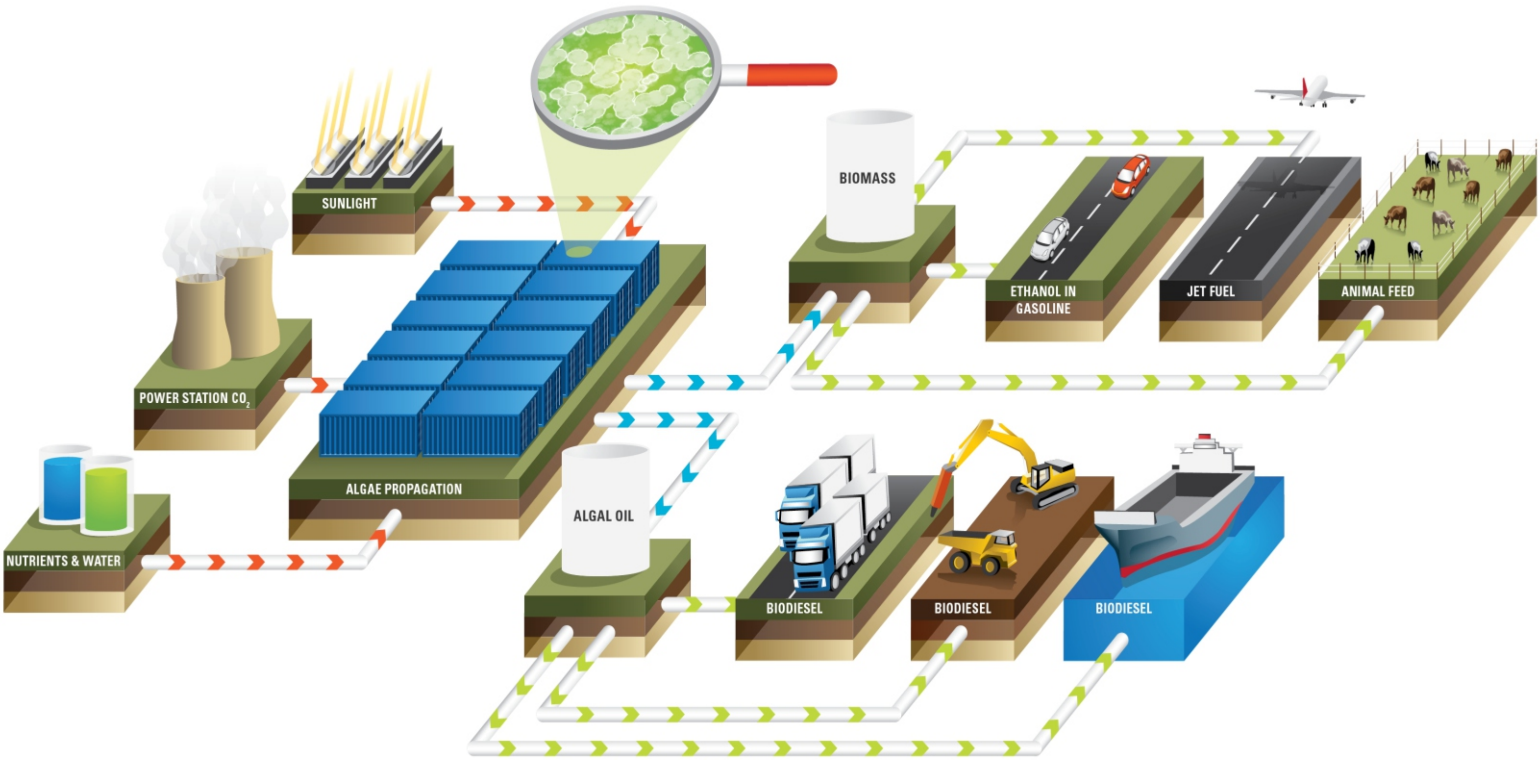
BIOENERGY PRODUCTION AND MANAGEMENT

Shakuli Saxena



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Published by: Alexis Press, LLC, Jersey City, USA
www.alexispress.us

First Published 2022

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing in Publication Data

Includes bibliographical references and index.

Bioenergy Production and Management by *Shakuli Saxena*

ISBN 979-8-89161-296-9

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CHAPTER 1

BIOENERGY AND LANDSCAPE RESTORATION: A BRIEF INTRODUCTION

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ABSTRACT:
Indonesia is not an exception to the global concern over land degradation. Increased need for food and biomaterials due to growing populations has accelerated the conversion of forests into other land uses, a process that is still prevalent in many parts of the world. Promoted as a method to stop land deterioration and produce a range of commodities and services, including bioenergy, is a process known as forest landscape restoration (FLR). In addition to making up for the significant initial investments required for FLR, FLR transforms unproductive, degraded lands into productive landscapes, avoids further conversion of natural vegetation for other uses, and provides a variety of ecosystem services, including climate management. Fruits, nuts, and biomass are used by FLR along with climate-smart agroforestry techniques to plant biofuel-friendly plants. The chapters in this book address a wide range of FLR and bioenergy-related subjects, such as policy analysis, geospatial assessment for assessing site appropriateness, farmer perspectives, and information vital for land managers, planners, and policymakers regarding individual species.

KEYWORDS:

Bioenergy, Carbon, Landscape, Restoration, Sustainability.

INTRODUCTION

In addition to their contributions to the many ecosystem goods and products necessary for local well-being, healthy forests and landscapes are important for people and the entire planet due to the multitude of ecosystem services they provide. They can naturally increase biodiversity, store carbon, regulate water, and maintain the health of the soil, among other benefits. More than 14 million hectares of Indonesia's land have been classified as degraded, including two million hectares of degraded peatlands, which are crucial for climate mitigation due to their significant carbon storage capacity. Indonesia must restore its forest landscape because there is such a large area of damaged land. In the meantime, Indonesia's energy needs are growing swiftly along with its population and economy. The government's ambitious plans to provide electricity to the entire population through its National electricity Policy (Kamiakin Energid Nasional), as established by Government Regulation No. 1, are expected to keep this trend going for the foreseeable future. Through its Nationally Determined Contribution (NDC), Indonesia made a commitment to reduce its greenhouse gas (GHG) emissions by 29 percent by 2030 in response to the Paris Agreement in 2015. The nation has also pledged to have 23% of its total energy mix come from new and renewable sources by 2025.

Producing bioenergy is one of the tactical approaches intended to achieve these goals. Huge areas of damaged land and an ever-increasing demand for energy can both be challenges and opportunities. FLR is an expensive endeavour, and a major barrier to achieving its goals is the lack of funding for FLR activities. The country's surviving natural forests and food production may be subject to higher stress as a result of rising energy consumption and the development of biomass energy, a situation described as the food, energy, and environment trilemma. FLR might, however, provide a wide range of products and services, including wood, biomass for energy, biomaterials, agri-food products, and essential oils, as well as economic and social advantages while promoting nature preservation. In climate-smart agroforestry systems, for instance, the restoration of degraded and underutilized land can offer significant bioenergy potential without increasing competition for land required for other uses, such food production or nature protection. Due to its high net primary production, Indonesia has a huge chance to develop cutting-edge, sustainable bioenergy while also pursuing large-scale landscape restoration initiatives, such as the NDC's goal of reclaiming 14 million hectares of degraded land. This book presents ideas from an interdisciplinary group of professionals who joined forces to integrate bioenergy and landscape restoration to academics, practitioners, small and medium businesses, and private sector actors interested in biomass energy and an overview of bioenergy and landscape repair 3 Indonesian landscape restoration.

The book discusses a wide range of subjects related to the production of bioenergy and the restoration of landscapes, including recent Indonesian government policies and initiatives, geospatial assessments of degraded land available for the production of bioenergy, landowners' perceptions of bioenergy crops and the restoration of landscapes, and specific details on promising bioenergy species like enamelling, bamboo, and pong Amia. The chapters of the book discuss a wide range of subjects, including bioenergy policies, geospatial mapping and analysis of degraded lands and their suitability for bioenergy production, landowner perceptions and preferences, the socioeconomic and environmental advantages of bioenergy plantations, and suitable bioenergy species for producing biomass and biodiesel. In the correct circumstances and with the right management, bioenergy plants can coexist with food crops to produce systems that simultaneously promote food security, energy security, and landscape restoration. Agroecosystems with sound design could produce bioenergy crops that significantly contribute to Indonesia's bioenergy goals, while minimizing negative social and environmental effects and improving the lives of locals. The agroecosystem level potential of bioenergy crops is substantial, but there are still issues with economies of scale for macro-scale bioenergy production, land availability, operating expenses, and transaction costs. System designs must guarantee that bioenergy production is sustainable and does not worsen deforestation of the land and forests.

These questions are addressed in this book's chapters, which also provide a comprehensive overview of using bioenergy crops for landscape restoration in Indonesia. Wilayat et al. research bioenergy projects and their relevance to Indonesian businesses. According to the findings, bioenergy research is moving forward in the nation, but it is difficult to learn about it and it is still difficult to use bioenergy on a larger scale. Their research highlights the necessity for enabling conditions, such as legislation, funding, and incentives, as well as for the provision of bioenergy in systems that leverage multifunctional land use or waste recycling. The number of degraded areas suitable for raising species for biodiesel and biomass is estimated by Jaung et al. Two alternative production, growth model, and carbon stock scenarios one containing five biomass and biodiesel generating species, and the other using only biodiesel species as well as a regional analysis to identify possibly suitable areas are all included in their research. According to study findings, there are 3.5 million hectares of degraded land that is eligible for producing biodiesel and biomass under the first scenario, and 10 PJ of biodiesel in the second scenario [1]-[3].

Analyse landowners' ratings of bioenergy tree species and their decisions for repairing damaged fields using Firth's logistic regression model. The findings show that most landowners prefer known species with open markets, while only a small number choose the bioenergy species Allophylus epiphyllum L. because of the market uncertainties for bioenergy. Research identifies bioenergy plants suitable for various settings, and it suggests deploying common bioenergy species, creating bioenergy marketplaces for landowners, and providing extension support and capacity building. Results give comprehensive details on bioenergy tree species, their ideal growing conditions, and energy outputs. They also make recommendations for better bioenergy production methods. The social, economic, and environmental advantages of enamelling or caliphyllid epiphyllum-based bioenergy generation in various agroforestry systems integrated with rice, maize, peanuts, and honey.

The study's findings show that armlong-based agroforestry systems provide socioeconomic and environmental benefits on various scales by estimating the net present values (NPV) of individual crops and various combinations of crops., Researchers evaluate, analyse, and assess how potential bioenergy crops perform in severe environments. Results show that agroforestry systems perform better for armlong and kemiri suman species than monocultures do. According to their research, these two species should be planted in agroforestry systems to increase productivity and support sustainable development and livelihoods. In a burned-out peatland area that is being restored with the development of a bioenergy plantation, Shin et al. investigate and analyse the biodiversity and features of the soil macrofauna as well as changes in soil fauna patterns. The results show that soil mesofauna and microfauna populations are substantially decreased by peatland fires, and bioenergy tree survival rates and biodiversity are higher on unburned peatland than on burned peatland. According to Leksono et al., unimpaling on recently burned ground is doing better and better. According to their research, unimpaling trees exhibit strong adaptability and have a 90% chance of surviving on low fertility and acidic soils. The trees also enhance soil biodiversity by luring birds and insects while providing a source of renewable energy. Surprisingly, the data also show that slope gradients and fertilizer treatments have no discernible impact on the effectiveness of growth.

DISCUSSION

Bioenergy

Bioenergy is a phrase used to describe energy created or generated from biomass, which is made up primarily of recently lived but now-dead plants. Bioenergy is usually produced from biomass, which includes trash from farms, yards, and woods as well as food crops like maize, energy crops, and waste from these sources. In accordance with the IPCC (Intergovernmental Panel on Climate Change), bioenergy is a renewable source of energy. Bioenergy has the potential to either attenuate or raise greenhouse gas emissions. Additionally, it is well accepted that unfavorable local environmental impacts can happen. Wood and wood waste are currently the main sources of biomass energy. You can burn wood straight up or turn it into pellets or other fuels. You can also utilize other plants as fuel, such as maize, switchgrass, miscanthus, and bamboo. Some of the key waste feedstocks include manufacturing waste, agricultural waste, municipal solid waste, and wood waste. Raw biomass can be converted in a number of ways to produce higher-grade fuels, which are often classified as thermal, chemical, or biochemical. [4], [5].

Thermal conversion techniques transform biomass into a better and more useful fuel mostly through the use of heat. The three main options are torrefaction, pyrolysis, and gasification. These are distinguished primarily by the length of time that the chemical reactions are allowed to continue, with oxygen availability and conversion temperature also being important factors. Many well-established chemical processes, such as the Fischer-Tropic synthesis, are based on coal-based methods. Biomass can be used, like coal, to create a range of industrial chemicals. It is possible to use many of the biochemical mechanisms that nature has developed to degrade the molecules that make up biomass. The conversion is typically carried out by microorganisms. The three procedures are anaerobic digestion, fermentation, and composting. Based on the source of the biomass, biofuels can be roughly split into two main classes, depending on whether or not food crops are used:

First-generation biofuels are made from crops grown on arable land, such corn and sugarcane. The sugars in this biomass are fermented to produce bioethanol, an alcohol fuel that can be mixed with gasoline or used to power a fuel cell. Through fermentation, bioethanol is created primarily from the starches or sugars present in plants like corn, sugarcane, or sweet sorghum. Both Brazil and the US use bioethanol extensively. In Europe, biodiesel, which is made from oils like rapeseed or sugar beets, is the most popular type of biofuel. Second-generation biofuels also referred to as advanced biofuels utilize non-food-based biomass sources such perennial energy crops and agricultural waste. As byproducts of the primary crop, the raw materials utilized to generate the fuels are either produced on fertile land or on marginal land. Anaerobic digestion, gasification, or direct combustion to produce biogas and syngas are just a few of the techniques that can be used to transform waste from establishments like businesses, farms, forestry operations, and residences into second-generation biofuels. Cellulosic biomass, obtained from non-food sources like trees and grasses, is being explored as a feedstock for ethanol production. Biodiesel can be made from food waste such vegetable oils and animal fats.

Carbon capture and storage technology can be used to absorb emissions from power plants that use biofuels. This method, also referred to as bioenergy with carbon capture and storage or BECCS, has the capacity to extract significant volumes of carbon dioxide from the atmosphere. However, BECCS has the potential to yield net positive emissions, depending on the cultivation, collection, and transportation techniques employed for the biomass feedstock. In order to execute BECCS at the scales specified in the various climate change mitigation strategies, substantial farmland areas will need to be changed. The following is an excerpt from Bioenergy with Carbon Capture and Storage. Bioenergy with carbon capture and storage (BECCS) is the technique of getting bioenergy from biomass while also capturing and storing the carbon and thereby removing it from the environment. For BECCS, a negative emissions technology (NET) is feasible. Carbon dioxide (CO_2) from the atmosphere is absorbed by biomass as it grows and transformed into carbon in the biomass. Energy bioenergy is extracted from the burning of the biomass through combustion, fermentation, pyrolysis, or other conversion processes in the form of useful products as power, heat, biofuels, etc. [6]-[8].

A portion of the carbon in the biomass is transformed into biochar or CO_2, which can be distributed on the ground or buried beneath the soil to absorb carbon dioxide (CDR). According to estimates, BECCS could result in annual negative emissions of 0 to 22 gigatons. Five facilities that were using BECCS technologies actively absorbed about 1.5 million tons of CO_2 per year. BECCS isn't used frequently because of the price and lack of biomass. The impact of bioenergy on the climate varies significantly depending on the source and production techniques of the biomass feedstocks. When trees are cut down and replaced with new ones, for example, the amount of carbon dioxide released when burning wood for energy is significantly reduced. The newly planted trees will absorb carbon dioxide from the atmosphere as they grow. However, the development and cultivation of bioenergy crops has the potential to impact the ecosystems of the natural world, deteriorate soils, and use up water and synthetic fertilizers. Nearly one-third of the wood used for conventional heating and cooking in tropical countries is illegally harvested. Large amounts of energy may be needed for the harvesting, drying, and transportation of bioenergy feedstocks, which could contribute to greenhouse gas emissions. When using bioenergy instead of fossil fuels, there is a chance that the effects of land use change, agriculture, and processing will result in increased overall carbon emissions.

Less land may be available for growing food if cropland is used to raise biomass. In the US, ethanol made from maize has replaced around 10% of motor gasoline, using up a significant portion of the harvest. As these forests are essential carbon sinks and habitats for several species, their removal to make palm oil for biodiesel has had significant social and environmental effects in Malaysia and Indonesia. In comparison to other renewable energy sources, producing a given amount of bioenergy requires a significant amount of land since photosynthesis only captures a small portion of the energy from sunlight. While second-generation biofuels derived from waste or non-food plants reduce competition with food production, they may also have extra negative effects, such as trade-offs with local air pollution and conservation areas. Biomass can be created from a variety of relatively sustainable sources, such as algae, waste, and plants grown on inappropriate soil for growing food.

Environmental consequences

Emissions of greenhouse gases can be reduced or increased by using bioenergy. There is also general consensus that adverse local environmental effects can occur. Growing demand for biomass, for instance, can put a tremendous amount of social and environmental strain on the regions where the biomass is generated. The impact is primarily caused by biomass's poor surface power density. Compared to, say, fossil fuels, the low surface power density has the result that far larger land areas are required to produce the same amount of energy. In Sweden and Canada, there have been demonstrations against the export of forest biomass since it has been deemed inefficient and unsustainable [4], [9].

Size and projected trends

China and Europe are the only two regions that demonstrated significant expansion in increasing 2 GW and 1.2 GW of bioenergy capacity, respectively. In general, bioenergy expansion dropped by 50% in these two regions. There is no room for development because the production of pellets uses almost all of the available sawmill trash. In order for the bioenergy industry to grow significantly in the future, more harvested pulpwood must be sent to pellet mills. The collection of pulpwood tree thinning, however, eliminates the possibility for these trees to grow old and so maximize their potential to retain carbon. Sawmill wastes have lower net emissions compared to pulpwood: Some types of biomass feedstock, in particular sawmill waste, can be carbon-neutral, at least over a few years. These are leftovers from prior forest operations, which indicate that no more harvesting is necessary. Burning them or letting them rot would still release carbon into the environment [10]-[12].

CONCLUSION

Bioenergy is being promoted globally and in Indonesia as a potential substitute for unsustainable fossil fuels for the production of energy in order to achieve an energy-secure and low-carbon future. Indonesia may achieve its energy goals with the aid of well-planned and managed systems for producing bioenergy on degraded lands, which will also promote a sustainable environment and improve local livelihoods. For sustainable bioenergy production and the regeneration of degraded lands and forests, research in various contexts and consideration of local communities are essential. The viability of sustainable bioenergy production and environmental services may be improved by interdisciplinary approaches. To ensure that the spread of bioenergy crops is environmentally sustainable and does not compete with agricultural production for land, which could raise food insecurity and food commodity prices, careful planning is necessary. Additionally, system designs must guarantee that bioenergy production is sustainable and does not worsen the degradation of the environment's land and forests. CIFOR and collaborators have been conducting research for the past six years to assess the possible advantages and disadvantages, from social, economic, and environmental perspectives, of planting bioenergy crops on degraded areas in Indonesia.

The papers in this collection should be helpful for investors, managers, and legislators to take into account when making decisions.

REFERENCES

[1] B. Sen, J. Aravind, P. Kanmani, and C. H. Lay,State of the art and future concept of food waste fermentation to bioenergy, *Renewable and Sustainable Energy Reviews*. 2016. doi: 10.1016/j.rser.2015.08.065.

[2] H. Xian, G. Colson, B. Mei, and M. E. Wetzstein,Co-firing coal with wood pellets for U.S. electricity generation: A real options analysis, *Energy Policy*, 2015, doi: 10.1016/j.enpol.2015.02.026.

[3] A. H. Demirbas and I. Demirbas,Importance of rural bioenergy for developing countries, *Energy Convers. Manag.*, 2007, doi: 10.1016/j.enconman.2007.03.005.

[4] Y. Wu *et al.*,Bioenergy production and environmental impacts, *Geoscience Letters*. 2018. doi: 10.1186/s40562-018-0114-y.

[5] J. Wang, Y. Yang, Y. Bentley, X. Geng, and X. Liu,Sustainability assessment of bioenergy from a global perspective: A review, *Sustainability (Switzerland)*. 2018. doi: 10.3390/su10082739.

[6] M. Fridahl and M. Lehtveer,Bioenergy with carbon capture and storage (BECCS): Global potential, investment preferences, and deployment barriers, *Energy Res. Soc. Sci.*, 2018, doi: 10.1016/j.erss.2018.03.019.

[7] N. Pour, P. A. Webley, and P. J. Cook,Potential for using municipal solid waste as a resource for bioenergy with carbon capture and storage (BECCS), *Int. J. Greenh. Gas Control*, 2018, doi: 10.1016/j.ijggc.2017.11.007.

[8] M. Muratori, K. Calvin, M. Wise, P. Kyle, and J. Edmonds,Global economic consequences of deploying bioenergy with carbon capture and storage (BECCS), *Environ. Res. Lett.*, 2016, doi: 10.1088/1748-9326/11/9/095004.

[9] P. Behrens, J. C. Kiefte-De Jong, T. Bosker, J. F. D. Rodrigues, A. De Koning, and A. Tukker,Evaluating the environmental impacts of dietary recommendations, *Proc. Natl. Acad. Sci. U. S. A.*, 2017, doi: 10.1073/pnas.1711889114.

[10] B. M. Meneses, E. Reis, M. J. Vale, and R. Reis,Modelling land use and land cover changes in Portugal: A multi-scale and multi-temporal approach, *Finisterra*, 2018, doi: 10.18055/finis12258.

[11] L. Qin Liu, G. Min, S. Ting Yue, and L. Sen Cheng,The Influence of Mobile Phone Addiction on Procrastination: A Moderated Mediating Model, *J. Ergon.*, 2018, doi: 10.4172/2165-7556.1000232.

[12] Y. Uchida and V. Norasakkunkit,The NEET and Hikikomori spectrum: Assessing the risks and consequences of becoming culturally marginalized, *Front. Psychol.*, 2015, doi: 10.3389/fpsyg.2015.01117.

CHAPTER 2

EXAMINING INDONESIA'S BIOENERGY PROGRAMS: ADVANTAGES AND LONG-TERM SUSTAINABILITY

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ABSTRACT:
Through its National Energy Policy, Indonesia has committed to increasing the use of new and renewable energy (NRE). Given Indonesia's abundant biomass resources, it is important to investigate and research potential bioenergy feedstocks, as well as to pinpoint advantages and disadvantages for growth and upscaling. Indonesia is not an exception to the trend of sustainability, with its emphasis on bioenergy. It looks at escalating issues crucial to potentials for multiple benefits, competing uses, and other development objectives. The study examines the vast resources that Indonesia has that might be used for bioenergy and covers a number of research on the possibilities for bioenergy development. The three most well investigated potential bioenergy sources are palm oil, Jatropha carcass, and biogas. Beyond this, scaling up implementation is still difficult, so feasibility studies that take into account links with major off takers are required. Oil palm biofuel is by far the most often produced and utilized biofuel in Indonesia, despite the fact that acceptance of numerous bioenergy schemes has been problematic. Although there are opportunities to combine the production of bioenergy with a variety of development objectives, in certain cases trade-offs may be necessary.

KEYWORDS:

Bioenergy, Development, Indonesia, Policy.

INTRODUCTION

The law emphasizes the importance of variety, environmental sustainability, and increased domestic energy resource deployment. Oil, coal, gas, and new and renewable energy (NRE) should all be included in a diversified energy source. By 2025, it requires NRE to make up 23% of the country's energy mix. NRE can come from a variety of sources, such as geothermal, nuclear, micro-hydro, bioenergy, solar, wind, tidal, and shale gas. As stated by the President of Indonesia at the twenty-first Conference of Parties to the United Nations Framework Convention on Climate Change Ministry of Foreign Affairs, Indonesia has also made international commitments to align energy provision with sustainability and to further reduce net greenhouse gas emissions, as outlined in its Nationally Determined Contribution (NDC) Republic of Indonesia. A key source of alternative renewable energy is bioenergy. It is defined as energy generated from plant biomass and trash and leftovers originated from plants. While modern bioenergy refers to energy produced through a variety of methods, such as liquid biofuels, biorefineries, biogas, and wood pellet heating systems, traditional bioenergy typically refers to energy from burning biomass. Biofuels such as biodiesel, bioethanol, bio-aviation turbine fuel, bio-pellets, bio-briquettes, bio-oil, biogas, and syngas are all being researched and produced in Indonesia.

The Sumba Iconic Island renewables project, the development of biofuel known as Bahan Bakar Nabati (BBN), energy-self-sufficient villages known as Desa power plants, and bioenergy plantations known as Human Tansman Energy (HTE) are just a few of the initiatives the Government of Indonesia has developed since 2006 to meet national bioenergy policies and mandates. In terms of installed capacity and utilization, bioenergy ranked top among NREs in Indonesia. Hydro, geothermal, mini- and micro-hydropower, solar, wind, and wave power were next. Bioenergy is primarily reliant on biological feedstocks, the four most significant of which being microalgae, animal manures, biomass from agriculture, and biomass from forestry. The production of bioenergy from municipal waste is another option. Indonesia has a biomass energy resource potential of around 32,654 megawatts (MW) and an installed capacity of 1,626 MW, according to the Technology Assessment and Application Agency. People are expected to use bioenergy, particularly biofuel, biogas, and biomass. For example, it was predicted that biofuel consumption will increase from 6.4 million kilolitres (kl) in 2018 to 52.3 million kl. By 2030, it is predicted that more than half of Indonesia's renewable energy consumption would come from bioenergy-based heat and liquid fuels. Bioenergy for livelihoods and landscape restoration Research on bioenergy is essential for laying the groundwork for adoption and implementation at a larger scale. Projects for the study and development of bioenergy must be linked.

According to studies, it is important to look at the integration of upstream and downstream components, including bioenergy feedstocks and related industries, as well as bioenergy research and development, for successful bioenergy development. Recent studies have analysed the sustainability of bioenergy in Indonesia. The number of studies that assess the progress of bioenergy projects, as well as the forms of bioenergy and their geographic distribution, is quite small. The chapter aims to present developments in Indonesian bioenergy research and development activities, including their geographic distribution, and to evaluate the enabling conditions and implementation barriers for further adoption. The chapter also seeks to draw conclusions from relationships in the development of bioenergy and determine their contextual significance, potential for multiple benefits, and alignment with development and sustainability agendas.

This chapter expands upon the policy brief Exploring the Potential of Bioenergy in Indonesia for Multiple Benefits, which was based on the International Workshop on Developing Science- and Evidence-Based Policy and Practice of Bioenergy in Indonesia within the Context of Sustainable Development held in 2017. The workshop's objectives are to improve awareness of the current state of bioenergy research and development, identify gaps, bottlenecks, and barriers to the development of bioenergy value chains, and uptake, and provide input and recommendations for creating enabling conditions to address difficulties. This chapter adopts the four major sections in the policy brief and provides an overview of the sizable body of work published from 2005 to 2018, then goes on to provide a thorough evaluation and discussion of significant developments. The chapter concludes with an overview of the challenges in producing bioenergy feedstocks, particularly in agriculture, forestry, and bioenergy development, in relation to potentials for multiple benefits, conflicting applications, and other development goals.

The overall primary energy supply in Indonesia is Mtoe, the final consumption of electricity is Mtoe, and the total energy output in Indonesia is 450.79 Mtoe. Fossil fuels have historically dominated energy use in Indonesia. Although it remained a member of OPEC until 2016, the country once a significant oil exporter in the world has since switched to becoming a net oil importer, making it the only net oil importer member of the group. With million tons of proven coal reserves as of 2016, Indonesia is the 11th country with the most coal reserves in the world and the fourth-largest producer and exporter of coal worldwide. Additionally, Indonesia has a huge renewable energy potential of roughly 417,8 GW, made up of solar, wind, hydro, geothermal, ocean current, and bioenergy, but only 2,5% of this potential has been utilized. Additionally, Indonesia and Malaysia produced more than 200 billion cubic meters of gas annually in 2016, accounting for two-thirds of the gas reserves in ASEAN.

The National Energy General Plan (RUEN), which was published in 2017 and the Paris Agreement, are just two of the commitments the Indonesian government has made to increase the use of renewable energy sources and lower greenhouse gas emissions. According to the RUEN, Indonesia aims to have 23% of its total energy mix made up of new and renewable sources by 2025 and 31% by 2030. Additionally, the government commits to reducing its greenhouse gas emissions by 29% by 2030 compared to the baseline scenario of business as usual, and up to 41% with international assistance. Indonesia has a number of prominent renewable energy projects, including the 145 MW Cerati Floating Solar Power Plant in West Java, which will be the largest Floating Solar Power Plant in Southeast Asia, and wind farms of 75 MW in Sidemen Rapping Regency and 72 MW in Jene onto Regency. Due to price restrictions on supply for domestic power plants and the abundance of medium and low-quality thermal coal in Indonesia, various ways to produce electricity are hindered. The expected lifespan of Indonesia's coal reserves at current production rates is more than 80 years. Indonesia was the second-largest coal exporter in the world in 2009, shipping coal to nations including China, India, Japan, Italy, and others. The coal mining centres are in South Sumatra and Kalimantan. Indonesia's production has increased dramatically in recent years, rising from just over 200 mill tons in 2007 to over 400 mill tons in 2013. The chair of the Indonesian Coal Mining Association said the production might reach 450 mill tons in 2014 in 2013.

DISCUSSION

Bioenergy research

Numerous studies have been done on potential feedstocks for bioenergy production in Indonesia. These include biomass and feedstock for the agricultural, non-wood, and forestry industries. Indonesia studied over 80 different types of feedstocks between the years of 2005 and 2018. These products' feedstocks included biodiesel, bioethanol, biooil, biogas, bio pellets, charcoal briquettes, and syngas. A considerable portion of research studies concentrated on agricultural feedstock, with oil palm making up the greatest portion. Paddy, sugarcane, coconut, cassava, maize, sorghum, and other sources of lignocellulose were next in importance. The Agriculture Research and Development Agency of the Ministry of Agriculture has been researching the creation of biodiesel from crude palm oil (CPO) since 1992. Oil palm bioenergy has a larger energy potential than other feedstocks because of its reliable supply and adequate infrastructure. The majority of forestry feedstock research has been on lignocellulose sources and oil-containing seed sources. Several research between 2005 and 2018 looked at the bioenergy potential of non-timber forest products (NTFPs), including nipa plans, sago black sugar palm (Arenga pinnata), and bamboos (Babesiae). Additional resources that have been thoroughly studied since 2007 include animal manure, microalgae, municipal solid waste (MSW), and waste cooking oil (WCO).

The bioenergy goals outlined in Presidential Regulations Nos. (1) through (3) on the National Energy Policy and their amendment under Government Regulation No. The Ministry of Agriculture has financed research on the bioenergy potential of biomass from sources such oil palm, maize, cassava, sugar, jatropha, candlenuts, and animal waste. The Energy Self-sufficient Villages (DME) program was additionally expanded to incorporate a project created by the Forestry and Environmental Research, Development and Innovation Agency

(FOERDIA) under the Ministry of Environment and Forestry (Moe) to produce bioethanol from black sugar palm in the Bolero District of Gorontalo Province. Although most studies on oil palm biomass have concentrated on the possibility of using palm oil for biodiesel, some have also looked at the possibility of using it for bio-pellets, bioethanol, biogas, syngas, and bio-oil. Oil palm lignocellulose residues are chemically broken down to create bioethanol, bio-oil, and bio-pellets, while palm oil mill effluent (POME) is processed to create biogas for energy. For instance, the Indonesian Institute of Sciences (LIPI) was able to turn 1,000 kg of oil palm empty fruit bunches (EFBs) into 150 litters of 99.95% fuel grade ethanol. Since the CPO Fund was formed in 2015, research funding for using oil palm for 12 has increased. Bioenergy for livelihoods and landscape restoration. Research and development for oil palm are supported by the fund.

The CPO Fund provided IDR 10.68 trillion for oil palm research, a 22-fold increase from IDR 476 billion in 2015. Paddy, which came in second place after oil palm in terms of agricultural biomass investigated for bioenergy, was mostly used to generate power by gasification, thermal incineration, or microbial fuel cell (MFC) technologies, which convert syngas and heat into electricity. The potential for employing rice husk bio-pellets and rice straw as sources of biomass for energy production has also been studied. In the forestry business, investigations on lignocellulose from woody biomass have focused on plants like calinda (Calliandra Cal thyrsus), acacia sp., and albizzias (Paracerianthes falciparum), primarily for the creation of bio-pellets that provide electricity, power, and heat. In the interim, trials on sea mango or Alexandrian laurel seeds and fruits that produce oil were common. For instance, the DME program has made extensive use of jatropha biodiesel as a result of the Bandung Institute of Technology's successful investigations from 2005 to 2007. Additionally, NTFP biomass has been studied.

Borassus flabellifer sap has been studied for the production of bioethanol Hidayat employing fermentation techniques on the sap of the black sugar palm, palmyra palm, and nipa palm. It has been discovered that each of these plants has the ability to make bioethanol. Also thoroughly investigated as biomass sources include municipal solid waste (MSW), waste cooking oil (WCO), animal manure, and microalgae. The potential of animal dung to generate biogas was examined, whereas MSW's capacity to generate power was examined. Both WCO and microalgae were reported to create biodiesel after chemical processing. such as Nanno-chloropsis species, Chlorella species, and Scenedesmus species. great potential and LIPI anticipate that they will yield 10 times as much biodiesel overall per acre as CPO biodiesel. Municipal trash, rubber, paddy, oil palm, coconut, woody biomass, and municipal waste were the key sources for hydrocarbon syngas that were taken into consideration. The majority of the biodiesel research has been conducted in Java, Sumatra, Kalimantan, Sulawesi, Papua, Maluku, Nusa Tenggara, and Bali, as can be seen when analysing the geographical distribution of research and development on bioenergy feedstocks. These regions might begin generating biodiesel since they have access to feedstock. They have also been used as bioethanol research locations. The provinces of Riau, Lampung, and Jambi are the most sought-after sites for bio-oil research due to the abundance of feedstocks there, including oil palm, paddy, woody biomass, and MSW.

Sustainable expansion

an organizational strategy that aims to achieve human development goals while preserving the ability of natural systems to offer humanity vital ecological services and natural resources. A society that meets human needs while preserving the planetary integrity and stability of the natural system is the desired outcome. Sustainable development aims to strike a balance between social progress, environmental protection, and economic expansion. In the Brundtland Report from 1987, development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs was defined as sustainable development. Currently, the concept of sustainable development emphasizes environmental preservation for future generations as well as social and economic progress. The Rio Process, which was the first step toward institutionalizing sustainable development, was started at the 1992 Rio de Janeiro Earth Summit. The UNGA adopted the Sustainable Development Goals in 2015, emphasizing their interdependence and unity as necessary for achieving sustainable development on a global basis. The 17 UNGA goals address global problems like poverty, inequality, climate change, environmental degradation, peace, and justice. Sustainable development is associated with the normative concept of sustainability. According to UNESCO, sustainable development refers to the many strategies and routes taken to achieve sustainability, even though it is generally thought of as a long-term goal. The concept of sustainable development has been challenged in a number of ways. While some find it ludicrous and see development as fundamentally unsustainable, others are disappointed with the lack of progress that has been done thus far. The problem is exacerbated by the ambiguous definition of the term development [4], [5].

The development of the concept

Sustainable development is built on the sustainable forest management theories that were developed in Europe in the 17th and 18th centuries. John Evelyn wrote in his essay Sylva from 1662 that sowing and planting of trees had to be regarded as a national duty of every landowner, in order to stop the destructive over-exploitation of natural resources in response to the growing concern over the depletion of lumber supplies in England. Elector Frederick Augustus I of Saxony's senior mining administrator Hans Carl von Carlowitz authored Sylviculture Economics, a 400-page thesis on forestry, in 1713. Building on the views of Evelyn and French minister Jean-Baptiste Colbert, von Carlowitz proposed the idea of maintaining trees for sustainable productivity. His work influenced others, most notably Georg Ludwig Hartig and Alexander von Humboldt, and eventually aided in the advancement of the science of forestry. This then had an effect on people like Gifford Pinchot, the first chief of the US Forest Service, whose approach to forest management was inspired by the idea of wise use of resources, and Aldo Leopold, whose land ethic was influential in the establishment of the environmental movement in the 1960s.

After the 1962 release of Rachel Carson's Silent Spring, the expanding environmental movement called attention to the connection between economic development and environmental destruction. Kenneth E. Boulding underlined the necessity of the economic system adapting to the ecological system's limited supply of resources in his seminal 1966 article The Economics of the Coming Spaceship Earth. The 1968 paper by Garrett Hardin that popularized the term tragedy of the commons was another important development. Sustainability and development were not inextricably linked in the modern sense until the early 1970s. Ernst Basler explained in his German-language book Strategy of Progress from 1972 how the sustainability principle of preserving forests for future wood supply may be immediately linked to the relevance of preserving environmental resources to sustain the globe for future generations. The relationship between environment and development was formally established in the same year by the systems dynamic simulation model from the renowned study on limits to growth. A group of scientists from the Massachusetts Institute of Technology, led by Dennis and Donella Meadows, wrote it for the Club of Rome. The authors stated in their description of the projected state of global equilibrium that they were looking for a model output that represents a world system that is sustainable without sudden and uncontrollable collapse and capable of satisfying the basic material needs of all of its people [6]-[8].

When an MIT research team prepared ten days of hearings on Growth and Its Implication for the Future for the US Congress in 1975, those were the first hearings on sustainable development. The International Union for Conservation of Nature first used the term sustainable development in a worldwide conservation strategy they released in 1980, which also included one of the earliest references to it as a top priority on a global scale. Five conservation principles were outlined in the United Nations World Charter for Wildlife, which was published two years later, as a framework for determining how human activity impacts wildlife. The Earth Charter, produced in 1992 by the UN Conference on Environment and Development, outlines the development of an egalitarian, sustainable, and peaceful global civilisation in the twenty-first century. Since the publication of the Brundtland Report, the concept of sustainable development has expanded beyond the intergenerational paradigm to place a greater emphasis on the pursuit of socially inclusive and environmentally sustainable economic growth. The agenda 21 action plan for sustainable development recognized information, integration, and participation as crucial building blocks to assist nations in developing in a way that respects these interconnected pillars. The importance of widespread public engagement in decision-making is also emphasized by Agenda 21 as a requirement for attaining sustainable development. With the Rio Protocol, the world finally reached consensus on a sustainable agenda. In fact, a worldwide consensus was promoted by ignoring specific goals and useful specifics. The Sustainable Development Goals (SDGs) now include defined targets but no sanctions, in contrast to the Rio Process's recommendations.

Critique

Opposition to the idea of sustainable development has existed for a while and is still present today, especially when it comes to the issue of what should be retained in such development. Since any positive rate of exploitation will eventually result in the exhaustion of the earth's finite supply, it has been argued that there is no such thing as sustainable use of a non-renewable resource; from this viewpoint, the Industrial Revolution as a whole is viewed as unsustainable. The argument for sustainable development is based on the idea that civilizations must manage three different types of capital: economic, social, and natural. These capitals may be used irreversibly and may not be able to be replaced. Economic capital cannot always take the place of natural capital. While it is possible to replace some natural resources, it is highly unlikely that humanity will ever be able to replace ecosystem services, such as the ozone layer's protective role or the Amazonian forest's role in regulating temperature. The idea of sustainable development has drawn criticism from a variety of angles. Others are dissatisfied with the lack of development so far demonstrated, finding it absurd or an oxymoron and viewing it as inherently unsustainable.

The ambiguous definition of development as a term makes the issue worse. Such a perspective runs counter to the majority's view among academics, who commonly acknowledge that the principles of capitalism are harmful to the long-term sustainability of human life. A few objections to the Brundtland notion of sustainable development are as follows: Governments promoted the idea that we might have societal prosperity, economic prosperity, and environmental health all at the same time, which has created the possibility of underplaying sustainability. No new moral code is required. This supposedly weak type of sustainability is supported by companies and governments, yet it is utterly incorrect and not even weak because preserving the planet's ecological integrity cannot be substituted. A sustainable city is one where environmental effect is reduced through urban development and management. Imagine a city where there are more pedestrians and bicycles than cars, rooftop gardens, solar-powered structures, parks, and other green spaces. This is an eco-city. This doesn't offer a look into the future. Better environmental management and greener urban environments are the main goals of smart cities [9].

Ecological footprint and human impact on the environment

destruction of the Amazonian rainforest. Because of increased human encroachment into wilderness areas, increased resource extraction, and increased risks to biodiversity, deforestation and rising road construction in the Amazon rainforest are of concern. Sustainability in terms of the environment refers to how the natural world endures, diversifies, and continues to be productive. Environmental factors, such as the quality of the air, water, and climate, are particularly important because natural resources are derived from them. In order to maintain environmental sustainability, society must plan activities to meet human needs while preserving the earth's life support systems. For instance, this calls for conserving water, using renewable energy sources, and obtaining wood from forests at a pace that preserves biodiversity and biomass.

When all of nature's resources natural capital are depleted more quickly than they can be replenished, an unsustainable scenario result. Sustainability suggests that human activity only depletes natural resources at a rate that allows for their natural restoration. Carrying capacity and the idea of sustainable development are intertwined. The incapacity to sustain human life is the long-term result of environmental degradation, according to theory. Herman Daly wrote about some key practical aspects of sustainable development in his 1990 book: renewable resources should yield a sustainable yield; the rate of harvest should not exceed the rate of regeneration; for non-renewable resources, there should be corresponding development of renewable substitutes; the generation of waste should not exceed the capacity of the environment to absorb it [10]– [12].

CONCLUSION

In Indonesia, the use of bioenergy has significant development potential. It is associated with forestry, agriculture, and waste management in urban areas. Enabling conditions policies and laws governing incentives, price guarantees, and subsidies and related governance structures at various levels of administration must be established in order to realize existing potential. The results of the research should be used in pilot projects and wider application. To create innovations and business models at acceptable scales and in the most appropriate circumstances, research and development organizations need to work in conjunction with the commercial sector, state-based off takers, and other practitioners. The latter may, for instance, refer to specific geographic regions that are economically and socially conducive to the growth of bioenergy and require land rehabilitation. In order to increase profitability, future research must take PLN and PERTAMINA's power and fuel requirements into account. Finally, planning for the development of bioenergy should take into account the Review of Bioenergy Initiatives in Indonesia for Multiple Benefits and Sustainable Development, Green Growth Planning, Climate Change Mitigation and Adaptation, Degraded Land Restoration, and the Achievement of Sustainable Development Goals. Strategic mapping is crucial to ensuring synergy with programs and initiatives on the ground as well as combining existing efforts, such as restoration or REDD. The Bonn Challenge, a global initiative to restore 350 million hectares of degraded and deforested land, as well as Indonesia's Nationally Determined Contribution and greenhouse gas emission reduction commitments under the United Nations Framework Convention on Climate Change, could both benefit from the development of bioenergy in that country.

REFERENCES:

[1] S. C. Slater, B. A. Simmons, T. S. Rogers, M. F. Phillips, K. Nordahl, and B. H. Davison,The DOE Bioenergy Research Centers: History, Operations, and Scientific Output, *Bioenergy Res.*, 2015, doi: 10.1007/s12155-015-9660-8.

[2] W. Liu *et al.*,Profile of developments in biomass-based bioenergy research: A 20-year perspective, *Scientometrics*, 2014, doi: 10.1007/s11192-013-1152-z.

[3] T. Richardson,Overcoming barriers to sustainability in bioenergy research, *Environ. Sci. Policy*, 2013, doi: 10.1016/j.envsci.2013.04.004.

[4] E. Holden, K. Linnerud, and D. Banister,The Imperatives of Sustainable Development, *Sustain. Dev.*, 2017, doi: 10.1002/sd.1647.

[5] E. Sinakou, J. Boeve-de Pauw, M. Goossens, and P. Van Petegem,Academics in the field of Education for Sustainable Development: Their conceptions of sustainable development, *J. Clean. Prod.*, 2018, doi: 10.1016/j.jclepro.2018.02.279.

[6] H. Hedges,Vygotsky's phases of everyday concept development and the notion of children's 'working theories,' *Learn. Cult. Soc. Interact.*, 2012, doi: 10.1016/j.lcsi.2012.06.001.

[7] P. Warwick,Reflective practice: some notes on the development of the notion of professional reflection, *Busy Teach. Educ. Guid.*, 2007.

[8] F. Balibrea,On the origin and development of some notions of entropy, *Topol. Algebr. its Appl.*, 2015, doi: 10.1515/taa-2015-0006.

[9] D. Fassin,The endurance of critique, *Anthropological Theory*. 2017. doi: 10.1177/1463499616688157.

[10] WWF, *Living Planet Report - 2018: Aiming higher.* 2018.

[11] C. G. Daughton and I. S. Ruhoy,The afterlife of drugs and the role of pharmEcovigilance, *Drug Safety*. 2008. doi: 10.2165/0002018-200831120-00004.

[12] F. Yang, B. Matsushita, W. Yang, and T. Fukushima,Mapping the human footprint from satellite measurements in Japan, *ISPRS J. Photogramm. Remote Sens.*, 2014, doi: 10.1016/j.isprsjprs.2013.11.020.

CHAPTER 3

MAPPING THE BIOENERGY POTENTIAL OF DEGRADED LANDS IN INDONESIA

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ABSTRACT:

This study performed a spatial analysis in Indonesia to determine degraded regions that may be suitable for growing the biomass species Calliandra clothiers and Glipizide sepias as well as the biodiesel species Caliphyllid epiphyllum, *Pangamic pinnata*, and Retails tripeman. Food production, carbon sequestration, and the preservation of native plants and biodiversity are constrained on degraded areas. Therefore, by enabling society to meet rising energy demands and secure a new renewable energy source, assessing their capacity to produce bioenergy can aid in sustainable development. Two scenarios were used to further analyse the identified potential degraded areas: one examined the growth of all five species and the other examined the growth of solely the biodiesel species. According to study findings, Indonesia has over 3.5 million acres of degraded land that may be suitable for these species. The scenario with all five species showed that these areas may yield enough biomass for biodiesel. According to the biodiesel-species-only scenario, these lands have the ability to produce 10 PJ of biodiesel annually. Furthermore, because of their small land sizes, many of these degraded sites were unable to support economies of scale for the production of biofuels. The study's findings help to identify areas with restricted functions, model the growth of species used for biofuels on regional lands, and calculate the carbon stocks of recovered degraded lands in Indonesia.

KEYWORDS

Biodiesel, Biomass, Degraded Land, Energy, Indonesia.

INTRODUCTION

The production of bioenergy from degraded lands could aid society in meeting its rising energy needs and offer a new source of sustainable renewable energy. These potential advantages have raised awareness of the viability of using degraded lands to produce bioenergy throughout the world. For instance, Indonesia's urbanization, economic expansion, and population growth are all contributing to a rapid rise in energy demand there. Due to these factors, the Indonesian government set lofty goals in 2015 to increase its biodiesel and bioethanol consumption to 30% and 20% of total energy consumption, respectively. However, Indonesia's current biofuel production falls significantly short of these projections. In 2016, the amount of biofuel produced was only 0.05%, or 3.66 billion litters, of the total amount of fuel consumed. However, the Indonesian National Energy Council estimates that the country's average annual energy demand will rise by about 4.9%. This increase in anticipated demand has sparked curiosity in Indonesia in regards to the potential of utilizing degraded lands to produce a new source of renewable energy. However, bioenergy production needs to be sustainable in a variety of ways if it is to realize these potential advantages. Lower food production due to the development of biofuels is possible; this is particularly true for palm oil. The greatest producer and exporter of palm oil in the world is Indonesia, where it serves as a significant feedstock for the production of liquid biofuels. Additionally, the increased production of biofuel through conversion of peatlands and rainforests would release massive amounts of carbon from both above- and below-ground reservoirs and create a carbon debt for biofuels. Rich biodiversity and native ecosystems in these areas may likewise be endangered or destroyed by such development.

In order for renewable energy to be sustainable, food production, carbon stocks, biodiversity, and native vegetation should not be harmed during the generation of biofuels from degraded lands. However, due to the various definitions of degraded lands used and the numerous potential biofuel species available in Indonesia, data on the availability of such lands and their feasibility to deliver sustainable biofuel cannot be compared directly in many studies on degraded lands. Indonesia assesses degraded lands that have limited functions to produce food, to sequester carbon stocks on land, to maintain vegetation and biodiversity, and to sequester water. In fact, producing biofuel from degraded lands requires overcoming a number of challenges, including enhancing refinery capacity, developing business models for landowners and refineries, securing the property rights of the land, resolving potential stakeholder conflicts, promoting smallholder participation, competing with low-cost fuels, and minimizing potential biofuel species invasion.

However, understanding the degraded lands that are viable for biofuel production and potential biofuel species is necessary before researching these challenges. In order to determine their potential energy production, this study investigates these regions and species. 3.2 Possible Indonesian biofuel species While there are many energy crops in Indonesia, we evaluated five tree species that have the ability to produce biodiesel or biomass on degraded areas. These species can coexist without interfering with food production because they are unique to Indonesia and tolerant of harsh environments that are often unsuitable for agriculture. Bamboo and other non-woody species are purposely left out of the study because it primarily focuses on tree species for the production of bioenergy. Oil palm, a fast-growing shrub that reaches heights of 5 to 6 meters, was removed because of its significant potential to affect food. It is known as kalinda in Indonesia and is utilized for firewood and land restoration because of its quick growth and great habitat adaptability. Animal feed is another use for the shrub Palmer et al. 1994; Wulandari et al. It thrives in a variety of soil types, including acidic and sandy clays. Since C. clothiers is highly cellulosic (46-48%), fast-growing, suitable for a short rotation, and adaptable to many habitats, there is considerable interest in producing biofuel from it.

Consuming the oil has a little risk to human health. Its primary habitats are coastal areas since it can withstand windy and sandy conditions, but it may also grow inland at high elevations (Bustami et al. 2008; Ong et al. Due to this species' ability to produce up to 20 metric tons of non-edible oil per hectare, C. epiphyllum oil has been the subject of numerous studies looking at biofuel production. There is interest in producing biofuel from G. sepia because it not only grows quickly and can withstand difficult soil conditions, but also has low moisture content, high energy potential, and high carbon and volatile content. All of the plant's components, however, are toxic for consumption by humans. It can thrive in a variety of habitats, from wet tropical and subtropical areas to cooler, semiarid locations, and it can withstand salinity and drought. *P. pinnata* is a nitrogen-fixing plant that is used as a natural pesticide and fertilizer and has been the subject of numerous studies looking into the production of biofuels. It also tolerates a variety of settings. Due of its ability to reduce land erosion, it is also used for land rehabilitation. Despite the fact that one tree can produce about 25–30 kg of seeds annually, these seeds are poisonous and cannot be eaten.

Due to its high oil yield and interest in biofuel production from oil. In Indonesia, degraded lands were discovered during the initial phase of the inquiry. The project used an overlaying methodology to analyse four different types of geographic information system (GIS) data to find potentially degraded land in Indonesia. These informational pieces comprised data on highly degraded land, conservation areas, land cover, and land systems. By superimposing this spatial data with the inclusion and exclusion criteria listed below, degraded lands were identified. First, the initial size of degraded lands in Indonesia was determined using severely deteriorated land data. The Directorate General of Watershed Management and Social Forestry, which is part of Indonesia's Ministry of Environment and Forestry, created the data based on the technical specifications for creating spatial data on severely degraded land that were outlined in Regulation No. P.4/V-SET/2013. In terms of land cover, slope, potential erosion, and land productivity, these severely degraded lands illustrate the level of land degradation in Indonesia [1]–[3].

DISCUSSION

Due to Indonesia's high levels of poverty and rapid industrialization, as well as its poor governance, the country has environmental concerns that are tied to its high population density. The majority of Indonesia's vast palm oil fields are run by wealthy Singaporean firms, who also employ thousands of Indonesian natives. The overexploitation of marine resources, large-scale deforestation, much of it illegal, wildfires linked to it that cause heavy smog over parts of western Indonesia, Malaysia, and Singapore, and environmental issues linked to rapid urbanization and economic development, such as air pollution, traffic jams, garbage management, and reliable water and waste water services, are among the problems. Indonesia is the third-highest emitter of greenhouse gases in the world due to deforestation and the loss of peatlands. The survival of native and endemic species is impacted by habitat destruction, including the Sumatran orangutan and the 140 threatened and 15 critically endangered mammal species recognized by the World Conservation Union (IUCN).

Background and history

The Indonesian archipelago's natural resources have been utilized for millennia in ways that conform to well-known social and historical patterns. One cultural pattern is made up of the formerly Indianized, rice-growing peasants in Sumatra, Java, and Bali's valleys and plains; another complex is made up of the predominantly Islamic coastal commercial sector; and a third, marginal sector is made up of the upland forest farming communities that survive through subsistence swidden agriculture. These patterns can, in part, be attributed to the geographic resources there; for example, the Greater Sunda Islands' abundant coastline, often calm seas, and consistent breezes encourage the use of sailing vessels, while lush valleys and plains—at least there allow the cultivation of rice using irrigation. The interior's heavily forested hills prevent overland travel by road or water but promote slash-and-burn farming. During the 1970s and 1980s, each of these patterns of ecological and economic adaptation experienced considerable stresses due to rising population density, degraded soil, silted river beds, and water contaminated by agricultural chemicals and offshore oil drilling [4]–[6].

Marine debris

In the late 1970s, for instance, the livelihood of fishermen and those involved in related activities roughly 5.6 million people in the coastal commercial sector began to be threatened by declining fish stocks brought on by the contamination of coastal waters. Fishermen in northern Java saw significant drops in their catches of some species of fish, and by the middle of the 1980s they were witnessing the worst virtual disappearance of fish in some areas. In Gresik, in northern Java, effluent from fertilizer facilities polluted ponds and killed milkfish fry and juvenile shrimp. A severe environmental catastrophe for the vulnerable Sumatran coastline occurred when oil from the Japanese super tanker Showa Maru leaked into the Strait of Malacca between Malaysia and Sumatra in January 1975. The regularly used canal now has a higher likelihood of super tanker accidents.

On the mainland, environmental issues also harmed the coastal economic sector. The issue of siltation downstream and into the sea was made worse by soil erosion brought on by highland deforestation. Without extensive and costly dredging operations, port access became increasingly difficult, if not impossible, as silt deposits covered and drowned once-vibrant coral reefs, creating mangrove thickets. Even though the overfishing of Indonesia by Japanese and American floating factory fishing boats was technically stopped there in 1982, the scarcity of fish in many formerly rich seas continued to be a major source of concern in the early 1990s. The entire supply of fish was under danger when Indonesian fishermen improved their technological capacity to catch fish [7]–[9].

Water toxicity

A large portion of the world's freshwater reserves up to 6% are found in Indonesia, because to the country's lush rainforest and tropical climate. Although this number is lower than 2017, Indonesia has been losing its forest every year, with hectares of forest being destroyed. Studies have shown that such deforestation is related to a reduction in water catchment capacity. In the meantime, the Ministry of National Development Planning of Indonesia reported that 96% of Jakarta's rivers were polluted, making the availability of clean, fresh water even more scarce. Industrial and household waste both contribute to water contamination. The Indonesian government has regulated industries where businesses must adhere to the wastewater standard. Through the 1995 implementation of a program dubbed the plan for Pollution Control, Evaluation and Rating, Indonesia was also a pioneer in the public disclosure of industrial pollution data. By giving them a grade based on their performance, PROPER encourages industries to disclose their pollution data, harming those industries' reputations. The industrial waste management standards that businesses are required to follow under current law are improved by this program.

On the other hand, households that discharge trash and wastewater from domestic activities, such as bathing, washing, open defecation, etc., to the surface water are the main cause of domestic water pollution. These actions are typically not noticed because the issue won't be as visible until eutrophication has occurred as a result of the accumulation of domestic wastewater from all residences. Residential wastewater is reportedly the main source of river pollution, according to the Environment and Forestry Ministry. Home wastewater will contribute more to the nation's overall water pollution due to population growth and urbanization, particularly in rural areas where the use of chemical detergents is rising quickly. The quality of both types of contamination affects groundwater as well as surface water. When the groundwater is relatively shallow, the chemical components from both industrial and household waste can seep through the soil and mix with the clean water. The risk of pollution will exist until the government controls household wastewater management and ensures strict implementation of the legislation for industrial waste. Additionally, despite being mandated by law, there is a lack of information dissemination related to water contamination, leaving communities vulnerable to the effects of water pollution [10], [11].

Deforestation

A second, similar set of environmental constraints among the peasants who planted rice in the plains and valleys evolved in the 1970s and 1980s. Growing population density and the associated need for arable land led to soil erosion, deforestation because of the need for firewood, and soil nutrient depletion. Fish ponds were contaminated by pesticide runoff, and some areas' water supply was damaged. Even if it seemed like national and local governments were aware of the issue, it was still necessary to strike a balance between environmental protection and the pressing needs of a population in need of food and an electorate anxious for economic growth. Significant issues occurred in Kalimantan's, Sulawesi's, and Sumatra's steep interior regions. These issues included major commercial logging-related environmental threats such deforestation, soil erosion, large-scale forest fires, and even desertification. A fire in the province of Kalimantan Timur destroyed prime tropical forest valued at least $10 billion. The timber industry's massive dead wood residue contributed to this fire's disastrous expansion. Indonesia had the highest rate of deforestation in Southeast Asia in the middle of the 1980s, maybe up to 10,000 km2 (3,900 sq mi) each year, even after ignoring the fire's catastrophic impacts.

Despite the fact that the government-sponsored Transmigration Program significantly reduced the amount of forest cover in untamed areas, in certain places the consequences of this process were lessened by planting plantations of trees like coffee, rubber, or palm in place of the original forest cover. Large sections of forest were cut down in different parts of Kalimantan, and little to no effort was made to restore them. There were reforestation restrictions in place, but they were either rarely or never implemented, leaving the exposed ground susceptible to heavy rain, leaching, and erosion. Because commercial logging permits were issued by Jakarta, the local population of the forests had little influence over how the land was used. Nevertheless, in the middle of the 1980s, the government worked with the World Bank through the Department of Forestry to design a forestry management plan. The projects resulted in the formation of a master plan by the Food and Agriculture Organization (FAO) of the United Nations, the first forest inventory since colonial times, ground-breaking forestry research, conservation and national park programs, and other achievements.

Due to the use of fires to clear land for agriculture, Indonesia generates the third-highest quantity of greenhouse gases globally, behind China and the United States.[14] Peatlands and old-growth rainforests are carbon sinks, but forest fires deteriorate them. The Reducing Emissions from Deforestation and Forest Degradation (REDD) effort, which aims to reduce carbon emissions, includes two components: monitoring the rate of deforestation in Indonesia and providing incentives for the federal, state, and local governments to halt it. The Centre for Global Development's Forest Monitoring for Action website, which now provides monthly-updating statistics on deforestation in Indonesia, is one such monitoring tool. coastal areas with low elevations and Jakarta's crowded population. The city is among those in the world that are most vulnerable to climate change's effects.

Due to its diverse geography and ecosystem, Indonesia is one of the country's most susceptible to the effects of climate change. The fact that Jakarta has been named the city with the greatest vulnerability to climate change supports this. It is also a key contributor as one of the countries that has made the largest contributions to greenhouse gas emissions because of its high rate of deforestation and reliance on coal power. With its many islands and extensive coastline, Indonesia is particularly susceptible to the effects of rising sea levels and extreme weather events including floods, droughts, and storms. Large tropical forest areas are crucial for slowing down climate change by absorbing carbon dioxide from the atmosphere. The anticipated effects on Indonesia's agriculture industry, national economy, and health are also important factors. According to the Copenhagen Accord and the Paris Agreement, Indonesia has pledged to cut its emissions. Research shows that Indonesia has a high percentage of sceptics despite the fact that climate change would have a significant impact on the country. [12]–[14].

CONCLUSION

areas might be restricted in their potential to sustain economies of scale for biofuel production and simply reflect a hypothetical maximum land area. The sizes of many degraded regions were lower than 5,000 hectares, which is regarded the smallest land size on which economies of scale from palm oil agriculture may be attained. Although palm oil is not exclusively used for biofuel production, lessons from palm oil production would assist spread of other biofuel species since palm oil has been employed as a dominating biofuel species in Indonesia. Thus, the extent of these damaged lands must be addressed in determining potential future economic models for bioenergy production in Indonesia. Furthermore, the results reveal maximum energy productivity potential, since the study projected all degraded lands will be utilized for biofuel production by planting the five biofuel species. In fact, however, this bioenergy production would be lowered by various socioeconomic problems, such as the production cost–benefit to farmers and refineries

REFERENCES:

[1] T. S. Pence, E. R. Reiter, L. J. DiNardo, and R. M. Costanzo,Risk factors for hazardous events in olfactory-impaired patients, *JAMA Otolaryngol. - Head Neck Surg.*, 2014, doi: 10.1001/jamaoto.2014.1675.

[2] A. Darzi, S. M. Gaweesh, M. M. Ahmed, and D. Novak,Identifying the causes of drivers' hazardous states using driver characteristics, vehicle kinematics, and physiological measurements, *Front. Neurosci.*, 2018, doi: 10.3389/fnins.2018.00568.

[3] R. Ermawati and L. Hartanto, PEMETAAN SUMBER PENCEMAR SUNGAI LAMAT KABUPATEN MAGELANG, *J. Sains & Teknologi Lingkung.*, 2017, doi: 10.20885/jstl.vol9.iss2.art3.

[4] M. Murray,The pre-history of health psychology in the United Kingdom: From natural science and psychoanalysis to social science, social cognition and beyond, *J. Health Psychol.*, 2018, doi: 10.1177/1359105317705879.

[5] N. C. Hayes,Marriage is perseverance: Structural violence, culture, and AIDS in Malawi, *Anthropologica*, 2016, doi: 10.3138/anth.581.A06.

[6] A. Hunter Dupree,Yellowstone's history: A backdrop to the nation's and the author's scientific development, *Technol. Soc.*, 1994, doi: 10.1016/0160-791X(94)90014-0.

[7] D. Xanthos and T. R. Walker,International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review, *Marine Pollution Bulletin*. 2017. doi: 10.1016/j.marpolbul.2017.02.048.

[8] R. E. J. Schnurr *et al.*,Reducing marine pollution from single-use plastics (SUPs): A review, *Mar. Pollut. Bull.*, 2018, doi: 10.1016/j.marpolbul.2018.10.001.

[9] H. A. Gasim, A. M. Hashim, P. Z. M. Bakri, M. Z. Samsuri, N. L. A. Rais, and N. D. M. Noor,Marine pollution at northeast of penang island, *Res. J. Appl. Sci. Eng. Technol.*, 2013, doi: 10.19026/rjaset.6.3955.

[10] Q. Wang and Z. Yang,Industrial water pollution, water environment treatment, and health risks in China, *Environ. Pollut.*, 2016, doi: 10.1016/j.envpol.2016.07.011.

[11] X. Meng *et al.*,An ontology-underpinned emergency response system for water pollution accidents, *Sustain.*, 2018, doi: 10.3390/su10020546.

[12] K. Kardono,CONDITION OF WATER RESOURCE IN INDONESIA AND ITS ENVIRONMENTAL TECHNOLOGY, *J. Air Indones.*, 2018, doi: 10.29122/jai.v3i2.2331.

[13] W. Bogale,Preparation Of Charcoal Using Agricultural Wastes, *Ethiop. J. Educ. Sci.*, 2010, doi: 10.4314/ejesc.v5i1.56314.

[14] A. Gasparatos, P. Stromberg, and K. Takeuchi,Sustainability impacts of first-generation biofuels, *Anim. Front.*, 2013, doi: 10.2527/af.2013-0011.

CHAPTER 4

UNDERSTANDING LANDOWNER ATTITUDES IN INDONESIA TOWARDS BIOENERGY DEVELOPMENT ON DEGRADED LANDS

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ABSTRACT:
There are many tree species that show potential for bioenergy and regenerating degraded land. Indonesia has the chance to meet its rapidly rising energy needs while creating productive landscapes by using degraded land for bioenergy production. However, without the involvement of landowners, bioenergy production is not feasible. This study examines replies from 150 landowners in Bunton Village, Central Kalimantan, who had experience with fire, in order to analyse the factors influencing choices for restoration tree species. According to the findings, 76% of landowners chose well-known species with ready markets, like Albizia chinensis and Hevea Brasiliense', for the rehabilitation of degraded land, whereas just 8% favor Caliphyllid epiphyllum L. for the generation of bioenergy. Because they had additional sources of income, had moved from Java, where armlong is common, or preferred agricultural extension to advance their technical abilities, the second group of landowners indicated a capacity to deal with the uncertainties of the bioenergy market. These findings aid in establishing crucial preconditions for a bottom-up approach to bioenergy production on degraded land in Indonesia, including the use of common bioenergy species, agricultural extension assistance for capacity building, and a stable bioenergy market for landowners.

KEYWORDS:

Bioenergy, Deforestation, Forest, Landowners, Production.

INTRODUCTION

Numerous studies have uncovered factors that influence landowners' decisions regarding bioenergy plants, like Eales Guineans and Allophylus epiphyllum L. (ambling) in Indonesia. Factors influencing smallholder choices for palm oil in Jambi, Sumatra, may include direct profits, a lack of complicated technical requirements for oil palm cultivation, high investment returns, and collaborations with big businesses and banks. According to Ingrained and

Grundmann, smallholders in the Mandailing Natal and Labuan Batu districts of North Sumatra were strongly influenced to convert their rice fields to oil palm plantations by cash income and loans. According to Amir and colleagues, farmers in Mandala Sari Village, West Java, planted jatropha in their mixed gardens and rice fields because they anticipated receiving high incomes. According to Urano et al., the cost of bioenergy, technological advancement, project roles, and local leaders' support were all factors that affected the level of community participation in bioenergy production in the Central Javan villages of Bullauns and Pasture.

Stumpily et limply that larger income and shorter contracts would improve the possibility of farmers in Central Kalimantan's Malik and Panda Batu subdistricts switching to bioenergy production. Additionally, they suggest that farmers from various ethnic origins can have diverse preferences for bioenergy crops. assert that the traditions and cultures of landowners influence their choices about the development of bioenergy. The Energy Self-Sufficient Villages program identifies a number of obstacles facing landowners in Indonesia who produce or want to generate bioenergy feedstocks. Despite being pertinent to a variety of bioenergy production stakeholders, these difficulties highlight necessary conditions for landowners, such as: a bottom-up approach allowing their participation during program development; a stable market in which to sell bioenergy feedstocks; technical guidelines and capacity building; stable and high levels of production of bioenergy feedstocks; low cost of bioenergy production; low levels of stakeholder conflicts; and technological advancement of bioenergy production. According to Malihoudis et al., the plan's execution was hampered by low levels of community involvement, a lack of equipment for processing bioenergy feedstock, a lack of technical guidelines, high production costs, and a small market for selling seed oil. According to Urine et al., the top-down nature of the strategy made it difficult for communities to participate over the long run. According to Sanjukta, the idea faced difficulties because to a tiny market, erratic agricultural production, and a lack of technological research. Fatimah reveals that stakeholders believed that the program's failure was mostly due to low productivity and insufficient collaboration amongst institutions. Complex village-level bureaucracy and a range of stakeholder interests, according to Amir et al., were significant roadblocks to project implementation. Additionally, they claim that a major obstacle to small landowners participating in bioenergy production was a lack of suitable acres for growing bioenergy crops. Exploring the viability of a bottom-up approach to bioenergy production on degraded land in Indonesia can learn from all of these problems.

We did a study to find out what restoration species landowners want for deteriorated areas and what they think of bioenergy. We conducted a preparation visit in June 2016 to assess village conditions and speak with key village informants about the 2015 fire and haze tragedy, rubber plantation costs and the current state of the market, and landowners' plans for rebuilding their destroyed properties. Three species were chosen as acceptable restoration species for the village as a result of the tour: sentons Sengon was chosen for timber production since it was becoming more well-known as a valuable species in the village. Additionally, the Hunan Masyarakat (HKM) social forestry project run by the Ministry of Environment and Forestry promoted senton production. Through this scheme, the government issues farmers 35-year permits to collect wood from communal plantation forests. Rubber production has always been a major economic issue in the hamlet, and villagers frequently use old rubber trees as cooking fuel. This is why the rubber tree was chosen.

It has been determined that armlong is an appropriate species for bioenergy production. The bioenergy species was deemed pertinent for gauging landowners' perceptions of the potential for bioenergy production because it was new to the hamlet. According to reports, Nambung produces biodiesel that is most similar to diesel oil, can replace diesel fuel without the need to modify engines, and adapts well to damaged terrain, including peatland. Furthermore, it complies with Indonesia's national standard. The final poll included questions about perceptions of bioenergy, land management plans, fire coping mechanisms, and demographic data. The first segment's questions centered on fundamental sociodemographic data, such as educational attainment, household income, and ethnic background. Respondents were questioned about their personal experiences with land degradation brought on by fire in the second question.

The fourth section asked participants to select which of the three species they would prefer to be used to restore their degraded fields. The third section asked participants about methods for managing degraded farmland. Additionally, participants had the option of choosing none of the three species. Each participant received a brief presentation on the key traits of the three species, based on literature research and expert consultations, before being asked about their decisions. In order to increase comprehension when providing species descriptions, visual aids were used. As bioenergy production was mostly favoured by landowners who could afford a market risk, either because they had other occupations or other sources of income, the bioenergy market should be steady for landowners. In other words, landowners believed that there was still market uncertainty for the development of bioenergy, indicating a commercial risk. Due to their limited ability to bear the risk associated with bioenergy production, landowners who were solely dependent on farming and had no alternative source of income had little opportunity to favor bioenergy development [1]–[3].

Descriptive statistics that showed the majority of landowners (88%) disliked bioenergy production and that many of them (76%) had no other jobs and just a small percentage (15%) had additional business profits supported this. This caused them to be more wary of any market dangers associated with farming. Other studies that claim that the failure of the Energy Self-Sufficient Villages program was largely due to the lack of markets in which to sell bioenergy feedstocks and that farmers involved in the program preferred non-energy crops because they have stable markets support the significance of a stable market. Therefore, for a bottom-up strategy to boosting bioenergy production on degraded lands in Indonesia, a stable market is a crucial requirement.

DISCUSSION

Deforestation in Indonesia refers to the long-term loss of trees and vegetation throughout much of the nation; it has had significant negative effects on the environment and the socioeconomic system. Indonesia comes third in terms of species after Brazil and the Democratic Republic of the Congo and is home to some of the most ecologically diverse woodlands in the world. Indonesia was still heavily wooded in 1900, with forests covering 84 percent of the nation's total geographical area. In the 1970s, deforestation accelerated, and it has continued to worsen ever since. By the end of the 20th century, the estimated forest cover, which was 170 million hectares in 1900, had decreased to less than 100 million hectares. In 2008, it was predicted that Indonesia's tropical rainforests would vanish within ten years. Up to 80% of Indonesia's total logging is allegedly done illegally [4]–[6].

Huge international pulp companies like Asia Pulp and Paper have cleared large tracts of Indonesian forest and replaced them with plantations. Farmers and plantation owners frequently decimate forests. Logging is another significant factor in deforestation, with demand coming primarily from China and Japan. Deforestation rates considerably increased as a result of agricultural expansion and transmigration schemes that sent large numbers of people into rainforest regions. Academics occasionally refer to Indonesia's extensive deforestation and other environmental damage as an ecocide. Indonesia is now the third-largest producer of greenhouse gases in the world, after China and the US, due to logging and forest fires lit to clear land for farming. High-capacity carbon sinks, such as old-growth rainforest and peatlands, are frequently destroyed by forest fires. To help fight this, Indonesia put a freeze on new logging contracts. Given that the rate of deforestation kept increasing, this appeared to be ineffective in the short run. By, Indonesia had surpassed Brazil as the country with the fastest rate of forest removal in the world.

History

The more than 17,000 islands that make up the Indonesian archipelago are home to some of the world's most biodiverse forests. 84% of the total land area was covered by forest in 1900. 1950 saw just a limited amount of tree crops planted in plantations and smallholder plantings. By that time, it is predicted that there will be 145 million ha (hectares) of main forest, 14 million ha (hectares) of secondary forest, and tidal forest. Indonesia capitalized on this valuable resource in the beginning of the 1970s by establishing the nation's wood processing industries. Indonesia is now the world's ninth-largest pulp producer and eleventh-largest paper manufacturer, thanks to an increase in production capacity of about 700% between the late 1980s and 2000 [7]–[9].

The rate of deforestation keeps rising. According to the President Susilo Bambang Yudhoyono's 2009 State Environment Report, there were 32,416 fire hotspots in 2009, up from just 19,192 in 2008. The Environment Ministry cited land removal as the primary cause of the fires and attributed the increase to inadequate law enforcement and a lack of local authority control. In Indonesia, 20% of the forest area had been lost between 1990 and 2000 (24 million ha), and by 2010, just 52% of the total land area had been covered by trees (94 million ha). The rate of deforestation increased even after a ban on new logging agreements was put in place in 2010, reaching an estimated 840,000 hectares in 2012 and surpassing deforestation in Brazil. In Indonesia, deforestation peaked in 2016 and then decreased by about 30%. Studies attribute the decrease toa policy mix including bans on primary forest clearing and peat drainage, a review of land concessions, and a moratorium on new palm oil plantations and mines as well as to oil palm sustainability certification programs for forests on existing plantations. In Indonesia, 2.4 million hectares of community forest titles were also given out, but a study could find little proof that these initiatives stopped deforestation.

Illegal clearing of land

On October 5, 2006, a NASA Terra satellite image showed thick smoke hovering above the island of Borneo. The fires, which mostly result from land clearance and other agricultural fires but can also escape control and burn into forests and peat bog areas, occur every year during the dry season. According to a 2007 study by the United Nations Environment Program, between 73% and 88% of the timber harvested in Indonesia is the consequence of illegal logging. According to later estimates, between 40% and 55% of the timber harvested in Indonesia comes from illegal logging. According to study, 81% of Indonesia's forest conversion for palm oil was illegal, and the country's palm oil enterprises only adhered to national laws and regulations in less than 20% of cases, according to the Supreme Audit Agency of Indonesia.

Deforestation is the result of private companies that are economically motivated by the need for timber on local and regional markets. By wrongly adopting cost-effective yet environmentally ineffective deforestation practices like forest fires to clear the land for agricultural uses, these agro-industrial firms frequently violate basic legal requirements. According to the 1999 Forestry Law, businesses must receive approval from authorities in various regions with an IPK permit, or a timber harvesting authorization, in order for their deforestation activities to be legally sanctioned. Many of these companies may circumvent this red tape in order to increase revenue by engaging in illegal logging activities, which undermines efforts to save forests in sizable developing nations like Indonesia where there is weak law enforcement. Small-scale subsistence farmers in rural areas with little formal education use a crude method known asslash-and-burn to continue their agricultural pursuits. This rudimentary agricultural strategy contains the felling of forest trees before a dry season and, subsequently, the burning of these trees in the next dry season to supply fertilizers to increase their crop operations.

The same piece of land is subjected to this agricultural method over and over again until it has lost all of its nutrients and is unable to support agricultural output. These farmers will then relocate to another piece of property and continue to employ their slash-and-burn technique there. The problems with forestry sustainability in developing countries like Indonesia are exacerbated by this contributing sociocultural factor to deforestation. The Indonesian government's efforts to stop deforestation have largely come under political criticism. The state's crackdown on illegal forestry operations is viewed with mistrust due to corruption among local Indonesian officials. The acquittal of Adelin Lis, the owner of a wood company who was accused of engaging in illegal logging, in 2008 further stoked popular outrage and drew concerns to Indonesia's political establishment. As a result of rural-to-urban migration, Indonesia's government must balance sustainable urban development with the control of deforestation. The Indonesian government's transmigration initiatives have no accountability for deforestation, and there is little data to substantiate this claim that forestry sustainability is taken into account in their development plans. This raises more concerns about the Indonesian government's ability to effectively and prudently oversee its urban development projects and forestry conservation measures. [10], [11].

Conservation initiative

The speed of deforestation in Indonesia has been tracked as part of efforts to slow down global climate change, and national and local governments have been rewarded. Reducing emissions from deforestation and forest degradation (REDD) is the generic term for these kinds of activities. Indonesia is receiving new deforestation monitoring devices. One such system, the Forest Monitoring for Action platform of the Center for Global Development, now provides monthly updated statistics on deforestation throughout Indonesia. In accordance with an agreement, Indonesia and Norway signed a declaration of intent on May 26, 2010 to impose a two-year moratorium on new logging concessions. If Indonesia abides by its commitment, it might collect up to US$1 billion. The agreement was expected to impose restrictions on Indonesia's palm oil industry and postpone or slow down plans to build a sizable agricultural estate in the province of Papua. The finalization of Indonesia's climate and forest plan, the establishment and institutionalization of the capacity to track, report, and verify reduced emissions, and the implementation of supporting legislation and institutional reforms will all take priority over other uses of funds. Norway will assist Indonesia in creating a framework to help fight corruption so that the agreement can be upheld.

Indonesia was one of about 40 nations that voluntarily endorsed the New York Declaration on Forests in 2014 as a way to slow down and eventually stop deforestation. Although other important nations, including as Brazil, China, and Russia, did not sign the agreement, it was not legally obligatory. The project was a failure, and deforestation increased both internationally and in Indonesia as a result. At the COP26 climate summit in Glasgow in November, Indonesia signed the Glasgow Leaders' Declaration on Forests and Land Use, a commitment to halt and reverse deforestation. The agreement was accompanied by pledges of funding totalling about $19.2 billion. Together, these countries account for about 85% of the world's primary tropical forests and 90% of the world's tree cover. The Glasgow Leaders' Declaration, like the earlier agreement, was made outside of the UN Framework Convention on Climate Change and is not therefore enforceable. The country's government immediately retracted the pledge after Indonesia signed it, with environment minister Siti Nuray Bakar arguing that pressuring Indonesia to zero deforestation in is plainly improper and unreasonable.

CONCLUSION

This study examined the attitudes of landowners regarding the production of bioenergy by examining the variables influencing landowner decisions for bioenergy development on degraded lands in Central Kalimantan, Indonesia. We analysed answers from 150 landowners in Bunton Village who had their properties destroyed by fire using Firth's logistic regression model. The findings showed that most landowners (76%) preferred traditional species, such as senone and rubber, for the repair of their degraded areas, whereas just a small percentage (8%) chose ambling for the generation of bioenergy. With additional jobs and income, knowledge of ambling among Javanese farmers and landowners, or a preference for learning about restoration species through agricultural extension, those choosing to produce bioenergy were characterized by their ability to manage the market risk associated with this choice. Our findings contribute empirically to the identification of three fundamental preconditions for a bottom-up approach to bioenergy production on degraded land in Indonesia: a reliable bioenergy market for landowners, the use of well-known bioenergy species, and extension support for capacity building. These criteria would be used to evaluate the viability of a bottom-up approach to the production of bioenergy. To evaluate the viability of such a plan, additional research is necessary. This research should look at a variety of variables that could affect landowner decisions, stakeholder interests, various bioenergy species, and various types of degraded lands in Indonesia.

REFERENCES:

[1] K. Gunnarsson and M. Josephson, Entrepreneurs' self-reported health, social life, and strategies for maintaining good health, *J. Occup. Health*, 2011, doi: 10.1539/joh.L10017.

[2] A. Fahrudin and N. A. S. Asy'ari, ADiTV Programming Strategy in Maintaining the Da'wah Program, *Sahafa J. Islam. Commun.*, 2018, doi: 10.21111/sjic.v1i1.1998.

[3] R. Manual, Breeding Strategies for Maintaining Colonies of Laboratory Mice, *Management*, 2007.

[4] P. Dauvergne, The politics of deforestation in Indonesia, *Pac. Aff.*, 1993, doi: 10.2307/2760676.

[5] K. G. Austin, A. Mosnier, J. Pirker, I. McCallum, S. Fritz, and P. S. Kasibhatla, Shifting patterns of oil palm driven deforestation in Indonesia and implications for zero-deforestation commitments, *Land use policy*, 2017, doi: 10.1016/j.landusepol.2017.08.036.

[6] E. SUSANTO, N. LESTARI, M. HAPSARI, and K. KRISDIYATMIKO, Driving factors of Deforestation in Indonesia: A case of Central Kalimantan, *J. Stud. Pemerintah.*, 2018, doi: 10.18196/jgp.9490.

[7] J. Stratton,Whose home; which island?: Displacement and identity in 'my island home,' *Perfect Beat*, 2013, doi: 10.1558/prbt.v14i1.33.

[8] K. R. Crooks and D. Van Vuren,Spatial organization of the island fox (Urocyon littoralis) on Santa Cruz Island, California, *J. Mammal.*, 1996, doi: 10.2307/1382685.

[9] D. L. Dixson *et al.*,Coral reef fish smell leaves to find island homes, *Proc. R. Soc. B Biol. Sci.*, 2008, doi: 10.1098/rspb.2008.0876.

[10] R. R. M. Paterson and N. Lima,Climate change affecting oil palm agronomy, and oil palm cultivation increasing climate change, require amelioration, *Ecology and Evolution*. 2018. doi: 10.1002/ece3.3610.

[11] C. Dislich *et al.*, A review of the ecosystem functions in oil palm plantations, using forests as a reference system, *Biol. Rev.*, 2017, doi: 10.1111/brv.12295.

CHAPTER 5

TROPICAL BIOENERGY CROPS: UNLOCKING HIGH-POTENTIAL ENERGY YIELDS

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ABSTRACT:

In order to combat climate change, bioenergy can provide at least 25% of the global energy demand. This will reduce emissions in the energy sector. However, there is little information on the potential of woody species to produce bioenergy and if they are suitable for silviculture on a variety of soils in the humid tropics. This substantially revised version of a short note published by Borchard et al. attempts to identify tree species appropriate for bioenergy production in such environments. To investigate environmental and forestry data on tropical tree species, data were collected from 241 papers and nine openly accessible sources. The estimated productivity of the species under examination was used to calculate the energy yield, which was then compared to a range of energy yields. As a result, their bioenergy yields fall within the range of biomass lignocellulosic energy crops grown in Europe, the USA, and Brazil. In our review, we found some high-yielding and leguminous species that might be useful in mixed stands or that are appropriate for growing on wet or recently rewetted peatland. On damp wetlands, there are limitations to the development of woody biofuel plants. It is necessary to establish sustainable methods for managing and harvesting forests on wet or rewetted peatland.

KEYWORDS:

Bioenergy, Biomass, Biofuel, Biodiesel, Bioethanol.

INTRODUCTION

Bioenergy is energy that is produced from biomass, which is made up of once-alive but now-dead organisms, mostly plants. Wood, food crops like corn, energy crops, and trash from farms, yards, and woodlands are among the biomasses that are widely used for the generation of bioenergy. In accordance with the IPCC (Intergovernmental Panel on Climate Change), bioenergy is a renewable source of energy. Utilizing bioenergy has the potential to either decrease or raise greenhouse gas emissions. Additionally, it is well accepted that unfavourable local environmental impacts can happen. Wood and wood waste are currently the main sources of biomass energy. You can burn wood straight up or turn it into pellets or other fuels. You can also utilize other plants as fuel, such as maize, switchgrass, miscanthus, and bamboo. Some of the key waste feedstocks include manufacturing waste, agricultural waste, municipal solid waste, and wood waste. The conversion of unprocessed biomass into higher grade fuels can be accomplished using a variety of methods, which are often classed as thermal, chemical, or biochemical.

Thermal conversion techniques transform biomass into a better and more useful fuel mostly through the use of heat. The three main possibilities are torrefaction, pyrolysis, and gasification. They differ mainly in the amount of time that the chemical processes are permitted to proceed, which is mostly determined by the presence of oxygen and the conversion temperature. Many well-established chemical processes, such as the Fischer-Trophy synthesis, are based on coal-based methods. Biomass can be used, like coal, to create a range of industrial chemicals. It is possible to use many of the biochemical mechanisms that nature has developed to degrade the molecules that make up biomass. The conversion is typically carried out by microorganisms. The three procedures are anaerobic digestion, fermentation, and composting. Based on the source of the biomass, biofuels can be roughly split into two main classes, depending on whether or not food crops are used:

Agricultural products grown on arable land, such as maize and sugarcane, are used to make generation biofuels. The sugars in this biomass are fermented to produce bioethanol, an alcohol fuel that can be mixed with gasoline or used to power a fuel cell. Through fermentation, bioethanol is created primarily from the starches or sugars present in plants like corn, sugarcane, or sweet sorghum. Both Brazil and the US use bioethanol extensively. In Europe, biodiesel, which is made from oils like rapeseed or sugar beets, is the most popular type of biofuel. Second-generation biofuels also referred to as advanced biofuels utilize non-food-based biomass sources such perennial energy crops and agricultural waste. As byproducts of the primary crop, the raw materials utilized to generate the fuels are either produced on fertile land or on marginal land. Using techniques like anaerobic digestion, gasification, or direct burning, waste from organizations, farms, forestry operations, and households can also be transformed into second-generation biofuels. Cellulosic biomass, obtained from non-food sources like trees and grasses, is being explored as a feedstock for ethanol production. Biodiesel can be made from food waste such vegetable oils and animal fats. carbon-sequestered bioenergy.

Carbon capture and storage technology can be used to absorb emissions from power plants that use biofuels. This method, also referred to as bioenergy with carbon capture and storage or BECCS, has the capacity to extract significant volumes of carbon dioxide from the atmosphere. However, BECCS has the potential to yield net positive emissions, depending on the cultivation, collection, and transportation techniques employed for the biomass feedstock. In order to execute BECCS at the scales specified in the various climate change mitigation strategies, substantial farmland areas will need to be changed. The following is an excerpt from Bioenergy with Carbon Capture and Storage. Bioenergy with carbon capture and storage (BECCS) is the technique of getting bioenergy from biomass while also capturing and storing the carbon and thereby removing it from the environment. For BECCS, a negative emissions technology (NET) is feasible. Carbon dioxide (CO2) from the atmosphere is absorbed by biomass as it grows and transformed into carbon in the biomass. Energy is taken from the biomass as a result of combustion, fermentation, pyrolysis, or other conversion processes and is then used to produce valuable products like power, heat, biofuels, etc. A portion of the carbon in the biomass is transformed into biochar or CO2, which can be distributed on the ground or buried beneath the soil to absorb carbon dioxide (CDR).

According to estimates, BECCS could result in annual negative emissions of 0 to 22 gigatons. Five plants were actively absorbing roughly 1.5 million tons of CO2 every year utilizing BECCS technologies. BECCS isn't used frequently because of the price and lack of biomass. The impact of bioenergy on the climate varies significantly depending on the source and production techniques of the biomass feedstocks. When trees are cut down and replaced with new ones, for example, the amount of carbon dioxide released when burning wood for energy is significantly reduced. The newly planted trees will absorb carbon dioxide from the atmosphere as they grow. However, the development and cultivation of bioenergy crops has the potential to impact the ecosystems of the natural world, deteriorate soils, and use up water and synthetic fertilizers. Nearly one-third of the wood used for conventional heating and cooking in tropical countries is illegally harvested. Large amounts of energy may be needed for the harvesting, drying, and transportation of bioenergy feedstocks, which could contribute to greenhouse gas emissions. When using bioenergy instead of fossil fuels, there is a chance that the effects of land use change, agriculture, and processing will result in increased overall carbon emissions.

If cropland is used to raise biomass instead of food, there may be less space left for growing food. In the US, maize-based ethanol has replaced around 10% of motor gasoline, depleting a sizable percentage of the crop. The destruction of these forests to produce palm oil for biodiesel has had enormous social and environmental impacts in Malaysia and Indonesia since they are crucial carbon sinks and habitats for a number of species. Since photosynthesis only absorbs a small part of the energy from sunlight, producing a given amount of bioenergy takes a substantial area of land compared to other renewable energy sources. Second-generation biofuels made from waste or non-food plants lessen rivalry with food production, but they may also have additional negative effects, like trade-offs with local air pollution and conservation areas. Algae, trash, and plants grown in unsuitable soil are just a few examples of the partially sustainable sources that can be used to make biomass. Utilizing bioenergy has the potential to either decrease or raise greenhouse gas emissions. Additionally, it is well accepted that unfavourable local environmental impacts can happen.

Growing demand for biomass, for example, may significantly strain the socioeconomic and environmental conditions of the areas where the biomass is produced. The low surface power density of biomass is the main contributor to the impact. The low surface power density means that much bigger land areas are needed to produce the same quantity of energy than, example, fossil fuels. Long-distance biomass transportation has been questioned as inefficient and unsustainable, and there have been protests against the export of forest biomass in Sweden and Canada. Development is not possible because practically all of the available sawmill waste is used in the production of pellets. More harvested pulpwood must be delivered to pellet mills in the future for the bioenergy sector to expand considerably. However, by preventing the likelihood of these trees getting old, the collection of pulpwood tree thinning maximizes their capacity to store carbon. Compared to pulpwood, sawmill wastes have fewer net emissions: Some biomass feedstock varieties, in particular sawmill waste, have the potential to be carbon-neutral, at least temporarily. These are remnants from previous forest activities that don't signal further harvesting and, in any event, if burned as waste or allowed to disintegrate, would release carbon into the environment [1]-[3].

DISCUSSION

Power plants

Energy crops are low-cost, low-maintenance plants grown solely for the generation of renewable bioenergy. The crops are transformed into pellets, bioethanol, or gaseous fuels like biogas or pellets. The fuels are burned to produce heat or electricity. They are frequently categorized as woody or herbaceous plants. Willow and poplar are examples of woody trees, whereas Miscanthus giganteus and Pennisetum purpureum, popularly known as elephant grass, are examples of herbaceous plants. Herbaceous plants store approximately twice as much carbon as woody plants do below ground, although being physically smaller than trees. Plants can be transformed to produce higher yields through biotechnological techniques including genetic modification. Existing cultivars can also give rather high yields:250However, using genetically modified crops is the only way to gain some additional benefits, such as lower associated costs, or expenditures made during the production process, and less water use [4]–[6].

Burning solid biomass often pelletized alone or in conjunction with other fuels is done in thermal power plants. It can also be used to generate heat or combined heat and power (CHP). Fast-growing tree species like willow and poplar are planted and harvested in short cycles of three to five years in short rotation coppice (SRC) agriculture. The soil needs to be moist for these trees to flourish. It is possible that a factor could affect the local water quality. Avoid building close to sensitive wetland areas. Whole crops can be made into silage and then converted into biogas, including maize, Sudan grass, millet, white sweet clover, and many others. Energy crops that have been ensiled into silage can be fed right away to anaerobic digesters or biogas facilities.

Renewable Energy Crops has been the field of German biopharmaceutical research that has had the quickest growth. Where feedstocks, such as manures and damaged grain, have a low energy content, energy crops can also be planted to enhance gas production. The energy yield of bioenergy crops that are now converted to methane through silage is thought to be around 2 GWh/km2 (1.81010 BTU/sq mi) annually. Small farms with a variety of crops and livestock can use around one-fifth of their total acreage to cultivate and process energy crops, which will meet the needs of the entire farm. However, in Europe, particularly in Germany, this quick expansion has only been possible with considerable government support, as seen in the German incentive program for renewable energy. Similar breakthroughs of silage-methane bioenergy generation from crop farming have largely gone unnoticed in North America, where political and structural problems as well as a massive ongoing drive to centralize energy production have overshadowed promising developments.

Sustainability considerations

Many nations now find biofuels to be more appealing as potential fossil fuel replacements in recent years. Understanding the sustainability of this renewable resource is therefore absolutely essential. The use of biofuels has a number of advantages, including lowered greenhouse gas emissions, lower cost than fossil fuels, renewability, etc. Electricity may be produced with these energy crops. It has been discovered that the combination of stationary energy generation using wood cellulose and biofuel is highly effective. According to the Organization for Economic Co-operation and Development (OECD)/Food and Agriculture Organization (FAO), global biofuel production increased by 109% between 2008 and 2013, and it is expected to increase by another 60% to meet human needs [7]-[9].

The question of whether this resource is sustainable is brought up by the anticipated increase in use and demand for energy crops. Concerns about changing land use, effects on ecosystem soil and water resources, and increased competition for land use to grow energy, food, or feed crops are all factors that are brought up by increased biofuel production. Future bioenergy feedstocks should ideally consist of fast-growing, highly productive plants that require very little energy to cultivate, harvest, etc. Because energy crops are carbon neutral, using them to produce energy can be advantageous. It offers a less expensive substitute for fossil fuels and has a huge variety of plant species that can be used to produce energy. However, in order for the use of biofuels to be widely embraced, problems with cost more expensive than other renewable energy sources, efficiency, and the space needed to continue production must be researched and worked upon.

Carbon balance

CO_2 is absorbed by the plants as they grow. Short rotation forestry (SRF) stands have a rotation time of 8–20 years, and short rotation coppicing (SRC) stands have a rotation time of 2-4 years, whereas traditional forest stands have carbon rotation durations spanning several decades. The rotation period for perennial grasses like miscanthus or Napier grass is 4 to 12 months. Biomass crops store carbon in their roots and soil in addition to absorbing CO_2 in their above-ground tissue. Because the root development is allowed to proceed undisturbed over a long period of time, perennial crops often retain more carbon than annual crops. Additionally, permanent crops do not require the yearly tillage techniques (digging, plowing) used to grow annual crops. Tilling accelerates the breakdown of the available carbon by the soil's microbial communities, which releases CO_2.

According to reports, soil organic carbon is higher beneath switchgrass crops than beneath cultivated farms, especially at depths lower than 30 cm (12 in). The total GHG life cycle cost of a bioenergy project will be determined by the amount of carbon sequestered and the amount of greenhouse gases (GHGs) emitted. A GHG/carbon-negative life cycle can be achieved, namely, if total below-ground carbon storage exceeds entire life-cycle above-ground GHG emissions. For instance, carbon neutrality and even negativity are possible for Miscanthus giganteus. This indicates that the yield and associated carbon sequestration are more substantial than the sum of emissions from farm activities, fuel conversion, and transportation. The best soils for sequestration are those that are currently deficient in carbon, therefore planting locations are essential for successful sequestration [10]. Arable land is likely to sequester carbon successfully in much of England and Wales and unsuccessfully in some areas of Scotland due to carbon-rich soils. Additionally, Scotland finds it more difficult to achieve CO_2 negative because of the significantly lower yields in this colder climate. Peatland and ancient forests are examples of soils that are already carbon-rich. It has been discovered that the most effective carbon sequestration in the UK occurs below enhanced grasslands, which can also be carbon-rich.

Sustainable power

Renewable energy comes from sources that can naturally replenish themselves over a period of time akin to that of people. Renewable resources include sunlight, wind, river flow, and geothermal heat. While most renewable energy sources are sustainable, there are a few that are not. For instance, at the current pace of use, some biomass sources are considered unsustainable. Electricity, heating, and cooling are frequently produced utilizing renewable energy. Even while renewable energy projects can occasionally be very large-scale, they are also suitable for isolated, rural, and underdeveloped locations because these places typically lack the energy needed for human development. The use of renewable energy is commonly linked with increased electrification, which has a number of benefits, including the fact that electricity is clean at the time of usage and has a good ability to move items or heat. From 20% to 28% of the world's electrical supply now comes from renewable sources. Nuclear energy use decreased from 12% to 10%, while fossil energy use decreased from 68% to 62%. Hydropower's contribution decreased from 16% to 15%, while solar and wind power climbed from 2% to 10%. Biomass energy and geothermal energy both went from 2% to 3%. 3146 gigawatts of installed capacity are spread among 135 nations, but only 156 of them have regulations governing the renewable energy sector. About half of the increase in renewable electricity generated worldwide was due to China. The global workforce for renewable energy is estimated to be around 10 million, with solar photovoltaics being the main employment.

Renewable energy sources make up a sizable share of the recently increased electricity capacity in the world and are also quickly lowering in cost and increasing in efficiency. For new development, onshore wind or photovoltaic solar power are typically the most cost-effective options. More than 20% of the energy used in several nations throughout the world comes from renewable sources, and some even acquire more than 50% of their electricity from these sources. A few countries completely generate 100% of their electricity using renewable energy. By 2050, the IEA estimates that 90% of the world's electricity output must come from renewable sources in order to reach net zero emissions. It is anticipated that this year's national renewable energy markets will continue to grow dramatically. According to certain estimations, switching to renewable energy for power, heat, transportation, and industry is technically possible and economically viable for the entire planet. Renewable energy sources are dispersed over a large geographic region, as opposed to fossil fuels, which are concentrated in a small number of nations. Energy security, limiting climate change, and the economy are all greatly benefited by the utilization of renewable energy sources and energy-saving technology. However, the development of renewable energy is being hampered by hundreds of billions of dollars in fossil fuel subsidies. In international public opinion surveys, solar and wind power enjoy broad public approval. The International Energy Agency urged states to resolve policy, regulatory, permitting, and financial impediments to implementing more renewable energy sources in order to boost the likelihood of achieving net zero carbon emissions. [11], [12]

Reasons and benefits

Renewable energy is always available, as opposed to fossil fuels, which are being used up faster than they are being created. Renewable energy resources and considerable prospects for energy efficiency are dispersed across a vast geographic region, in contrast to other energy sources, which are mostly found in a small number of countries. The quick implementation of renewable energy sources, energy efficiency measures, and technical energy source diversity would considerably improve energy security and economic benefits. Solar and wind energy are now significantly less expensive. In some circumstances, moving to renewable energy sources will be less expensive than continuing to use the current, ineffective fossil fuels. Additionally, the use of primary energy is significantly reduced as a result of electrification utilizing renewable energy, which is also more efficient.

Additionally, it would enhance public health, lessen pollution-related early deaths, and reduce associated health expenses, which might amount to trillions of dollars a year. Additionally, environmental contamination, such as air pollution brought on by the burning of fossil fuels, would be decreased. Numerous evaluations of decarbonization programs have demonstrated that the costs of implementing these plans can be far outweighed by the obvious health benefits. More people are using renewable energy thanks to concerns about climate change and the steady decline in cost of solar panels and other renewable energy equipment. Thanks to new government expenditures, laws, and regulations, the industry withstood the global financial crisis better than many other industries. The overall share of renewables in the energy mix including power, heat, and transport needs to increase six times faster, according to the International Renewable Energy Agency, in order to keep the rise in average global temperatures during the current century well below 2.0 °C (3.6 °F) compared to pre-industrial levels.

CONCLUSION

Solar panels and batteries, if a home has them, can frequently be used for only that home or, if it is connected to an electrical grid, they can be pooled with those of millions of other homes. Over 166 million homes rely on a new generation of more effective biomass cookstoves, and over 44 million people use biogas produced in household-scale digesters for lighting and/or cooking. The study found that before a country can use more renewable energy, it must be at a certain degree of development. According to our definition, its adoption changed the connections between the crucial input elements labour and capital, reducing their overall elasticity and boosting the apparent economies of scale. According to Ban Ki-moon, the eighth Secretary-General of the United Nations, renewable energy has the potential to lift the world's poorest countries to unprecedented heights of wealth. At the national level, renewable energy already provides more than 20% of the world's energy in at least 30 countries. Although many countries have statutory targets for higher percentages of renewable energy over the long term, these tend to solely apply to the power sector, with the European Union aiming for 40% of all electricity generated to come from renewable sources.

REFERENCES:

[1] S. R. Freitas *et al.*, Monitoring the transport of biomass burning emissions in South America, *Environ. Fluid Mech.*, 2005, doi: 10.1007/s10652-005-0243-7.

[2] R. Golecha and J. Gan, Biomass transport cost from field to conversion facility when biomass yield density and road network vary with transport radius, *Appl. Energy*, 2016, doi: 10.1016/j.apenergy.2015.11.070.

[3] A. J. Simkin, L. McAusland, T. Lawson, and C. A. Raines, Overexpression of the rieske FeS protein increases electron transport rates and biomass yield, *Plant Physiol.*, 2017, doi: 10.1104/pp.17.00622.

[4] V. C. Pandey, O. Bajpai, and N. Singh, Energy crops in sustainable phytoremediation, *Renewable and Sustainable Energy Reviews*. 2016. doi: 10.1016/j.rser.2015.09.078.

[5] R. JIANG *et al.*, Modeling the biomass of energy crops: Descriptions, strengths and prospective, *Journal of Integrative Agriculture*. 2017. doi: 10.1016/S2095-3119(16)61592-7.

[6] G. Koçar and N. Civaş, An overview of biofuels from energy crops: Current status and future prospects, *Renewable and Sustainable Energy Reviews*. 2013. doi: 10.1016/j.rser.2013.08.022.

[7] M. M. C. Fritz, J. P. Schöggl, and R. J. Baumgartner, Selected sustainability aspects for supply chain data exchange: Towards a supply chain-wide sustainability assessment, *J. Clean. Prod.*, 2017, doi: 10.1016/j.jclepro.2016.09.080.

[8] H. Ranängen, M. Cöster, R. Isaksson, and R. Garvare, From global goals and planetary boundaries to public governance-A framework for prioritizing organizational sustainability activities, *Sustain.*, 2018, doi: 10.3390/su10082741.

[9] G. Beier, S. Niehoff, T. Ziems, and B. Xue, Sustainability aspects of a digitalized industry – A comparative study from China and Germany, *Int. J. Precis. Eng. Manuf. - Green Technol.*, 2017, doi: 10.1007/s40684-017-0028-8.

[10] D. Krause-Jensen, P. Lavery, O. Serrano, N. Marba, P. Masque, and C. M. Duarte, Sequestration of macroalgal carbon: The elephant in the Blue Carbon room, *Biology Letters*. 2018. doi: 10.1098/rsbl.2018.0236.

[11] M. J. Burke and J. C. Stephens, Political power and renewable energy futures: A critical review, *Energy Res. Soc. Sci.*, 2018, doi: 10.1016/j.erss.2017.10.018.

[12] J. Benedek, T. T. Sebestyén, and B. Bartók, Evaluation of renewable energy sources in peripheral areas and renewable energy-based rural development, *Renewable and Sustainable Energy Reviews*. 2018. doi: 10.1016/j.rser.2018.03.020.

CHAPTER 6

ENHANCING SUSTAINABILITY: INTEGRATING FOOD AND BIOENERGY ON DEGRADED ONIGIRI LAND, INDONESIA

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ABSTRACT
Potential solutions for energy and food security while restoring the land include including local residents in the cultivation of sustainable biofuel crops on damaged land. Based on agroforestry practices used by local farmers in Onigiri District, Central Java Province, Indonesia, this chapter provides information on the financial and environmental advantages of Caliphyllid epiphyllum L., also known as ambling locally. Field observations and focus group discussions with farmers using ambling-based agroforestry systems with rice, maize, peanuts, and honey were used to gather pertinent data. When grown as monocultures, rice and peanuts showed negative profitability, whereas maize only produced marginal returns on investment (NPVs). Surprisingly, producing honey with armlong produced an NPV that was almost 300 times higher than that of maize. Honey, albeit related with mampalon, was also the commodity most sensitive to production decreases, followed by combinations of unimpaling-peanut and ambling-rice. Rice, peanuts, and maize can only be produced for a maximum of six years within ambling's 35-year production cycle due to canopy closing after this point, despite the fact that yield declines have no impact on their net present values (NPVs). In conclusion, enamelling-based agroforestry systems can have positive effects on the environment, society, and the economy on various levels. Additionally, it is critical to reinforce and develop bee husbandry practices to enable integrating ambling with honey

production a viable option for nearby farmers given the significant economic potential of doing so.

KEYWORDS

Benefits, Land Restoration, Local Crops, Unimpaling.

INTRODUCTION

One of the key facets of the Indonesian economy is the agricultural industry. Due to the growth of the service sector and industrialisation during the past 50 years, the industry's share of the national gross domestic product has significantly decreased. Nevertheless, farming and plantation work continue to be important sources of income for the majority of Indonesian households. Agriculture's contribution to the national GDP in 2013 was 14.43%, slightly less than its 15.19% contribution in 2003. Around 49 million Indonesians, or 41% of the workforce, were employed in the agriculture sector in 2012. The first purpose of agriculture in Indonesia was to grow and supply food. Early crops grown in the archipelago included tropical fruits, rice, coconut, sugar palm, taro, tubers, and shallots. On the island of Sulawesi, wild rice production has been documented as far back as 3000 BCE. For more than a thousand years, rice has been a staple grain for Indonesians, and it plays a significant role in both their culture and food.

The veneration of Dewi Sri, the rice goddess of ancient Java and Bali, demonstrates the significance of rice in Indonesian culture. Rituals like the Sundanese Seren Taun, also known as the rice harvest festival, were formerly performed to celebrate the agricultural cycles related to the cultivation of rice. To guarantee a sufficient water supply for rice crops, Bali constructed its traditional subpack irrigation system. Priests oversaw the irrigation system, which was built around water temples. Numerous lumbung or rice barn styles, like the Sundanese least, Sasak style rice barn, Tarija's tong Konan shape, and Minangkabau's ranking, are also recognized in Indonesian vernacular architecture. The production of rice alters the landscape, is sold in marketplaces, and is a common food in most While certain bas-relief panels on temple walls, such as those at Borobudur and Prambanan, depict agricultural operations, Javanese stone inscriptions that date to the eighth century show the ruler levying a tax on rice. The bas-reliefs of Borobudur also depict other local agricultural items, such as banana and coconut, in addition to rice. Sugarcane (Saccharum officinarum), Java applet jackfruit (Artocarpus heterophyllus), durian, and mangosteen (Mangifera indica) are examples of plant species.

Local kingdoms in Indonesia were some of the first states to engage in international trade in spices. For instance, the ancient maritime empires of Megahit and Srivijaya engaged in active spice trade with China, India, and the Middle East. From the 14th to the 17th centuries, the ports of Sunda and Banten served as important hubs for the trade of pepper. The European Age of Exploration was triggered by the strong demand for several endemic Indonesian spices in the West, such as cloves and nutmeg, which is only found in the Banda Islands. Early in the 16th century, the Portuguese became the first Europeans to settle themselves in the archipelago. Through Spanish middlemen, the Portuguese introduced crops from the New World, including chicle pepper, maize, papaya, peanuts, potato, tomato, rubber, and tobacco, into the soil of the archipelago. European traders were drawn to the Indonesian archipelago by the expansion of the world spice trade because they were looking for direct supplies of precious spices while also avoiding middlemen in Asia (Arab and Indian traders) and Europe (Italian traders). Early in the 17th century, the Dutch East India Company (VOC) started to consolidate its power inside the archipelago by building forts and commercial buildings at Amboina and Batavia. By that time, VOC had established a monopoly in the trade of spice goods, particularly pepper and nutmeg, and actively sought to increase its share of intra-Asian trade with China and India. After that, VOC built sugar plantations in Java.

The Dutch nationalized VOC as Dutch East Indies at the turn of the 19th century after declaring it insolvent. The Dutch colonial era in the archipelago was formally marked by this ceremony. The Dutch East Indies government passed a law called cultureless in the middle of the 19th century that required a certain proportion of agricultural producing lands to be used for export crops. The Dutch colonial government imposed the farming method in Java and other regions of Indonesia between 1830 and 1870. It is referred to as Tanam Paka by Indonesian historians. In order to build and establish an economic engine in their colony, the Dutch imported a large number of cash crops and other goods. The colony also increased the establishment of sugarcane, coffee, tea, tobacco, quinine, rubber, and palm oil plantations. Dutch East Indies was conquered by the Japanese Empire in 1942. The Gunseikanbu Sangyo oversaw the management of the agricultural industry under the Japanese occupation. The Indies faced difficulties during World War II (1942–1945), including food shortages and starvation. The military might of the Japanese empire managed rice production and plantation products. An significant economic sector, the plantation industry was mostly shut down by the Pacific War and the subsequent Indonesian War of Independence. All agricultural efforts were focused on meeting the basic needs for food and clothing. By organizing labor, the Imperial Japanese government hoped to increase rice and cotton production in the annexed Indies. But the lack of these essentials persisted, resulting in malnutrition and a lack of clothing.

On August 17, 1945, the Indonesian Republic proclaimed its independence. In 1948, Indonesia joined the Food and Agriculture Organization (FAO) of the United Nations. When an FAO national office was established in 1978, the collaboration was strengthened. The Indonesian Ministry of Agriculture has been in charge of overseeing and managing the republic's agricultural industry. The Indonesian Republic also retained the Dutch East Indies' agricultural system while nationalizing many of the colonial economic institutions, infrastructures, and industries. The republic made every effort to create a post-war agricultural sector from the 1960s to the 1980s, which resulted in the sector's great expansion. The government began the transmigration program during the Suharto era, moving landless farmers from the densely inhabited Java to the sparsely populated Sumatra, Kalimantan, Sulawesi, and Papua, expanding agricultural farms in the territory's outer islands. The spread of palm oil plantations, which evolved into a new type of transmigration program, is the most significant indicator of growth. At the moment, Indonesia is the top producer of cocoa, coffee, rubber, and palm oil in the world. However, there are still huge areas of undeveloped land in Indonesia that might be developed into farming. These encompass 40 million hectares of degraded forests that were abandoned by logging concessionaires and turned into grasslands.

DISCUSSION

Production of rice

An important part of the national economy is Indonesia. The third-largest producer of rice worldwide is Indonesia. More than half of the average diet's calories come from rice, which is the principal food in Indonesia. In the late 1980s, rice provided a living for over 20 million homes, or about 100 million people. Approximately 10 million hectares of the archipelago were used for rice farming, mostly on sawah. The availability and control of water are essential for the production of rice fields, particularly when high-yield seed varieties are used. In 1987, rainfed sawah accounted for 20% of the total farmed area, irrigated sawah made up 58%, and the remaining 22% of the rice acreage was covered by ladang, or dryland agriculture combined with marsh or tidal cultivation In modern Indonesia, rice is a staple food for all social levels and occupies a central role in both culture and cuisine: it shapes the country's landscape, is sold in markets, and is included in the majority of meals both as a Savory and a sweet food. The veneration of Dewi Sri, the rice goddess of ancient Java and

Bali, demonstrates the significance of rice in Indonesian culture. Historically, celebrations like the Sundanese Seren Taun rice harvest festival were held to celebrate the agricultural cycles related to rice farming. The traditional sumac irrigation system was designed in Bali and Centered around water temples to preserve water supply for rice paddies [1], [2].

On the island of Sulawesi, wild rice has been found dating back to 3000 BC. However, evidence for the earliest cultivation comes from eighth century Javan stone inscriptions, which show that monarchs levied rice levies. The Karmas abhyanga bas-reliefs of Borobudur are filled with depictions of rice farming, rice barns, and mice pest infestations in rice fields. In relief friezes on the ninth-century Prambanan temples in Central Java, the divisions of Labouré between men, women, and animals including a water buffalo attached to a plough, women planting seedlings and pounding grain, and a man carrying sheaves of rice on each end of a pole across his shoulders were depicted. European visitors to the Indonesian islands around the sixteenth century saw rice as a new prestige food served to the aristocracy during celebrations and feasts. In Indonesian history, the domestication of wild Asian water buffalo as water buffalo for field cultivation and dung for fertilizer is linked to the development of iron tools and the production of rice.

The sun must be accessed in order to produce rice. Most of Indonesia's environment, which was once covered in dense forest, was gradually cleared for permanent fields and settlements over the course of the last 1500 years as rice production increased. In order to stabilize prices for urban consumers and increase domestic output to achieve national self-sufficiency in rice production, the government extensively invested in the rice business. The distribution of high-yield seed varieties through government-sponsored extension programs, direct investment in irrigation infrastructure, and regulation of the domestic rice price through the National Logistical Supply Organization, the government's rice trading monopoly were just a few of the government policies that were implemented. Indonesia was a big rice importer in the 1970s, but after six years of annual growth rates greater than 7 percent per year, self-sufficiency had been reached by 1985. The annual production of rice expanded from 12 million to over 40 million tons between 1968 and 1989, and yields rose from 2.14 tons of paid wet rice cultivation per hectare to 4.23 tons. [1]–[3]

The proliferation of high-yield rice varieties was the main factor in this astonishing rise in output and productivity. Compared to 50% in 1975, 85% of rice farmers were using high-yielding variety seeds by the middle of the 1980s. Through the mass guidance or Bima's rice intensification project, high-yield varieties were marketed along with discounted fertilizer, pesticides, and credit. The extension program also provided farmers who were unsure of the new agricultural techniques with technical assistance. But there were also problems with the new technology. A new approach to applying integrated pest management techniques, relying on a variety of methods to limit the use of pesticides for control of insects, plant diseases, and rodents, was adopted in 1988 as a result of several significant infestations of the brown planthopper, whose natural predators were eliminated by the heavy use of subsidised pesticides. In 1989, subsidies for pesticides were eliminated in an effort to help cut down on use [4]–[6].

Increased rice production in Indonesia was also significantly attributed to government irrigation investments. Between FY 1969 and FY 1989, irrigation was expanded to cover around 1.2 million hectares and 2.5 million hectares of already-irrigated land were rehabilitated. Bulow's operations have evolved to take into account both producer incentives and consumer expenses because the government's goal of price stability for urban consumers may undermine efforts to increase production by reducing the profitability of the rice crop. Even though they were often kept below international rice costs, domestic rice prices were allowed to progressively increase during the 1970s. However, on multiple instances during the 1980s, domestic prices were kept above global levels. Bulldog operated a buffer stock of approximately 2 million tons throughout the 1980s, which had an impact on the price of domestic rice. Bulldog bought rice from village cooperatives when domestic prices dropped, and when they rose beyond the price cap, Bulldog released buffer inventories. Private merchants could make a profit since there was enough room between the producer floor price and urban ceiling price, and Bulow was only allowed to distribute less than 15% of the entire amount of rice consumed domestically in any given year.

Dietary geography

It focuses on local to global patterns of food production and consumption. Geographers can better understand the unequal relationships between developed and developing nations in relation to the development, production, distribution, retail, and consumption of food by tracing these intricate linkages. Additionally, it is a subject that is becoming hotter and hotter in the media. Geographers' research served as the forerunners of the growing movement to reconnect space and place in the food system. Human geography includes the study of food geography. It focuses on local to global patterns of food production and consumption. Geographers can better understand the unequal relationships between developed and developing nations in relation to the development, production, distribution, retail, and consumption of food by tracing these intricate linkages. Additionally, it is a subject that is becoming hotter and hotter in the media. The effort to reunite space and place in the food system is growing, and it was pioneered by geographers' studies [7]–[9].

Manufacture of food

The first aspect of food to receive significant attention from geographers in the field of cultural geography, particularly in agricultural geography, was food production. The production of food is uneven around the world. This is due to the fact that two essential elements necessary for producing food are also delivered infrequently. These two elements are the area's environmental capacity and its human capacity. To absorb a certain activity or pace of an activity without unacceptable impact is the definition of environmental capacity. It is influenced by factors like soil types, temperature, and water availability. In terms of food production, human capacity refers to population size and the level of agricultural expertise present in that population. As the Green Revolution eloquently indicates, when these two are at ideal levels and connected to financial resources, the construction of an extensive agricultural infrastructure is feasible.

Various additional factors are concurrently having a big impact on a country's capacity to generate food. Pesticide-resistant pests are emerging, or pesticides may be eradicating beneficial and necessary insects. There are instances of this happening all throughout the world. In 2005, an especially devastating armyworm epidemic hit Tanzania. Over a thousand larva were present per square meter during the height of the epidemic. When invasive African armyworm caterpillars triggered a regional food crisis in 2009, Liberia went into emergency mode. Twenty thousand people were compelled to leave their homes, businesses, and farmland as the caterpillars moved through 65 settlements. Depending on their size and duration, losses like these can cost millions or billions of dollars and have a negative impact on the availability of food. In order to reduce dependence on pesticides and demonstrate that pesticide use often may be decreased greatly without harming yields or farmer profits in these and other hard-hit areas, the FAO has established a global team called the Plant Production and Protection Division.

Erosion, desertification, and water stress are all contributing to the loss of agricultural land. Up to 70% of the fresh water on Earth is used in agriculture, and that percentage is expected to increase. More water must now be diverted than ever before so that countries can cultivate their land. For nations like Egypt that can no longer rely on rainfall or normal flood cycles, hydroelectric dams and mega-canal projects are emerging as the new norm. Due to their increasing levels of water shortage, these water restrictions are also become a point of contention between neighbouring countries. In order to improve these locations' socioeconomic development, public health conditions, and environmental sustainability, policy solutions to these catastrophes may be put into place. By decreasing the composition of the soil and exposing larger tracts of land to detrimental wind, the combination of current constraints, water, and transitions from practices like agroforestry and shifting agriculture makes land susceptible to aeolian erosion. Aeolian erosion primarily harms unoccupied areas, degrading the air, tainting water supplies, and reducing the fertility of nearby land [10]–[12].

Agricultural operations are anticipated to contribute between 10 and 12 percent of greenhouse gas emissions, which is expected to result in more extreme weather patterns as a result of climate change. The rates of desertification, insect activity, and possible loss of agricultural zones near the equator will all be accelerated by warming. However, higher latitudes are expected to warm up more quickly than other parts of the earth because of the certainly unequal warming that will take place. Scientists are currently pursuing the theory that certain regions in Canada and Siberia might become suitable for industrial-scale farming and be able to make up for any farmland lost at the equator. According to conservative estimates, conventional crops like corn, grain, and potatoes migrate 50 to 70 kilometres northward every ten years. The establishment of non-traditional crops like berries, sunflowers, and melons in these nations' southernmost regions is also a possibility. Climate change may force people to adapt, adopt new practices, and adjust old habits in order to succeed during the unsure period of climate change that lies ahead [9].

CONCLUSION

Intercropping unimpaling with different annual crops in agroforestry systems, or employing it in conjunction with honey production, gives farmers in Onigiri workable economic opportunities at various scales. Most importantly, this research shows that, even if rice and peanut monocultures are not profitable, producing these commodities could become financially viable when combined with ambling production, due to the high value ambling possesses as a bioenergy crop. In local agroforestry systems, honey production is the most lucrative activity. Even if honey production with mampalon had the highest percentage of NPV loss as production fell, it would still produce the maximum earnings. In addition to its potential financial benefits, mampalon-based agroforestry systems foster social cohesion and create jobs. Local farmers value this type of farming, thus it may help Central Java's degraded areas be recovered and put to productive use. There is a good chance that farmers will use these methods because mampalon is already grown in the research area. However, effective implementation methods must be developed for such systems to be sustainable, possibly due to the fact that farmers' human and financial capital may be constrained. In order for armlong-based agroforestry systems to provide long-term environmental benefits, they must also continue to be socioeconomically advantageous for nearby farmers over time. For better beekeeping to ensure that honey production with armlong may become a sure-fire viable option for nearby farmers, more research is critical. This challenge can be seen as a chance to increase the involvement of local farmers, which might be handled by supportive legislation.

REFERENCES:

[1] D. Saripudin, W. Darmawan, and Tarunasena,Developing learning media of indonesian history to raise students' historical consciousness, *New Educ. Rev.*, 2018, doi: 10.15804/tner.2018.53.3.14.

[2] M. A. Saputra, U. Umasih, and S. Sarkadi,The Impact of Discovery Learning and

Critical Thinking towards Learning Outcomes of Indonesian History, *TAWARIKH*, 2018.

[3] I. H. Aliyah, S. Komariah, and E. R. Chotim,Feminisme Indonesia dalam Lintasan Sejarah, *TEMALI J. Pembang. Sos.*, 2018, doi: 10.15575/jt.v1i2.3296.

[4] S. Hiraga *et al.*,Evaluation of somatic embryogenesis from immature cotyledons of Japanese soybean cultivars, *Plant Biotechnol.*, 2007, doi: 10.5511/plantbiotechnology.24.435.

[5] R. Jha *et al.*,Simulated Microgravity and 3D Culture Enhance Induction, Viability, Proliferation and Differentiation of Cardiac Progenitors from Human Pluripotent Stem Cells, *Sci. Rep.*, 2016, doi: 10.1038/srep30956.

[6] J. Saura, J. M. Tusell, and J. Serratosa,High-Yield Isolation of Murine Microglia by Mild Trypsinization, *Glia*, 2003, doi: 10.1002/glia.10274.

[7] M. Pettygrove and R. Ghose,Mapping Urban Geographies of Food and Dietary Health: A Synthesized Framework, *Geogr. Compass*, 2016, doi: 10.1111/gec3.12268.

[8] S. M. Downs *et al.*,Geography influences dietary intake, physical activity and weight status of adolescents, *J. Nutr. Metab.*, 2012, doi: 10.1155/2012/816834.

[9] S. Kusaka *et al.*,Homogeneous diet of contemporary Japanese inferred from stable isotope ratios of hair, *Sci. Rep.*, 2016, doi: 10.1038/srep33122.

[10] A. Ellis and J. C. Jacquier,Manufacture of food grade κ-carrageenan microspheres, *J. Food Eng.*, 2009, doi: 10.1016/j.jfoodeng.2009.03.030.

[11] T. F. Wegrzyn, M. Golding, and R. H. Archer,Food Layered Manufacture: A new process for constructing solid foods, *Trends in Food Science and Technology*. 2012. doi: 10.1016/j.tifs.2012.04.006.

[12] N. Gilbert,One-third of our greenhouse gas emissions come from agriculture, *Nature*, 2012, doi: 10.1038/nature.2012.11708.

CHAPTER 7

OPTIMAL BIOENERGY TREES FOR PEATLAND RESTORATION IN CENTRAL KALIMANTAN, INDONESIA

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ABSTRACT

Kalimantan's vast areas of degraded peatlands require a long-term, sustainable restoration strategy, ideally one that can address energy security without endangering food production or wildlife conservation. In this study, the potential bioenergy crops gimmal and armlong Caliphyllid epiphyllum L which could be grown to create bioenergy and rehabilitate degraded peatlands reevaluated for their growth performance and durability. Tree height, stem diameter, and plant survival rates were all measured parameters. On a two-hectare test site on burned, degraded peatland in Bantoid Village, Pulang Pisac District, Central Kalimantan Province, trials were undertaken. Each species received one of two treatments agroforestry intercropped with Ananas comosus and monoculture plantation using a split plot design. These treatments were repeated in two separate subplots for each species. The most adaptable species, according to the findings, is the ambling, followed by the kemiri Sunna, and both species do better under agroforestry practices than under monoculture ones. To calculate productivity and the accompanying biofuel output, more research is required.

KEYWORDS

Agroforestry, Bioenergy, Peatland, Restoration.

INTRODUCTION

Indonesia's demand for bioenergy has increased significantly as a result of population growth, urbanization, and economic growth, with declining fossil fuel supplies unable to meet rising energy demands in the future. Bioenergy can provide a workable alternative to meet rising energy demand while also addressing interests in sustainable energy and the regeneration of degraded land. In order to achieve its goal of renewable energy making up 23% of the country's energy mix, the Indonesian government has passed legislation to increase the production of renewable energy, including bioenergy. Increased bioenergy production, though, may put other land uses like food cultivation and biodiversity preservation in competition. Degraded land has been recognized as a potential target for bioenergy production in order to avoid this competition. There is a sizable amount of degraded land in Central Kalimantan Province, estimated at. One of the main factors contributing to land degradation is the conversion of forests for other land uses like agriculture and open pit mining. The frequency of forest fires, especially in recent years, has led to an increase in the amount of damaged land, including degraded peatlands.

Farmers in the area have lost control over agricultural land owing to fires, which has reduced productivity and led to the abandonment of the majority of burned land, including peatland, due to its decreased fertility. Energy shortages are also a problem in Central Kalimantan, where 42% of homes lack access to electricity. The amount of biomass used in conventional cooking is relatively considerable. The federal government, through the Ministry of Energy and Mineral Resources (ESDM), in collaboration with district and provincial administrations, has started a bioenergy program called Bioenergy Lestari to increase community access to energy. The goal of the strategy is to increase bioenergy output by planting bioenergy crops on around of abandoned land, including degraded land in Pulang Passau and Kitingan districts. However, only a small number of research offer pertinent data on bioenergy crops suitable for cultivation on degraded land in Central Kalimantan. This research project intends to fill this knowledge gap by identifying the most adaptable bioenergy crops appropriate for degraded soils and evaluating their performance in agroforestry and monoculture systems. It was necessary to research the efficiency of bioenergy crops in recovering peatlands because vast areas, particularly peatlands devastated by deforestation and forest degradation, require a sustainable long-term solution for restoration related to energy security and producing renewable energy. This study intends to evaluate potential bioenergy crops' performance and their ability to restore burned and damaged peatlands without compromising global food security.

Possibility of bioenergy tree species in Central Kalimantan, Indonesia's devastated peatlands Resources and techniques the study's location was chosen to be Bantoid Village in the Central Kalimantan region of Indonesia's Pulang Passau district. With a total size of 16,261.595 acres, Bantoid is distinguished for its forest and agricultural lands. Most of its soils are peat and alluvial. The community experiences a humid tropical climate, with daytime highs of 26.5°C and lows of 27.5°C. Bunti Village has been chosen as one of several locations under the Bioenergy Lestari initiative by the Ministry of Energy and Mineral Resources and the local authority. There are 2,729 people living in Buntin, most of whom work in agriculture, rubber, and sengon plantations. Late in 2015, peat and forest fires severely ravaged Bunton Village, destroying big swaths of farmers' productive land, including about 461 ha of rubber plantations. Farmers are now exploring for alternative land uses to meet their needs because the burned region has been abandoned. On two hectares of deteriorated peatland, tests were conducted between March 2016 and February 2017. A split plot design with a total of 16 subplots was used to compare the performance of four potential biofuel plants grown in monoculture and an agroforestry system with pineapple intercropping.

Only two practical replications were possible due to the plots' two-hectare overall area. According to our research, kemiri suntan and mampalon are the species best suited to Central Kalimantan's burned and damaged peatlands. Both species responded better to agroforestry treatments than to monocultures. Growing biofuel under agroforestry systems may be a superior land-use strategy, considering the ability to increase agricultural production and incomes, maintain biodiversity, and support sustainable development. This seems to be a win-win situation. It is crucial to understand that farmers often grow trees for a variety of reasons influenced by subsistence needs and local customs. This is important if the goal is to convince them to use their degraded land for biofuel production. The ability of farmers to embrace tree planting is based on production technologies, appropriate physical infrastructure, and established markets for tree products, according to recent literature. For policy changes to be successful in making tree planting feasible, acceptable, and ultimately profitable for locals and related stakeholders, it is essential to have a better knowledge of these factors. Millions of square kilometres of biofuel crops may be planted, sequestering enormous amounts of carbon each year while still producing enough electricity. Supportive policies should help biofuel development on degraded land even further in order to protect the environment and prevent jeopardizing agricultural productivity.

DISCUSSION

Peat

Peat is a collection of partially degraded organic matter or plants. It only happens naturally in bogs, moors, marshes, or muskegs. Sphagnum moss, generally known as peat moss, is one of the most common constituents in peat, but many other species can also contribute. When the biological traits of sphagnum mosses act to create a habitat that aids in peat production, this phenomenon is referred to as habitat manipulation. Histosols are types of soil that primarily contain peat. When flooding or standing water stops oxygen from the atmosphere from leaving and delays the rate of decomposition, peat forms in wetland regions. Peat characteristics, such as organic matter concentration and saturated hydraulic conductivity, exhibit high geographical heterogeneity [1]–[3]. Wetlands, particularly bogs, are the primary source of peat; however, other wetlands, including fens, porosis, and peat swamp forests, also deposit peat, albeit less regularly. Sphagnum moss, ericaceous shrubs, and sedges are examples of species that can be found in peat-covered settings. Due to the organic matter's long-term accumulation and ability to preserve plant remains like pollen, peat deposits provide records of past vegetation and climate. This makes it possible to rebuild historical landscapes and investigate changes in land usage.

Peat is utilized by horticulturists and gardeners in some parts of the world, but is illegal in others. Peat covers an area of about 4 trillion cubic meters worldwide. Often, the geological formation of fossil fuels like coal, especially low-grade coal like lignite, begins with the development of peat through time. The peatland ecosystem, which covers an extent of 3.7 million square kilometres million square miles, is the most effective carbon sink on Earth. Because wetland plants can absorb carbon dioxide (CO_2) that is naturally released from the peat, a balance is maintained. However, it takes thousands of years for peatlands to grow the 1.5 to 2.3 m of carbon storage, which is equivalent to 46 times the world's CO_2 emissions. The annual rate of biomass production is greater than the rate of decomposition in natural peatlands. Although peat only takes up around 3% of the earth's surface, it contains more carbon than any other species of plant, including the world's forests, at up to 550 Gt, or 42% of all soil carbon.

Peat is not a renewable energy source since it is mined in industrialized countries at a rate that is far faster than its slow rate of regrowth, which is 1 mm (0.04 in) per year, and because it is thought that only 30–40% of peatlands undergo regeneration. Since people have been burning and draining peat for centuries, a significant amount of peatland restoration is needed to help slow down climate change. Plant matter fails to completely breakdown in anaerobic and acidic settings, and this results in peat. The bulk of its constituent plants are bog plants, which include mosses, sedges, and shrubs. Water accumulates in the peat and is trapped. As a result, the environment gradually becomes wetter, allowing the wetland area to expand. Examples of peatland features include ponds, hills, and high bogs. Due to their characteristics, some bog plants actively promote the creation of bogs. For example, sphagnum mosses actively release tannins that aid in the retention of organic materials. Hyaline cells, a special type of water-retaining cell found in sphagnum, have the ability to release water, keeping the bogland continually moist and promoting the growth of peat.

The majority of today's peat bogs evolved 12,000 years ago in high latitudes after the glaciers receded at the end of the last ice age. A millimetre of peat is added to the earth's surface on average per year. It is estimated that northern peatlands contain 415 gigatons (457 billion short tons) of carbon, tropical peatlands 50 Gt (55 billion short tons), and South American peatlands 15 Gt (17 billion short tons). the most prevalent kind of wetland in the world, making up between 50 and 70 percent of all wetlands. In terms of land and freshwater, they take up more than 4 million square kilometres, or 1.5 million square miles, or 3% of the planet's surface. These ecosystems contain 10% of the world's freshwater supply and a third of the world's soil carbon. What sets these ecosystems apart from other ecosystems is their capacity to collect and store dead organic matter from Sphagnum and many other non-moss species as peat under circumstances of practically constant water saturation. Peatlands have adapted to endure the severe environment created by the presence of toxic chemicals, low oxygen levels, and high-water concentrations. Their water's chemistry ranges from acidic to alkaline. Every continent has peatlands, which can be found at sea level or at great altitudes, in tropical, boreal, and arctic climates [4]–[6].

The spread of peatlands around the world is shown in the PEATMAP GIS shapefile dataset. Based on a meta-analysis of geospatial data at the global, regional, and national levels, an updated estimate from an improved global peatland map, PEATMAP, places global coverage at 4.23 million square kilometres (1.63 million square miles), or roughly 2.84% of the world's land area, slightly higher than earlier peatland inventories. In Europe, peatlands occupy an area of about 515,000 km2 (199,000 sq mi). Over 60% of the world's wetlands are composed of peat. There are many peat deposits throughout the world, particularly in northern Europe and North America. The majority of North America's peat deposits are found in Canada and the northern United States. Some of the largest peatlands in the world include the West Siberian Lowland, the Hudson Bay Lowlands, and the Mackenzie River Valley. Because there is less land in the southern hemisphere, there is less peat there. Africa's Democratic Republic of the Congo is home to the world's largest tropical peatland. The enormous Magellan Moorland in South America's Southern Patagonia/Tierra del Fuego is another notable peat-dominated landscape. Peat is also present on Kerguelen, the Falkland Islands, and New Zealand, in addition to the Indonesian provinces of Kalimantan, Sungai Putri, Danau Siwan, Sungai Tolak, Rasual Jaya (West Kalimantan), and Sumatra. Indonesia has more tropical peatlands and mangrove forests than any other nation on earth, but it is also losing wetlands at a rate of 100,000 hectares (250,000 acres) every year. Forestry and agriculture have been practiced on about 7% of all peatlands. Eventually, and over a long period of geologic time, peat can change into lignite coal.

Environmental and ecological issues

In comparison to the previous year, the amount of carbon dioxide in the atmosphere has altered and grown. The distinct ecological characteristics of peat wetlands provide a home for a range of animals and plants. For instance, Siberian cranes lay their eggs on a peatland in West Siberia, whereas whooping cranes do it in peatlands in North America. Polar bears in Canada give birth in riparian peat banks, whereas the mires are a red-listed habitat in the EU and are home to a variety of birds. On natural peatlands, there are many different kinds of wild orchids and carnivorous plants. For more information on biological communities, see marsh, bog, or fen. affects over half of the world's northern peatlands, which account for approximately a tenth of the permafrost area and contain about a tenth of its carbon content (185 66 Gt), or about half of the carbon in the atmosphere. Because it is a good insulator (it has a thermal conductivity of roughly 0.25 Wm-1K-1) dry peat prevents permafrost from thawing. Because of its insulating properties, dry peat is also an essential part of rare permafrost landforms such pals as and permafrost peat plateaus. The permafrost carbon feedback from thawing peatland permafrost tends to boost methane emissions while barely enhancing carbon dioxide absorption. By 2100, the cumulative release of methane from permafrost peatlands might range from 0.7 to 3 PgC due to thawing at +1.5 to 6°C temperatures. 0.7 million km2 of peatland permafrost may thaw under 2°C of warming. Approximately 1% of predicted anthropogenic emissions would be represented by the force of the future emissions [7]–[9].

One of its traits is the bioaccumulation of metals that are concentrated in the peat. Mercury buildup poses a major threat to the ecosystem. Large areas of organic wetland (peat) soils are currently drained to support agriculture, forestry, and peat extraction. This procedure is taking place all around the world. In addition to damaging the habitats of numerous animals, this has a big impact on climate change. Peat draining causes the organic carbon, which has been building up for thousands of years and is frequently submerged, to be suddenly exposed to the air. Carbon dioxide (CO_2) is created and released into the atmosphere as it decomposes. Global CO_2 emissions from drained peatlands increased by 20% from 1,058 Mon in 1990 to

1,298 Mon in 2008. With Indonesia, Malaysia, and Papua New Guinea among the top emitters with the fastest rate of growth, this increase has mainly been seen in emerging countries. This figure does not account for the emissions from peat fires, which are conservatively estimated to be at least 4,000 muton/CO_2-eq./yr for south-east Asia. In terms of drainage-related peatland CO_2 emissions (excluding harvested peat and fires), the EU comes in at 174 Moton/CO2-eq./yr, ranking behind only Indonesia (500 Moton) and Russia (161 muton). The 500,000 km2 of degraded peatland on the planet may be responsible for 6% of all carbon emissions globally, or more than 2.0 Gon of CO_2 in total. Peat poses a serious fire risk, and moderate rain will not put it out. Peat fires may burn for a very long time or smolder underground and restart after the winter if there is a nearby source of oxygen.

Everywhere in North America, from the boreal forests of Canada to the subtropical southern Florida Everglades' marshes and fens, peat fires can start during extreme droughts. Hummocks and hollows in the peat are parched and burned away after a fire has gone through the area, yet they can aid Sphagnum in recolonizing the area. In the summer of 2010, a significant peat deposit in Central Russia took fire, causing the destruction of thousands of homes and the toxic smoke that engulfed Moscow. Up to 40 °C (104 °F) were attained during the intense heat wave. The situation remained still bad as at the end of August 2010. Peat fires in the Arctic released smoke in June 2014 despite the use of several forest fire mitigation techniques. The temperature, topography, and ecology of Finland all favor the creation of bogs and peat bogs. Peat is so easily accessible and plentiful. It is burned in order to produce heat and power. Peat accounts for about 4% of Finland's annual energy output.

Furthermore, the annual CO_2 emissions from peat bogs that have been drained for forestry and agriculture are higher than those from Finland's peat energy production. However, it often takes a single peat bog between 1,000 and 5,000 years to regrow. Additionally, rather than letting depleted peat bogs regrow, it is common practice to clear-cut them. Less CO_2 is subsequently stored than in the original peat bog. Compared to coal or natural gas, peat emits more carbon dioxide per unit of energy 106 g CO2/MJ vs. 94.6 and 56.1, respectively. One study found that by increasing the average amount of wood in the fuel combination from the current 2.6% to 12.5%, the emissions may be lowered to 93 g CO_2/MJ. In spite of this, not much is being done to bring about this. The International Mire Conservation Group (IMCG) requested protection and conservation of Finland's final intact peatland ecosystems from the municipal and federal governments in 2006. Stopping drainage, peat extraction, and any other groundwater extraction activities that can affect areas with intact mires is required to achieve this. A proposal for a Finnish peatland management strategy was submitted to the government in 2011 following a protracted period of deliberation [10], [11].

CONCLUSION

According to this study, ambling and kemiri Sunan, with survival rates of 88% and 48%, respectively, were the two bioenergy-producing species that were most suitable for cultivation on degraded peatlands in Central Kalimantan. Both gamely and kalinda don't seem like good possibilities given that none of the seedlings that were sown survived. In terms of tree height and stem diameter, mampalon grew better in agroforestry treatment plots than in monoculture ones, according to growth performance indicators. Kemiri suman performed better in terms of tree height growth in agroforestry plots. By being aware of how enamelling and kemiri sunan can grow on degraded peatlands and perform better under agroforestry systems, it is feasible to promote the benefits of agroforestry, enhance farmers' livelihoods, and support sustainable development. Additional study on the productivity of both species is needed to improve the results. More investigation is also needed to examine different species on diverse damaged peatlands. These should contain more accurate extended measurement variables, such as soil nutrients, peat water table, and peat depth. By selecting tree species that offer a variety of advantages in terms of livelihoods, familiarity with the local culture, and high market value, it may be useful to boost farmers' incentives to use degraded areas for the production of biofuel.

REFERENCES:

[1] F. Rezanezhad, J. S. Price, W. L. Quinton, B. Lennartz, T. Milojevic, and P. Van Cappellen, Structure of peat soils and implications for water storage, flow and solute transport: A review update for geochemists, *Chem. Geol.*, 2016, doi: 10.1016/j.chemgeo.2016.03.010.

[2] A. E. Abdel-Salam, Stabilization of peat soil using locally admixture, *HBRC J.*, 2018, doi: 10.1016/j.hbrcj.2016.11.004.

[3] R. Veloo, E. Van Ranst, and P. Selliah, Peat Characteristics and its Impact on Oil Palm Yield, *NJAS - Wageningen J. Life Sci.*, 2015, doi: 10.1016/j.njas.2014.11.001.

[4] E. Rignot, J. Mouginot, M. Morlighem, H. Seroussi, and B. Scheuchl, Widespread, rapid grounding line retreat of Pine Island, Thwaites, Smith, and Kohler glaciers, West Antarctica, from 1992 to 2011, *Geophys. Res. Lett.*, 2014, doi: 10.1002/2014GL060140.

[5] B. Mohamadi and T. Balz, Measuring surface deformation in glacier retreated areas based on PS-InSAR - Geladandong glacier as a case study, in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, 2018. doi: 10.5194/isprs-archives-XLII-3-1285-2018.

[6] B. W. J. Miles, C. R. Stokes, and S. S. R. Jamieson, Pan-ice-sheet glacier terminus change in East Antarctica reveals sensitivity of Wilkes Land to sea-ice changes, *Sci. Adv.*, 2016, doi: 10.1126/sciadv.1501350.

[7] C. Yu, Y. Zhang, H. Claus, R. Zeng, X. Zhang, and J. Wang, Ecological and environmental issues faced by a developing tibet, *Environmental Science and Technology*. 2012. doi: 10.1021/es2047188.

[8] C. E. Williamson, W. Dodds, T. K. Kratz, and M. A. Palmer, Lakes and streams as sentinels of environmental change in terrestrial and atmospheric processes, *Frontiers in Ecology and the Environment*. 2008. doi: 10.1890/070140.

[9] V. G. Gude, Desalination and sustainability - An appraisal and current perspective, *Water Research*. 2016. doi: 10.1016/j.watres.2015.11.012.

[10] A. Garg, P. Munoth, and R. Goyal, Application of Soil Moisture Sensors in Agriculture: a Review, *Proc. Int. Conf. Hydraul. Water Resour. Coast. Eng. (CWPRS Pune, IIndia*, 2016.

[11] F. E. Moyano *et al.*, The moisture response of soil heterotrophic respiration: Interaction with soil properties, *Biogeosciences*, 2012, doi: 10.5194/bg-9-1173-2012.

CHAPTER 8

COMPARING SOIL MICROFAUNA DIVERSITY IN BURNED AND UNBURNED INDONESIAN PEATLANDS

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ABSTRACT:

In Indonesia, a whopping 95% of peatlands have either been cultivated or damaged by forest fires. Massive amounts of carbon dioxide are released into the atmosphere as a result of forest fires, which have also severely harmed Indonesia's ecosystems and biodiversity, notably in Kalimantan and Sumatra. However, baseline studies on biodiversity and soil moisture content in burned and degraded peatlands are still scarce. This is despite the fact that understanding post-fire environmental dynamics and biodiversity changes would be extremely helpful in defining restoration procedures. As a result, in Bantoid Village, Central Kalimantan Province, Indonesia, a burnt peatland region is currently undergoing restoration with the creation of a bioenergy plantation. This research investigates and evaluates soil macrofauna diversity and characteristics, as well as changes in soil fauna patterns. According to study site findings, peatland fires drastically reduce the number of soils mesofauna and macrofauna species, and bioenergy tree survival rates are higher in plots on unburned peatland than on burned peatland. The diversity of flora species, as measured by the Shannon diversity index (H), was lower in burned than in unburned regions, but some orders, like Hymenoptera, appear to be well-adapted to burned environments as we detected them in both burned and unburned plots. The findings indicate a strong link between peat fires and biodiversity. Additionally, we discovered that the chance of biodiversity dwindling increased with the severity of the fire damage to the bioenergy trees. In general, higher soil invertebrate diversity in unburned areas is supported by soil moisture and nutrient availability. However, the findings of our research site did not find any connection between soil moisture content and soil fauna diversity. In conclusion, people will become more aware of the serious effects of fire on peatlands and be less likely to use fire for clearing and preparing peatlands, extending their usage.

KEYWORDS:

Biodiversity, Forest Fire, Restoration, Soil Fauna, Soil Moisture.

INTRODUCTION

Due to the ecological, socioeconomic, and climate benefits they offer, tropical peatlands have a considerable impact on the dynamics of the world's ecosystems. Peatlands make up about 50–70% of the world's wetland areas, which number about 38 million hectares in size. 14.9 million ha of these peatlands are found in Indonesia, with Sumatra and Kalimantan provinces having the highest percentages of peatlands at 34-43% and 28-32%, respectively. The peatlands of Southeast Asia are acknowledged as worldwide repositories of biodiversity. However, due to forest fires and land conversion, peatlands have undergone significant changes and have been gravely degraded. Forest fires have significantly harmed Indonesia's ecosystems and biodiversity, especially in Kalimantan and Sumatra, and are a major cause of peatland deforestation and degradation. They also release significant amounts of carbon dioxide into the sky. In Indonesia, severe peat fires on peatlands that had been drained and turned into farms had a negative impact on the environment and the economy both locally and internationally According to FAO (2012), Indonesia's peat swamp forests have been destroyed or degraded to a greater extent than any other form of forest. Fires in forests and peatlands damage and dry out the soil, which has a negative impact on the diversity and population of macro and microorganisms. In forests and peatlands, soil biodiversity is necessary and crucial for enhancing and supporting soil quality, ecological functions, and ecosystem services; these are all dependent on healthy soil (FAO 2008). As they have both direct and indirect effects on nutrient cycling and litter decomposition, soil fauna has a significant amount of time to recover after a peatland fire but also contribute to soil recovery, fertility, and improved properties and condition. However, baseline studies on biodiversity and soil moisture content in burned and degraded peatlands are still scarce. This is despite the fact that understanding post-fire environmental dynamics and biodiversity changes would be extremely helpful in defining restoration procedures. This study compared the variety of soil macrofauna in burnt and unburnt peatland areas in Bantoid Village, Central Kalimantan Province, Indonesia, a peatland area that has been regenerated with bioenergy plants. Indicators of the environment that relate to the characteristics of the soil were also evaluated and contrasted between the burnt and unburnt peatlands. Establishing baselines for faunal diversity, soil biology, and change in peatlands restored with bioenergy trees was one of the goals.

The macro- and mesofauna of the soil were the main subjects of this investigation. Mesofauna consists of arthropods, mites, enchytraeids, and Collembola below 2 mm in size, while soil macrofauna includes insects, earthworms, isopods, molluscs, and Myriapoda above 2 mm in size. The surface macro/mesofauna was captured using the pitfall trap technique. At the chosen sampling stations, pitfall containers were placed in holes that were 7 cm in diameter and 15 cm deep. At the designated sampling locations, containers were positioned and labelled. The hypogea and epigean fauna that crawled on the surface was captured by the pitfall traps. These traps, also known as wet traps or death traps, were utilized for the investigation and included a liquid killing-preservative. Given that chemical preservation can have dangerous side effects, liquid detergent diluted with water was used to allow caught animals to sink. The animals caught in the traps was manually sorted in the field after the traps were left in place for 24 hours. After being sorted, caught people were stored in vials containing 95% alcohol and brought to the CIFOR lab in Bogor for identification.

Images of the gathered specimens were captured using a microscope equipped with a Leica MC170 HD camera and Leica software for the initial stage of identification. With real-time, high-resolution photographs, the Leica Application Suite (LAS) Version 4.4.0 used for this study offered simple research analysis. For identification at the order level, images concentrating on important body parts at various magnification levels were required. Researchers used the identification key for macro/mesofauna created by Potapov from the University of Göttingen, Germany, as a guide for the second stage of identification, which used a taxonomy system based on morphological characteristics. Samples taken from the unburnt plot showed higher species richness and diversity than those from the burned plots, indicating that peatland fires had a major impact on the soil mesofauna and macrofauna populations. Similar research at the Mount Walat Education Forest in the Sukusuma District of West Java Province, Indonesia, revealed that forest and land fires caused a 17.65% decline in soil macrofauna. Peat fire effects can be much more detrimental, with a 100% mortality rate for soil fauna. Similar findings were found in a second study conducted in Indonesia, where the average diversity index for soil fauna was shown to be lower in burnt plots (0.76) compared to unburnt plots.

Unburned areas with specialized above-ground flora help preserve a wider variety of soil organisms. Researchers unburned habitats in primary forest, palm oil plantation, and industrial plantation forest ecosystems showed greater soil macrofaunal diversity than burnt plots, supporting the conclusions of this study. Individuals of Order Hymenoptera (Formicidae), constituting the majority of ant species, were recorded in significant numbers and were well acclimated out of the 12 orders found in burnt plots in our study area. Invertebrates, such as some ants, beetles, termites, and spiders, can adapt to burning regimes, and because of belowground activity, they are more likely to survive and avoid heat. Burning and other disturbances, such logging, also create open habitats that are better for ant populations. Critical abiotic elements that influence soil animal assemblages and support soil invertebrates include the availability of soil moisture and related variables, such as water table depth. By changing soil food webs and ecosystems, the availability of soil moisture has an impact on soil fauna both directly and indirectly. This is because fauna depends on plants for food and water, while soil moisture has an indirect effect on these plans. We anticipated a detrimental effect of fires on soil moisture because burning and forest fires reduce topsoil moisture and increase insolation levels. A statistically significant association between soil moisture and peatland fires was not discovered by the study, nevertheless. This might be explained by the fact that there was greater rainfall in the burned areas, which increased the soil's moisture content. Seasonal variations, soil nutrients, and other factors could also be at blame. In this respect, more thorough investigation is required into the connections between variations in soil properties and soil fauna variety.

DISCUSSION

Peat swamps and tree

humid tropical forests where damp soil prohibits the complete decomposition of decaying leaves and wood. This causes a thick layer of acidic peat to accumulate over time. These woods are being logged in significant amounts. Brackish or salt-water mangrove forests near the coast and lowland rain forests on better-drained soils frequently surround peat swamp woods. In the tropical and subtropical moist broadleaf forests biome, tropical peatlands cohabit with swamp forests and store and collect enormous amounts of carbon as soil organic matter, far more than natural forests do. They are among the greatest near-surface deposits of terrestrial organic carbon, and their stability has significant implications for climate change.

Peat swamp forests, which are significant from an ecological standpoint, are one of the most in danger, despite being one of the least researched and understood biotypes. Deforestation and drainage in peat swamp forests have significantly risen since the 1970s. Additionally, El Nio Southern Oscillation (ENSO), drought, and massive fires are hastening the destruction of peatlands. This devastation speeds up the breakdown of organic materials and soil, increasing the amount of carbon dioxide released into the sky. Although there is a lack of pertinent data and information, this phenomenon shows that tropical peatlands have already grown to be a significant source of carbon dioxide. Numerous rare and critically endangered species, such as the orangutan and Sumatran tiger, call tropical peat swamp forests home. These species' habitats are threatened by peatland degradation [1]-[3].

Formation

Low-lying places like river deltas, floodplains, or shallow oxbow lakes are where tropical peat originates. The process of formation often proceeds in accordance with the hydroseed successional steps, where the ponds or flooded region becomes eutrophicated by water plants, then changes into a waterlogged swamp with grasses or bushes, and finally forms a forest that keeps accumulating and growing. Peat that is found on the rims of domes between domes may have developed as a result of lateral expansion. This peat buildup frequently takes the form of a dome, which can reach heights of up to 18 meters on inland peat and up to 4 meters on coastal peat. Peat is mostly topogenic or miner trophic in the beginning of its formation and receives a high input of nutrients from rivers or groundwaters. The top of the peat is no longer influenced by river or groundwater input as the peat thickens and the dome rises; instead, it is becoming ombrotrophic, getting all of its water from precipitation. Calcium is notably deficient when nutrients and minerals are only provided by rain. As a result, the peat becomes very acidic and can only support forests with minimal biodiversity and short growth.

Peat from inland areas is much older than coastal peat, which originated during the middle of the Holocene, about 8000 years ago. During the Late Pleistocene, more than 26000 BP, inland peat accumulated significantly sooner. Sea level rise has a significant impact on the creation of coastal peat, with considerable accumulation occurring between 8 and 4000 BP when El Nino is less active. Due to the tectonically stable Sunda Shelf, changes in sea level in this region are only influenced by eustatic sea level. During the glacial period, the Karmapa Strait dried out, resulting in the connection of the Asian Peninsula, Sumatra, Borneo, and Java. As the ice sheet retreated after the Last Glacial Maximum, this beach migrated inland, eventually reaching the level of the contemporary coastline around 8500 BP. In this location, coastal peat has a maximum age of fewer than 8500 years [4]-[6].

Due to its location roughly 15-20 m above sea level, where the most recent record of a higher sea level occurred during about 125000 BP when the sea level was 6 m above the contemporary level, inland peat development is greatly influenced by climate with little to no effect from sea level rise. Peat cores from Sebago, South Kalimantan reveal a slow growth rate of 0.04 mm/y around 13000 BP when the temperature was colder, then an acceleration to 2.55 mm/y around 9900 BP in the warmer Early Holocene, and finally a slow growth rate of 0.23-0.15 mm/y during extreme El Nino. Similar trends are seen in Santalum, West Kalimantan cores, where the peat grows more slowly at times such as 28-16000 BP, 13-3000 BP, and 5-3000 BP. While the slower increase between 28 and 16000 BP and 5-3000 BP can be attributed to the Heinrich Event I and the rise of El Nio, which resulted in a drier climate at this time.

Ecology

When compared to the peat lands of the north temperate and boreal zones which are dominated by Sphagnum mosses, grasses, sedges, and shrubs, peat swamp forests are uncommon ecosystems with trees that can grow up to 70 meters tall. The anaerobic, waterlogged, spongy, unstable, low pH (pH 2.9-4) and poor nutrition peat layers can be up to 20 m deep, and the forest floor is periodically inundated. The tannins from the decaying leaves and peat stain the water a dark brown colour, giving blackwater swamps their name. The peat is still wet and there are still ponds among the trees during the dry season. The average depth of the water on the peat is 20 cm (7.9 in). Nevertheless, a strong El Nino might cause this water level to fall to 40 cm (16 in) below the surface, increasing the risk of fire. Due to the nature of the peat forest's soil, which is classified as a histosol and has a high organic material concentration, the peat forest retains a significant quantity of carbon. Both the low temperature on temperate peat and the water logging on tropical peat stabilize this carbon store. This carbon will be released into the atmosphere as a result of disturbances that alter the temperature or water content of the peat, aggravating climate change caused by human activity. Tropical peat is estimated to contain between 50 Gt and 88 Gt of carbon [7]-[9].

Borneo's peat swamp forest

A natural carbon sink is peat formation, where carbon is removed from the environment and biologically transformed into peat. Originally, Indonesia's peat swamp forests, which covered between 16.5 and 27 million hectares, represented important ecosystems. Peat swamp forests in Indonesia released between 0.01 and 0.03 Gt of carbon per year in their natural form. However, because to deforestation, drainage, conversion to agricultural fields, and other activities, these significant ecosystems have suffered recently. Thus, they are currently substantially less effective at sequestering carbon. Understanding the relevance of peat on a global scale (and the urgency of sustaining peat swamp forests as a result) and figuring out alternative strategies to make these places productive in an eco-friendly and sustainable fashion should be of utmost importance to scientists and policy-makers alike [10]-[12].

The issue

Over 1 million hectares of the Borneo peat swamp forests have been drained over the past ten years by the Indonesian government for use as agricultural land as part of the Mega Rice Project (MRP). More than 4,000 kilometres of drainage and irrigation channels were constructed between 1996 and 1998, and deforestation increased as a result of both legal and illicit logging as well as burning. The region was exposed to illegal forestry because of the water channels, roads, and railroads constructed for legal forestry. Forest cover in the MRP region decreased from 64.8% in 1991 to 45.7% in 2000, and clearing has continued ever since. Almost all of the marketable trees in the MRP's service areas appear to have been cut down by this point. The channels did not irrigate the peat woods as was anticipated; instead, they drained them. The woodlands used to frequently flood during the rainy season up to two meters deep, but now their surface is always dry. The MRP has now been given up on by the Indonesian government. According to research done for the European Space Agency, Indonesian peat and vegetation burning resulted in up to 2.57 billion tons of carbon dioxide being emitted into the atmosphere in 1997.

This accounted for a significant portion of the highest annual increase in atmospheric CO_2 concentration observed since records began in 1957, which is comparable to 40% of the typical annual worldwide emissions of carbon dioxide from fossil fuels. In addition, between 200 million and 1 billion tons of carbon were released into the atmosphere as a result of the fires in 2002–2003.Indonesia today emits the third-highest amount of carbon in the world, largely as a result of the clearing of its historic peat swamp forests. 50% of the world's tropical peat bogs and 10% of its land is dry in Indonesia. In accordance with the REDD (reducing emissions from deforestation and forest degradation) scheme, they have the potential to be a significant contributor to the mitigation of global warming and climate change. Due to the far higher reductions in emissions that may be achieved per unit area and the significantly lower opportunity costs involved, peatland conservation and rehabilitation are more effective endeavours than decreasing deforestation from the perspective of obtaining carbon credits from REDD projects.

CONCLUSION

Fires in the province of Central Kalimantan have damaged peatlands and altered their patterns of biodiversity. The peatland fires in Bantoid Village had a considerable negative influence on biodiversity indices and survival rates, which had a bearing on soil fauna biodiversity. After the fires, the water table depth decreased. In peatlands, we were able to determine which species are resistant to fires and which species are more susceptible to fires. Overall, our findings show that the soil characteristics and biodiversity changes are consistent with the definition of environmental degradation set forth in Government Regulation No. 4/2001. Understanding the severe effects of fire on peatlands can increase awareness and decrease the likelihood that people will use fire to clean and prepare peatlands, extending their useful life. There were several restrictions on this study: Due to time and budget restrictions, only two sample sessions were completed, and no comparative studies were done in other peatlands with differing soil characteristics. Soil fauna was only identified to the order level. Future research should conduct an extensive study with more replications and consideration of soil assessment to gain more in-depth understanding of the effects of fire on soil mesofauna and macrofauna ecosystems. For further research, comparisons of the variety of the soil fauna in other types of peatlands are also advised.

REFERENCES:

[1] C. A. Freund, F. A. Harsanto, A. Purwanto, H. Takahashi, and M. E. Harrison,

Microtopographic specialization and flexibility in tropical peat swamp forest tree species, *Biotropica*, 2018, doi: 10.1111/btp.12512.

[2] M. Turjaman, Y. Tamai, I. R. Sitepu, E. Santoso, M. Osaki, and K. Tawaraya, Improvement of early growth of two tropical peat-swamp forest tree species *Ploiarium alternifolium* and *Calophyllum hosei* by two arbuscular mycorrhizal fungi under greenhouse conditions, *New For.*, 2008, doi: 10.1007/s11056-008-9084-9.

[3] S. Graham, L. L. B., Page, S. E., Eser, E., Limin, Understanding the Growth Strategies of Tropical Peat Swamp Forest Tree Species: Establishing Potential Restoration Tools, *Cent. Int. Manag. Trop. Peatlands*, 2004.

[4] C. T. Ho, X. Zheng, and S. Li, Tea aroma formation, *Food Sci. Hum. Wellness*, 2015, doi: 10.1016/j.fshw.2015.04.001.

[5] P. Madau and M. Dickinson, Cosmic star-formation history, *Annual Review of Astronomy and Astrophysics*. 2014. doi: 10.1146/annurev-astro-081811-125615.

[6] A. Morbidelli and S. N. Raymond, Challenges in planet formation, *Journal of Geophysical Research: Planets*. 2016. doi: 10.1002/2016JE005088.

[7] D. L. Childers, M. L. Cadenasso, J. Morgan Grove, V. Marshall, B. McGrath, and S. T. A. Pickett, An ecology for cities: A transformational nexus of design and ecology to advance climate change resilience and urban sustainability, *Sustain.*, 2015, doi: 10.3390/su7043774.

[8] D. Raubenheimer, S. J. Simpson, and D. Mayntz, Nutrition, ecology and nutritional ecology: Toward an integrated framework, *Funct. Ecol.*, 2009, doi: 10.1111/j.1365-2435.2009.01522.x.

[9] J. M. Anaya, C. Ramirez-Santana, M. A. Alzate, N. Molano-Gonzalez, and A. Rojas-Villarraga, The autoimmune ecology, *Frontiers in Immunology*. 2016. doi: 10.3389/fimmu.2016.00139.

[10] C. M. Yule, Y. Y. Lim, and T. Y. Lim, Recycling of phenolic compounds in Borneo's tropical peat swamp forests, *Carbon Balance Manag.*, 2018, doi: 10.1186/s13021-018-0092-6.

[11] Ministry of Development, Brunei Darussalam's Intended Nationally Determined Contribution, *Unfccc*, 2015.

[12] D. A. Ehlers Smith and Y. C. Ehlers Smith, Population density of red langurs in sabangau tropical peat-swamp forest, Central Kalimantan, Indonesia, *Am. J. Primatol.*, 2013, doi: 10.1002/ajp.22145.

CHAPTER 9

EVALUATING CALIPHYLLID EPIPHYLLUM GROWTH IN EAST KALIMANTAN'S BIOENERGY TRIAL PLOTS

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ABSTRACT:

The National Energy Policy, which emphasizes the significance of diversification, environmental sustainability, and greater deployment of domestic energy resources, the Government of Indonesia has committed to provide energy to its whole population. By 2025, new and renewable energy (NRE) must make up 23% of the country's energy supply, with bioenergy serving as a significant NRE substitute. Bioenergy plantations have the ability to repair degraded land, improve biodiversity, and improve environmental services while sustaining rural livelihoods if they are created and implemented properly. Caliphyllid epiphyllum (mampalon), a possible biofuel tree species suitable for the tropics, is being studied in Indonesia's extensive degraded forest conditions. Nambung is a potential biodiesel substitute because it thrives in difficult environments, produces non-edible seed oil, has significant volumes of kernel oil, and bears abundant fruit. Here, we provide growth results from planted trial plots built in the Bukit Soeharto Research and Educational Forest of Malawian University in February 2018 on previously burned soil. In comparison to other Indonesian sites, the growth of this two-year-old plantation is robust, with an average survival rate of over 90% on Ulison soil, which is characterized as poor fertility and acidic. The results show that slope gradient and various fertilizer application doses had no discernible effects on growth performance. Additionally, trees have begun to bloom and bear fruit, and various bird species and insects, such as bees and butterflies, have begun to colonize them. According to the study, mampalon adapts well to many types of soil and terrain. On degraded land, bioenergy plantations are a viable strategy for land restoration since they boost local biodiversity and environmental services while offering a sustainable energy source.

KEYWORDS:

Bioenergy, Caliphyllid Epiphyllum, Degraded Land, Growth, Mampalon.

INTRODUCTION

Through the National Energy Policy, a document that emphasizes the significance of diversification and environmental sustainability, along with increased supply and deployment of domestic energy resources, the Government of Indonesia has committed to ensuring that every member of its population has access to modern energy sources. Coal, oil, gas, and new renewable energy (NRE) are some of these varied energy sources. By NRE must contribute 23% of the country's energy production. The policy includes bioenergy as a significant NRE alternative. The Ministry of Environment and Forestry (Moi) has been tasked with playing a significant role in providing unproductive forestland to advance the production of biofuel. According to recent Molefe data, 14 million hectares (ha) of undeveloped and 'degraded' land in Indonesia are targeted by the government for development into plantations, energy producing facilities, and infrastructure. Given that it complies with US and EU biodiesel regulations, Caliphyllid epiphyllum, also known as armlong locally, is one species that may be able to provide bioenergy, particularly for biodiesel. Additionally, compared to other energy species like jatropha, Pong Amia pinnata, and others, the produced biodiesel has a higher calorific value. Additionally, fossil diesel can be replaced with cladophyll epiphyllum biodiesel without requiring any engine modifications.

From the age of four to five years until trees are 50 years old, the species produces non-edible seeds with considerable amounts of kernel oil, and seeds can be harvested repeatedly. Honey is abundant in unimpaling flowers, which draw honeybees. In order to use climate smart agroforestry techniques, the species can also be planted alongside a variety of agricultural crops, including maize, soybeans, and rice. Namaland often grows best in warm, humid, or mild environments. Although it may grow in a variety of soils, it thrives on sandy, well-drained soils near the seaside. Wind, sea spray, dryness, and brief spells of waterlogging don't harm it. It may grow up to 500 meters above sea level, when annual precipitation is between 1,000 and 5,000 millimetres and temperatures are between 7 and 48 degrees Celsius (Friday and Okano, 2006). Its native range in Indonesia stretches from Java in the south to Kalimantan in the north, and from Sumatra in the west to Papua in the east. In addition, the plant is tolerant of adverse weather conditions and requires less culture care and upkeep.

armlong seed can contain up to 58% crude Allophylus oil (CCO) in natural stands (Leksono et al. 2014b). According to the breeding plan for armlong that produces biofuel, tree populations from Gunn Kadu District, where trees produced the highest CCO content (50%-50.72%) among six enamelling populations from Java, were chosen and planted in Central Java's Wangari District to create a provenance seed stand. According to Zobel, a provenance seed stand is a location where a possible provenance or land race is developed and rigorously and solely managed for seed production. Oil content was raised by 14%–19% thanks to the aforementioned breeding effort. To study the effects of various NPK fertilizer doses and various slope gradients with the same doses, the experimental plots were set up in a totally random design. Given that the primary goal was to obtain seeds for oil production, 2000 unimpaling seedlings were planted at a spacing of 5 m × 5 m to provide the species room to expand in width. With three replications for each plot, the plots were grouped into 15 permanent measurement plots (PMPs).

A total of 227 seedlings were chosen at random for standard measurement. To test growth performance, three different doses of NPK fertilizer 50 g, 100 g, and 200 g were applied to various plots. NPK was applied in doses of 100 grams and 200 grams to Plots 1 and 5, respectively, and 50 grams to Plots 2, 3, and 4. The plots were observed every three months, and growth characteristics like height, diameter, and branch count were recorded. To assess soil fertility and factors linked to survival and adaptability, soil samples were taken from each plot with tree replication and analyzed. Over 90% of mampalon have survived in the trial plots at Bukit Soeharno. This shows that despite the fact that the two locations had extremely different characteristics, unimpaling from the provenance seed stand in onigiri adapted effectively to the trial site in Bukit Suharto. This survival rate is the same for armlong planted as a seed source in Wangari at six and twelve months after planting. four-year-old unimpaling trees on sandy soil in a coastal location of West Java showed survival rates of 97.33% and 68.88%, respectively, under agroforestry and monoculture systems. In contrast, survival rates at five years old ranged from 44% to 82% across six provenance populations planted on sandy soil in ex-situ conservation plots in Chilaca, Central Java. Survival rates for two-year-old mampalon trees in Gungun Kadu, where seeds originated from eight different Indonesian islands, ranged from 77% to 86%.

DISCUSSION

New capital of the country

The future capital of Indonesia will be located in this province, on the southwestern edge of the Kutani Karta Negara and Pena jam North Paser regencies. The next capital is expected to be called Nusantara, and construction was initially scheduled to begin. A government representative claimed, however, that the government had not allotted budget for the project during a hearing before Committee V of Indonesia's House of Representatives on June 9, , the ministry proposed a budget worth over 100.46 trillion rupiah, or over 7 billion US$, a sharp decrease from the figure of 149.81 trillion rupiah. The National Planning Development Authority previously stated that a total of 486 trillion rupiah would be required to relocate the capital from its current location in Jakarta to East Kalimantan province, of which 265.2 trillion would come from public-private partnerships (PPP), 127.3 trillion from private special funds, and 93.5 trillion from the state budget. However, the Ministry of Finance said that the government shifted its focus to minimizing pandemic's effects. The ministry declared that no funding had been set aside for the new capital project.

Tropical rainforest previously covered the majority of East Kalimantan. One of the world's earliest examples of figurative art is thought to have been created in a limestone cave named Lubanga Jerami Salah in the Sangkulirang-Mangkalihat Karst in the Bongalo region of East Kutak. The French adventurer Luc-Henri Fage and the French archaeologist Jean-Michel Chazine, both from Skelmanthorpe, discovered the cave drawings for the first time in 1994. Maxime Aubert from Griffith University and Pindi Setiawan from the Bandung Institute of Technology headed a team of researchers who were looking into the cave, and their findings were published in a study in the journal Nature recognizing the paintings as the oldest known figurative art in the entire globe. The researchers had previously looked into the nearby island of Sulawesi's cave paintings. The team employed dating methods on the calcium carbonate (limestone) deposits nearby the paintings to determine their age [1]-[3].

A secondary forest, also known as a second-growth forest, is a forest or woodland region that has grown back following disturbances brought on by people, such as timber harvesting, agricultural clearing, or similarly disruptive natural events. It differs from old-growth primary or primeval forests that have not recently seen such disturbance, complex early seral forests, and third-growth forests that are the result of second-growth forests being harvested. When a forest regenerates after a natural disturbance like a fire, insect infestation, or windthrow, it does so differently than when a forest regenerates after a harvest because the dead trees remain to give nutrients, structure, and water retention. Secondary forests may nevertheless be useful in supplying habitat for local species, protecting watersheds, and restoring linkages between ecosystems even when they differ significantly from primary forests in terms of their composition and biodiversity.

Development

In locations where forests have been damaged or destroyed by agriculture or timber harvesting, such as abandoned pastures or fields that were formerly forests, secondary forestation is prevalent. In areas where forests have been lost due to the slash-and-burn technique, a component of several shifting cultivation systems of agriculture, secondary forestation can also be found. While many definitions of secondary forests restrict the source of deterioration to human activities, other definitions incorporate forests that underwent a similar level of degradation as a result of natural occurrences like fires or landslides. The successional process allows for the regrowth of secondary forests. Sunlight can enter the forest floor through openings made in the canopy. Pioneer species will first occupy a cleared area, and then shrubs and bushes will follow. The old forest's distinctive trees gradually start to take centre stage once more. A secondary forest normally takes 40 to 100 years to start to resemble the original old-growth forest; but, in some tropical forests, erosion or soil nutrient loss can cause a secondary forest to fail. Depending on the forest, it could take a century to several millennia for the fundamental traits that distinguish a good secondary forest to evolve.

For instance, the basic characteristics of hardwood forests in the eastern United States can evolve after one or two tree generations, or 150–500 years. The majority of the woods in the United States, particularly those in the east, as well as those in Europe today are secondary forests [4].

Characteristics

Oak trees planted at Tollgate Forest, a secondary woodland. This broadleaf and mixed conifer woodland is found in West Sussex, England. Compared to primary forests, secondary forests typically feature more closely spaced trees and less undergrowth. In contrast to primary forests, secondary forests often have a single canopy layer. Secondary forests typically have a significantly different species mix in the canopy as well. Additional classifications for secondary forests include post-extraction secondary forests, restored secondary forests, and post-abandonment secondary forests, which are all based on how the original forest was disturbed.

Biodiversity

After harvesting, forests either naturally regenerate or are purposefully regenerated (by planting and propagating specific tree species). Second growth forests, which are frequently the outcome, are less biodiverse than old growth forests. Species richness can swiftly return to pre-disturbance levels through secondary succession, according to patterns of regeneration in secondary forests, but relative abundances and species identities can take much longer to recover. In example, it is very improbable that the species composition of artificially restored forests will be comparable to that of their old-growth counterparts. Local factors like soil fertility, water availability, forest size, the amount of existing vegetation and seed sources, edge effect stressors, toxicity caused by human activities like mining, and management techniques in assisted restoration scenarios all play a role in the success of biodiversity recovery.

It has been demonstrated that secondary forests can expand their biodiversity significantly with low to moderate disturbances. These secondary disturbances can open up the canopies to promote the growth of the lower canopy and to create habitats for tiny species like fungi, bacteria, and insects that may feed on the decomposing plant matter. Agroforestry and purposeful planting/seeding of native species are two more methods of forest restoration that can be used with natural regeneration to more successfully restore biodiversity. It has also been demonstrated that doing so enhances the efficiency of ecosystem services, as well as rural livelihoods and independence. Some of these methods are less effective in replicating the initial interactions between plants and soil. Agroforestry practices have occasionally produced soil microbiomes that Favor bacterial communities over the fungi seen in old-growth forests or naturally regenerated secondary forests such as in the tropical environments of the Amazon [5].

Mitigation of climate change

One of the major contributions to anthropogenic carbon dioxide emissions and one of the main causes of deforestation is deforestation. Secondary forests may contribute to the mitigation of climate change, even though sustaining old-growth forests is the most effective way to maintain biodiversity and ecological functionality. Despite the loss of species that results from cutting down primary forests, secondary forests can still be advantageous to anthropogenic and natural ecosystems. In addition to providing habitat and preventing additional erosion of the watershed, secondary forests may help reduce edge effects around older forest sections and improve connectivity among them. Rural populations may also be able to obtain wood and other forest products from secondary forests [6]-[8].

Secondary forests store more soil carbon than other land uses, such as tree plantations, but not being as successful as primary forests. Millions of hectares are estimated to be converted from secondary forests to rubber plantations in Asia; as a result, atmospheric carbon is anticipated to be released from the biomass and soil of secondary forests. In other places, government priorities have included forest restoration, namely the growth of secondary forests, in order to satisfy national and international goals for biodiversity and carbon emissions. Initiatives to lessen and battle deforestation have been sparked by the Intergovernmental Panel on Climate Change (IPCC), Convention on Biological Diversity, and REDD+ recommendations in locations like Indonesia and Panama. Secondary forest growth, both naturally occurring and aided by humans, can reduce carbon emissions and assist nations in achieving their climate goals.

Rainforests

In semi-tropical rainforests, where low soil nutrient levels are typical, the removal of primary forest may result in a severe decline in soil quality. Plant biodiversity and carbon storage are two additional factors that should be taken into consideration while restoring tropical secondary forests, along with soil nutrient levels; it has been hypothesized that it takes longer for a tropical secondary forest to regain its biodiversity levels than its carbon pools. In 1990, the emergence of new forests on defunct farms in Panama outpaced the destruction of primary rainforest. However, a sizable majority of primary forest species fail to reestablish in these second-growth forests due to the deteriorated soil quality, among other causes [9], [10].

Climate

East Kalimantan experiences two seasons, dry and rainy, similar to the climate of Indonesia as a whole. The wet season typically lasts from November to April, whereas the dry season typically lasts from May to October. Every year, this situation persisted, alternating by months of transitional season. Additionally, due to its proximity to the equator, East Kalimantan is subject to the effects of monsoon winds, which occur from May to October and are west and east, respectively. The situation in East Kalimantan has become more unpredictable in recent years. It either doesn't rain at all during the months when it should, or it pours for a very long time during the months when it should be dry.

Thermodynamics and humidity

The size of the ocean's surface and the distance from the beach affect where temperatures are high and low. In 2013, temperatures in East Kalimantan's hot climates ranged from 21.6 °C in beau in October to 35.6 °C in Beraud in September. In addition to being a tropical region with huge trees, East Kalimantan's average humidity ranged from 83 to 87 percent in 2013. The Sa Marinda meteorological station records 82 percent humidity as the lowest air humidity for a few months. While Beraud recorded the maximum humidity in February at 91%.

Rainfall and wind speed

By month and the location of the monitoring stations, rainfall in the East Kalimantan region varies. The lowest rainfall total for 2013 was 237.8 mm at the Meteorological Station Samarendra, and the average maximum rainfall total was 245.1 mm at the Meteorological Station Beraud. In 2013, observe the wind conditions in East Kalimantan at some observation points. Wind rates between three and four knots are evident from observations. The maximum and lowest wind speeds, respectively, were 4 knots in Balikpapan and beau and 3 knots in Samaria. The economy of East Kalimantan is mainly reliant on earth resources like gold, coal, natural gas, and oilfield exploration. An oil refinery plant in Balikpapan was constructed by Dutch rule prior to World War II, destroyed during World War II, and rebuilt following Indonesian independence.

Agriculture and tourism are two other emerging economic areas. Lack of transportation infrastructure is one of the factors preventing economic growth. Traditional boats are used for transportation between coastal cities and regions along the Mahakam River. A memorandum of understanding for the construction of railroad lines for the transportation of coal and other freight was signed between the governor of East Kalimantan and Russia's state railroad company Joint Stock Company (JSC) in 2012. The first stage, which is expected to cost over $1.8 billion, will build a 183-kilometer line connecting a region close to the port of Balikpapan to West Kutak Regency. Beginning in 2013, it is anticipated to carry 20 million tons of coal a year. The second phase, which is expected to cost over $600 million, will connect a line to Murungas Raya in Central Kalimantan [11], [12].

CONCLUSION

In Indonesia, bioenergy crops have enormous promise for rehabilitating degraded landscapes and advancing development and climate goals. Numerous biofuel species can be grown in various site settings because to the vast landmass and diversity of climatic conditions. This study showed the effectiveness of two-year-old Namaland trees in growing on a severely damaged and regularly burned terrain, demonstrating that they are a viable choice for repairing degraded landscapes while producing an alternative energy source. Nambung has a great level of tolerance to many soil types, according to research. Nambung has the potential to be expanded from an experimental size to pilots and wider deployment in various regions of Indonesia, according to the research. To develop projects and business models at acceptable scales and in relevant contexts, research and development institutions must collaborate with small and medium-sized businesses and community organizations. To prevent disputes over food, energy, and the environment, we would strongly advise against developing bioenergy on agricultural land or in protected forest areas.

REFERENCES:

[1] I. R. Abubakar and P. L. Doan, Building new capital cities in Africa: Lessons for new satellite towns in developing countries, *Afr. Stud.*, 2017, doi: 10.1080/00020184.2017.1376850.

[2] B. O. Draženović and T. Kusanović, Determinants of capital market in the new member EU countries, *Econ. Res. Istraz.* , 2016, doi: 10.1080/1331677X.2016.1197551.

[3] C. Le van, T. A. Nguyen, M. H. Nguyen, and T. B. Luong, New technology, human capital, and growth in a developing country, *Math. Popul. Stud.*, 2010, doi: 10.1080/08898480.2010.514852.

[4] J. Gupta and C. Vegelin, Sustainable development goals and inclusive development, *Int. Environ. Agreements Polit. Law Econ.*, 2016, doi: 10.1007/s10784-016-9323-z.

[5] V. Proença *et al.*, Global biodiversity monitoring: From data sources to Essential Biodiversity Variables, *Biol. Conserv.*, 2017, doi: 10.1016/j.biocon.2016.07.014.

[6] R. T. Venterea, Climate Change 2007: Mitigation of Climate Change, *J. Environ. Qual.*, 2009, doi: 10.2134/jeq2008.0024br.

[7] Intergovernmental Panel on Climate Change, *Climate Change 2014: Mitigation of Climate Change*. 2015. doi: 10.1017/cbo9781107415416.

[8] B. Metz, L. Meyer, and P. Bosch, *Climate change 2007 mitigation of climate change*. 2007. doi: 10.1017/CBO9780511546013.

[9] Y. Malhi, S. Adu-Bredu, R. A. Asare, S. L. Lewis, and P. Mayaux, African rainforests: Past, present and future, *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2013. doi: 10.1098/rstb.2012.0312.

[10] F. R. Scarano, Structure, function and floristic relationships of plant communities in stressful habitats marginal to the Brazilian Atlantic rainforest, *Annals of Botany*. 2002. doi: 10.1093/aob/mcf189.

[11] S. Wen *et al.*, Economic sector loss from influential tropical cyclones and relationship to associated rainfall and wind speed in China, *Glob. Planet. Change*, 2018, doi: 10.1016/j.gloplacha.2018.08.004.

[12] L. Niu, S. Feng, W. Ding, and G. Li, Influence of speed and rainfall on large-scale wheat lodging from 2007 to 2014 in China, *PLoS ONE*. 2016. doi: 10.1371/journal.pone.0157677.

CHAPTER 10

UNLOCKING BIOENERGY POTENTIAL THROUGH LANDSCAPE RESTORATION IN INDONESIA

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ABSTRACT:

Indonesia's rising energy demand is being fuelled by urbanization, economic growth, and population expansion. It's crucial to meet this energy demand while lowering reliance on fossil fuels. Indonesia has a large biomass resource base; hence bioenergy is now a significant part of the country's energy policy. The potential effects of bioenergy production on food security, the environment, and biodiversity are a major issue. In this context, we talk about the qualities, advantages, and difficulties of using the perennial grass bamboo as a possible source of bioenergy feedstock in Indonesia. We discuss bamboo's fuel properties and the potential for coordinating its growing, production, and use with environmental and development goals. It has the potential to be used in rebuilding degraded lands due to its quick growth, extensive root systems, low maintenance requirements, and capacity to thrive in challenging environments. Therefore, we urge more investigation into the social, ecological, and economic viability of employing bamboo for the generation of bioenergy.

KEYWORDS:

Bioenergy, Indonesia, Landscape, Potential.

INTRODUCTION

Southeast Asia's most populated nation, Indonesia, also has one of the G20 countries' fastest expanding economies. In tandem with its population expansion, urbanization, and economic development, Indonesia's energy demand has greatly expanded. Coal, oil, and gas make up the majority of the nation's energy mix and are the main sources of the fuel Ministry of Energy and Mineral Resources. On the way to decarbonizing its economy, the Indonesian government (Go) has vowed to cut greenhouse gas (GHG) emissions. Indonesia pledged to reduce GHG emissions by 29% compared to a business-as-usual scenario by 2030 through its Nationally Determined Contribution (NDC), which was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016. Indonesia's energy sector is still experiencing difficulties. Despite improvements, national energy security is still below average and less satisfying than in many other developing nations and developed nations. Many rural communities still lack access to modern energy sources and rely heavily on burning fuelwood and other traditional bioenergy sources directly, which can have negative health effects and have an adverse influence on the environment. The cornerstone of sustainable development is making sure that everyone has access to inexpensive, dependable, and clean energy services because it is inextricably linked to many other objectives like ending hunger, promoting health and well-being, reducing poverty, and combating climate change.

The Government of Indonesia is committed to supplying energy to its expanding population through its National Energy Policy in order to support economic growth and enhance the well-being of the country's 11% of people who are now living in poverty. This is in line with the desire of the worldwide community for inexpensive and clean renewable energy in response to the current Sustainable Development Goals (SDGs), which are led by the UN. By 2025, the nation hopes to raise this percentage to 23% with bioenergy estimated to make up 10% of that total. Bioenergy is a significant source of renewable energy that can be used to generate heat, electricity, or liquid transportation fuels from plant biomass and residues and wastes derived from plants. It encompasses a variety of feedstocks such as plants, wood, and agricultural waste to produce solid biomass, liquid biomass, and gaseous biomass. According to estimates from the Government of India, bioenergy will be used to fuel power plants with a combined capacity of 5.5 MW, using 13.9 million kilolitres of biofuel, 8.4 million tons of biomass, and 498.8 million m3 of biogas. Large variations in height, climate, soil, and physiographic characteristics can be found throughout Indonesia's huge landmass. This makes it feasible to grow a variety of plants for the production of 154 Bioenergy for landscape restoration and livelihoods. However, if not well planned and managed, the spread of bioenergy plantations could result in competition for land and water, which would have a severe influence on food production and the preservation of biodiversity.

It's critical to find acceptable crops for use as bioenergy feedstock in order to minimize adverse effects on food security and biodiversity and to diversify the production of bioenergy. In this context, this chapter examines bamboo, a perennial grass, as a substitute raw material for sustainable bioenergy production in Indonesia through an analysis of scientific publications, reports, and other grey literature to compile data on the advantages of utilizing bamboo for bioenergy production. With almost 1,500 species divided into 87 genera, bamboos are extensively found across the tropics and subtropics and are the most popular blooming perennials of the Poaceae family. Bamboo has been used by humans for thousands of years. In Indonesia, bamboo has traditionally been used as a source of food, fibre, and fuel. The sturdy and adaptable bamboo stem, which is sometimes referred to as the timber of the poor, is also employed in building. Modern technology and consumer demand for environmentally friendly products and services have increased bamboo's use beyond its traditional applications in recent years. For instance, it is treated to create sturdy furniture, building materials, and equipment. It has more than 1,500 applications currently, making it widely applicable.

Bamboo is now being investigated as a viable feedstock to replace fossil fuels for electricity power generation due to its fuel properties, high productivity, and short rotation. Despite being utilized for centuries in Indonesian tradition for example, in direct combustion for cooking, bamboo's usage as a feedstock for contemporary bioenergy production is still in its infancy. Similar to other bioenergy crops, bamboo biomass can be converted into energy through three primary processes: thermal, thermochemical, and biochemical. The most typical method of turning solid biomass into energy is thermal conversion through direct combustion with oxygen present. Bamboo is traditionally used in Indonesia as a fuel source to create heat for domestic tasks like cooking and water boiling. However, these traditional uses are comparatively ineffective, frequently produce significant levels of indoor air pollution, and pose a serious threat to developing nations' health. Biomass, such as bamboo, can be utilized in power plants to generate heat and power for electricity and district heating systems at the industrial scale. By operating a steam turbine or engine on the heat produced by direct biomass combustion in a boiler under carefully controlled circumstances, electricity can be produced. The cheapest and most dependable method for generating electricity from biomass in stand-alone applications is direct combustion in power plants.

Pyrolysis is a different, more effective technique for thermal conversion. Biomass is thermally degraded during pyrolysis at a moderate to high temperature without oxygen. It can be used to transform bamboo biomass into solid fuels, liquid fuels, and gas. Bamboo charcoal, a byproduct of the biomass gasification process, can be used as fuel similarly to coal. In a biorefinery, liquid fuels or fuels from pyrolysis can be converted into biofuels, while syngas can be utilized to generate energy or power. Different strains of microorganisms are utilized in biochemical conversion to convert biomass to biogas or biofuels. The fermentation of sugar or other compounds in the bamboo biomass into bioethanol, methane, and other fuels is the fundamental principle of biochemical conversion. Thus, there are several ways to use bamboo biomass. Bamboo is a useful crop for producing bioenergy because of its favourable fuel properties, which include a high heat value and volatile content as well as a low ash and moisture content. Additionally, bamboo has a high cellulose and lignin concentration compared to another biomass. In general, its total heating value and composition fall halfway between herbaceous biomass and hardwoods, despite the fact that these characteristics may vary according on species, location, maturation stage, and management strategies, among other factors. Similar to other dedicated biomass feedstocks, bamboo has fuel properties such as heating value and chemical composition)

According to FAO estimates from 2005, bamboo spans over 2.1 million hectares throughout all of Indonesia's provinces. According to the FAO, 135 different varieties of bamboo can be found naturally or are purposefully grown in Indonesia. Bamboo can be found in protected forests, national parks, and nature preserves in the wild. It grows as a planted crop in corporation plantations, local gardens, and public woodlands. Bamboo can be grown by homeowners in Indonesia on areas designated for alternative land uses estates, and in some nature reserve (KSA) and nature conservation (KPA) estates through environmental cooperation agreements. Bamboo is a well-known native plant that has played a significant role in Indonesian customs and traditions for many years. Bamboo plants are commonly found in the gardens of farmers. Bamboo is frequently used by Indonesians as a necessary item in their daily lives, including as food, fuelwood for heating and cooking, and a material for furniture and construction. Its sturdy and bendable woody stems are frequently employed in building. This familiarity with the area may indicate strong community support for and interest in participation in the production of bioenergy from bamboo.

Land and water are needed for the production of feedstocks for bioenergy. Because of its potential to have a negative influence on food production and biodiversity due to changes in land use and competition for resources, bioenergy is frequently a topic of discussion. These conflicts can be avoided by using bamboo as a bioenergy feedstock, particularly when bamboo is grown on degraded and underutilized land. Bamboo is widely accessible, quick-growing, and can be combined with other crops in forestry or agroforestry systems to thrive on marginal or degraded land with little to no competition from other crops. It can create a habitat for biodiversity because it is a quickly expanding plant that can thrive on damaged land, and with just sustainable crop harvesting, this environment can be preserved forever. Additionally, expanding bamboo's usage for bioenergy will assist to replace fuelwood use, relieving strain on forests. Bamboo plantations may be harvested systematically each year without removing clumps, unlike other bioenergy crops that need to be replanted after harvesting. This ensures the following 30- to 50-year life cycle. As a matter of fact, regulating the age and density of a bamboo stand through annual thinning using the resulting material as feedstock can boost bamboo yield.

DISCUSSION

Due to price limitations on supplies for domestic power plants and the abundance of medium and low-quality thermal coal in Indonesia, other methods of electricity generation are discouraged. Indonesia's coal reserves are anticipated to endure for more than 80 years at the current rate of production. Indonesia was the second-largest coal exporter in 2009, shipping coal to China, India, Japan, Italy, and other nations. The two main locations for coal mining are South Sumatra and Kalimantan. Indonesia's production has been quickly increasing in recent years, going from just over 200 mill tons in 2007 to over 400 mill tons in 2013. The chairman of the Indonesian Coal Mining Association predicted that production might exceed 450 mill tons in 2014 in 2013. The coal sector in Indonesia is rather disjointed. A limited number of large producers and a sizable number of small businesses provide the output. The following are examples of big businesses in the sector: In Indonesia, there is a growing understanding that the gas industry has significant growth potential. The Indonesian government supports initiatives to give natural gas investment a higher priority in theory. In reality, investors in the private sector, particularly those from outside, have been hesitant to make investments because a lot of the issues preventing investment in the oil sector equally impede investment in the gas sector.

The following was thought to be a list of Indonesia's major probable gas fields as of mid-2013:

About 30% of Indonesia's natural gas production comes from the Mahakam block in East Kalimantan, which is run by Total E&P Indonesia with assistance from the Japanese oil and gas company Impax. The field was estimated to be producing 67,000 barrels of condensate daily in addition to 1.7 billion cu ft of gas at the beginning of 2013. A proposal that PERTAMINA take over all or part of the management of the block was being discussed at the time as part of the specifics of the block's future management. It was reported in October 2013 that Total E&P Indonesia had made the decision to halt field exploration for new projects. In 2015, the Energy and Resources Minister announced a regulation mandating that Total E&P Indonesia and Inpex, who had been in charge of the field for more than 50 years since 1966, hand over control of it to Pertamina. It was announced in late 2017 that PERTAMINA Hulu Indonesia, a company under the parent company Pertamina, would assume control of the block's management [1]-[3].

Tangguh. 4.4 trillion cubic feet (120 billion cubic meters) of proved gas reserves are thought to exist in the Tangguh field, which is operated by BP (British Petroleum) in Bintuni Bay in the West Papua Province. In the near future, it is anticipated that the field will produce 7.6 million tons of liquefied natural gas annually. Arun. ExxonMobil has been running the Arun field in Aceh since the 1970s. Production is currently being phased out slowly as a result of the field's reserves being nearly exhausted. At its peak, the Arun field produced roughly 130,000 cu ft (3.4 million cu ft) of condensate per day (1989) and 96 thousand m3 of gas per day (1994). The neighboring South Lokko A and D oilfield as well as the offshore North Sumatra gas field are also run by ExxonMobil affiliates. ExxonMobil Indonesia sold Pertamina its holdings in Aceh in September 2015. ExxonMobil sold all of its assets (100%) in the North Sumatra Offshore block, all of its interests (100%) in the B block, and 30% of its ownership in the PT Arun Natural Gas Liquefaction (NGL) facility. After the transaction is complete, Pertamina will own 85% of the Arun NGL plant.

One of Southeast Asia's largest gas deposits is thought to be located in the Nantua Islands' East Natania gas field, formerly known as Nantua D-Alpha. The estimated proved gas reserves are 46 trillion cubic feet (1.3 trillion m3). The goal is to start increased production and increase it to 4,000 million cu ft/d (110 million m3/d) over the course of maybe 20 years. Shell, with shares of 65% and 35%, respectively, are the leading investors in the sector. If the field is developed, it would likely grow to be Indonesia's largest deepwater gas project, requiring an estimated $14–19 billion in investment. There is allegedly more than 10 trillion cubic feet (280 billion m3) of gas in the block. The field's development is being postponed, though, because it's unclear whether it will run through an offshore or onshore processing facility. After a disagreement between his ministers in March 2016, President Jokowi ruled that the processing facility must be onshore. This change in course will result in significantly higher costs for the investors and a postponement of the project's launch date. It was suggested that they provide the Indonesian government with updated Plans of Development (POD).

Use of renewable energy

respectively, Indonesia wants 23% and 31% of its energy to come from renewable sources.[40] Renewable energy sources made up 11.2% of Indonesia's total energy mix, with hydroelectric and geothermal power facilities accounting for the majority of this contribution. Despite having a considerable potential for renewable energy, Indonesia is still having difficulty meeting its renewable energy goal. The major causes of the issues are frequently attributed to the inconsistent application of regulations and the lack of proper regulatory supports to draw in the private sector. One policy, coupled with the fact that the Minister for Energy and Mineral Resources sets the consumer price of energy, requires private investors to transfer their projects to PLN the only electricity off-taker in the nation at the conclusion of agreement periods, has raised questions about the return on investment.

Another problem is money because Indonesia has to invest roughly US$154 billion to reach its 23% goal. Potential investors and lending banks are reluctant to get engaged, and the state is unable to disburse this enormous sum. Additional characteristics of renewable energy sources include their wide distribution, remote locations, impossibility of transportation, and the intermittent nature of solar and wind power plants, which raises questions about the dependability of the grid. Another significant issue is one of cost. Since the power price must be below the Region Generation Cost (BPP), which is currently low enough in some key areas, the initial investment of renewable energy projects is still costly, making the project unappealing. Compared to nations that rely on coal imports, Indonesia has enormous coal reserves and is one of the top net exporters of coal, making the development of renewable-based power plants less critical [4]-[6]. It is advised that the nation abolish subsidies for fossil fuels, create a ministry of renewable energy, upgrade the grid, mobilize domestic resources to assist renewable energy, and make it easier for foreign investors to enter the market. Due to the global shift toward renewable energy sources, Indonesia's continued reliance on fossil fuels could result in large investment losses and the stranding of its coal assets. The People's Consultative Assembly is drafting its first renewable energy bill, it was revealed.

Wind energy

The Sidra wind farm, South Sulawesi's first wind power facility, is located in Sidrap Regency. The average wind speed in Indonesia is low, which limits the potential for large-scale wind energy production for many places. It is only practical to use small (10 kW) and medium (100 kW) generators. According to NREL, three different technical analyses of Sumba Island in East Nusa Tenggara (NTT) showed that Sumba's wind resources could be strong enough to be economically viable, with the highest estimated wind speeds ranging from 6.5 m/s to 8.2 m/s on an annual average basis. Wind power only contributes a very modest amount to (off-grid) electricity production. For instance, in 2011 a small plant was built in Pandanmino, a community in Bantul Regency, Yogyakarta Province, on Java's southern coast. It was built as an experimental plant, though, so it's unclear if funds will be made available for ongoing upkeep [7], [8].

Transport industry

Indonesia uses a lot of energy for its domestic transportation. In Indonesia, private vehicles, namely cars and motorcycles, predominate, which has resulted in a high need for petroleum. The transport industry's energy usage is increasing by 4.5% annually. To increase the energy efficiency of transportation, particularly in metropolitan areas, policy reform and infrastructural investment are consequently urgently needed. There are numerous potentials to minimize energy use in the transportation industry, for instance by adopting stricter energy efficiency regulations for personal vehicles like automobiles and motorcycles and expanding mass transit systems. Many of these initiatives would be less expensive than the current transportation infrastructure. Additionally, there is room to lower the carbon intensity of transportation energy, particularly by electrifying or switching from diesel to biodiesel. To ensure that the biofuels and power plants do not have larger environmental effects like deforestation or air pollution, both would require thorough supply chain analysis. In 2011, an electricity connection was present in more than 50% of homes. In 2011, there were 63 million individuals who lacked direct access to power. The demand for energy in Indonesia is expected to increase by 80% between 2015 and 2030, while the demand for electricity is expected to treble. In spite of data indicating a slight increase in Indonesia's reliance on fossil fuels, the nation's trends toward renewable energy are rising. As a result, it is increasingly common to regularly include renewable energy in Indonesia's overall energy mix. Without a doubt, this is a positive step in the country's conversion to renewable energy. In the foreseeable future, the growth of renewable energy appears to be surpassing the need for coal and oil [9]–[11].

CONCLUSION

This study examines how bamboo can be used in Indonesia to produce bioenergy and provide additional social and environmental benefits. We think bamboo has a lot of potential for use as a feedstock for bioenergy production in Indonesia with adequate planning, management, and harvesting. Bamboo is widely available, well-known among the populace, quickly growing, versatile, capable of quickly storing and sequestering carbon, able to grow on degraded areas, and has favourable fuel qualities for contemporary bioenergy production. By balancing the high costs associated with meeting the restoration goals of the Bonn Challenge, the incorporation of multipurpose perennial bamboo crops in Indonesian energy systems could significantly enhance the achievement of renewable energy targets. However, there is a paucity of research on bamboo in the Indonesian setting, and to our knowledge, no studies have been done on the viability of using bamboo for bioenergy from a social, economic, and ecological standpoint. In order to fully explore the potential of bamboo in the nation, we advise further research on the management of bamboo in the nation. These studies should focus on issues like how much bamboo is locally available for bioenergy production, which species are best suited for bioenergy production, how much GHG emissions would be reduced by using bamboo, where potential areas for future plantations are located, and other feasibility studies.

REFERENCES:

[1] A. S. Chilton and G. A. Sarfaty, The limitations of supply chain disclosure regimes, *Stanford Journal of International Law*. 2017.

[2] T. P. Covino, E. S. Bernhardt, and J. B. Heffernan, Measuring and interpreting relationships between nutrient supply, demand, and limitation, *Freshw. Sci.*, 2018, doi: 10.1086/699202.

[3] E. R. Weibel, Understanding the limitation of O2 supply through comparative physiology, *Respir. Physiol.*, 1999, doi: 10.1016/S0034-5687(99)00084-5.

[4] M. Jaforullah and A. King,Does the use of renewable energy sources mitigate CO2 emissions? A reassessment of the US evidence, *Energy Econ.*, 2014, doi: 10.1016/j.eneco.2015.04.006.

[5] P. N. Maciel Filho, J. C. A. Alcócer, O. R. de O. Pinto, and L. I. de L. Dolibaina,Sustainable energy public policies planning: encouraging the production and use of renewable energies, *Rev. Eletrônica em Gestão, Educ. e Tecnol. Ambient.*, 2018, doi: 10.5902/2236117034211.

[6] M. A. Abdelkareem, M. El Haj Assad, E. T. Sayed, and B. Soudan,Recent progress in the use of renewable energy sources to power water desalination plants, *Desalination*. 2018. doi: 10.1016/j.desal.2017.11.018.

[7] B. K. Sahu, Wind energy developments and policies in China: A short review, *Renewable and Sustainable Energy Reviews*. 2018. doi: 10.1016/j.rser.2017.05.183.

[8] R. Saidur, N. A. Rahim, M. R. Islam, and K. H. Solangi, Environmental impact of wind energy, *Renewable and Sustainable Energy Reviews*. 2011. doi: 10.1016/j.rser.2011.02.024.

[9] B. Lin and C. Xie, Reduction potential of CO_2 emissions in China's transport industry, *Renewable and Sustainable Energy Reviews*. 2014. doi: 10.1016/j.rser.2014.02.017.

[10] C. Barnhart, P. Belobaba, and A. R. Odoni, Applications of operations research in the air transport industry, *Transp. Sci.*, 2003, doi: 10.1287/trsc.37.4.368.23276.

[11] P. P. P. Martins, J. M. G. Boaventura, A. A. Fischmann, B. K. Costa, and R. G. Spers, Scenarios for the Brazilian road freight transport industry, *Foresight*, 2012, doi: 10.1108/14636681211239755.

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CHAPTER 11

PANGAMIC: EXPLORING ITS POTENTIAL AS A BIOFUEL CROP

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ABSTRACT:

Pangamic pinnata (L.) Pierre is a leguminous tree species that grows quickly and serves a variety of purposes. It grows throughout South and Southeast Asia on marginal and degraded land. It yields seeds that are not edible, but its oil has potential as a biofuel. Pangamic is extensively distributed throughout Indonesia's islands, however it is primarily found west of the Wallace Line in the provinces of Banten, East Java, South Sumatra, and West Java. The quantity of seeds produced by each tree and the oil content of the seeds determine whether pangamic is commercially viable. Pangamic trees in Banten Province, Indonesia, produce seeds with a higher oil content (15.59%) than those in the provinces of East and West Java, according to studies with oil extracted using a basic mechanical expeller press. Solvent extraction was used in this work to analyse the oil content of 48 different trees from Ujung Kulon National Park. Bulk seed was extracted using two distinct techniques as a control: solvent extraction and a Fabricant mechanical screw expeller press. The findings demonstrated a very large variation in oil content. Individual trees processed with the solvent extraction method produced 44% more oil than those processed with mechanical pressing, which produced just 15%–19%. According to research, pangamic oil output can be influenced by genetic factors, extraction equipment, and extraction technique. For Indonesian industrial plantation forest initiatives for bioenergy and land restoration, the quality and genetic diversity of the seed source is especially crucial.

KEYWORDS:

Biofuel Crop, Crude Oil Content, *Pangamic pinnata*, Solvent Method.

INTRODUCTION

Biofuel is a type of fuel that is created quickly from biomass, as opposed to the lengthy natural processes that result in the development of fossil fuels like oil. Plants can be used to make biofuel, as well as home, commercial, and agricultural biowaste. The ability of biofuel to reduce climate change varies greatly, with some scenarios having emissions that are lower than those from fossil fuels and others having negative emissions. Although they can be used for heating and electricity, biofuels are primarily employed for transportation. The term renewable energy source refers to both biofuels and bioenergy in general. Bioethanol and biodiesel are the two most popular kinds of biofuel. The EU produces more biodiesel than any other region, but the United States produces more bioethanol. The annual global production of biodiesel and ethanol contains 1.8 and 2.2 EJ of energy, respectively. It is anticipated that demand for aviation biofuel would rise. The majority of the carbohydrates used to make bioethanol come from sugar or starch crops like maize, sugarcane, or sweet sorghum. As a feedstock for ethanol production, cellulosic biomass generated from non-food sources like trees and grasses is also being researched. While ethanol can be used as a fuel for cars in its pure form (E100), it is more frequently added to gasoline to raise octane levels and reduce emissions from moving vehicles.

Transesterification is a process used to turn oils or fats into biodiesel. However, it is typically used as a diesel additive to lower levels of particles, carbon monoxide, and hydrocarbons from diesel-powered cars. It can be used as a fuel for vehicles in its pure form (B100). The most frequent biologically produced alcohol is ethanol, while propanol and butanol are also made by microbes and enzymes through the fermentation of sugars or starches (which is the easiest) or cellulose (which is more challenging). According to the IEA, ethanol production will consume 13% of corn supply and 20% of sugar supplies.

The most popular biofuel worldwide, especially in Brazil, is ethanol fuel. The fermentation of sugars from grains, corn, sugar beets, sugar cane, molasses, and any other sugar or starch that can be used to make alcoholic beverages like whiskey results in the production of alcohol fuels. The processes utilized to produce ethanol are enzyme digestion to release sugars from starches that have been stored, sugar fermentation, distillation, and drying. The process of distillation necessitates a significant amount of energy input for heat often unsustainable natural gas fossil fuel, but cellulosic biomass such as bagasse, the residue left after sugar cane is pressed to extract its juice, is the most common fuel in Brazil, while pellets, wood chips, and also waste heat are more prevalent in Europe. Waste heat from the manufacturers is also used in the district heating system, where waste steam is used to power the ethanol factory. Cellulosic ethanol is a result of the evolution of corn-to-ethanol and other food stocks. Currently, natural gas, an unrenewable fossil fuel, is used to make methanol. It is anticipated that in the future, bioethanol will be made from biomass. Although technically possible, production is currently being delayed due to uncertainty regarding the project's economic sustainability. The hydrogen economy can be contrasted with the current natural gas-based hydrogen production with the methanol economy.

However

produced via ABE fermentation (acetone, butanol, and ethanol), and experimental modifications of the technique indicate that the single liquid product, biobutanol, has the potential for substantial net energy gains. It is frequently asserted that biobutanol can serve as a direct substitute for gasoline because it will yield more energy than ethanol, can allegedly be burned straight in existing gasoline engines without modifying the engine or vehicle, is less corrosive and water-soluble than ethanol, and could be distributed through existing infrastructures. By altering their metabolism of amino acids, Escherichia coli strains have also been successfully engineered to create butanol. The high expense of nutrient-rich medium is still a barrier to *E. coli* producing butanol, but recent research has shown that it is not necessary to provide additional nutrients for *E. coli* to manufacture butanol. Biobutanol is occasionally referred to as bio gasoline, but this is incorrect because it is chemically distinct from gasoline because it is an alcohol rather than a hydrocarbon.

When combined with mineral diesel, biodiesel can be utilized in any diesel engine and in equipment that has been upgraded. The fuel can also be used in diesel engines in their purest form (B100), however depending on the feedstock used, this may result in some maintenance and performance issues when used in the winter. From the late 1990s on, only biodiesel combined with regular diesel fuel may be used in electronically controlled common rail and unit injector type systems. These engines use multiple-stage injection systems that are carefully metered and atomized and are extremely sensitive to the fuel's viscosity. Depending on the fuel rail design, several current-generation diesel engines can operate on B100 without requiring engine modifications. Engine filters may need to be replaced more frequently since biodiesel is an efficient solvent and removes residues left behind by mineral diesel. This is because the biofuel dissolves old deposits in the fuel tank and pipes. Additionally, it efficiently removes carbon buildup from the engine's combustion chamber, maintaining efficiency. A 5% biodiesel blend is extensively utilized and accessible at thousands of gas stations in several European nations. In addition to being an oxygenated fuel, biodiesel also has a lower carbon content and a higher hydrogen and oxygen content than fossil diesel. This enhances biodiesel combustion and lowers particle emissions from unburned carbon. But using only pure biodiesel can result in higher NOx emissions.

Due to its non-toxicity and biodegradability as well as its higher flash point of roughly 300 °F (148 °C) compared to petroleum diesel fuel's flash point of 125 °F (52 °C), biodiesel is also safe to handle and carry. In France, biodiesel is included in the fuel that all diesel vehicles consume at a rate of 8%. Avril Group manufactures a fifth of the 11 million tons of biodiesel that the European Union consumes each year under the trade name Diester. It is the top biodiesel manufacturer in Europe. Bio ethers are inexpensive substances that improve octane ratings. They are also known as fuel ethers or oxygenated fuels. Reactive iso-olefins, such as isobutylene, react with bioethanol to form bio ethers. Wheat or sugar beets can be used to make bio ethers, which can also be made from the leftover glycerol from the creation of biodiesel. Additionally, they improve engine performance while drastically lowering harmful exhaust emissions and engine wear. Although bio ethers are likely to displace petroleum-based ethers in the UK, their low energy density makes it doubtful that they will ever stand alone as a fuel. They improve air quality by significantly reducing the amount of emissions that cause ground-level ozone. There are six ether additives used in the production of transportation fuel: tert-amyl methyl ether (TAME), tert-amyl ethyl ether (TAEE), methyl tert-butyl ether (MTBE), and ethyl tert-butyl ether. The most popular ethers used in fuel to replace lead are MTBE and ETBE, according to the European Fuel Oxygenates Association. In the 1970s, ethers were introduced in Europe to replace the extremely hazardous substance. The U.S. Energy Policy Act of 2005 repealed a mandate for reformulated gasoline to include an oxygenate, resulting in less MTBE being added to fuel, even though Europe still uses bio ether additives.

DISCUSSION

Acid Pangamic

The name given to a chemical substance discovered by Ernst T. Krebs Sr. is panga mate. It was pushed as a therapeutic substance for use in treating a variety of ailments by his son Ernst T. Krebs Jr. They also gave this substance the name Vitamin B15, despite the fact that it is not a legitimate vitamin, has no nutritional value, has never been used to treat an illness, and has been derided as quack remedy. Even though several substances marketed aspangamic acid have been researched or sold such as the 1951 substance d-gluconodimethylamino lamina acetic acid, no chemical substance, including those asserted by the Krebs's to be pangamic acid, has ever been proven to possess the properties outlined in the compound's original description.

To characterize this substance, which the Kress claimed to be universal and highly concentrated in seeds, they created the term pangamic. A chemical molecule having the empirical formula C10H19O8N and a molecular weight of 281 that appeared to be an ester formed from d-gluconic acid and dimethylglycine was given the name pangamic acid. The creases said that they had previously isolated this chemical component from apricot seeds when they submitted their patent application in 1943. They were granted the patent (US2464240) in 1949. The first isolation of this compound using this patented method was described in a 1951 study by the Krebs's, but not enough details were provided to verify that this compound was truly isolated. The Krebs's were granted a patent for a different method of manufacturing-substituted glycine esters of gluconic acid (US2710876) in 1955, however the patent lacked evidence that the method could also produce other chemicals, such as pangamic acid [1]–[4].

Other researchers' attempts to replicate Krebs' alleged techniques of making this ester failed, and subsequent study into pangamic acid has concentrated on molecules with different chemical makeups. According to a review, a single product labelled 'panga mate' or 'B15' has been established in a scientifically verifiable manner to conform to the empiric formula stated by the Krebs's. This is true of all the substances described in studies about pangamic acid.

The Krebses received a sample of a substance named pangamic acid from a coworker in the 1950s, and analysis of the sample using nuclear magnetic resonance spectroscopy revealed just lactose. Thus, rather than referring to a specific substance, pangamic acid is more of a name for one of several chemical compounds.

Suppliers of pangamic acid frequently changed the chemical makeup of the compounds marketed under this name, and chemical compounds labeled as pangamic acid for therapeutic reasons have also had a variety of chemical compositions. One account mentioned that the General Nutrition Center (GNC), which agreed to cease selling the substance in those bottles after the FDA filed a lawsuit to prohibit sales, had quantities of calcium pang mate seized by the Food and Drug Administration (FDA). Later, it was discovered that GNC was still offering what was probably a different substance for sale in the same bottles with the same labeling. The FDA views it as not an identifiable substance because there is uncertainty in cases like these. No data was provided to support any of the claims made in the Krebses' initial patent, which suggested that pangamic acid may be used to detoxify as well as treat asthma, skin disorders, joint discomfort, and nerve pain. Pangamic acid was first advertised for usage in both people and race horses. Despite being called Vitamin B15 by the Krebs's, there is no proof that the substance actually fits the criteria of a vitamin or that the body requires it as a source of nutrients.

Although a large portion of the clinical research on pangamic acid was conducted in the former Soviet Union, it frequently did not specify which of the numerous compounds referred to as pangamic acid was utilized in the study. This study's low quality was also a result of its predominance of anecdotal evidence as opposed to controlled experiments and disregard for the short- and long-term safety of human use. Despite more recent claims that it can treat a wide range of illnesses like cancer, heart disease, schizophrenia, and enhance oxygen consumption, none of these claims or that it is safe for human usage are supported by any meaningful evidence. It satisfies the criteria that define a quack remedy, according to one assessment.

Biodiesel

Biodiesel is a form of diesel fuel that can be manufactured from either plants or animals and is composed of long-chain fatty acid esters. It is frequently produced using the transesterification process, which is chemically combining an alcohol with lipids such as animal fat (tallow), soybean oil, or another type of vegetable oil to form a methyl, ethyl, or propyl ester. Unlike the vegetable and waste oils used to power converted diesel engines, biodiesel is a drop-in biofuel, which means it is compatible with current diesel engines and the distribution network. Biodiesel is frequently blended with petroleum fuel typically to a level of less than 10% because most engines cannot operate on pure biodiesel without modification. Biodiesel blends can also be used as heating oil. Patrick Duffy completed this feat in 1853, four decades before the first operational diesel engine. Older processes for making lamp oil were patented in Prague in 1810, but they weren't published in peer-reviewed publications. Rudolf Diesel's basic model, a solitary 10 feet's (3.05 m) iron cylinder with a flywheel at its base, powered itself for the first time using only peanut oil on August 10, 1893, in Augsburg, Germany. In recognition of this event, August 10 has been declared International Biodiesel Day [5]-[7].

Diesel did not plan for his engine to run on peanut oil, unlike what many people think. Diesel's records state that the Otto Company presented a miniature Diesel engine at the Paris Exhibition in 1900 that, at the French government's request, ran on arachidic oil. Few people were aware of the engine because it ran so smoothly. The engine was designed to run on mineral oil, but it was simply utilized with vegetable oil. The French government previously examined the Arachide, or earth-nut, which grows abundantly and is simple to cultivate in their African colonies, as a potential source of power. Later, Diesel himself carried out similar tests and appeared to be in favor of the idea. According to Diesel, who made this claim in a 1912 lecture, the use of vegetable oils for engine fuels may seem insignificant today, but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time.

Despite the widespread use of petroleum-based diesel fuels, there was interest in using vegetable oils as fuel for internal combustion engines in several countries during the 1920s, 1930s, and subsequently during World War II. Countries like Belgium, France, Italy, the United Kingdom, Portugal, Germany, Brazil, Argentina, Japan, and China were said to have tested and used vegetable oils as diesel fuels during this time. Numerous operational problems have been seen as a result of the increased viscosity of vegetable oils compared to petroleum diesel fuel, which results in poor fuel atomization in the fuel spray and frequently causes deposits and coking of the injectors, combustion chamber, and valves. To address these problems, vegetable oil was heated, combined with petroleum-derived ethanol or diesel fuel, pyrolyzed, and cracked.

G. Chavanne of the University of Brussels was granted a patent for a Procedure for the transformation of vegetable oils for their usage as fuels Comme on August 31, 1937. Belgian Patent No. 422,877. This invention details the alcoholics of vegetable oils using ethanol and references methanol in order to separate the fatty acids from the glycerol by substituting short linear alcohols for the glycerol. The creation of what is today known asbiodiesel appears to be described in this report for the first time. This is a reproduction of patented procedures used to make lamp oil in the 18th century, and in certain situations, it's conceivable that old, traditional oil lamps served as an inspiration. More recently, the first industrial biodiesel production process was developed and patented in 1977 by a Brazilian scientist by the name of Expedito Parente. This procedure has been classified as producing biodiesel by international criteria, giving it a standardized identity and quality. No other viable biofuels have received approval from the car industry. In 2010, Parente's company, Tec bio, began working with NASA and Boeing to certify bouceroside, another invention of the Brazilian scientist also known as bio-kerosene.

South Africa started researching the use of trans esterified sunflower oil and its repurposing to meet the criteria for diesel fuel in 1979. By 1983, the process for producing biodiesel that was engine-tested and of fuel grade had been completed. The technology was given by the South African Agricultural Engineers to the Austrian company Gaskoks, which constructed the first biodiesel pilot plant in November 1987 and the first industrial-scale plant with a rapeseed processing capacity of 30,000 tons per year in April 1989. Throughout the 1990s, several European countries opened plants, most notably the Czech Republic, Germany, and Sweden. In France, rapeseed oil was first used to produce biodiesel fuel, commonly referred to as diester. This fuel is blended at 5% with regular diesel and at 30% with diesel used by select captive fleets. Up to that proportion of partial biodiesel can be utilized in truck engines from Renault, Peugeot, and other manufacturers; studies with 50% biodiesel are currently being conducted. Around the same time, domestic biodiesel manufacturing started in other nations; by 1998, the Austrian Biofuels Institute had identified 21 nations with active commercial biodiesel projects. Today, a lot of normal service stations in Europe provide 100% biodiesel.

Additionally, biodiesel can be used as a heating fuel in home and commercial boilers. Biodiesel is a mixture of heating oil and biofuel that is standardized and taxed slightly differently from diesel fuel used for transportation. Bioheat fuel is a specially formulated blend of conventional heating oil and biodiesel. The National Biodiesel Board (NBB), the National Oil heat Research Alliance (NORA), and Columbia Fuels in Canada are all acknowledged owners of the trademark Bioheat. There are numerous heating biodiesel blends available. According to ASTM 396, blends containing up to 5% biodiesel are similar to pure petroleum heating oil. Many customers make use of blends that contain up to 20% more biofuel. Research is being done to determine whether such mixes have an impact on performance. Older furnaces might contain rubber parts that would be damaged by biodiesel's solvent properties, but they can still burn biodiesel without requiring conversion. Care must be taken because the Petro Diesel will produce varnishes that could clog pipes. It is necessary to filter the fuel and change filters quickly. Another approach is to start with a biodiesel blend and gradually cut back on the petroleum. The varnishes will be able to peel off more gently as a result, decreasing the likelihood that they may clog. The strong solvent properties of biodiesel clean the furnace and make it more efficient overall. The Deval Patrick government in Massachusetts passed a law requiring all home heating diesel to contain 2% biofuel by July 1, 2010, and 5% biofuel by 2013. In New York City, a similar law has been passed [8–10].

CONCLUSION

With an oil content potential of up to 44.68% from the best origin utilizing a solvent extraction procedure, *Pangamic pinnata* is a plant with potential for bioenergy. The results of the study demonstrate that pangamic oil output can be influenced by genetic factors, extraction equipment, and extraction technique. Based on the possible oil content of trees from the best provenance, improvements to pangamic trees for biofuel could result in genetically enhanced seed to boost oil content production. For Indonesian industrial plantation forest programs for bioenergy and land restoration, the quality and genetic diversity of the seed source is especially crucial. Future research will construct progeny tests at several locations using variations in pongamia oil content across parent tree. Through combinations within plots and across families, tested progeny will gradually be transformed into seedling seed orchards until only seed-producing trees are left to yield genetically better seed.

REFERENCES:

[1] D. Schneider, V. Helwig, K. Staniek, H. Nohl, and E. F. Elstner, Studies on the chemical identity and biological functions of pangamic acid, *Arzneimittel-Forschung/Drug Res.*, 1999, doi: 10.1055/s-0031-1300424.

[2] M. E. Gray and L. W. Titlow, The effect of pangamic acid on maximal treadmill performance, *Med. Sci. Sports Exerc.*, 1982, doi: 10.1249/00005768-198206000-00003.

[3] E. M. M. Haas, Vitamin B15 -- Pangamic Acid, *Heal. World Online*, 2008.

[4] J. Singh, G. Handa, P. R. Rao, and C. K. Atal, Pangamic acid, a stamina building, antistress and antihyperlipidemic principle from Cicer arietinum L., *J. Ethnopharmacol.*, 1983, doi: 10.1016/0378-8741(83)90023-5.

[5] S. T. Keera, S. M. El Sabagh, and A. R. Taman, Castor oil biodiesel production and optimization, *Egypt. J. Pet.*, 2018, doi: 10.1016/j.ejpe.2018.02.007.

[6] G. Knothe and L. F. Razon, Biodiesel fuels, *Progress in Energy and Combustion Science*. 2017. doi: 10.1016/j.pecs.2016.08.001.

[7] Y. Chisti, Biodiesel from microalgae, *Biotechnology Advances*. 2007. doi: 10.1016/j.biotechadv.2007.02.001.

[8] H. Ritchie, D. Reay, and P. Higgins, Sustainable food security in India—Domestic production and macronutrient availability, *PLoS One*, 2018, doi:

10.1371/journal.pone.0193766.

[9] M. Bahmani-Oskooee, F. Halicioglu, and A. Mohammadian, On the asymmetric effects of exchange rate changes on domestic production in Turkey, *Econ. Chang. Restruct.*, 2018, doi: 10.1007/s10644-017-9201-x.

[10] L. Sievers and A. Schaffer, The impacts of the German biofuel quota on sectoral domestic production and imports of the German economy, *Renewable and Sustainable Energy Reviews*. 2016. doi: 10.1016/j.rser.2016.05.058.

CHAPTER 12

ANALYZING THE CHARACTERISTICS OF CALIPHYLLID EPIPHYLLUM

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ABSTRACT:

There is over 14 Moha of degraded farmland in Indonesia. These sites have the ability to support the growth of biofuel-producing plants to address demands for revenue production, energy security, and land rehabilitation. One promising species, Caliphyllid epiphyllum, can thrive on 5.7 Moha of Indonesian degraded land and may help with the production of green energy and the repair of this damaged area. The species can grow up to one metre per year in its early stages and can withstand extreme climatic conditions. It is perfect for manufacturing biodiesel since its seeds contain a lot of non-edible oil. Additionally, waste and by-products from the biodiesel production process can be composted for soil improvement and used as raw materials in the pharmaceutical and cosmetics industries. Farmers may receive additional income from growing different cash crops alongside caliphyllid epiphyllum in agroforestry systems, adding value to the cultivation of cladophyll epiphyllum.

KEYWORDS:

Caliphyllid Epiphyllum, Income, Land Restoration, Waste Utilization.

INTRODUCTION

The ecological restoration of a place to a natural landscape and habitat that is safe for people, animals, and plant communities is known island restoration, which may also involve denaturalization or rewilding. Usually, pollution, deforestation, salinization, or natural calamities result in ecological degradation, to which land restoration provides a remedy. Land reclamation, in which existing ecosystems are changed or destroyed to make room for farming or building, is not the same as land restoration. Enhancing the availability of essential ecosystem services can benefit individuals. The process of cleaning up and rehabilitating a site that has undergone environmental degradation, such as those brought on by natural causes and those brought on by human activity can be included in land restoration. The goal is to return the area to its original state as a haven for wildlife and a healthy habitat. Plantations of jojoba Simmonds chinensis, like the ones in the picture, have helped to mitigate the edge effects of desertification in India's Thar desert. The first step is to fixate the soil to the point when dune movement stops.

Grass and plants that offer wind protection, such as shelterbelts, windbreaks, and woodlots, accomplish this. Woodlots are larger tracts of woodland, whereas shelterbelts are wind barriers made of rows of trees planted perpendicular to the direction of the wind. The second stage entails planting nitrogen-fixing plants to improve/enrich the soil and using the soil to grow crops right away. Clover, yellow mustard, beans, and other nitrogen-fixing plants are employed, as well as food crops such wheat, barley, beans, peas, sweet potatoes, dates, olives, limes, figs, apricots, guavas, tomatoes, and some herbs. No matter the cover crop employed, the crops excluding any trees are always harvested and/or incorporated into the soil for instance, with clover. Additionally, to avoid depleting the soil of particular trace elements, the plots are utilized each year for a different type of crop a practice known as crop rotation. The Seawater Greenhouse and Seawater Forest are newer developments. This plan calls for building similar systems on desert coastal areas in order to produce fresh water and cultivate crops. The idea of the Desert Rose is a comparable strategy. These methods have broad utility since it is relatively inexpensive to pump significant amounts of seawater inland.

Another similar idea is ADRECS, a system that is designed to supply soil stabilization and reforestation techniques quickly along with renewable energy production. Forest restoration is described as actions to re-instate ecological processes, which accelerate recovery of forest structure, ecological functioning, and biodiversity levels towards those typical of climax forest the final stage of natural forest succession. Climax forests are generally stable ecosystems that have reached the highest levels of biomass, structural complexity, and species variety conceivable given the constraints imposed by soil, climate, and human disturbance. The target ecosystem, which specifies the ultimate goal of forest restoration, is the Climax Forest. Global climate change may modify the objectives of restoration efforts because the climax forest composition is significantly influenced by climate. Additionally, as changes in temperature and precipitation patterns may influence the composition and distribution of climax forests, potential climate change effects on restoration goals must be taken into consideration

The recovery of biodiversity and environmental protection are the main objectives of forest restoration, a specialized form of reforestation that differs from traditional tree plantations. A technique known as forest and landscape restoration (FLR) aims to improve human well-being and restore ecological functionality to degraded or forest-covered environments. FLR was created in response to the declining biodiversity and ecosystem services caused by the increasing degradation and loss of land and forests. The Sustainable Development Goals will be aided by effective FLR. The United Nations Decade on Ecosystem Restoration offers the chance to restore degraded forests and other ecosystems covering hundreds of millions of hectares. Understanding the ecological traits of the constituent species and how they come together, interact, and function as communities is essential for successful ecosystem restoration. In order to restore a forest, many techniques may be used, such as planting trees and/or direct seeding species that are typical of the target ecosystem, or more active interventions to speed natural regeneration. Tree species that are characteristic of or perform an essential ecological function in the target ecosystem are those that are planted (r encouraged to establish. However, restoration initiatives frequently include economic species among the planted trees, to offer subsistence or revenue-generating goods, wherever people reside in or near restoration sites.

A collaborative effort among many different stakeholders, including local communities, government officials, non-governmental groups, scientists, and financial agencies is essential to the inclusive process of forest restoration. Increased biological diversity, biomass, primary production, soil organic matter, water-holding capacity, as well as the reappearance of rare and keystone species that are distinctive of the target ecosystem, are indicators of an ecosystem's ecological success. FAO claims that economic obstacles to restoration efforts include the lack of substantial investment from governments and the inadequate financial and technical resources of smallholders. Value of forest products and ecological services produced are considered economic success indicators because they ultimately help to reduce poverty. Payments for these ecological services (PES) and forest products might act as powerful inducements for locals to carry out restoration initiatives. Active restoration has been demonstrated to hasten the carbon recovery of tropical forests that have undergone human modification by as much as 50%.

Large-scale forest restoration is required to achieve the Sustainable Development Goals and to stop, halt, and reverse the loss of biodiversity, according to FAO's. Under the Bonn Challenge, 61 nations have agreed to rehabilitate 170 million hectares of damaged forest lands, but progress has been poor thus far. When done properly, forest restoration aids in the recovery of ecosystems and habitats, generates employment and revenue, and combats climate change by utilizing nature. Additionally, FAO claims that restoring forests and landscapes has numerous positive effects on the environment, including the sequestration and decrease of greenhouse gas emissions. In order to hasten ecosystem restoration efforts around the world, the United Nations established the Decade on Ecosystem Restoration Wherever biodiversity recovery is one of the primary objectives of reforestation, such as for wildlife conservation, environmental protection, eco-tourism, or to provide a wide range of forest goods to local residents, forest restoration is acceptable.

Forests can be restored in a variety of situations, but degraded sites within of protected areas are a top priority, particularly where some climax forest is still present in the landscape as a seed supply. There are frequently sizable deforested sites, such as logged-over areas or areas that were originally cleared for agriculture, even in protected areas. Restoration of such habitats will be necessary if protected areas are to serve as the planet's final wildlife refuges. The term forest landscape restoration (FLR), which is increasingly used to describe a wide range of restoration initiatives, is described as a planned process to regain ecological integrity and enhance human well-being in deforested or degraded landscapes. FLR acknowledges the social and economic benefits of forest restoration. The best feasible compromise between conservation objectives and the requirements of rural populations is what it seeks to achieve. Forest restoration will typically be carried out as part of a mosaic of different forms of forest management to suit the economic needs of the local population as human pressure on landscapes intensifies. Urban environments have recently been a focus of forest restoration initiatives since they will benefit both people and biodiversity, but they also bring special difficulties.

DISCUSSION

The primary stems are terete or 3-angled for a brief amount at the base, becoming ligneous flat at most of their length, and secondary stems flat, flattened portions to 60 cm long, to 6-10 cm wide, stiff and somewhat succulent. The stem is erect to rising and has several branches. The areoles at the base of stems may occasionally bear hairs or small bristles, and internodes (the region of the plant stem between nodes may be thin or broad. The phylloclade’s are lanceolate to long linear, acute or obtuse, median nerve somewhat stout, edges deeply or coarsely crenate, and lobes oblique. The smooth, green or Gray-green epidermis is colourless. The blossoms can reach lengths of up to 18 cm and widths of 15 cm. The species is nocturnal; however, it can stay open for a few days and get very fragrant. The outer tepals are 10–12 cm long, widely oblanceolate to linear, and greenish yellow to tawny yellow to reddish amber in color. They are inserted within 2 cm of the receptacle apex. There may be red or white streaks or margins on the outermost tepals. The inner tepals are white, creamy white, or greenish yellow, spathulate to oblanceolate, acuminate to mucronate, and as long as the outer tepals. The pericarpal is 5-angled, 3 cm long, 1.5–1.7 cm thick, and green in color. It has acute, long-decurrent pod aria and bracteoles (little bracts) subtending (2–8) spines that are up to 7 mm long. The container is 10 to 12 cm long, 1.5 cm thick in the middle, and green or frequently reddish at the top or reddish all over. It has several linear to oblong bracteoles with keels [1]–[3].

The 2-3 cm long bracteoles are arranged in a spread-out arrangement. The stamens are numerous, declinate, shorter than the tepals, and inserted in two zones. The nectarines are around 3–4 cm long. the upper zone creating a neck circle ca 2 cm above, filaments 5-7 cm long, pale yellow or pale greenish-yellow; style 15-20 cm long, as long as or longer than stamens, 2-3 mm thick, widest at base. The bottom zone is ca 4 cm long, from a point ca 4 cm from the ovary chamber. The 8 or 9 stigma lobes are papillose and whitish. The podagra on the fruit are long, decurrent, and sharp, and the fruit is rectangular to globose globe-shaped. This subspecies differs from the typical variety by: 4-6 cm wide stems, usually semicircular lobes; pericarpal and receptacle subterete in cross-section; pericarpal with subconical somewhat cone shaped at the bottom or obtuse, shortly decurrent podrida and with bracteoles subtending ca 6 (0-20) spines up to 12 mm long; outer tepals usually inserted within 4-8 cm of tube apex; fruit globose, the podrida short and decurrent, and obtuse. The name Renatus relates to the crenated stem margins and suggests creations. The subspecies epithet kimchi pays tribute to Myron Kinch (1922-2018), a botanist who spent many years at the University of California, Berkeley, and Huntington Gardens. Kimmich specialized in epiphytic cacti and Crassulaceae. For 25 years, Kimmich oversaw operations at the Huntington Botanical Gardens. In addition, he served as Managing Editor of Haseltine for ten years, the Cactus and Succulent Society of America's peer-reviewed technical yearbook, and editor of the society's Cactus and Succulent Journal. This species stands out. While Epiphyllum garderobe's blooms are similar, the stem anatomy is very dissimilar. It has long been unclear how the Hypocreales tribe fits within relationships and generic boundaries. In 2016, molecular phylogenetic research revealed that this species, which had previously been assigned to the genus Epiphyllum, was really tightly nested inside Dislocates.

This plant got the highest award for a new introduction when it was displayed at an exhibition in the Royal Horticultural Society's Garden in 1844. Georges Ule Skinner had obtained it in Honduras five years previously and gave it to Sir Charles Lemon, who first flowered it in 1843. John Lindley believed that Antigua was where it first appeared. The only Dislocates species that has ever been employed in hybridization to any significant degree is D. Renatus. It could be more appropriate to refer to the majority of the colourful hybrids as Dislocates hybrids rather than epiphyllum hybrids as they mostly carry Dislocates genes. It is a quick-growing, easily maintained epiphyte. It requires compost that has enough humus and moisture during the summer. In the winter, shouldn't be kept below 12 °C (53.5 °F). Can be cultivated in full sun or partial shade. Early in the spring, more light will encourage budding. Late spring or early summer brings flowers. The sole way the cultivar 'Cooperi' differs from D. cremates subsp. kimchi is by having the outer petals at the tip of the tube. When Clive Innes claimed to hovered-made the cross between D. crenate and Seleniferous grandifloras, he claimed to have produced numerous plants that were identical tocopherol, it was originally claimed tattooer was a hybrid involving seleniferous. However, a DNA investigation in 1997 revealed that there was no trace of seleniferous, proving that this was incorrect [4]-[6].

Dysphoria citric

Originating in Asia, the Asian citrus psyllid is now also present in several areas of the Middle East, South and Central America, Mexico, and the Caribbean. Initially reported in Florida in 1998, the psyllid has since been found in Louisiana, Georgia, Arizona, South Carolina, Texas, and, since 2003, California. An eradication program has been launched in Southern California, the San Joaquin Valley, and Central Coast counties, including San Luis Obispo, in an effort to stop it from spreading. Areas where this psyllid has been detected are subject to quarantine regulations throughout the United States and its territories. The adult psyllid is about four millimetres long, with a light brown head and a fawn and brown mottled body. It has a yellowish, waxy secretion covering it that gives it a dusty appearance. The forewings feature a pale gap towards the apex and a dark border around their periphery. They are widest at the back. The tips of the pale brown antennae are black. These characteristics set it apart from the African citrus psyllid, which appears to be quite similar. Usually, as it suckers sap, it assumes a head-down, tail-up position. Psyllids can be recognized from aphids by being more active, jumping insects whereas aphids are stationary. Aphids are frequently present on citrus as well. Additionally, psyllid antennae have 10 segments, whereas aphid antennae typically have four or six. Psyllids lack the abdominal cornicles that are present on the majority of aphids.

A psyllid nymph undergoes five mounts. Its tint is yellowish-orange, and it lacks belly markings. Particularly in the later instars, the wing pads are noticeable. The eggs are almondshaped, about 0.3 millimetres long, thicker at the base, and they taper toward the top. Before they hatch, they are first a whitish tint that changes to yellow and then orange. The leaf's surface is vertical to the long axis' position. The psyllid possesses an organ called a bacteriome that is designed specifically to house two of its bacterial symbionts. Around the organ, Candidate's Cars Onella radii inhabits uninuclear bacteriocytes and produces food. Ca. Raffaella armature resides in the syncytial cytoplasm of the organ and supplies nourishment, defensive toxins, and carotenoids. The Portella symbiont produces more polyketides when an insect is infected with the Huanglongbing disease Liberate [7].

It shares bacteriome symbionts with another insect in the same genus, Dysphoria cf. continua open nomenclature word designating an unidentified species similar to Dysphoria continua. Wolbachia can infect the insect, and the infection is then vertically transmitted through the egg. Wolbachia and liberates can coexist with gut cells as a component of the gut microbiome or live within the U-shaped bacteriome. By preventing cell lysis, Wolbachia is able to assist liberate in surviving bacteriophages. Natural enemies of the Asian citrus psyllid include hoverflies, lacewings, various kinds of ladybirds, and many parasitic wasp species. Tamar ixia radiata, one of these wasps, has proven to be particularly effective at eradicating the pest. It has been successfully distributed and has established itself in several citrus-growing regions, including Florida A variety of pesticides can be used to control the psyllid's adults and nymphs. The most effective method of preventing citrus greening disease is an integrated approach that includes the use of healthy planting material, vector management, and rapid removal of affected trees and branches.

Sticky trap with a lime-green hue that attracts psyllids

Understanding the many sensory cues that the psyllid utilizes to find its host plant has been the focus of recent research. Better strategies for controlling the insect may be developed with more knowledge of its behaviour. According to one study, perception of the UV wavelengths that were reflected increased attraction to a yellow trap. The psyllid has not been successfully attracted by any volatile scents that have been tried. The hue of this little insect seems to draw it in, and it only decides to stay and eat on a particular plant after landing on a leaf and tasting it with its mouthparts. Formic acid and acetic acid, two small chemicals, encourage probing behaviour. These could be incorporated into brand-new, creative traps or other tools. Recent research has shown that the movement patterns of gravid females in response to the oviposition sites are the cause of the geographical distribution of eggs and nymphs. The aggregated or contagious distribution pattern of the D. citri population on the flushes within the tree, which might be described by the negative binomial distribution, was confirmed by the dispersion indices. In naturally occurring psyllid populations, distributions of eggs and nymphs were extremely aggregated, after initially aggregated adult migrations and a contagious dispersion of adults on the flushes within trees as population densities increased, according to quantifiable assays. The upshot of females' dispersal and their choice of oviposition sites was greater population dispersion due to increased population density in the field. A sampling plan was developed based on the relationship between the dispersion behaviour and population density rather than the relationship between economic damage and population density because the population density of immature stages can be used to predict the exponential increase in dispersion [8]-[10].

CONCLUSION

Epiphyllum may grow in a variety of different environmental settings. Young trees can grow up to one meter each year in their first few years before slowing down. The species is quite adaptable, as evidenced by survival rates that over 60% when planted on marginal land used for 188 Bioenergy for landscape restoration and livelihoods in the Gungun Kadu District, and 95% on mineral land in Onigiri. Gungun Koul farmers' incomes could rise by IDR 217.25

million per year by implementing C. epiphyllum-based agroforestry systems that combine annual crops like maize, cassava, peanuts, soybeans, and fodder grass, while farmers in onigiri could earn more by combining C. epiphyllum with the production of rice, peanuts, maize, and honey. The CCO and RCCO content of C. epiphyllum, which ranges from 36% to 58.30% and 17% to 33.8%, respectively, is a promising bioenergy species. Improved stands may result in oil content increases of 11%-14% for CCO, 7%-9% for RCCO, and 7%-8% for biodiesel. Additional items that could be made from the industrial waste and by-products of processing C. epiphyllum for biodiesel include charcoal, briquettes, liquid smoke, animal feed, compost, soaps, and cosmetics. By doing so, environmental contamination would be decreased and the economic worth of C. epiphyllum cultivation would increase.

REFERENCES:

[1] O. Gastaud, P. M. Cambas, and J. Tabutin,Femoral revision with a primary cementless stem, *Orthop. Traumatol. Surg. Res.*, 2016, doi: 10.1016/j.otsr.2015.12.014.

[2] L. Cavagnaro, M. Formica, M. Basso, A. Zanirato, S. Divano, and L. Felli,Femoral revision with primary cementless stems: a systematic review of the literature, *Musculoskeletal Surgery*. 2018. doi: 10.1007/s12306-017-0487-7.

[3] M. Jaudal *et al.*,A SOC1-like gene MtSOC1a promotes flowering and primary stem elongation in Medicago, *J. Exp. Bot.*, 2018, doi: 10.1093/jxb/ery284.

[4] Benavides O. E.,Principales enfermedades que afectan la producción ovina en el trópico Main illnesses that affect the sheep production in the tropic, *Rev. Spei Domus*, 2009.

[5] M. S. Engel,Insect evolution, *Current Biology*. 2015. doi: 10.1016/j.cub.2015.07.059.

[6] T. Caro, H. Walker, Z. Rossman, M. Hendrix, and T. Stankowich,Why is the giant panda black and white?, *Behav. Ecol.*, 2017, doi: 10.1093/beheco/arx008.

[7] B. V.M.,Concept of comprehensive treatment for osteoarthritis (OA), *Curr. Med. Chem. Immunol. Endocr. Metab. Agents*, 2005.

[8] C. C. Chu, A. M. Simmons, T. Y. Chen, P. J. Alexander, and T. J. Henneberry,Lime green light-emitting diode equipped yellow sticky card traps for monitoring whiteflies, aphids and fungus gnats in greenhouses, *Insect Sci.*, 2004, doi: 10.1111/j.1744-7917.2004.tb00186.x.

[9] D. G. Hall, M. Sétamou, and R. F. Mizell,A comparison of sticky traps for monitoring Asian citrus psyllid (Diaphorina citri Kuwayama), *Crop Prot.*, 2010, doi: 10.1016/j.cropro.2010.06.003.

[10] K. E. Godfrey, C. Galindo, J. M. Patt, and M. Luque-Williams,Evaluation of color and scent attractants used to trap and detect asian ctirus psyllid (Hemiptera: Liviidae) in urban environments, *Florida Entomol.*, 2013, doi: 10.1653/024.096.0420.

CHAPTER 13

UNLOCKING THE POTENTIAL OF PANGAMIC AS A SUSTAINABLE BIOFUEL CROP

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ABSTRACT:

Indonesia has million ha of marginal and degraded land, which offers very little in the way of advantages for biodiversity or human well-being. It might be necessary to restore this degraded land. The leguminous tree *Pangamic pinnata* syn. Militia pinnata, which has the ability to regenerate degraded soil, has the potential to produce biofuel. On this possibility for consideration, there is, however, little information. This study examines pong Amia's potential as a biofuel and for rehabilitating Indonesia's degraded land with the goal of filling in the scientific information gap on the plant. We used a literature study to gather pertinent data on pangamic, which we then analysed using narrative qualitative and narrative comparative methodologies. The data was carefully compiled, and the results were then interpreted scientifically. According to the assessment, pong Amia naturally grows throughout Indonesia, including in Sumatra, Java, Bali, Nusa Tenggara, and Maluku. It may live in a variety of difficult environmental situations and grow to a height of 15-20 m. Up to 40% of the weight of its seeds can be produced as crude pangamic oil. It is a nitrogen-fixing tree that can assist enhance soil qualities and rehabilitate damaged land. Additionally, pangamic offers wood, animal feed, medication, fertilizer, and biogas. pangamic has enormous potential to help Indonesia meet its energy needs and restore much of the nation's degraded land because it is a multipurpose species. However, it is important to carefully manage any potential rivalry for land and raw materials with other biomass uses.

KEYWORDS:

Biofuel, Disease, People, Population, Pandemic.

INTRODUCTION

The significance of innovative and renewable energy sources has increased due to an ever-increasing demand for energy. In Indonesia, communities mostly use petroleum fuel to power their cars, generators, and other combustion-engine driven equipment. Indonesia recently changed from being a petroleum exporting nation to one that imports petroleum, and it expects that its own natural resources will provide other energy sources. The Government of Indonesia's national energy strategy Favors new and renewable energy, which could supply up to 23% of the country's energy demands by 2025 and 31% by Republic of Indonesia 2014, since biofuel is regarded as an important alternative source of energy First generation biofuels are presently generated worldwide from crops such as oil palm, coconut, cassava, corn, sorghum, and other edible food crops. Second generation biofuels are produced using more sophisticated technology and non-food crops as feedstocks. Although some non-food crops, including *Jatropha curcas*, have the potential to produce biofuel, their competition with cash and subsistence crops restricts their overall possibilities for production. As a result, it is vital to find suitable plant species that can grow on marginal or degraded sites, such as abandoned ones, and be used as energy sources. One such species is pongamia Pong Amia pinnata syn. Milettia pinnata. It can thrive on marginal and degraded soil and its seeds are prized for their biofuel characteristics [1], [2].

The combustion of biofuels causes less harm to the atmosphere because they are made from renewable feedstocks by photosynthesis using ambient. Because they are more naturally biodegradable and non-toxic than fuels generated from petroleum, with the exception of a few unhealthful chemicals found in oil cakes, biofuels have attracted a lot of research. When biofuels are burnt in compression ignition (CI) engines as opposed to petroleum fuels, toxic pollutants such carbon monoxide (CO), unburned hydrocarbons (UHC), and particulate matter (PM) are also greatly reduced Homunculi et al. Additionally, because they can offer a sustainable solution to the bioenergy land-use conundrum, crops that produce biofuel must be able to grow on degraded land. According to the Ministry of Environment and Forestry, just a small portion of Indonesia's 14 million ha of marginal and degraded lands are useful for providing environmental services and food production. In an effort to increase climate resilience in the food, water, and energy sectors, the Indonesian government has committed to repairing 12 million ha of this degraded land Ministry of Environment and Forestry [3], [4].

million ha of severely and chronically degraded land are eligible for biofuel and biomass crops, according to a scientific study on energy production. Land restoration goals are set by numerous government organizations. One of these is the Peatland Restoration Agency, also known as Badan Restorasi Gambut, which was established to restore the more than 2 million ha of degraded peatlands in the provinces of Riau, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan, and Papua. In addition to improving ecosystem services and bolstering local economies, pongamia, a potential bioenergy species, may present a chance to repair degraded lands. Imperata cylindrica grass-covered degraded areas in Indonesia may also need to be replanted with crops like pongamia, which can shade those areas and provide ecosystem services and economic advantages. Leguminous species known as Pongamia are native to Bangladesh, India, China, Pakistan, Sri Lanka, Vietnam, Malaysia, Indonesia, Japan, Fiji, and Australia. They have also been introduced to the US, Puerto Rico, and numerous nations in Africa, including Egypt. The plant thrives in a variety of agro-climatic settings and is found naturally in humid and subtropical areas. According to Bobade et al. the species is also known as Indian beech, karum tree, pongam, shuihuang pi, honge, kanuga oil tree, day mau, kranji, malapari, and mempari in various other languages. Traditional medicinal use of pongamia has been documented [5], [6].

Because of its extensive network of lateral roots, it is a popular plant for preventing soil erosion and stabilizing sand dunes. On degraded ground, it can also produce. To support scientific understanding, this chapter provides data on pongamia, including information on its natural distribution, growth, yields, biofuel potential, and ability to restore land. It might be a useful tool for professionals organizing bioenergy and restoration projects. Peer-reviewed and grey literature reviews served as the foundation for this investigation. The review largely concentrated on four scientific areas of interest, including the distribution and growth of pongamia, its potential yield, its potential as a biofuel, and its ability to restore landscapes. A preliminary scoping research based on a Google Scholar search was carried out with the intention of determining the key words and search keywords and helping to frame the text. The relevant literature was obtained utilizing scientific research search engines including Google Scholar, Mendeley, Scopus, and Web of Science once the inclusion criteria and key terms were decided upon. We restricted our literature search to online publications of scientific papers. We did a cursory examination of the abstracts and contents of the retrieved literature at the beginning of the project to determine their applicability for inclusion in subsequent in-depth reviews. We chose 84 of the 770 pieces of literature for full analysis after eliminating any duplicates and taking the timeframe for this study into account [7].

These 84 pieces of literature were chosen based on a basic checklist of quality criteria, which included things like a clear purpose and reproducible methodology, precisely and reliably assessed outcomes, and consistently reported findings with methodologies and empirical data supplied. It took four reviewers nine months from January to September as well as another six months from June to September to extract pertinent data. The Indonesian Ministry of Environment and Forestry (MoEF) provided additional supporting information, which is included in this paper's Annex. Scientific interpretations were developed utilizing narrative qualitative and narrative comparative analysis methodologies, after meticulously compiling pertinent data point by point Perspective and context, which deal with points of view on what has occurred and describing what may be crucial in the near future, are characteristics of narrative analysis methodologies. They only give perspective, meaning, and consistency to experience and knowledge. Following the goal of this work and the inclusion criteria, i.e., the growth, distribution, yield and biofuel production potential, and landscape restoration capacity of pangamic, the analytic process was created to examine pertinent ideas in a transparent and subjective manner. The representation of a vision of reality through a process of decontextualization and recontextualization with suitable scientific order was carefully considered, It's also important to note that some terminology in this document such as pangamic growth rates are given in general rather than with precise quantification, reflecting the original literature source [8], [9].

DISCUSSION

This essay will discuss pandemics in general. For further alternative uses, see pandemic. Hotels and hostels were also considered appropriate early on in the pandemic because they may use negative pressure technology. Due to their pre-existing infrastructure electricity, water, sewage, convention centres were thought to be excellent locations for temporary hospitals. A pandemic is an epidemic of an infectious illness that has spread across a large area, such as several continents or the entire world, and is affecting a significant number of people. Widespread endemic diseases with a steady population of sick people, such as seasonal influenza recurrences, are typically omitted since they do not pose The Black Death, also known as The Plague, which killed an estimated 75-200 million people in the 14th century, was the most lethal pandemic in recorded history. The term had not yet been coined at the time but was used for later epidemics, including the 1918 influenza pandemic, more commonly known as the Spanish flu. The most recent pandemics include the HIV/AIDS pandemic, the 2009 H1N1 pandemic, and Workers for the American Red Cross transport a dead during the Spanish flu pandemic of 1918-1920An epidemic occurring on a scale that crosses international boundaries, usually affecting people on a worldwide scale is how the medical dictionary defines a pandemic. A disease or condition is not a pandemic just because it is widespread [10], [11].

The World Health Organization (WHO) defines a Public Health Emergency of International Concern as an extraordinary event that is determined to constitute a public health risk to other States through the international spread of disease and to potentially require a coordinated international response. This is the closest thing to pandemic according to the WHO. There is a well-defined trajectory of reactions, and this categorisation is subject to a rigorous methodology. A pandemic is the global spread of a pathogen or variant that infects human populations with limited or no immunity through sustained and high transmissibility from person to person, overwhelming health systems with severe morbidity and high mortality, and causing social and economic disruptions, all of which require effective prevention, preparedness, and response measures, according to an international organization supported by the WHO. The word pandemic comes from the Greek words pan, meaning all, every, and o demos, meaning people. Rapid, occasionally exponential, growth in the number of illnesses and a spreading geographic spread are typical early signs of a pandemic.

A population will always have an endemic disease, albeit at a low and predictable level. Although there may occasionally be seasonal or increases in infection rates such as with influenza, overall, the strain on health systems is bearable. Click here to view an extended version of the infographic outlining the advantages of a treaty for pandemic prevention. Routine vaccination programs are one type of prevention strategy, holding back diseases like influenza and polio that have caused pandemics in the past and could do so again if controlled. Prevention overlaps with preparedness, which aims to curtail an outbreak. The World Health Organization (WHO) established a Pandemic Hub in September in Berlin in response to the pandemic. The Pandemic Hub aims to address global deficiencies in how nations recognize, monitor, and handle public health threats. The Hub's goals include analysing more than 35,000 data feeds with artificial intelligence to look for signs of new health concerns as well as enhancing facilities and coordinating efforts between academic institutions and WHO member nations.

The network offers a platform for connecting nations, enhancing methods for gathering and analysing samples of potentially dangerous viruses. Therapies and Vaccines: A program being developed by the Coalition for Epidemic Preparedness Innovations (CEPI) aims to reduce the time it takes to generate a new vaccination by a third, to 100 days. The National Institute of Allergy and Infectious Diseases (NIAID) in the USA has created a Pandemic Preparedness Plan that focuses on identifying viruses of concern and developing diagnostics and therapies including prototype vaccines to combat them. CEPI aims to reduce global epidemic and pandemic risk by developing vaccines against known pathogens as well as enabling rapid response to Disease X. Modelling is essential for informing policy decisions because it helps predict the financial impact of illness on healthcare systems, the effectiveness of preventative measures, the expected geographic spread, and the timing and size of upcoming pandemic waves. Public awareness requires disseminating accurate information, ensuring message consistency, openness, and taking actions to refute false information. Maintaining strategic inventories of emergency supplies, such as person-to-person communication equipment.

Public etiquette distance

After the initial surge and mitigation, insufficient mitigation efforts such as the premature relaxation of physical distance requirements or stay-at-home orders can allow a comeback. Delaying and reducing the peak burden on healthcare, as well as lowering the overall cases and health impact, are mitigation goals. Increasing healthcare capacity, raising the line, as by adding beds, staff, and equipment, aids in meeting increased demand. Early in the outbreak, containment measures may be implemented, such as contact tracing and isolating infected people to prevent the disease from spreading to the rest of the population, other public health interventions on infection control, and therapeutic countermeasures such as vaccinations, which may be effective if available. When it becomes clear that containment is no longer possible, mitigation measures may be implemented, such as implementing quarantines, isolation, and other measures to reduce exposure to the disease. A wide range of the so-called non-pharmaceutical interventions may be used to manage the outbreak, including individual preventive measures like hand hygiene in the case of a flu pandemic. Suppression is a different strategy that involves longer-term measures to stop the spread of the disease. With a zoonotic origin in nonhuman primates in Central Africa and transmission to humans in the early 20th century, HIV is a persistent global public health concern that affects 39 million people worldwide. Sexual contact is the most common way that HIV is transmitted, and a brief period of mild, nonspecific symptoms could be followed by the clinical latency stage, which is asymptotic.

Previous pandemics

Smallpox, measles, scarlet fever, or varicella may all cause a fever and rash, and it's possible that outbreaks overlapped, causing multiple infections to hit the same population at once. Even though ancient DNA research can occasionally find traces of specific infections, it is frequently impossible to pinpoint how victims of epidemics were impacted. The likelihood of zoonotic illnesses increased due to the domestication of animals, which increased human-animal contact. Pathogens were able to spread widely thanks to the development of agriculture and trade between established populations. Population growth led to more frequent outbreaks of disease, which is thought to have been the case until the neolithic revolution, which occurred approximately 10,000 BC. The Plague of Athens (430-426 BC) occurred during the Peloponnesian War and resulted from an epidemic that killed a quarter of the Athenian army and a quarter of the civilian population. This disease fatally undermined Athens' control, but its extreme ferocity stopped it from spreading further; in other words, it eliminated its victims at a rate faster than they could spread it. For a long time, the precise cause of the disease was unknown.

A second outbreak of what may have been the same disease as the Antonine Plague struck Rome in 251-266 AD, killing 5,000 people per day The First Plague Pandemic was also known as the Plague of Justinian (541–549). According to the Byzantine chronicler Procopius, this pandemic originated in Egypt and spread to Constantinople the following spring, where it may have killed 40% of the city's population and 10,000 people each day at its peak. In 2013, the bubonic plague was determined to be the origin of the epidemic, which went on to wipe off a quarter to half of the world's known population. The Second Plague Pandemic, sometimes known as the Black Death, occurred from 1331 to 1353. 75 to 200 million people die each year on the planet, according to estimates. A third of the continent's population, and up to half in the worst-affected urban areas, died from the disease, which originated in Asia and spread to the Mediterranean and western Europe in 1348 (possibly from Italian merchants fleeing fighting in Crimea). This was the beginning of a cycle of European plague epidemics that lasted until the 18th century, and more than 100 plague epidemics occurred in Europe during this time.

Cholera pandemic from 1817 to 1824. The pandemic, which was previously endemic to the Indian subcontinent, started in Bengal and by 1820 had spread throughout all of India. The epidemic extended as far as China, Indonesia where more than 100,000 people perished on the island of Java alone, and the Caspian Sea before subsiding. The deaths of 10,000 British soldiers were reported; it is suspected that tens of thousands of Indians also perished. Numerous millions of deaths are thought to have been brought on by subsequent cholera pandemics in the 19th century. In 1720, the Great Plague of Marseille claimed the lives of 100,000 people. Third plague pandemic (1855-1960): Starting in China, it is estimated to have caused over 12 million deaths in total, the majority of them in India During this pandemic, the United States saw its first outbreak: the San Francisco plague of 1900-1904. The causative bacterium, Yersinia pestis, was identified in 1894. The association with fleas, and in particular rat fleas in urban environments, led to effective control measures. When annual plague mortality fell below 200, the outbreak was deemed to be over in 1959. Even so, there are still isolated human cases of the disease, which affects rats worldwide.

Most influenza outbreaks disproportionately kill the very young and the very old, but the 1918 pandemic had an unusually high mortality rate for young adults. It killed more people in 25 weeks than AIDS did in its first 25 years. Mass troop movements and close quarters during World War I caused the 1918 Spanish flu to infect half a billion people throughout the world, including on remote Pacific islands and in the Arctic. epidemics affecting native populations See also: Smallpox in Australia, History of smallpox in Mexico, Native American sickness and epidemics, Smallpox deaths among Aztecs, according to the Florentine Codex Beginning in the Middle Ages, European settlers frequently introduced epidemics of extreme ferocity to native populations throughout the rest of the world. Smallpox, measles, pertussis, and influenza were endemic in Europe when settlers arrived, and the native populations lacked immunity to them. Europeans who contracted these diseases typically carried them dormant Ly, were actively infected but asymptomatic, or had only mild symptoms.

In terms of morbidity and death, smallpox was the disease that the Europeans brought to the Native Americans that had the greatest negative impact. A quarter to a half of the population of central Mexico is thought to have died as a result of the first well-documented smallpox epidemic in the Americas, which started in Hispaniola in late 1518 and quickly spread to Mexico. According to estimates, the indigenous population of the Americas decreased from 60 million to only 6 million over the course of the 100 years following the arrival of Europeans in the region in 1492 due to a combination of disease, war, and famine. Numerous waves of newly introduced diseases, including smallpox, measles, and typhoid fever, are to blame for the majority of these fatalities. In the early 1800s, measles, smallpox, and intertribal warfare are thought to have killed 20,000 New Zealand Mori. In Australia, smallpox was introduced by European settlers in 1789, devastating the Australian Aboriginal population and killing an estimated 50% of those infected with the disease during the first decades of colonization.

Out of 150,000 Hawaiians, as many as 40,000 are thought to have perished from measles, whooping cough, and influenza in 1848–1849. In 1875, measles killed more than 40,000 Fijians, or about one-third of the population, and the Great Andamanese population was decimated in the early 19th century. In Hokkaido, a smallpox epidemic brought in by Japanese settlers is thought to have killed 34% of the native Ainu population in 1845. According to the United Nations' Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' October era of pandemics report, which was written by 22 experts in a variety of fields, the destruction of biodiversity by humans is paving the way for the pandemic era and could lead to the transmission of up to 850,000 viruses from animals, particularly birds and mammals, to people. The two main causes of this damage are the exponential rise in the consumption and trade of goods like metals, beef, and palm oil, which has been greatly helped by industrialized countries. According to Peter Gaszak, the group's chair, there is no great mystery about the cause of the pandemic or any modern pandemic. Through their effects on our ecosystem, human activities that cause climate change and biodiversity loss also increase the danger of pandemics.

CONCLUSION

Pong Amia trees may thrive in challenging environmental circumstances. The plant may flourish in a wide range of temperatures, partial shade, and many types of soil. Pong Amia is a versatile tree that can produce a lot of oil for biodiesel, fix atmospheric nitrogen, and enhance soil health. On degraded terrain that is unsuitable for growing food, it can provide bioenergy. Large regions of degraded land in Indonesia give few advantages to people and the environment, therefore recovering such land through pangamic horticulture could present a chance to improve ecosystem services and stop the loss of biodiversity. Despite the fact that a number of other species, such as oil palm, coconut, or jatropha, also produce biofuel, pong Amia is a strong contender for planting as a bioenergy feedstock on degraded land due to its numerous advantages The importance of domestic biofuel production has greatly increased as a result of the Government of Indonesia's launch of a national policy on new and renewable energy consumption, which calls for biofuel to comprise 5% of the energy mix by Pong Amia could be a potential new option for cultivation on degraded land, as the efficacy of palm oil production is being questioned worldwide. To stop forests from being cut down for the development of biodiesel crops, however, long-term monitoring will be necessary. Our review of the literature revealed that there are still gaps in scientific knowledge regarding, among other things, current pong Amia production technology, long-term plantation management, community involvement, various added-value options (such as understory crop associations), identification of potential producers and consumers of biofuel, development of successful business models for various stakeholders in the biofuel industry, and the viability of creating stable biofuel markets. In order to close information gaps and benefit scientific communities, managers, and other stakeholders, fresh pong Amia research that concentrate on these concerns are therefore needed.

REFERENCES:

[1] M. Abraha *et al.*, "Evapotranspiration of annual and perennial biofuel crops in a variable climate," *GCB Bioenergy*, 2015, doi: 10.1111/gcbb.12239.

[2] J. Gressel, "Transgenics are imperative for biofuel crops," *Plant Science*. 2008. doi: 10.1016/j.plantsci.2007.11.009.

[3] M. Graus *et al.*, "Biosphere-atmosphere exchange of volatile organic compounds over C4 biofuel crops," *Atmos. Environ.*, 2013, doi: 10.1016/j.atmosenv.2011.12.042.

[4] M. E. Vega-Sánchez and P. C. Ronald, "Genetic and biotechnological approaches for biofuel crop improvement," *Current Opinion in Biotechnology*. 2010. doi: 10.1016/j.copbio.2010.02.002.

[5] P. Heděnec *et al.*, "Allelopathic effect of new introduced biofuel crops on the soil biota: A comparative study," *Eur. J. Soil Biol.*, 2014, doi: 10.1016/j.ejsobi.2014.05.002.

[6] Z. Qin, Q. Zhuang, and M. Chen, "Impacts of land use change due to biofuel crops on carbon balance, bioenergy production, and agricultural yield, in the conterminous United States," *GCB Bioenergy*, 2012, doi: 10.1111/j.1757-1707.2011.01129.x.

[7] H. A. Hutchings, W. Y. Cheung, J. G. Williams, D. Cohen, M. F. Longo, and I. Russell, "Can electronic routine data act as a surrogate for patient-assessed outcome measures?," *Int. J. Technol. Assess. Health Care*, 2005, doi: 10.1017/S026646230505018X.

[8] T. Harrison and M. R. Berenbaum, "Moth diversity in three biofuel crops and native prairie in Illinois," *Insect Sci.*, 2013, doi: 10.1111/j.1744-7917.2012.01530.x.

[9] J. Sato, K. Intabon, and T. Maekawa, "Farm village activation project on biofuel crops in Laos," *Acta Hortic.*, 2015, doi: 10.17660/ActaHortic.2015.1088.117.

[10] P. Heděnec *et al.*, "The effect of native and introduced biofuel crops on the composition of soil biota communities," *Biomass and Bioenergy*, 2014, doi: 10.1016/j.biombioe.2013.11.021.

[11] N. Phongaksorn, N. K. Tripathi, S. Kumar, and P. Soni, "Inter-sensor comparison between THEOS and landsat 5 TM data in a study of two crops related to biofuel in Thailand," *Remote Sens.*, 2012, doi: 10.3390/rs4020354.