	Objective Value	Sub-District	Objective Value
40 subdistrict in Bogor District and 6 subdistrict in Bogor City							
1	<i>Demand</i> -Closest Distance	Dramaga	723,134.51	Ciomas	732,866.31	Bojong-gede	748,737.64
2	<i>Demand</i> -Fastest Time	Ciomas	952,074.31	Ciawi	952,965.69	Dramaga	956,760.77
3	<i>Demand</i> -Production-Closest Distance	Dramaga	6,127,932.78	Ciomas	6,486,937.38	Ciampea	6,733,612.22
4	<i>Demand</i> - Production - Fastest Time	Kemang	8,457,065.77	Dramaga	8,513,616.9	Ciawi	8,557,052.81

Source: Analysis results (2018)

748,737.64.

The second model that considers demand and the fastest travel time, the first alternative for the wholesale market location is Ciomas subdistrict with an objective value of 952,074.31. The second alternative for the wholesale market location is Ciawi subdistrict with an objective value of 952,965.69. While the third alternative for the wholesale market location is Dramaga subdistrict with an objective value of 956,760.77. This value shows the minimum total transportation costs in units of minutes.

The third model that considers the production demand and the closest distance, the first alternative for

the wholesale market location is Dramaga subdistrict with an objective value of 6,127,932.78. The second alternative is Ciomas subdistrict with an objective value of 6,486,937.38. While the third alternative for the wholesale market location is Ciampea subdistrict with an objective value of 6,733,612.22. These values indicate the minimum total cost of transportation in units of tonnes of kilometers.

The fourth model that considers the production demand and the fastest travel time, the first alternative for the wholesale market location is the Kemang subdistrict with an objective value of 8,457,065.77. The second alternative for the wholesale market location is Dramaga subdistrict with an objective value of

8,513,616.90. Whereas the third alternative is Ciawi subdistrict with an objective value of 8,557,052.81. These values indicate the minimum total cost of transportation in units of minutes. The first alternative is because it has the smallest objective value. Ciomas subdistrict is the location of the second alternative wholesale market, while for the third alternative the wholesale market can be located in Bojonggede subdistrict or Ciampea subdistrict.

Dramaga subdistrict as the location of the first alternative wholesale market, is currently experiencing a fairly rapid development marked by the emergence of housing and trade facilities around Dramaga. The advantages of this district as a wholesale market location are: 1) The environment is still possible for the wholesale market development because Dramaga subdistrict still has a lot of vacant land; 2) It has a strategic location because it is close to several subdistricts that have quite high vegetable production in Bogor District such as Cibungbulang subdistrict, Ciampea subdistrict and Leuwiliang subdistrict; 3) Dramaga subdistrict has a location that tends to be in the middle near Bogor City. It has the potential for rapid development; 4) The location of Dramaga subdistrict is passed by primary collector road I (national road) that connects the boundaries of Lebak / Jasinga- Leuwiliang- Ciampea District and Bogor City; 5) The planned Bogor Ring Road is planned to reach Dramaga subdistrict, this will further increase accessibility to and from Dramaga subdistrict; 6) The planned construction of a new southern ring road in the city of Bogor from Jalan Sindangbarang to Jalan Raya Sukabumi which will further increase accessibility to and from the subdistrict of Dramaga. Based on these advantages, the Dramaga District has the potential to be built in the Bogor District.

The second alternative wholesale market location is Ciomas Subdistrict, Ciomas Subdistrict has a high density level compared to other subdistricts in Bogor District. The strengths and weaknesses of the Ciomas Subdistrict as a wholesale market location are: 1) Ciomas Subdistrict has a moderate population, compared to other subdistricts in Bogor District, but has a high density level marked by the large number of housing and trade facilities built in the subdistrict; 2) Ciomas Subdistrict has the Laladon Terminal, but in its operation the terminal has not been accompanied by the enforcement of regulations on public transport routes through the area; 3) Primary collector I (national road) road connecting the boundaries of Lebak/Jasinga-Leuwiliang-Ciampea District and Bogor City; 4) There is a market built in Ciomas Subdistrict which is adjacent to the Laladon Terminal. The purpose of building this market is to further optimize and stimulate the utility of the Laladon Terminal. But until now the market is relatively quiet; 5) There is a plan to construct a new southern ring road in the city of Bogor from Jalan Sindangbarang to Jalan

Raya Sukabumi which will further increase accessibility to and from Ciomas Subdistrict.

The third alternative wholesale market locations are Bojonggede subdistrict and Ciampea subdistrict. Bojonggede subdistrict is included in the advanced type with industrial community and service growth. This subdistrict is included in the Cibinong Raya region which has a function as a service node and distribution of marketing, production and the main service center for the Bogor District. This subdistrict has a fairly limited availability of land, which at present the development of the Bojonggede area as one of the densely populated residential areas and unfavorable topographic conditions because it has varied land contours. Ciampea subdistrict is dominated by villages with backward type with agricultural communities. Ciampea subdistrict is passed by primary collector road I (national road) connecting the boundaries of Lebak / Jasinga – Leuwiliang – Ciampea District and Bogor City. Based on primary data from 10 existing markets, Ciampea subdistrict is one of the suppliers of spinach and kale in existing markets.

The concept of market development based on distribution per district based on social aspects can be viewed from regional Development based on Population Projection, which is a routinely used parameter. The development of the population of Bogor District over a period of 5 years (2014-2018) and the results of the projections up to 2038 based on population growth data per district in Bogor District within a period of 5 years (2014-2018), then in total for the 20 year planning year (2018-2038). The total population of Bogor District in 2038 is projected to be 8,389,697 people. While based on population projections per district the largest population group identified is in Gunungputri subdistrict with a very high population of 1,350,862 people and the smallest is in Cariu subdistrict with a population of 41,746 people with the other areas having relatively stable growth rates. Based on the results of these projections, it can be identified that the development of the region will be centered in the Gunungputri subdistrict in addition to Cibinong as the district capital and the area which will be slow in its development is the Cariu subdistrict. The results of this prediction will be used to predict market development based on the distribution of supporting populations in the future (2038). Based on district and city market planning standards and the results of projections up to 2038 can be seen in Table 5.

Guidelines for Minimum Service Standards Guidelines for Determination of Minimum Service Standards in Spatial Planning, Housing and Settlements and Public Works (Minister of Settlement and Regional Infrastructure Decree No.534/KPTS/M/2001), which stipulates that the Environmental Facilities in this case commercial facilities are part from the level of availability of primary and secondary needs that must be available in each district with at least 1 (one) market

available for every 30,000 population and easily accessible. In addition, based on the type of market, the supporting population ratio is as follows: type A: 220,000, type B: 60,000, and types C and D: 15,000.

Based on population growth data per district in Bogor District within a period of five years (2014-2018), then in total for the 20 year planning year (2018-2038), the total population of Bogor District in 2038 is projected to be

8,389,697 inhabitants and market needs based on supporting population standards of at least one market per 30,000 population for 1 market are 280 markets and based on existing market data (traditional and rural) as many as 78 markets and means that the needs until 2038 are 202 markets.

Based on the projected population per district identified groups of needs for market development are as

Table 5. Projection of total population in District of Bogor and the needs of market in 2038

No.	Subdistrict	2038	Traditional Markets	Public Markets	Number of Existing	Standard 30 thousands in habitants	Prediction of Needs
1	Nanggung	90,570	1	2	3	3	0
2	Leuwiliang	141,413	1	-	1	5	4
3	Leuwisadeng	80,983	-	2	2	3	1
4	Pamijahan	156,219	1	2	3	5	2
5	Cibungbulang	150,706	-	1	1	5	4
6	Ciampea	190,132	1	1	2	6	4
7	Tenjolaya	67,622	-	2	2	2	0
8	Dramaga	135,469	1	1	2	5	3
9	Ciomas	269,482	1	1	2	9	7
10	Tamansari	137,941	1	-	1	5	4
11	Cijeruk	110,811	1	-	1	4	3
12	Cigombong	145,027	1	-	1	5	4
13	Caringin	152,195	1	1	2	5	3
14	Ciawi	154,287	1	-	1	5	4
15	Cisarua	152,743	1	-	1	5	4
16	Megamendung	133,436	-	2	2	4	2
17	Sukaraja	293,896	1	1	2	10	8
18	Babakan Madang	185,305	-	1	1	6	5
19	Sukamakmur	88,996	-	1	1	3	2
20	Cariu	41,746	1	-	1	1	0
21	Tanjungsari	53,589	-	4	4	2	-2
22	Jonggol	202,483	1	2	3	7	4
23	Cileungsi	233,636	1	2	3	8	5
24	Klapanunggal	198,188	-	1	1	7	6
25	Gunugputri	1,350,862	-	2	2	45	43
26	Citeureup	319,671	1	1	2	11	9
27	Cibinong	727,947	1	-	1	24	23
28	Bojonggede	652,552	1	1	2	22	20
29	Tajurhalang	199,321	-	1	1	7	6
30	Kemang	164,938	1	2	3	5	2
31	Rancabungur	63,304	-	1	1	2	1
32	Parung	233,041	1	-	1	8	7
33	Ciseeng	156,500	2	-	2	5	3
34	Gunungsindur	226,816	1	-	1	8	7
35	Rumpin	165,220	1	2	3	6	3
36	Cigudeg	143,569	1	2	3	5	2
37	Sukajaya	60,141	-	3	3	2	-1
38	Jasinga	100,284	1	3	4	3	-1
39	Tenjo	83,822	1	3	4	3	-1
40	Parungpanjang	189,834	1	1	2	6	4
	District of Bogor	8,389,697	29	49	78	280	202

Source: Bogor District in Figures (2018); Analysis result of the research team (2018)

follows: the development of the number of markets is empty are 3 subdistricts i.e. Nanggung, Tenjolaya and Cariu; between 1-5 is 23 subdistricts i.e. Leuwiliang, Leuwisadeng, Pamijahan, Cibungbulang, Ciampea, Dramaga, Tamansari, Cijeruk, Cigombong, Caringin, Ciawi, Cisarua, Megamendung, Babakan Madang, Sukamakmur, Jonggol, Ciliang, Cijeruk, Cigombong, Caringin, Ciawi, Cisarua, Megamendung, Babakan Madang, Sukamakmur, Jonggol, Cileungsi, Kemang Rancabungur, Ciseeng, Rumpin, Cigudeg and Parungpanjang; between 6-10 is 7 subdistricts i.e. Ciomas, Sukaraja, Klapanunggal, Citeureup, Tajurhalang, Parung and Gunungsindur; greater than 10 are 3 subdistricts i.e. Gunungputri, Cibinong, and Bojonggede; and exceeded the number of needs is 4 subdistricts i.e. Tanjungsari, Sukajaya, Jasinga and Tenjo.

CONCLUSION

The identification of future market locations and/or market developments based on environmental aspects as follows: there are 26 traditional markets and 47 village traditional markets, scattered in the subdistricts the district; the number of trading facilities by type in 2016 was 1332 units and the most were supermarkets which both modern and traditional markets had increased for one year; the number of modern and traditional markets and village markets is 713 units with details of 642 units of modern shops and 73 units of traditional markets and village markets.

Based on the distribution, the best/fair market conditions are located in the district capital and around Bogor City and along the main road/arterial road or collector, while the good/decent market conditions are located relatively spread in each district and unfit/bad market conditions located in a district with low accessibility; identification of the feasibility of development and/or market development based on economic aspects as follows: as a residential area and a buffer zone of Jakarta, is one of the regions that has a rapid growth of modern markets during the period of 2010 to 2015 and with the largest population in West Java Province with a population of 5,459,668 people, so that it can become an area promising in the economic development of the region; the number of modern markets tends to experience positive growth over time, whereas traditional markets tend to experience negative growth; and the existing optimization model considers

the production demand and the fastest travel time, the first alternative for the wholesale market location is Kemang District, the second alternative Dramaga District and alternatives third, Ciawi Subdistrict.

Ciomas District is the location of the second alternative wholesale market, while for the third alternative the wholesale market can be located in Bojonggede District or Ciampea District; and the concept of market development based on distribution per district based on social aspects as follows: population growth per district within a period of 5 years (2014-2018) then in total for the 20 year planning year (2018-2038) a total of 8,389,697 people is projected, with the largest population subdistrict of Gunungputri District being 1,350,862 inhabitants and the smallest of Cariu Subdistricts namely 41,746 people and others relatively stable growth rate. The development of the region will be market needs based on supporting population standards of at least 30,000 for 1 market are 280 markets and based on existing market data (traditional and village) of 78 markets and means that the needs until 2038 are 202 markets.

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Biological and economic value of *Dipterocarpaceae*, the main timber forest product of Indonesia

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ABSTRACT

Dipterocarpaceae is known as a very important tree family both biologically and economically. Its distribution around the world covers the areas of Peninsular Malaysia, the Philippines, Sumatra, Kalimantan, Java, Sulawesi, Maluku to Papua. *Dipterocarpaceae* family has a high economic value, such as producing wood, balsam, resin, charcoal, fat, fruit, bark, essential oil, and camphor. Its products have very important roles for domestic use and export needs. As representatives of *Dipterocarpaceae*, the economic value of *Shorea* Roxb. ex Gaertner f, *Dipterocarpus* Gaertner f, and *Dryobalanops* Gaertner f will be discussed. Considering the very important role of *Dipterocarpaceae*, both biologically and economically, it is necessary to handle it sustainably, through the following actions such as conservation of genetic resources, seed physiology, seed handling, seedling ecology, root symbiosis and nutrition, pest and disease, management of natural forest, and plantation, and also non-timber forest product from *Dipterocarpaceae*.

ABSTRAK

Dipterocarpaceae dikenal sebagai famili pohon yang sangat penting baik secara biologis maupun ekonomis. Penyebarannya di seluruh dunia meliputi wilayah Semenanjung Malaysia, Filipina, Sumatera, Kalimantan, Jawa, Sulawesi, Maluku hingga Papua. Famili *Dipterocarpaceae* memiliki nilai ekonomi yang tinggi, seperti menghasilkan kayu, balsam, damar, arang, lemak, buah, kulit kayu, minyak atsiri, dan kapur barus. Produk-produknya memiliki peran yang sangat penting untuk kebutuhan domestik dan ekspor. Sebagai perwakilan *Dipterocarpaceae*, nilai ekonomi *Shorea* Roxb. ex Gaertner f, *Dipterocarpus* Gaertner f, dan *Dryobalanops* Gaertner f akan dibahas. Mengingat peranan *Dipterocarpaceae* yang sangat penting, baik secara biologis maupun ekonomis, maka perlu dilakukan penanganan secara berkelanjutan, melalui tindakan-tindakan seperti konservasi sumber daya genetik, fisiologi benih, penanganan benih, ekologi semai, simbiosis dan nutrisi akar, hama dan penyakit, pengelolaan hutan alam, dan perkebunan, serta hasil hutan bukan kayu dari *Dipterocarpaceae*.

Keywords: *biological, Dipterocarpaceae, economic, Indonesia, non-timber forest product*

INTRODUCTION

Timber is very important in South East Asian countries in the present stage of their economic development. Malaysia and Indonesia are well in the lead of the exporting countries of tropical timber. Throughout Malaysia, Brunei, and western Indonesia most lowland rain forests are dominated by a vast diversity of tree species of the family *Dipterocarpaceae* (Whitmore, 1986). Dipterocarp genera and species represent a particularly valuable contribution to the world's timber resources and are the most important element in the productive forests of South East Asia (Soerianegara and Lemmens, 1994; Yamada, 1997).

Dipterocarpaceae are probably the most recognized trees in the tropics. The pantropical *Dipterocarpaceae*, have a wide distribution throughout tropical Asia. Each country has from 1 to 200 species, so their use is very different in each country and the history of their management is different in each country, as can be seen from the differences in the strength of the research and development institutions. Information is shared between countries in the region on the management of

Dipterocarpaceae, through technical reports, proceedings and other scientific publications (Ashton, 1982; Stone, 1983; Appanah and Turnbull, 1994).

Dipterocarpaceae with their round, straight and beautiful stems, occur in the lowland tropical rainforest of the Malesia region, which includes Indonesia, Malaysia, the Philippines, and Papua New Guinea. They require rainfall of more than 1000 mm per year and/or a dry season of less than six months. At an altitude of more than 1000 m above sea level and less than 700 m above sea level, this family is less common. *Dipterocarpaceae* disappear at altitudes between 1,000 and 1,500 m; above 1,500 m, montane forest appears, in which the principal flora consists of *Fagaceae* (Yamada, 1997).

In Malesia there are three demarcation nodes, meaning that there are plant genera whose distribution limits stop at certain places. The first is located between the Australian continent and New Guinea (984 genera); second, located between the Philippines and Taiwan (686 genera); and third, between Malaysia and Thailand (575 genera) (Steenis, 1951; Stone, 1983).

More globally, the *Dipterocarpaceae* subfamily *Pakaraimaena* is found in the western part of Guyana in

Southern America the sub-family *Monotoideae* is found in Africa and Madagascar; and the sub-family *Dipterocarpoideae* occurs from Seychelles to East India and Malesia (Ashton, 1982; Stone, 1983).

Dipterocarps in Malesia occur in varying habitats and conditions, including (i). seasonal and non-seasonal areas; (ii). West Malesia Region, in nonseasonal areas, including the Philippines; (iii). Areas of red-yellow to dry soil and of moderate to low fertility, mostly on hilly coasts and islands, and some up to hilltops; and (iv). A small proportion of *Dipterocarpaceae* are riparian species, some of which disperse rapidly through water using their drifting fruits (Steenis, 1951; Ashton, 1982; Stone, 1983).

In general, the forests in the Malesia region are much richer than the forests in Africa and tropical America. For example, in the Dipterocarp forest in Wanariset, East Kalimantan, the number of tree species with a diameter of 10 cm and above reaches 239 in a 1.6 ha plot, making this forest the richest in Indonesia and the second richest in the world (Kartawinata et al., 2008). In East Malesia, the rain forest is generally low in stature and open with tall, large and emergent trees making up the main canopy.

The economic value of the *Dipterocarpaceae* forest, among others, is as a producer of both timber and non-timber products: wood, bark, balsam, resin, charcoal, fat, fruit, essential oil, and camphor. The biological value and economic importance of *Dipterocarpaceae* can be seen from their very dominant distribution in Southeast Asia.

BIOLOGICAL VALUE

Ecology of *Dipterocarpaceae*

The history of *Dipterocarpaceae* botany, as understood in modern terms, started more than two centuries ago when Rumphius first mentioned the family in 1750. At that time dipterocarp forests were considered to be inexhaustible sources of wild products. The dipterocarps were thought to dominate extensively throughout southeast Asia. As soon as the high value of their products (camphor, resins, timber) was perceived funds were made available for botanists to conduct expeditions and laboratory research. At present, underestimated and unrestricted exploitation has encouraged excessive harvesting of dipterocarps and together with modern technologies and economics, has finally endangered the future of dipterocarp forests (Maury-Lechon and Curtet, 1998).

The heartwood of Dipterocarps is dark color, sometimes containing resin, when wet it is red or reddish brown and when dry it is brown, gray-brown or red-brown. The wood weight is rather heavy to heavy, hard, coarse-grained, strong but only moderately durable, in a fresh state it is difficult to saw because of the high resin content (Heyne, 1987).

Dipterocarpaceae were distributed in the some types formation forest of Indonesia. Whitmore (1986), Soerianegara and Lemmens (1994) distinguished major forest formations on the basis of climatic and edaphic conditions. The forest formations are briefly described below, and some characteristic trees are mentioned:

- Tropical lowland evergreen rain forest. This is the predominant forest formation in South East Asia; it occurs in places where water stress is absent or only brief and intermittent, from sea level up to 1200 m altitude. It has the largest number of species. In western Malesia dipterocarps are dominant (especially species of the genera *Shorea*, *Dipterocarpus*, *Dryobalanops*, *Parashorea* and *Anisoptera*). The forest trees are very tall.
- Tropical semi evergreen rain forest. This type of forest formation is predominant in the seasonal regions of South East Asia; it occurs in places with regular annual water stress due to rainfall regime or soil conditions. The number of species is high but less than in the evergreen rain forest, and it contains fewer dipterocarps.
- Heath forest (also called "kerangas"). Heath forest develops over coarse siliceous deposits giving rise to podzols. It occurs particularly in Borneo. The storey formed by large saplings and small poles predominates and the canopy is low and uniform. Dipterocarps, mainly heavy wooded species, are often dominant among the larger trees (e.g. *Cotylelobium*, *Hopea* (giam) and *Shorea* (balau) species); Natural regeneration is often very slow because of the extreme poverty of the soil.
- Forest on limestone and ultrabasic rocks. Limestone hills provide a diversity of habitats and soils but the forest has no commercial value. Beach vegetation. On the beach ridge (the low ridge at the inland margin of a sandy beach) a vegetation type is found that is called the *Barringtonia* association. Typical tree species include *Barringtonia asiatica*, *Calophyllum inophyllum*, *Casuarina equisetifolia*, *Cocos nucifera*, *Terminalia catappa* and *Hibiscus tiliaceus*.
- Mangrove and brackish water forest. These forest formations occur in estuaries, deltas and mud flats subjected to regular tides. Peat swamp forest. A very special type of forest is found on peat soils, which are acid and fed only by rain water. It is particularly widespread in eastern Sumatra, near the coasts of Peninsular Malaysia, Borneo and Irian Jaya. The forest often has distinct zones from the outer part of the peat swamp to the inner part. Characteristic species are: *Copaifera palustris*, *Cratogeomys arborescens*, *Dactyloctenium aegyptium*, *Dryobalanops rappa*, *Gonystylus bancanus*, *Shorea albida* (northern Borneo) and *Tetramerista glabra*.

- Freshwater swamp forest. This type of forest occurs where the soil is regularly inundated with mineral rich fresh water. Some typical trees are *Alstonia*, *Campnosperma*, *Dyera*, *Melaleuca* and *Palaquium* species.
- Monsoon forest and tropical moist deciduous forest. These forest formations occur in a seasonal climate where water is periodically limiting to plant growth. The most important commercial timber species is teak (*Tectona grandis*); other characteristic species are *Dalbergia latifolia* (Thailand, Java) and *Eucalyptus* species (Papua New Guinea).
- Montane forest formations. By comparison with lowland rain forest, the montane rain forest has a lower canopy, with fewer, smaller emergent trees. Trees occurring in seasonally dry sites in the lower montane zone are *Pinus* and *Araucaria* species. *Shorea platyclados* is by far the most common lower montane dipterocarp in Peninsular Malaysia, and in New Guinea lower montane forest is often dominated by *Castanopsis* and *Nothofagus* species.

ECONOMIC VALUE

The wood export quantity of *Shorea spp.* (Meranti), *Dipterocarpus spp.* (keruing), *Dryobalanops spp.* (kapur) and *Gonyostilus spp.* (ramin) were very high per year. The total annual export of Indonesian timber (in 1989) it was worth 3,317 US\$, consisted of plywood 2,694 US\$ and sawn timber 623 US\$. Meranti (*Shorea*) and Kapur/Keruing (*Dryobalanops/Dipterocarpus*) are the biggest contributor of the timber trade from Indonesia. Contribution of each species, were Meranti (*Shorea*) 1,408,000 m³ (52%), Kapur/Keruing (*Dryobalanops/Dipterocarpus*) 463,000 m³ (17%), Pulai (*Alstonia*) 90,000 m³ (3%), Teak (*Tectona grandis*) 46,000 m³ (2%), Other timbers 2,692,000 (25%) (PROSEA, 1994).

Comparing in 2000, the timber production of Indonesia consists of logs 13,798,240 m³, sawn wood 2,789,543 m³, and plywood 4,442,735 m³ (BPS, 2011). In 2020, the timber forest production of Indonesia was 4,730.23 m³. The big four was meranti 34.75%, red meranti 13.82%, merbau 12.89% and acacia 10.58%. The other timbers, such as yellow meranti, mixed wood, bangkirai and kapur was around 2.5 to 7.01% (BPS, 2021).

As a representative of *Dipterocarpaceae*, genera of *Shorea* Roxb. Ex Gaertner f, *Dipterocarpus* Gaertner f, and *Dryobalanops* Gaertner f will be described according to trade groups, origin and geographic distribution, economical use, production and international trade in Indonesia, properties, description, wood anatomy as macroscopic character, and microscopic characters, other botanical information, propagation and planting, diseases and pests, harvesting, genetic resources,

breeding, and prospect species of (Soerianegara and Lemmens, 1994), as below:

Shorea Roxb. Ex Gaertner f. (red meranti)

In trade groups, *Shorea* is known as light red meranti and dark red meranti. consists of 194 species, 163 of which occur in Malesia. *Shorea* is used economically as the most important timber genus in the humid Asian tropics. Production and international trade in Indonesia is only export figures for sawn meranti as a whole are available. Wood properties red meranti is a light to medium heavy hardwood. Morphology description, medium sized to very large trees up to 60(-70) m tall; bole straight, cylindrical; diameter of 70-180 (-255) cm. Wood anatomy as macroscopic character is hearthwood light red, and microscopic characters its growth rings usually absent or distinct. Other botanical information, that at infrageneric level the species may be classified by anatomical features of the wood and bark. Propagation and planting, that until recently *Shorea* species were never planted. The only method for propagation was by seed, but without infection by suitable ectomycorrhizal fungi, attempt to grow seedlings failed. Natural regeneration and growth of planted seedlings in logged over or planted forest is generally satisfactory, but canopy manipulation is often needed for optimal growth of seeding and saplings. Diseases and pests is *Fusarium* fungi may kill seedlings. When harvesting of red meranti, logs float in water and can be transported by river. This is commonly practiced in Kalimantan. Yield of species, in forest of Kalimantan the standing volume of trees over 60 cm in diameter is usually 60-90 m³/ha, and 110 is not exceptional. Genetic resources, that a timber grade group including a large number of species blurs information on individual species threatened extinction, and such species may therefore receive insufficient protection. No breeding has been done, so far. Prospect species that producing red meranti are very promising for the establishment of large scale plantation (Ashton, 1982).

The other selected red meranti are *Shorea acuminata* Dyer, *S. albida* Sym, *S. almon* Foxw, *S. amplexicaulis* P. Ashton, *S. Argentifolia* Symp, *S. balangeran* (Korth.) Burck, *S. beccariana* Burck, *S. contorta* S. Vidal, *S. coriacea* Burck, *S. curtisii* Dyer ex King, *S. dasyphylla*, *S. fallax* Meijer, *S. ferruginea* Dyer ex Brandis, *S. flemmichii* Symp, *S. hemsleana* (King) King ex Foxw, *S. inaequilateralis* Sym, *S. johorensis* Foxw, *S. lepidota* (Korth.) Blume, *S. leprosula* Miq, *S. macrantha* Brandis, *S. macrophylla* (de Vriese) P Aston, *S. macroptera* Dyer, *S. mecistopteryx* Ridley, *S. negrosensis* Foxw, *S. ovalis* (Korth.) Blume, *S. ovata* Dyer ex Brandis, *S. pachyphylla* Ridley ex Sym, *S. palembanica* Miq, *S. palosapis* (Blanco) Merr, *S. parvipolia* Dyer, *S. pauciflora* King, *S. pinanga* R. Scheffer, *S. platycarpa* Heim, *S. platyclados* v. Slooten ex Foxw, *S. polysperma*, *S. quadrinervis* v Slooten, *S. rugosa* Heim, *S. scaberima* Burck, *S. scabrifa* Sym, *S. selanica* (DC.) Blume, *S. singkawang* (Miq.) Miq, *S. smitiana* Sym,

S. splendida (de Vriese) P. Ashton, *S. stenoptera* Burck, *S. teysmaniana* Dyer ex Brandis, *S. uliginosa* Foxw, and *S. venulose* Wood ex Meijer (Soerianegara and Lemmens, 1994).

***Shorea* Roxb. Ex Gaertner f. (white meranti)**

In trade groups it is known as white meranti, light weight hardwood. It has vernacular names white meranti, meranti putih, damar meranti. Origin and geographic distribution of *Shorea* consists of about 194 species, 163 of which occur in Malesia. *Shorea* is used economically as the most important timber genus in the humid Asian tropics. Production and international trade for Indonesia, only export figures for sawn meranti as a whole are available. Properties of white meranti is a lightweight hardwood. Description of trees is medium sized to very large trees up to 60 m tall; bole straight, cylindrical; diameter of 70-180 (-255) cm. Wood anatomy, as macroscopic character that its hearth-wood almost white, and as microscopic characters it growth rings usually indistinct or absent. Growth and development, that seedlings need shade until they reach a height of about 1,5 m. Other botanical information that anatomical feature of the wood and bark, as well as anther characters, provide useful evidence for classification of species at intrageneric level. Ecology of *Shorea* that species are confined to tropical climates with a mean annual rainfall exceeding 1600 mm and wit a dry season of less than 6 months. Propagation and planting, that seeds rapidly lose their viability. Stem cutting of *S. bracteolate* treated with growth regulators and planted in coarse river sand show 100% rooting success. The best planting material is 50-100 cm tall seedlings in the nursery, wildlings, or stump cuttings. Silviculture and management that natural regeneration of white meranti species in the forest is often gregarious. Diseases and pests that in plantation of *S. javanica* easily become infested by galls caused by bacterium *Phytopomonas tumefaciens*. Harvesting of trees in mix dipterocarp forest in Indonesia trees of over 50 cm in diameter are harvested, and at least 25 healthy trees/ha of 20-50 cm in diameter are left for future cut. Genetic resources that when large scale logging is practice without distinction at species level, certain species can become endangered. Prospect, that white meranti seem to have good potential for large scale enrichment planting and for the establishment of timber plantations, especially for plywood reproduction.

The other selected white meranti are *S. agamii* A. Ashton, *S. assamica* Dyer, *S. bentongensis* Foxw, *S. bracteolate* Dyer, *S. dealbata* Foxw, *S. gratissima* (Wallich ex Kurz) Dyer, *S. henryana* Pierre, *S. hypochra* Hance, *S. javanica* Koord. & Valetton, *S. lamellate* Foxw, *S. ochracea* Sym, *S. polita* S. Vidal, *S. resinosa*, *S. retinodes* v Slooten, *S. roxburghii* G. Don, *S. virescent* Parisjs (Soerianegara and Lemmens, 1994).

***Shorea* Roxb. Ex Gaertner f. (yellow meranti)**

In trade groups it is known as yellow meranti, light weight hardwood. Vernacular names is yellow meranti. Origin and geographic distribution of *Shorea* consists of about 194 species, 163 of which occur in Malesia. *Shorea* is used economically as the most important timber genus in the humid Asian tropics. Production and international trade for Indonesia, that only export figures for sawn meranti as a whole are available. Properties, yellow meranti is a lightweight hardwood. Description, medium sized to very large trees up to 60 (-75) m tall; bole straight, cylindrical; diameter of 150(-300) cm. Wood anatomy as macroscopic character that heartwood pale with age, often to light brown with yellowish tinge, and as microscopic characters that growth ring indistinct or absent. Growth and development, that the growth rates differ considerably between species. Other botanical information that anatomical feature of the wood and bark, useful evidence for classification of species at intrageneric level. Ecology, *Shorea* species are confined to tropical climates with a mean annual rainfall exceeding 1600 mm and wit a dry season of less than 6 months. Propagation and planting that seeds rapidly lose their viability. Silviculture and management that natural regeneration of yellow meranti may be abundant. Diseases and pests that many animal such as wild boars, squirrels and various kinds of insects feed on seeds and young plant. Harvesting in mix dipterocarp forest in Indonesia trees of over 50 cm in diameter are harvested, and at least 25 healthy trees/ha of 20-49 cm in diameter are left for future cut. Genetic resources that may easily lead to endangerment of species if large-scale logging without distinction at species level is practiced. Prospect, by comparison with red meranti and white meranti, not much is known about the propagation, planting and silviculture of yellow meranti.

Selection species of yellow meranti are *Shorea acuminatissima* Sym, *S. balanocarpoidea* Sym, *S. blumutensis* Foxw, *S. faguetiana* Heim, *S. gibbosa* Brandis, *S. hopeifolia* (Heim) Sym, *S. laxa* v. Slooten, *S. longiflora* (Brandis) Sym, *S. longismerpa* Roxb, *S. maxima* (King) Sym, *S. multiflora* (Burck) Sym, *S. polyandra* P. Ashton, *S. xanthophylla* Sym (Soerianegara and Lemmens, 1994).

***Shorea* Roxb. Ex Gaertner f. (balau and red balau)**

In trade groups balau is known as heavy hard hardwood, and Red balau as heavy hard hardwood. It has vernacular names of Balau (Indonesia: damar laut). Origin and geographic distribution of *Shorea* consists of about 194 species, 163 of which occur in Malesia. Uses *Shorea* is economically the most important timber genus in the humid Asian tropics. Production and international trade for Indonesia, that no export figures for balau and red balau are available. Properties of balau is heavy hardwood. Description, medium sized to very large trees

up to 60 (-75) m tall; bole straight, cylindrical; diameter of 180(-300) cm. Wood anatomy as macroscopic character it has heartwood yellowish brown when freshly cut, and as microscopic characters that growth ring indistinct or absent. Growth and development, optimal growth of seedlings was between 30-50% relative light intensity. Other botanical information, that anatomical feature of the wood and bark, useful evidence for classification of species at intrageneric level. Ecology, Shorea species are confined to tropical climates with a mean annual rainfall exceeding 1600 mm and with a dry season of less than 6 months. Propagation and planting that trials on propagation of balau and red balau have been carried out occasionally. Silviculture and management that under selective cutting systems, natural regeneration may be good, at least locally. Diseases and pests, that Seed and seedlings are regularly attacked by insect. Harvesting that the estimated average standing stock of balau in Indonesia is 4 m³/ha for trees with diameter exceeding 50 cm, and 4.5 m³/ha for trees with diameter exceeding 35 cm. Genetic resources, that some species are threatened in specific areas and should be protected. Prospect that in this reserves the forest should be kept free from any human disturbance.

Other selection species of balau and red balau are *Shorea astylosa* Foxw, *S. atrinervosa* Sym, *S. ciliate* King, *S. collina* Ridley, *S. elliptica* Burck, *S. exelliptica* Meijer, *S. falcifera* Dyer ex Brandis, *S. falciferoides* Foxw, *S. foxworthyi* Sym, *S. geniculate* Sym. Ex P. Ashton, *S. glauca* King, *S. guiso* (Blanco) Blume, *S. havilandii* Brandis, *S. kurnstleri* King, *S. laevis* Ridley, *S. lumutensis* Sym, *S. malibato* Foxw, *S. materialis* Ridley, *S. maxwelliana* King, *S. obtuse* Wallich ex Blume, *S. ochrophloia* Strugn. Ex Sym, *S. acrobiculata* Burck, *S. seminist* (de Vriese) v. Slooten, *S. siamensis* Miq, *S. submontane* Sym, *S. sumatrana* (v.Slooten ex Thorenaar) Sym. Ex Desch, *S. superba* Sym (Soerianegara and Lemmens, 1994).

***Dipterocarpus* Gaertner f.**

Trade group: keruing. Vernacular name: Keruing. Origin and geographic distribution, that *Dipterocarpus* consists of some 70 species and is distributed from Sri Lanka, India and Burma, through Indochina, Southern China and Thailand towards western Malesia. Uses of Keruing is an important source of general construction timber, for medium and heavy construction. Production and international trade, Keruing is one of the most important export timbers of South East Asia, second only to meranti. In Indonesia keruing is exported together with kapur (*Dryobalanopsis* spp.) in a combine export group.

Properties of Keruing is moderately heavy to heavy hardwood. Keruing description, that Medium-size to large, resinous tree of up to 65 m tall; bole usually branchless for as much as 35 m, straight with little taper with a diameter often exceeding 150 cm with a

maximum of 260 cm and usually with small and concave or sometimes tall and straight stout buttresses.

Wood anatomy. Macroscopic characters. Heartwood varying from greyish-brown, pink brown to red brown. Microscopic characters of growth rings indistinct. Growth and development, that viable fruits start to germinate a few days to a few week after they have fallen on the ground. Other botanical information that genus *Dipterocarpus* is characterized by its dark with warty lenticels. Ecology Keruing, that most species grow scattered, but some, such as *D. elongatus*, *D. gracilis* and *D. obtusifolius*, frequently occur gregariously.

Propagation and planting, that viability of the seeds is short. Silviculture and management that Keruing seedlings can persist in the forest for years under heavy shade. Diseases and pest that insect may damage seeds. Harvesting of Keruing timber is usually obtained from natural forest using selective cutting systems. Genetic resources, that although keruing is common over large areas, and is often outnumbered only by meranti (*Shorea* spp.), the trees usually occurs scattered.

Selected species are *Dipterocarpus acutangulus* Vescue, *D. alatus* Roxb. Ex G. Don, *D. applanatus* v. Slooten, *D. baudii* Korth, *D. borneensis* v. Slooten, *D. caudatus* Foxw, *D. chartaceus* Sym, *D. confertus* v Slooten, *D. conformis* v. Slooten, *D. Cornutus* Dyer, *D. costatus* Gaertner f, *D. costulatus* v. Slooten, *D. crinitus* Dyer, *D. dyery* Pierre, *D. eurynchus* Miq, *D. geniculatus* Vesque, *D. globosus* Vesque, *D. gracilis* Blume, *D. grandifloras* (Blanco), *D. hasseltii* Blume, *D. humeratus* v Slooten, *D. kerrii* King, *D. kunstleri* King, *D. lowii* Hook.f, *D. mundus* v Slooten, *D. oblongifolius* Blume, *D. obtusifolius* Teijsman. Ex Miq, *D. palembanicus* v. Slooten, *D. retusus* Blume, *D. rigidus* Ridley, *D. sublamellatus* Foxw, *D. tempehes* v. Slooten, *D. Validus* Blume, *D. verrucosus* Foxw. Ex v. Slooten (Soerianegara and Lemmens, 1994).

***Dryobalanops* Gaertner f.**

Trade group is keruing. Vernacular name is kapur. Origin and geographic distribution, that *Dryobalanops* consists of some 7 species and is confined to Peninsular Malaysia, Sumatra, Borneo, and intervening islands. Uses of kapur is an important construction timber for local use.

Production and international trade, that kapur is a commercially important timber, particularly in Borne. Properties of Kapur is moderately heavy timber. Description, that Large or very large, occasionally medium-sized trees, up to 60 (-75) m tall, with a straight, columnar bole, often up to 150 (-200) cm in diameter. Wood anatomy, that Macroscopic characters of Heartwood pink-brown or red-brown. Microscopic characters, that Growth rings indistinct. Growth and development, that Kapur trees are evergreen, and flowering of trees in certain areas is more or less concurrent. Other botanical information, that the genus *Dryobalanops* is homogeneous and well-defined. Ecology.

Kapur often occur gregariously as a canopy tree in lowland dipterocarp forest and mixed peat swamp forest. Propagation and planting. The seed weight is about 6 g to 10 g. Seeds can only be stored for a short period (up to 16 days). Silviculture and management, that Kapur is suitable for management under the selective logging system. Diseases and pest, that brown pinhead spot caused by insect is reported as a leaf diseases. Harvesting, that camphor oil can be obtained by tapping the bole. To collect the solid camphor, the tree must be felled. Yield, that measurements of trees in Peninsular Malaysia have shown that trees with a mean diameter 107 cm have an average timber volume 18.2 m³. Genetic resources, that since *Dryobalanops* species often occur gregariously or semi gregariously, natural regeneration is usually abundant, even in logged-over forest. Prospect, that Kapur seems very suitable for timber production in sustainable managed forest.

Other selected species are *Dryobalanops beccarii* Dyer, *D. fusca* v. Slooten, *D. keithii* Sym, *D. lanceolata* Burck, *D. obongifolia* Dyer, *D. rappa* Becc, *D. sumatrensis* (J.F.) Gmelin Kosterm (Soerianegara and Lemmens, 1994).

Plants are essential for human well-being. Considering the potential value of plants as well as the value of its other benefits, so we need to appreciate the value of ecosystems through conserving biodiversity and ecosystems, while remind that (1) biodiversity is best conserved in its natural habitat, (2) the integrity of an ecosystem is maintained through the interaction of species constituents and the interaction of species with environmental factors, (3) traits species in an ecosystem is the result of these interactions, (4) and knowledge about these species is still minimal, which means that preserving these species individually outside of their original ecosystem is not possible (Kartawinata, 2010).

Widyatmoko (2019), reported that based on threatened in Indonesia, *Dipterocarpaceae* was dominant family that their species threatened (up to 33%), followed by family of *Myristicaceae* (12%), *Nepenthaceae* (7%), dan *Orchidaceae* (5%). This is consequence of plant family that has high commercial value, so their population in the natural forests were degraded.

Woody trees are an element of natural resource production, that plays an important economic role in the Southeast Asian region. Without proper management, excessive use of trees such of logging, shifting cultivation, and various human activities, will result total destruction of tropical forests. Conservation is very necessary for proper management. Considering the very important role of *Dipterocarpaceae*, both botanically and economically, it is necessary to handle it sustainably, through the following actions such as conservation of genetic resources, seed physiology, seed handling, seedling ecology, root symbiosis and nutrition, pest and disease, management of natural forest, and plantation, and also non-timber forest product from *Dipterocarpaceae*.

We need to conserve both in situ and ex situ conservation for this high value of commercial trees species.

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Appendix 1. Economic value and distribution of *Dipterocarpaceae* in Malesia (Heyne, 1987)

No.	Name	Economic Value	Spread
1	<i>Dipterocarpus baudii</i> Korth (Keruwing)	timber	North Sumatran, Peninsular Malaysia
2	<i>D. crinita</i> Dyer (Keruwing bulu)	timber, balsam	East Sumatra, Peninsular Malaysia, Kalimantan
3	<i>D. gracilis</i> Bl. (Damar kacawai)	timber, balsam	All of Western Indonesia
4	<i>D. grandiflora</i> Blanco (Keruwing gombang)	timber, balsam	Philippine, Western Indonesia, except Java
5	<i>D. hasseltii</i> Bl. (Lagan)	timber, balsam	Western Indonesia, in Java is rare
6	<i>D. kunsleri</i> King. (Lagan)	timber, balsam	Sumatra
7	<i>D. marginata</i> Korth. (Keruwing)	timber, charcoal	Kalimantan
8	<i>D. retusa</i> Bl. (Palahlar)	timber	West Java, Central Java
9	<i>D. Skinneri</i> King. (Keruwing bulu)	timber, balsam	Peninsular Malaysia
10	<i>D. tampurau</i> Korth. (Tampurau)	timber, plank	Kalimantan, Sumatra, West Java
11	<i>D. trinervil</i> Bl. (Palahlar)	timber, balsam	Java
12	<i>D. warburgii</i> Brandis (Day)	timber	Central Kalimantan
13	<i>Anisoptera costata</i> Korth (Entenam, Tenam)	timber, resin	Western Indonesia
14	<i>A. marginata</i> Korth (Tenam, Resak gunung)	timber, resin	Western part of Indonesia (East Sumatra, Southeast Kalimantan)
15	<i>Dryobalanops champora</i> Colebr (Kayu kapur, kapur baru)	wood, resin, camphor, essential oil, fruit	North Sumatra (Tapanuli), West Sumatra
16	<i>D. oblongifolia</i> Dyer (Keladan, Petanang)	timber, fruit	Palembang, Kalimantan (to the west)
17	<i>D. oiocarpa</i> V.Sl. (Kayu kapur, Sintek)	timber	East Kalimantan
18	<i>Hopea selebica</i> Burck (Damar dere hitam)	timber	East Sulawesi
19	<i>H. mengarawan</i> Miq. (Merawan, Emang besi)	timber, bark, resin	West Nusantara (West Kalimantan, Southeast)
20	<i>H. sangal</i> Korth (Damar putih, Cengal)	timber, leather, resin	Lebong, Southeast Kalimantan, Bangka, Java
21	<i>Shorea acuminata</i> Dyer (Meranti hijau); dark red meranti	timber, resin	Peninsular Malaysia
22	<i>S. balangeran</i> Burck (Kaweh, Kahoi, Melangir)	timber, resin	Bangka, Belitung, Kalimantan
23	<i>S. bracteola</i> Dyer (Kedontang, Kayu putih)	timber	Bengkulu, Palembang
24	<i>S. collina</i> Ridley (Balau bukit)	timber, resin (low quality)	Malaka
25	<i>S. curtisii</i> King	timber	
26	<i>S. exemia</i> Scheff (Kalup, Lungkong)	timber, resin	Bangka, Belitung, South Sumatra, Lampung

27	<i>S. glauca</i> King (Simanto, Rasak)	timber, resin	Aceh, Simelue Island
28	<i>S. gibbertiana</i> Burck (Tengkawang layar, T. telur)	timber, fruit	West and Southeast Kalimantan (Sampit)
29	<i>S. kordersii</i> Brandis (Tenang, Asi-asin)	timber, resin	North Sulawesi, North Maluku
30	<i>S. leavis</i> Ridl. (Kumus)	timber, resin	Malay Peninsula
31	<i>S. lepidota</i> Bl. (Meranti beras, Tengkawang majau)	timber, resin, fruit	Palembang, West Sumatra, West-South-East Kalimantan
32	<i>S. leprosula</i> Miq. (Damar kerakah, Meranti sarang punai)	timber, resin	Aceh, Palembang, East Sumatra, West Sumatra, West-South-East Kalimantan
33	<i>S. macroptera</i> Dyer (Kayu kuning)	timber, resin	Malay Peninsula, Singkep Island
34	<i>S. martiniana</i> Scheff (Tengkawang pinang)	timber, resin	Sambas
35	<i>S. materialis</i> Ridl. (Balau betul)	timber, resin	Malay Peninsula
36	<i>S. parvifolia</i> Dyer (Meranti daun kecil, M.semak)	timber	Malay Peninsula
37	<i>S. rigida</i> Brandis (Kepung labu)	timber	Malay Peninsula
38	<i>S. scaberrima</i> Burck (Tengkawang babi)	timber	West Kalimantan (Sambas)
39	<i>S. selanica</i> Bl. (Kayu bapa, Bahut)	timber, resin	Maluku (P. Buru)
40	<i>S. singkawang</i> Miq. (Sengkawang, Tengkawang lisum)	timber, fat	Sumatra (Rawas, Minang), Malay Peninsula, Kalimantan
41	<i>S. stenoptera</i> Burck (Tengkawang tungkul)	fruit, resin	West Kalimantan (cultivated)
42	<i>S. teysmanniana</i> Dyer (Sasak)	timber, leather	Bangka
43	<i>S. utilis</i> King (Damar laut no. 1)	timber	Malay Peninsula, North Sumatra
44	<i>Parashorea lucida</i> Kurz. (Meranti hitam, Timbalon)	timber	West and Central Sumatra
45	<i>P. stellata</i> Kurz. (Damar laut, Seraya, Meranti)	timber (soft)	Malay Peninsula, Sumatra
46	<i>Isoptera borneensis</i> Scheff (Tengkawang tertindak)	timber, resin, fat	West and Southeast Kalimantan (Sampit)
47	<i>I. sumatrana</i> V. Sl. (Tengkawang)	timber, resin, fat	Palembang, West Sumatra
48	<i>Balanocarpus spec.</i> di\ v (Cengal)	timber, resin	Malay Peninsula
49	<i>Vatica bancana</i> Scheff (Resak gelingga, Kayu daging)	timber	Bangka, Belitung, Palembang, Lampung
50	<i>V. cupularis</i> V. Sl. (Damar tingkis, Rasak)	timber	Southeast Kalimantan
51	<i>V. faginea</i> Dyer (Damar batu)	timber, resin	Southeast Kalimantan
52	<i>V. leucocarpa</i> Foxw (Resak bukit)	timber	Riau Island, West Kalimantan
53	<i>V. papuana</i> Dyer (Damar alung, Salo hiru)	timber, resin	East Kalimantan, North Maluku, Irian Jaya
54	<i>V. rassak</i> Bl. (Rasak danau)	timber, resin	West Kalimantan, Southeast Kalimantan
55	<i>V. simalurensis</i> V. Sl. (Siloki, Silongkis)	timber	Simelue Island

56	<i>V. songa</i> V. Sl. (Songa)	timber	Norsala Island (West Sumatra)
57	<i>V. sumatrana</i> V. Sl. (Recop)	timber, resin, fat	Palembang, Lampung
58	<i>V. teysmanniana</i> Burck (Resak ayer, Resak paya)	timber, resin	East Sumatra, Bangka
59	<i>V. wallichii</i> Dyer (Resak ayer, Resak padang)	timber, resin	Malaka, East Sumatra, Kubu

Carrying capacity analysis of nature tourism activity in Selabintana, Gunung Gede Pangrango National Park, West Java

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ABSTRACT

Selabintana management area is one of the nature tourism areas in the Gunung Gede Pangrango National Park (GGPNP) which located in Sukabumi District, West Java. Within the management area which covers 2,547.93 ha, there is a camping ground and waterfall which both are the most attracted for visitors. Efforts are needed to harmonize nature tourism activities with conservation mission, so that visitors can enjoy but the natural environment is maintained. The objective of this research is to determine the carrying capacity for daily tourism and camping activities by considering the aspect of physical, environmental and management aspects. The survey conducted through interviews and questionnaires to 62 tourists, traders and managers of the national park area. The data were analyzed using the carrying capacity assessment method developed by Cifuentes, i.e. calculating the Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC), and Effective Carrying Capacity (ECC). As a result, EEC for daily tourism is 84 visitors/day (PCC > RCC > ECC with a score of 3,269 > 98 > 84), while EEC for camping is 60 visitors/day (PCC > RCC > with a score of 2,155 > 69 > 60). Thus, carrying capacity of nature tourism activities in conservation areas can be calculated based on physical carrying capacity, real carrying capacity, and effective carrying capacity.

ABSTRAK

Kawasan pengelolaan Selabintana merupakan salah satu areal wisata alam yang ada di Taman Nasional Gunung Gede Pangrango (TNGGP) yang terletak di Kabupaten Sukabumi, Jawa Barat. Di dalam areal pengelolaan yang luasnya 2.547,93 ha terdapat camping ground dan air terjun yang merupakan daya tarik utama yang bagi para pengunjung. Diperlukan adanya upaya untuk menyelaraskan kegiatan wisata alam dengan misi konservasi, agar pengunjung dapat menikmati namun lingkungan alam tetap terjaga. Tujuan dari penelitian ini adalah menentukan *carrying capacity* untuk kegiatan wisata harian dan berkemah dengan mempertimbangkan aspek fisik, lingkungan dan manajemen. Survey dilakukan melalui interview dan kuisioner terhadap 62 wisatawan, pedagang dan pengelola kawasan taman nasional. Data dianalisis dengan metode penilaian *carrying capacity* yang dikembangkan oleh Cifuentes, yaitu menghitung Daya Dukung Fisik (PCC), Daya Dukung Ril (RCC), serta Daya Dukung Efektif (ECC). Sebagai hasil, EEC untuk wisata harian adalah 84 pengunjung/hari (PCC > RCC > ECC dengan skor 3.269 > 98 > 84), sedangkan EEC untuk berkemah adalah 60 pengunjung/hari (PCC > RCC > dengan skor 2.155 > 69 > 60). Jadi, *carrying capacity* dalam kegiatan wisata alam di dalam kawasan konservasi dapat ditentukan berdasarkan daya dukung fisik, daya dukung ril, dan daya dukung efektif.

Keywords: *carrying capacity, nature tourism, national park*

INTRODUCTION

The involvement of stakeholders is a challenge in managing conservation areas such as national parks, so that an integrated management of national parks can be implemented. A such management model is currently needed considering the development of area zoning in the management strategy of a national park. One of the zone that has been being developed is the utilization zone. The type of utilization that has been widely developed in the management of national parks is the development of nature tourism businesses.

In the development of business-based nature tourism in a conservation area, various assessments are needed, especially those related to the carrying capacity of the environment. This is important to keep the conservation area sustainable, where the existing ecological system is maintained, the community can be involved, and there is

an access to get the benefits of a national park.

Gunung Gede Pangrango National Park has been designated as the core zone of UNESCO's Biosphere Reserve Cibodas since 1997. In the concept of a biosphere reserve, the district's administrative area has been internationally recognized as part of an area managed through UNESCO's MAB (Man and the Biosphere) landscape approach in the context of conservation, scientific and humanity development programmes. The Selabintana management area in Sukabumi District is one of the natural tourist sites within the Gunung Gede Pangrango National Park which has been known as a location for ecotourism activities that attracts many visitors.

In 2018, the management of the national park has improved facilities and infrastructure to support tourism activities in Selabintana. With the addition of these facilities and infrastructure, it will certainly have a

positive or negative impact on the development of natural tourism and environmental preservation. Therefore, we need a tourism management that can reduce negative impacts, which will cause damage to the environmental quality in the Selabintana management area.

In general, the determination of the carrying capacity of the environment and the carrying capacity of tourism aims to limit the use of a space or region. However, both have differences in their application. Physical carrying capacity or PCC is the maximum number of visitors that can be physically accommodated by the available space within a certain period of time. Real carrying capacity or RCC is the number of visitors who are allowed to visit a tourist attraction, with a correction factor (CF) which is translated from the characteristics of the object applied to the physical carrying capacity. Effective carrying capacity or ECC is the maximum number of visits where the object will always be stable in its available management capacity or MC (Cifuentes, 1992; Khair, 2006; Sustru, 2009; Sayan & Atik, 2011).

Based on various reasons above, it is necessary to have a formula that can be used in calculating the carrying capacity of natural tourism management, especially in a daily nature recreation areas and in campgrounds.

METHODS

This study was carried out in February-April 2021 in Selabintana management area of GGPNP, which covers an area of 2,547.93 ha. Administratively, it is located in Perbawati Village, Sukabumi District, West Java (Figure 1).

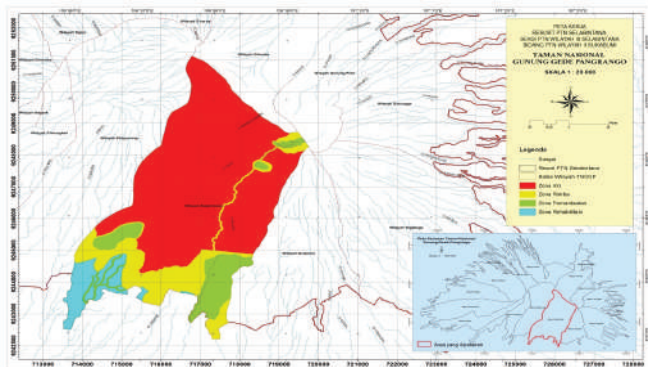


Figure 1. The map of study area in Selabintana management area of GGPNP, West Java.

In this study, there are two types of descriptive surveys, namely nature tourism activity in the waterfall area (daily tourism) and in the camping ground area in the utilization zone of the Selabintana management area. The scope of research on carrying capacity of nature tourism is limited to the definition of effective carrying capacity that developed by Cifuentes (1992). Data collection was carried out by two techniques, namely

observation and interviews (using a questionnaires).

The survey was conducted on 62 respondents consisting of tourists or visitors, tourism managers, and local traders who do business around the location. The direct observation technique is carried out to collect primary data, in the form of physical data (facilities and access, the length of the track in the tourist area), as well as observation and identification of the presence of trees and wildlife. Meanwhile, secondary data collected is data on tourism areas, road length, number of visitors, open period, wind speed, soil type, sunlight, and supporting data obtained from institutions. In the interview technique, the researcher met and deals directly with the respondent or the subject being studied. The data analysed using the following formula (Cifuentes, 1992):

$$ECC = RCC \times MC$$

$$MC = \frac{R_n}{R_t} \times 100\%$$

R_n : number of available officers

R_t : number of officers needed

$$RCC = PCC \times \frac{100-Cf1}{100} \times \frac{100-Cf2}{100} \times \dots \times \frac{100-Cfn}{100}$$

Where :

RCC (Real Carrying Capacity): maximum number of tourists allowed to visit by considering the factors of physical carrying capacity in the tourist area.

$$Cf_n = \frac{M_n}{M_t} \times 100\%$$

Cf_n : the n^{th} reducing/correction factor associated with the n^{th} variable

M_n : real condition on calculated f_n variable

M_t : maximum limit on f_n variable

$$PCC = A \times \frac{1}{B} \times Rf$$

Where :

PCC (Physical Carrying Capacity): maximum number of visitors that can be physically received in a tourist area at a given time (Fandeli & Muhammad, 2009)

A: size of tourism area

B: size of area required by a tourist while still obtaining satisfaction.

Rf: rotation factor or number of repeat visits per day.

RESULTS AND DISCUSSION

Carrying Capacity of Nature Tourism

Daily tourism activity in Selabintana operates between 07:30 to 16:00 (8.5 hours per day), while the result of interview with the tourists/visitors, show that the average of their spending time is 4 hours to do tourism activity

within the area of Selabintana. Then, the rotation factor or number of repeat visits per day (Rf) is 2.13. Thus, the maximum number of visitors that can be physically received in a tourist area at a given time (PCC) in this area is 3,792 visitors/day (rounded from 3,792.13).

For the camping activity in camping ground of Selabintana, park manager has provided 24 hours, but the average duration of camping activity that spent by visitors is 16 hours, with Rotation factor (Rf) is 1.5. Thus, the PCC for camping activity is 2,155 visitors/day (rounded from 2,155.1).

Real Carrying Capacity (RCC)

The study of the relevant correction factors for the natural characteristics is needed to conduct an RCC analysis. In Selabintana region, there are several correction factors, i.e. rainfall, landscape, soil erosion, slope, and biodiversity index.

Rainfall correction factor

Secondary data about the number of rain days in the last 5 years compared to the number of visit days. The number of rain days in the past 5 years is 781 days, and the number of visit days is 1,736 days. Then the rainfall index is 44.99% or index 0.45.

Landscape correction factor

The calculation is obtained based on weight assessment of the respondents on the terrain characteristics, vegetation, scenery, colours of view, and infrastructure. Survey is conducted using assessment instruments.

Erosion correction factor

Based on secondary data (Java and Madura soil maps) the type of soil in Selabintana management area is latosol soil type (30 points) and andosol (60 points) and Mt (75 points).

$$M1 = (30 + 60) / 2$$

$$M1 = 45$$

$$Cfe = 45 / 75 \times 100\%$$

$$Cfe = 60\% = 0.60$$

Thus, the potential index of soil erosion sensitivity is 0.6

Slope correction factor

The assessment was carried out by using a score on the criteria for the slope class on visitor route with a slope level score of 0-100.

$$Cfs = 46,66 / 100 \times 100\%$$

$$Cfs = 46.66\% = 0.47$$

Correction factor for daily visitor slope index is 46.66% or 0.47.

Correction factor for camping slope index is 34.28% or 0.34.

Biodiversity correction factor

Simpson's diversity index was employed to measuring the level of tree vegetation and birds (Cfd) or (Cf5). In the analysis of vegetation obtained 321 trees of 32 species. Thus, tree diversity index is 0.510 and the total number of variables for the index (Mt) is 1. Therefore, the calculation of correction factor for tree diversity is as follows:

$$Cftr = 0.510 / 1 \times 100\%$$

$$Cftr = 51\% = 0.51$$

The result of bird diversity index assessment within tourism area was obtained 218 individuals of birds from 32 species.

$$Cfbr = 2.61 / 3.5 \times 100\%$$

$$Cfbr = 74.57\% = 0.75$$

For obtaining the correction factor of diversity (which was generated from tree vegetation diversity and bird diversity indexes) can be calculated as follows:

$$Cfd = (Cftr + Cfbr) / 2$$

$$Cfd = (51\% + 74.57\%) / 2$$

$$Cfd = 62.78\% = 0.63$$

Based on the index assessment of each correction factor, then the RCC value for daily tourism and camping in Selabintana management area can be calculated as follows:

Real Carrying Capacity (RCC) of daily tourism in Selabintana:

$$RCC = 3,269 \times 0.55 \times 0.59 \times 0.40 \times 0.53 \times 0.37 = 98.17$$

Thus, the RCC value for daily tourism is 98 visitors/day (rounded from 98.17).

Real Carrying Capacity (RCC) of camping in Selabintana:

$$RCC = 2,155 \times 0.55 \times 0.59 \times 0.40 \times 0.66 \times 0.37 = 68,73$$

Thus, the RCC value for camping is 69 visitors/day (rounded from 68.73).

Carrying Capacity of Nature Tourism

Selabintana management area has 8 (eight) staff, but in carrying out their duties every day there are only 7 (seven) staff working because there is always 1 (one) person takes a day off. Thus, the value of management capacity (MC) can be calculated with the following equation:

Effective Carrying Capacity (ECC) for daily tourism:

$$ECC = PCC \times MC$$

$$ECC = 98 \times 0.875$$

$$ECC = 84.14$$

Thus, the value of ECC for daily tourism in Selabintana management area is 84 person/day (rounded from 84.14).

Effective Carrying Capacity (ECC) for camping:

$$ECC = PCC \times MC$$

$$ECC = 69 \times 0.875$$

$$ECC = 60.14$$

Thus, the value of ECC for camping in Selabintana management area is 60 person/day (rounded from 60.14).

Based on calculation result of daily tourism, we will know the value of Physical Carrying capacity (PCC), Real Carrying Capacity (RCC) and the Effective Carrying Capacity (ECC). Therefore, the equation obtained is $PCC > RCC > ECC$ with value of $3,269 > 98 > 84$. From the calculation result data, the visitors of daily tourism that can be physically accommodated is 3,269 visitors per day. Afterwards, with the presence of correction factor that affects space and nature tourism activity is 98 visitors per day. Thus, the maximum number of visitor that can be accommodated by Selabintana management area with its correction factor and considering its management capacity is 84 visitors per day.

The result of calculation for the camping activity, shows the value of Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC) and Effective Carrying Capacity (ECC), then the equation obtained is $PCC > RCC > ECC$ with value of $2,155 > 69 > 60$. From the calculation result, the visitors that can be physically accommodated is 2,155 visitors per day. Then, with the presence of correction factor that affects space and nature tourism activity is 69 visitors per day. Thus, the maximum number that could be accommodated by Selabintana management area with its correction factor and considering its management capacity is as many as 60 people per day.

CONCLUSION

A nature tourism area as one of the objects in conservation area (such as national park) management could be assessed through Physical Carrying Capacity (PCC). However, the capacity would turn into Real Carrying Capacity (RCC) through the study of natural factors correction. Those correction factors are the natural physical level, the ecology aspects preservation, and the vulnerability level of disaster. The final determination is Effective Carrying Capacity as the response of Management Capacity (MC) towards Real Carrying Capacity.

For the daily tourism and camping in Selabintana of Gunung Gede Pangrango National Park indicates the $PCC > RCC > ECC$ value, which means based on the

opening of Selabintana natural tourism could be applied in accordance with that equation.

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Correlation between the willingness to compromise and effectiveness of regional regulations with green consumer behaviour

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ABSTRACT

The objective of this study is to find the correlation between the effectiveness level of regional regulations and willingness to compromise with green consumer behaviour. This research applied use correlational surveys with 100 samples housewives in Bogor city. The data analysis technique used is multiple regression. The result of this research shows that there is a very significant positive relationship that has a local regulation permit with green consumer behaviour, with a variable contribution of 56.2%. There is a very significant positive relationship between willingness to compromise with green consumer behaviour, with the variable contribution being 38.3%. There is a very significant positive relationship between the application of local regulations and the willingness to compromise together with green consumer behaviour, with the variable contribution being 57.9%. The functional relationship between the application of local regulations and willingness to compromise with the green consumer behaviour variable fulfills the regression equation $\hat{Y}_{12} = 21.866 + 0.404X_1 + 0.214X_2$ and this relationship is significant.

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengetahui hubungan antara tingkat efektivitas peraturan daerah dan kemauan berkompromi dengan perilaku konsumen hijau. Penelitian ini menggunakan metode survei korelasional dengan sampel 100 ibu rumah tangga di kota Bogor. Teknik analisis data yang digunakan adalah regresi berganda. Hasil penelitian menunjukkan bahwa terdapat hubungan positif yang sangat signifikan antara izin peraturan daerah dengan perilaku konsumen hijau, dengan kontribusi variabel sebesar 56,2%. Terdapat hubungan positif yang sangat signifikan antara kesediaan berkompromi dengan perilaku konsumen hijau, dengan kontribusi variabel sebesar 38,3%. Terdapat hubungan positif yang sangat signifikan antara penerapan peraturan daerah dengan kemauan berkompromi dengan perilaku konsumen hijau, dengan kontribusi variabel sebesar 57,9%. Hubungan fungsional antara penerapan peraturan daerah dan kemauan berkompromi dengan variabel perilaku konsumen hijau memenuhi persamaan regresi $\hat{Y}_{12} = 21,866 + 0,404X_1 + 0,214X_2$ dan hubungan ini signifikan.

Keywords: *effectiveness, green consumer behaviour, local regulations, willingness to compromise*

INTRODUCTION

Fast economic growth encouraging the happening of consumption and natural resources exploitation in excessive way so that it inflicts environmental damage. The implication of environmental damage according to (Biswas & Roy, 2014) include global warming, environmental degradation (soil, air, and water), depletion of ozone layer, and as well as having an impact on the decline in the quality of social life and health caused by.

From all the types of trash, the most dangerous is certainly plastic waste. These days, the society using plastic as the food container and as well as other functions. Disposable food containers that made of plastic are considered more practical, whereas like what we know that this plastic material is difficult to decompose by soil. To this day, Indonesian Government continues to strive to reduce the amount of plastic waste. The various policies and program are arranged as the step in the reduction of plastic waste. Program trial have conducted in 2016 to reduce plastic waste by charging a

fee of two hundred rupiah for the consumers who want to use plastic bag for their groceries. At that time, the government collaborated with retailers and supermarkets to support the trial of that policy.

In compiling the laws and regulations, the local government loads and manages the application of regional autonomy and accommodates the particular conditions of the region. The local government has the authority and as well as the independence in managing all regional government affairs, in order to run their respective regional autonomy.

This research is a continuation of the previous relevant research about how effective the local regulations on public awareness of environmental care practice, and would like to find correlation between the effectiveness of regional regulations application and green consumer behaviour, correlation between willingness to compromise and green consumer behaviour, as well as correlation between regional regulations and willingness to compromise simultaneously with the green consumer behaviour.

METHODS

The research design that is used in this research is quantitative correlational survey design as seen on below diagram (Figure 1).

The population of housewives with the sample in this research was using random sampling or gradually sample (stratified sampling). The sampling process carried out in stages. According to Slovin formula, so that the sample that should be examined is minimum of 100 samples.

The data collecting technique was carried out using a Likert scale instrument for the three variables. The data analysis technique used in this research was correlational analysis used to find the relation or the influence between one variable and another.

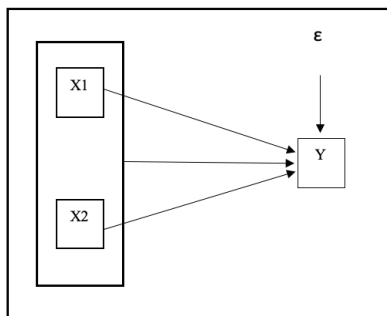


Figure 1. Diagram of research design

Where X1: the effectiveness of regional regulations application, X2 : willingness to compromise, Y: green consumer behaviour, and ε: the other variables that are not examined

RESULTS AND DISCUSSION

Correlation between the effectiveness of regional regulations application and green consumer behaviour

Based on the research result, there is found very significant correlation between the effectiveness of regional regulations application with green consumer behaviour. The equation of regression is $\hat{Y} = 38.1786 + 0.4876X_1$. (Figure 2). While there was coefficient of correlation 0.75 with significant different t test ($t=11.217$; $p<0.01$).

Through ANOVA test could explain that very significant different $F= 5.827$ ($p<0.01$) as is shown in Table 1.

The value of the coefficient of determination between effectiveness of regional regulations application variable and green consumer behaviour is 0.562 (56.2%). This matter indicates that 56.2% of green consumer behaviour caused by the presence of effectiveness of regional regulations application, while 43.8% caused by the other factors. The functional relation namely regression between effectiveness regional regulations

application (X_1) and green consumer behaviour (Y) is as well as significant and that regression follows.

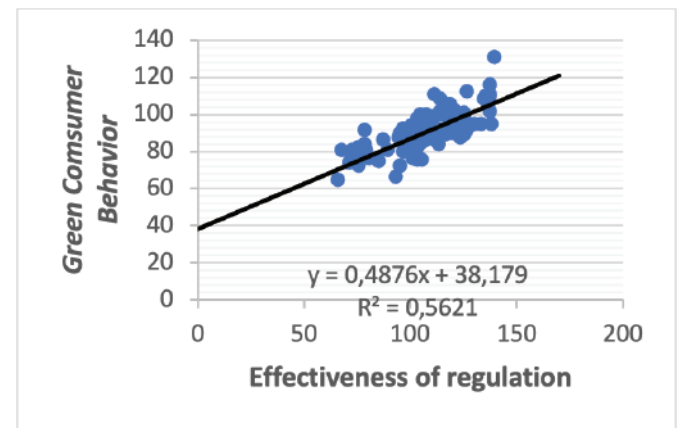


Figure 2. Regression equation of correlation between effectiveness of regulation with customers behaviour

Correlation between willingness to compromise and green consumer behaviour

Based on the research result, significant correlation was found between willingness to compromise variable and green consumer behaviour. The equation of regression $\hat{Y} = 5.4751 + 0.7199X_2$ (Figure 3). While there was coefficient of correlation 0,6189 with significant different t test ($t=7.801$; $p<0.01$).

Through ANOVA test could explain that very significant different $F= 5.827$ ($p<0.01$) as shown in Table 2.

The value of the coefficient of determination between willingness to compromise variable and green consumer behaviour is 0.383 (38.3%). This matter indicates that 38.3% green consumer behaviour caused by the presence of willingness to compromise contribution, while 61.7% caused by the other factors. The functional relation namely regression between willingness to compromise (X_2) and green consumer behaviour (Y) is as well as significant and the regression follows the equation $\hat{Y} = 5.4751 + 0.7199X_2$.

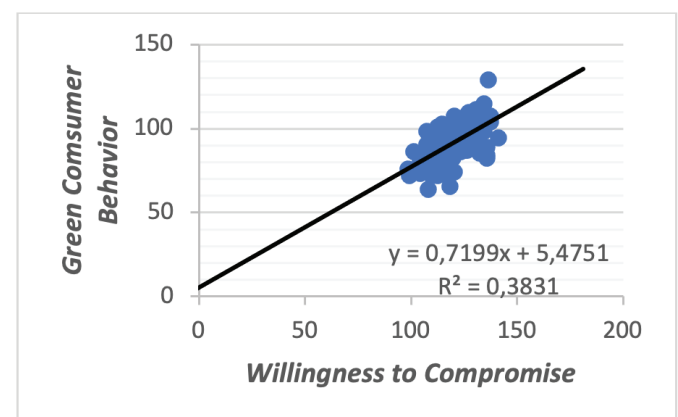


Figure 3. Regression equation between willingness to compromise with customers behaviour

Correlation between effectiveness of regional regulations application and willingness to compromises together with green consumer behaviour

The correlation between effectiveness of regional regulations and willingness to compromise simultaneously have the correlation coefficient 0.761 thee as significant different, so that the determination coefficient is 0.579 and it indicates that 57.9% green consumer behaviour could be materialized from the presence of effectiveness of regional regulations application variable and willingness to compromise

simultaneously and 42.1% is the contribution from the other factors. Functional relation, regression simultaneously between the effectiveness of Regional regulations and willingness to compromise with green consumer behaviour ($F= 66.7947$ $p<0.01$; Table 3) also significant and the regression follows the equation $\hat{Y} = 21.866 + 0.404X_1 + 0.214X_2$.

Both factors of effectiveness of regional regulations application and willingness to compromise simultaneously turned out to give contribution that significant for the enhancement of green consumer behaviour.

Table 1. ANOVA test of correlation between effectiveness of regulation with customers behaviour

Source	dk	JK	RJK	F	F table		Remarks
					0.05	0.01	
Total	100	839984.00					
Coefficient (a)	1	826281.00	826281.00				
Regression (b/a)	1	769.03	769.03				
Residual (S)	98	12933.97	131.98	5.827**	3.938	6.901	Very Sig.
	49	144763.18	2954.35	0.918 _{ns}	1.607	1.962	
Error	49	157697.15	3218.31				

Table 2. ANOVA test correlation between effectiveness of regulation with customers behaviour

Source	dk	JK	RJK	F	F table		Remarks
					0.05	0.01	
Total	100	839984.00					
Coefficient (a)	1	826281.00	826281.00				
Regression (b/a)	1	1244.38	1244.38				
Residual (S)	98	12458.62	127.13	9.788**	3.938	6.901	Very Sig.
	36	145238.53	4034.40	1.586 _{ns}	1.607	1.956	Linear
Error	62	157697.15	2543.50				

Table 3. Result of ANOVA regression of effectiveness of regional regulation application, willingness to compromise, and green consumer behaviour

Source	JK	dh	RJK	F	F table		Remarks
					$\alpha = 0.05$	$\alpha = 0.01$	
Regression (b/a)	7939	2	3969	66.7947**	3.090	4.831	Very Sig.
Residual (S)	5764	97	59.4259				
Total	13703	99					

CONCLUSION

There is positive relation that highly significant between effectiveness of regional regulations application and green consumer behaviour. The function relation between effectiveness of regional regulations application and green consumer behaviour fulfill the regression equation $\hat{Y}_1 = 38.1786 + 0.4876X_1$.

There is positive relation that highly significant between willingness to compromise and green consumer behaviour. The functional relation between willingness to compromise and green consumer behaviour fulfills the regression equation $\hat{Y}_2 = 5.4751 + 0.7199X_2$ and that relation is significant.

There is positive relation that highly significant

between effectiveness of regional regulations application and willingness to compromise simultaneously with green consumer behaviour fulfills the regression equation $\hat{Y}_{12} = 21.866 + 0.404X_1 + 0.214X_2$.

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GUIDELINES FOR AUTHORS

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

- The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
- The submission file is in OpenOffice, Microsoft Word, or RTF document file format.
- Where available, URLs for the references have been provided.
- The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
- The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.

Author Guidelines

The Indonesian Journal of Applied Environmental Studies will publish original work by:

- Indonesian or foreign scientists on any aspect of Indonesian environmental sciences, including environmental chemistry, environmental biology, ecology geoscience and environmental physics. Appropriate subjects include basic and applied research on atmospheric, terrestrial and aquatic environments pollution control and abatement technology, conservation of natural resources, environmental health study and toxicology, environmental quality assessment, environmental standards and criteria.
- Indonesian or foreign scientists on any aspect of regional environmental sciences, including environmental chemistry, environmental biology, ecology geoscience and environmental physics. Appropriate subjects include basic and applied research on atmospheric, terrestrial and aquatic environments pollution control and abatement technology, conservation of natural resources, environmental health study and toxicology, environmental quality assessment, environmental standards and criteria.

The Indonesian Journal of Applied Environmental Studies will publish original work by:

- Improve environmental intervention and management in Indonesia

- Enhances understanding of environmental needs in Indonesia
- Enhances the understanding of Indonesia's environmental management

The Journal language will be in English with abstracts in Bahasa Indonesia as well as English. Authors of full papers are encouraged to provide a Bahasa Indonesia/English translation of their abstract.

Submissions in Bahasa Indonesia will be accepted and translated into English only if accepted for publication.

Papers and Short Communications

Full Research Papers (2,000-7,000 words) and Short Communications (200-2,000 words) are invited on topics relevant to the Journal's focus, including:

- Environmental chemistry
- Environmental biology
- Ecology geoscience
- Environmental physics
- Basic and applied research on atmospheric
- Terrestrial and aquatic environments pollution control and abatement technology
- Conservation of natural resources
- Environmental health study and toxicology
- Environmental quality assessment
- Environmental standards and criteria

The Journal will not accept descriptions of new species, subspecies or other taxa.

How to Submit a Manuscript

Manuscripts should be submitted through online submission system (OJS) at

<https://journal.unpak.ac.id/index.php/InJAST/index>

In the cover letter, the Lead Author must confirm that:

- The submitted manuscript has not been published elsewhere
- All of the authors have read the submitted manuscript and agreed to its submission
- All research was conducted with the necessary approval and permits from the appropriate authorities

Review and editing

All contributors in English are strongly advised to ensure that their spelling and grammar is checked by a native English speaker before the manuscript is submitted to the Journal. The Editorial Team reserves the right to reject manuscripts that are poorly written.

Submission in Bahasa Indonesia is also accepted and the Journal secretariat will undertake a preliminary review of all manuscripts for suitability of content and format. Manuscripts that are rejected at this stage will not be sent for peer review and translation.

Manuscripts that pass through the preliminary review will be sent for translation and peer review by a minimum of two reviewers. Authors are welcome to suggest appropriate reviewers.

Proofs will be sent to authors as a portable document format (PDF) file attached to an e-mail note. Corrected proofs should be returned to the Editor within 3 days of receipt. Minor corrections can be communicated by e-mail.

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Concise reports (<300 words) on news of general interest to the study and management of Indonesia's environment. News reports may include,

- Announcements of new initiatives; for example, the launch of new projects, conferences or funding opportunities.
- Announcements of important new reports or other publications related to Indonesian environmental management.
- Summaries of important news from an authoritative published source; for example, new research technique, or a recent development in applied environmental management.
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Informative contributions (<650 words) in response to material published in the Journal.

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Full papers follow the style and format of papers published in the journal *Conservation Biology*. Authors should consult examples in *Conservation Biology* for

guidance on general style.

Contributions should be in Bahasa Indonesia and/or UK English, double-spaced and in 'doc', 'rtf' or 'wpd' format, preferably as one file attached to one covering e-mail.

The cover page should contain; The title and full mailing address, e-mail address and address of the Lead Author and all additional authors.

Contributing Papers should contain the following sections and be arranged in the following order: Abstract, Introduction, Methods, Results, Discussion, Acknowledgments, Literature Cited. Tables, figures and Plates (including legends), if included, should follow the Literature Cited.

All pages should be numbered consecutively. Do not number section headings or subheadings.

Title: This should be a succinct description of the work, in no more than 20 words.

Abstract: Abstracts should only be submitted for Full Papers. This should describe, in 100-300 words, the aims, methods, major findings and conclusions. It should be informative and intelligible

without reference to the text, and should not contain any references or undefined abbreviations. Authors are encouraged to submit an English translation of Indonesian text and an Indonesian translation of an English text.

Keywords: From five to eight pertinent words, in alphabetical order.

Literature cited in text: Enclose citations in text in parentheses e.g. "Asian tapirs are no elephants when it comes to seed dispersal (Campos-Arceiz et al., 2011)."

Use an ampersand (&) between author surnames when the citation is parenthetical: (Traeholt & Idris, 2011).

When a citation is not parenthetical, use "and": "Our results agree with the predictions of Wolf and Rhymer (2001)."

For citations with more than two authors, use et al.: (Campos-Arceiz et al., 2011). Do not italicize et al.

List parenthetical citations in alphabetical order and chronologically from oldest to most recent and separate entries with a semicolon: (Campos-Arceiz et al., 2011; Geissman, 2009, 2010).

Separate the years with commas when citing multiple papers by the same author: (Corlett, 2007, 2010; Geissman, 1984, 1995, 1999, 2000).

“**In press**” means the cited paper has been accepted unconditionally for publication. Provide the year of publication in the text (Bird, 2010) and in Literature Cited section provide the volume number, and substitute “in press” for page numbers (Bird, I.M. 2010. Nesting success in arid lands. *Conservation Biology* 24: in press.).

Papers in review must be cited as unpublished and should not appear in the Literature Cited section.

Use an initial for the first (given) name and spell out the last name (surname) for other sources of unpublished data or information: (R. Fowler, unpublished data; M.E. Soulé, personal communication).

Software: capitalize the first letter only if the name of the program is a word (e.g., Vortex, ArcGIS). If the name of the program is not a word, use all capital letters (e.g., SAS).

The following are examples of Literature Cited house style:

Campos-Arceiz, A. and R.T. Corlett (2011). Big animals in a shrinking world—studying the ecological role of Asian megafauna as agents of seed dispersal. *Innovation* 10: 50–53.

Campos-Arciez, A., Larringa, A.R., Weerasinghe, U.R., Takatsuki, S., Pastorini, J., Leimgruber, P., Fernando, P. and L. Santamaria (2008). Behavior rather than diet mediates seasonal differences in seed dispersal by Asian elephants. *Ecology* 89: 2684–2691.

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Traeholt, C., Bonthoeun, R., Rawson, B., Samuth, M., Virak, C. and Sok Vuthin (2005). Status review of pileated gibbon, *Hylobates pileatus* and yellow-cheeked crested gibbon, *Nomascus gabriellae*, in Cambodia. *Fauna & Flora International*, Phnom Penh, Cambodia.

Sun H. (2000). Status of the tiger and its conservation in Cambodia. MSc thesis, University of Minnesota, Minneapolis, USA.

IUCN (2010). 2010 IUCN Red List of Threatened Species. <http://www.redlist.org> [accessed 1 February 2011].

Biography: This should describe the main research interests of all authors (<150 words total), apart from what is obvious from the subject of the manuscript and the authors’ affiliations.

Tables, figures and plates: These should be self-explanatory, each on a separate page and with an appropriate caption. Figures can be submitted in colour as well as in black and white. The Editorial Team may decide to convert coloured figures into black and white should it be necessary due to printing cost and without diluting the message. Plates (black and white only) will only be included in an article if they form part of evidence that is integral to the subject studied (e.g., a photograph of a rare species), if they are of good quality, and if they do not need to be printed in colour.

Appendices: Lengthy tables, and questionnaires are discouraged. In special circumstances these may be made available for viewing online.

Species names: The first time a species is mentioned, its scientific name should follow in parenthesis and in italics: e.g., Asian elephant (*Elephas maximus*). English names should be in lower case throughout except where they incorporate a proper name (e.g., Asian elephant, Cookson’s wildebeest, long-billed vulture).

Abbreviations: Full expansion should be given at first mention in the text.

Units of measurement: Use metric units only for measurements of area, mass, height, etc.

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KONFLIK MANUSIA-GAJAH

Menurut catatan sejarah, konflik manusia dan gajah sudah terjadi sejak abad ke-19. Pada masa itu gajah sudah menjadi ancaman besar bagi kebun-kebun petani, karena kelompok gajah dapat menghancurkan ladang yang dilewatinya.

Konflik manusia-gajah di Padang Sugihan sudah berlangsung sejak adanya program transmigrasi di tahun 1981. Konflik ini mendorong pemerintah untuk melakukan penggiringan gajah besar-besaran yang melibatkan ratusan tentara, operasi ini dikenal dengan Operasi Ganesha.

Beberapa tahun kemudian, gajah yang telah digiring tersebut kembali ke tempat asalnya di Padang Sugihan. Sebagian petani yang tidak memiliki teknik dalam mengusir gajah dari kebun mereka malah menjadi korban amukan gajah. Hal ini karena gajah merasa terganggu dan terancam akibat pengusiran oleh petani. Tentu saja korban dari sisi manusia maupun gajah pun tidak dapat terelakkan.

APA YANG DAPAT KITA LAKUKAN?

Konflik manusia-gajah yang terus saja berlanjut mengantarkan kita kepada kekhawatiran akan masa depan gajah. Akan tetapi ada beberapa hal yang dapat kita lakukan untuk melakukan mitigasi konflik untuk memperbaiki keadaan yaitu dengan:

- ✓ Melestarikan habitat gajah
- ✓ Mencukupi ketersediaan pakan di wilayah mereka
- ✓ Mengadakan kegiatan sosialisasi kepada masyarakat sekitar mengenai mitigasi konflik manusia-gajah

KITA BISA HIDUP BERDAMPINGAN

BERSAMA KITA TANAM PAKAN GAJAH

Apa saja kegiatan yang dapat kita lakukan dari dana donasi?



1. Menanam tumbuhan pakan gajah

Kita akan memperbanyak pakan gajah di habitat mereka. Hal ini bertujuan agar kebutuhan pakan gajah terpenuhi, sehingga mengurangi intensitas gajah masuk ke lahan pertanian dan pemukiman manusia.



2. Mendorong respon cepat mitigasi konflik manusia-gajah

Kita akan membantu masyarakat yang tinggal di habitat gajah untuk bisa melakukan respon cepat dalam upaya mencegah dan mengatasi gajah yang masuk ke lahan pertanian dan pemukiman yang aman baik bagi keduanya.

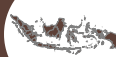
"Kami meyakini bahwa manusia dan gajah dapat hidup bersama dalam harmoni selama ketersediaan makanan antar keduanya tetap terjaga"

MENGAPA GAJAH PERLU DISELAMATKAN?



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Gajah sumatra adalah satwa liar langka yang dilindungi oleh Pemerintah Republik Indonesia. Sebanyak 85% gajah sumatra berada di luar kawasan konservasi yang ditetapkan pemerintah hal ini seringkali menyebabkan munculnya konflik antara manusia dan gajah.



Dalam tiga dekade terakhir, kantong populasi gajah sumatera menurun sebesar 50%. Saat ini hanya tersisa 22 kantong populasi gajah yang sebelumnya terdapat 44 kantong populasi.



Gajah adalah penyebar biji yang sangat penting untuk menjaga ekosistem hutan. Kotoran mereka juga merupakan sumber kehidupan serangga yang hidup di lantai hutan. Rata-rata gajah betina hanya melahirkan empat anak saja sepanjang hidupnya.



DAMPAK DARI UPAYA PELESTARIAN



Pelestarian habitat satwa mengurangi resiko konflik dan kematian manusia maupun gajah, serta mengurangi resiko kerusakan lahan pertanian masyarakat sebesar 50%.



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