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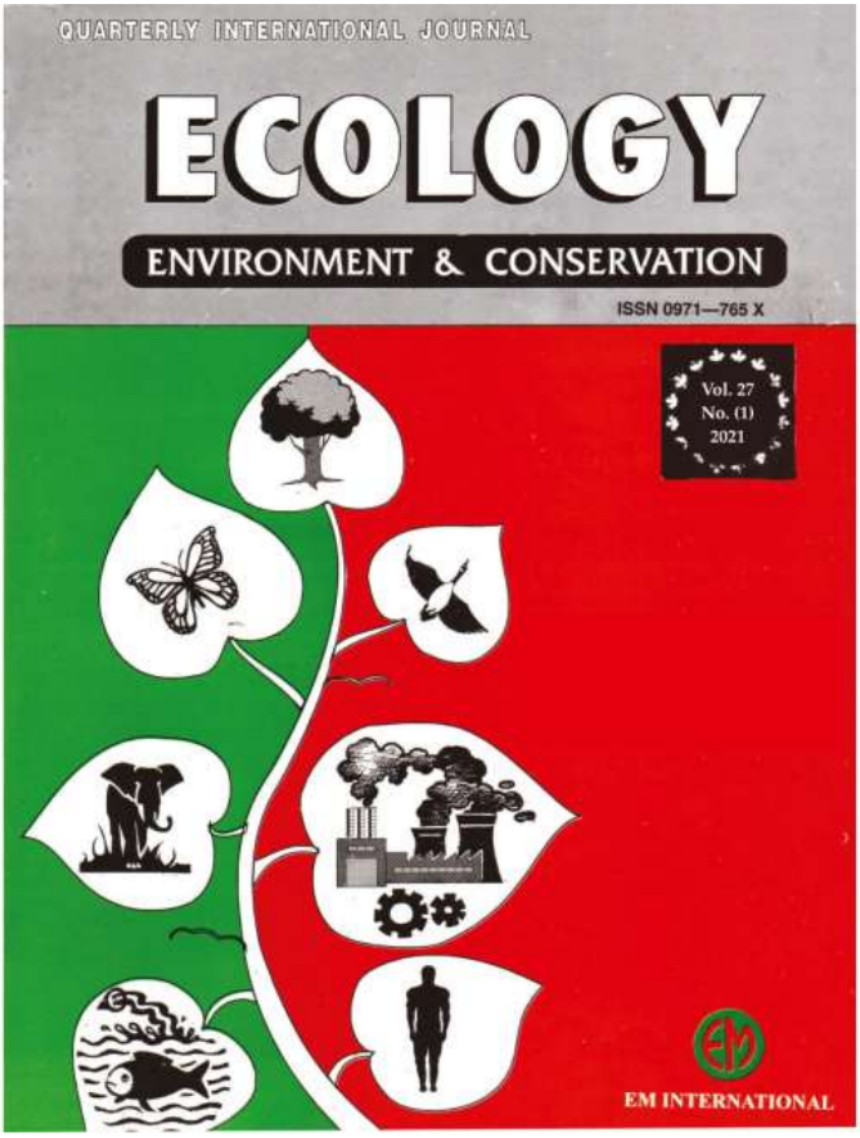

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STUDY OF SOME FACTORS TO TOLERANCE OF DIFFERENT ENVIRONMENTAL STRESS TO SWEET CORN PLANTS
Ali A. Arat and Ali H. Jasim

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Kudrat-E-Khuda (Babu)

STRATEGY DEVELOPMENT TO IMPROVE FOOD SECURITY AT THE HOUSEHOLD LEVEL OF RICE FARMERS IN SOUTH SULAWESI INDONESIA
Ida Rosada, Nurliani, Fatma A. Gobel, Farizah D. Amran and Aminah

ANALYSIS OF SOIL OF AGRICULTURAL FIELD USED FOR RICE PRODUCTION WITH RESPECT TO BORON AND FEW SELECTED CATIONS OF LAKHIMPUR DISTRICT OF ASSAM, INDIA
Md. Yamin Hassan, Naranaryayn Buragohain and Maitreyee Sarma Bezbarua

RAPFISH ANALYSIS ON SUSTAINABILITY STATUS OF POST-TIN MINING IN JEBUS SUBDISTRICT, WEST BANGKA REGENCY, BANGKA BELITUNG ISLANDS PROVINCE, INDONESIA
Fitri Ramdhani Harahap, Ridhah Taqwa, Restu Juniah and Elisa Wildayana

EFFECT OF DIFFERENT AGRICULTURAL MEDIA AND WOUNDING ON ROOTING AND GROWING OF GRAPES (VITIS VINIFERA L.) SEMI WOOD CUTTING
Suzan Ali Hussein, Raad Ahmed Medan and Ali Mohammed Noori

SUITABILITY FORMULATION AND PREDICTION OF SEAWEED (GRACILARIA VERRUCOSA) PRODUCTIVITY IN A POND AREA
Agus Dharmawan, Nuddin Harahab, Muhammad Musa and Soemarno

ADOPTING THE WATER QUALITY INDEX TO ASSESS THE VALIDITY OF GROUNDWATER IN AL-ZUBAIR CITY SOUTHERN IRAQ FOR DRINKING AND HUMAN CONSUMPTION
Bayan A. Mahdi, Mohammad Salim Moyel and Raghad Shubbar Jaafar

SEASONALITY OF LITTER DWELLING MICROARTHROPODS AND THEIR RELATION WITH THE CLIMATIC VARIABLES IN ACACIA PLANTATION OF CACHAR DISTRICT, ASSAM

Rajeeb Chetia Pator and Dulal Chandra Ray

IDENTIFICATION AND ANALYSIS OF MARINE ECOTOURISM POTENTIAL IN PACITAN, EAST JAVA, INDONESIA
Sukandar, C.S.U. Dewi, R.S.Q. Haq and R. Fatmawati

THERMAL POWER PLANT DISCHARGED WASTEWATER CHARACTERIZATION: A CASE STUDY
Afroza Akhter, Naseer Hussain Shah and Arif Inam

ANALYSIS OF FACTORS RELATED TO FLOOD MITIGATION IN THE WELANG WATERSHED, PASURUAN CITY
Heri Suroso, Loeki Enggar Fitri and Yati Sri Hayati

BIOGAS PRODUCTION TO PROMOTE RENEWABLE ENERGY – A CASE STUDY ON BHIMTAL AREA
Amrita Verma Pargaien, Saurabh Pargaien, Himanshu Joshi, Neema Bisht and Kamal Nayan Joshi

BIOREMEDIATION OF METAL IONS FROM AQUEOUS SOLUTIONS USING ALGAE CLADOPHORA SP.
Shareena Nazeer, Murtuza Ali Syed and Feroz Shaik

ATTITUDE AND PERCEPTION OF THE LOCAL COMMUNITY TOWARDS COMMUNITY BASED TOURISM DEVELOPMENT IN HAR KI DUN VALLEY UTTARAKHAND
Alka Maheshwari

COMPARING THE USE OF BIOPLASTIC CASSAVA AND PLASTICS ETHYLENE AS PACKAGING CAYENNE PEPPER
Akhmad Rizali

A REVIEW OF MULTI-DIMENSIONAL BENEFITS OF INNOVATIVE AGRICULTURAL PRACTICES WITH SPECIAL REFERENCE TO AGROFORESTRY AND AGROSILVIPASTORAL SYSTEM
Ankita Choudhary and Shilpi Rijhwani

SUSTAINABILITY MANAGEMENT EVALUATIONS OF BEE JAY BAKAU RESORT IN PROBOLINGGO USING MULTI DIMENSIONAL SCALING RAPECO TOURISM APPROACH
Mochammad Fattah, Candra AdiIntyas and Tiwi Nurjannati Utami

PRINCIPAL COMPONENT ANALYSIS OF THE PHYTOPLANKTON INTERACTION WITH THE ENVIRONMENTAL FACTORS IN KOTTAKAYAL (KERALA, INDIA)
Jensy Roshan F. and Sreejai R

IDENTIFICATION OF OXYGEN PRODUCTION AND OXYGEN DEMANDS IN PARKS AND GREEN PATHS AS AN ENVIRONMENTAL SUSTAINABILITY EFFORT IN SELONG AREA, JAKARTA, INDONESIA
Nur Intan Simangunsong and Rini Fitri

ECOLOGICAL ASSESSMENT AND WATER QUALITY USING BENTHIC DIATOM COMMUNITIES IN AN ECUADORIAN AMAZON RIVER
Luis Quevedo, Karla Merino, Sofia Godoy and Cumanda Carrera

INTERPRETATION OF SPECIES HABITAT RELATIONSHIP AND ANIMAL INTERACTION THROUGH REMOTE SENSING WITH REFERENCE TO SPOTTED DEER AND LANGUR POPULATIONS IN KANHA NATIONAL PARK, INDIA
Debashis Roy and Kamonasish Mistry

RANGE EXPANSION OF THE INVASIVE NILE TILAPIA OREOCHROMIS NILOTICUS (PERCIFORMES: CICHLIDAE) IN SULAWESI SEA AND FIRST RECORD FOR SANGIHE ISLAND, TAHUNA, NORTH SULAWESI, INDONESIA
Novalina Serdiati, LigaInsani, Muhammad Safir, Andi Heryanti Rukka, Septina F. Mangitung, Fitri Sil Valen, Muhammad Badrut Tamam and Veryl Hasan

CHANGING TREND OF FOREST COVER IN THE PABHA RESERVE FOREST IN THE LAKHIMPUR DISTRICT OF ASSAM, INDIA
Jyoti Saikia and Sailajananda Saikia

GLOBAL CITIZENSHIP ELEMENTS IN MALAYSIAN PRIMARY SCHOOL CURRICULUM TOWARDS SUSTAINABLE DEVELOPMENT GOALS (SDGS)
Sharifah Zarina Syed Zakaria, Raja Nur Amirah Raja Abu Bakar, Nasharudin Mat Isa, Siti Nur Diyana Mahmud, Azlina Abdullah, Che Nidzam Che Ahmad, Sharifah Intan Sharina Syed Abdullah, Nuriah Abd. Majid and Muhammad Rizal Razman

BIRDS IN SEMI-NATURAL WETLANDS OF ARID LANDSCAPE- A STUDY ON THEIR DIVERSITY IN KACHCHH REGION OF GUJARAT, INDIA
Prapti J. Gohil and Arun Kumar Roy Mahato

SUPPORTING SUSTAINABLE DEVELOPMENT GOALS (SDGS): EMBEDDING GLOBAL CITIZENSHIP EDUCATION ACROSS MALAYSIAN PRIMARY SCHOOLS CURRICULUM
Raja Nur Amirah Raja Abu Bakar, Sharifah Zarina Syed Zakaria1, Nasharudin Mat Isa, Nuriah Abd. Majid and Muhammad Rizal Razman

ANALYSIS OF CORRELATION AMONG ZOOPLANKTON IN TWO NEAR BY PONDS OF JAMMU REGION
Sarbjeet Kour, Nidhi Sharma, Rajan Verma, Supreet Kour and Vipan Kumar

TEACHERS' PERCEPTION AND ROLES REGARDING GLOBAL CITIZENSHIP FOR SUSTAINABLE DEVELOPMENT

Raja Nur Amirah Raja Abu Bakar, Sharifah Zarina Syed Zakaria, Nasharudin Mat Isa, Nuriah Abd. Majid and Muhammad Rizal Razman

FRESHWATER FISHES OF GEGAS DAM, SOUTH SUMATRA INDONESIA: COMPOSITION AND DIVERSITY
Dian Samitra, Harmoko, Sepriyaningsih, Zico Fakhrur Rozi, Arum Setiawan and Indra Yustian

EFFECTS OF TEMPERATURE ON COVID-19 TRANSMISSION IN INDIA
Indranil Bhattacharjee, Biplab Mandal, Anuradha Deb, Priyanka Sarangi and Partha Pratim Chakravorty1*

GENETIC RESOURCES PRESERVATION AND UTILIZATION OF INDONESIAN NATIVE FRESHWATER FISH CONSUMPTION
Kurniawan, Rudhy Gustiano, Irin Iriana Kusmini and Vitas Atmadi Prakoso

ANALYSIS OF CRIMINAL LAW APPLICATION IN ENVIRONMENTAL OFFENCES
Shivi Chola

INTERNATIONAL ENVIRONMENTAL LAW ENFORCEMENT USING ISO 14001 IN THE WTO FREE TRADE SYSTEM AND ITS IMPLEMENTATION IN INDONESIAN LAW
Ferdi

AN ANALYSIS OF TOTAL FACTOR PRODUCTIVITY OF COTTON IN TAMIL NADU
V. Kavitha, S. Usha Nandhini and V. David Chella Baskar

DIVERSITY OF ECTOPARASITES AND THEIR PATHOGENS IN BIRDS (PASSERIFORMES AND COLUMBIFORMES) IN BOUINAN REGION (BLIDA - ALGERIA)
Samia Ouarab, Affef Baaloudj, M. Aouar-Sadli, F. Medjdoub-Bensaad and Djouamaa Abdelkader

PRELIMINARY SURVEY FOR LEPIDOPTERAN FAUNA OF KALRAYAN HILLS, KALLAKURICHI DISTRICT, TAMIL NADU, INDIA
Pavithrra Dharani, S.K. and Kathirvelu, C.

CRUSTACEANS ECTOPARASITE OF TRACHINOTUS BLOCHII CULTIVATION IN HATCHERIES TUB AND FLOATING NET CAGES
Panji Aulia Syahputra, Kismiyati and Akhmad Taufiq Mukti

A STUDY ON ECOTOXICITY OF CARTAP HYDROCHLORIDE ON "PERIONYX EXCAVATUS"
Maminee Panda and Aliva Patnaik

ISOLATION AND CHARACTERIZATION OF SULFATE REDUCING BACTERIA FROM CULTIVATION POND SEDIMENTS
Bakhtiar Ibrahim, Sukoso, Rudi Sulistiyono and Saida

PERFORMANCE OF HERBICIDE APPLIED AT 2 TO 4 LEAF STAGE OF WEEDS ON WEED DYNAMICS AND YIELD IN SPRING PLANTED SUGARCANE
Shiv Poojan Yadav, Ramesh Kumar Singh, Anubha Singh, Deepak Kumar Yadav, Tikendra Kumar Yadav and Harsita Nayak

THE INFLUENCE OF SOCIAL FACTORS AND PSYCHOLOGICAL FACTORS IN LANDSCAPE DESIGN FOR CHILDREN'S PLAYGROUND (CPG)
Pangaribowo and Rustam Hakim Manan

SIGNIFICANCE OF ORGANIC FOOD TOWARDS HUMAN HEALTH IN THE PRESENT COVID-19 TIME
Deepa Tomar1, Monika Sharma and Chandra Kant Sharma

THE ROLE OF VEGETATION ON THERMAL COMFORT THE RIA RIO RESERVOIR AREA IN DKI JAKARTA PROVINCE
Rustam Hakim Manan and Hana Nadasiyatus

THE INFLUENCE OF BINARY IRRIGATION (BI), HUMIC ACID (HA), AND VARIOUS SALINE WATER ON WATER CONSUMPTION (WC), WATER USE EFFICIENCY (WUE) OF CORN (ZEA MAYS L.)
Wael F.A. Alshamary , A.M.H. Aljumily, Emad T. Abdel Ghani and Bassam A. Alkhateb

WINTER AVIFAUNAL ASSEMBLAGE IN A PERIURBAN AGRICULTURAL LANDSCAPE OF GANGETIC WEST BENGAL, INDIA
Pratyush Ghosh, Akash Chakraborty and Shouvanik Sengupta

IDENTIFICATION OF RUBIAH ISLAND AS A NATURE TOURISM DESTINATION IN SABANG, ACEH
Nur Intan Simangunsong, Rini Fitri and Dewi Rezalini Anwar

REMOVAL OF NICKEL (II) IONS FROM AQUEOUS SOLUTION USING ACTIVATED CARBON DEVELOPED FROM AZADIRACHTA INDICA A LOW COST ADSORBENT
Maninder Singh, D.P. Tiwari and Mamta Bhagat

DIVERSITY, VEGETATION STRUCTURE AND C STOCKS OF INUNDATED RIPARIAN FOREST PROTECTED FROM CONVERSION TO OIL PALM IN C. KALIMANTAN
Cahyo Prayogo, Risky Maulana Ishaq, Muhammad Khoirul Anwar, Didik Suprayogo, Choirul Anshori, Yudha Asmara, Bandung Sahari and Kurniatun Hairiah

SEASONAL VARIATION ASSESSMENT IN PHYSICOCHEMICAL PARAMETERS OF NAKATIA RIVER, UTTAR PRADESH (INDIA)
Deepti, Archana Bachheti, R.K. Bachheti and V.K. Mishra

DRINKING WATER QUALITY EVALUATION FOR GROUNDWATER OF DELHI, INDIA USING GIS TECHNIQUES
Ayushi Raghav and S.K. Singh

RESPONSE OF AVENA SATIVA L. INTERCROPPING WITH EGYPTIAN CLOVER TO DIFFERENT PLANTING DENSITY AND DISTANCES IN GREEN FODDER YIELD
Mundher Kh. Jabbar and Hayder A. Hasan

DISTRIBUTION AND POPULATION DENSITY FOREST DORMOUSE (DRYOMYS NITEDULA, RODENTIA, GLIRIDAE) IN A REGION OF THE MIDDLE VOLGA, RUSSIA
Alexey Andreychev

DIVERSITY OF EDIBLE PLANTS IN HOME GARDENS OF THE EASTERN CAPE PROVINCE, SOUTH AFRICA
Alfred Maroyi

POLLUTION IN RIVER GANGA DUE TO HEAVY METAL TOXICITY AND VARIOUS MITIGATION PLANS- A REVIEW
Akansha Patel, Vinod Kumar Chaudhary, Anurag Singh, Dhananjai Rai and Naveen Patel

SPATIAL DIVERSITY OF OXIDES IN SOIL AFFECTING CERAMICS IN BABIL GOVERNORATE
Afrah Kadhim Hasan and Samer Ahmed Alkarady

ASSESSMENT OF WATER QUALITY SUPPLIES IN SOME AREAS OF BASRAH GOVERNORATE, IRAQ
Ansam Jasim Mohammad, Nassir Abdullah Alyousif, Um Albneen Sadiq Al-Mosawi and Makia M. Al-Hejuje

EFFECT OF SOWING DATE AND PLANTING DISTANCE ON GROWTH AND YIELD OF OAT
Zaman S.A. Al-dulaimi, Maher H.S. Al-Asady and Husham S. Ali

EXPRESSION AND RECOMBINANT PROTEIN PURIFICATION OF PHYCOCYANIN α AND β SUBUNITS FROM ARTHROSPIRA PLATENSIS: ANTIMICROBIAL ACTIVITY
Rachanimuk Hiransuchalert, Kanchana Sittikankaew, Patchari Yocawibun, Maliwan Kutako, Chalee Paiboonkichakul, Sirawut Klinbunga and Narongsak Paunglarp

HYDROLOGICAL CHARACTERISTICS ANALYSIS OF OGAN WATERSHED, SOUTH SUMATRA, INDONESIA
Utari Hikmah Pratiwi, Eddy Ibrahim, Edward Saleh and Ngudiantoro

SEASONAL MICROPLASTIC DOCUMENTATION IN KERALA MANGROVE SEDIMENTS

Manju P. Nair, Minnu Maria Wilson, Jenees Mathew, Rosily A.V. and Anu Gopinath

SPATIO-TEMPORAL DYNAMICS OF MANGROVE FORESTS IN SURABAYA FROM 1996 THROUGH 2016
Sumarmi, Purwanto and Tuti Mutia

ASSESSMENT OF FOREST LAND DEGRADATION BY REMOTE SENSING AND GIS: A CASE STUDY OF JAISAMAND WILDLIFE SANCTUARY, UDAIPUR (RAJASTHAN)
Anil Panchal, Nidhi Rai and Nirmal Kumar Sharma

SIMULATION OF PREDICTION THE CAPACITY OF RANDEGAN LANDFILL, INDONESIA
Titien Setiyo Rini, Yuwono Budi Pratiknyo and Maritha Nilam Kusuma

EMPOWERMENT BASED PEATLAND ECOSYSTEM CONSERVATION FOR FIRE CONTROL AND ENVIRONMENTAL CONSERVATION
Zulkarnain and Owin Jamasy Djamaludin

ANALYSIS OF THE DISTRIBUTION OF SEA TURTLE NESTING GROUNDS BASED ON PHYSICAL CHARACTERISTICS ALONG THE COAST OF KRETEK DISTRICT, BANTUL REGENCY, YOGYAKARTA, INDONESIA
Rini Fathoni Lestari, Muhammad Kamal and Pramaditya Wicaksono

CONVERGENCE ANALYSIS OF TERRESTRIAL PROTECTED AREAS BY 159 COUNTRIES
Yu Sang Chang, Moon Jung Kim and Sung Jun Jo

EFFECT OF ENVIRONMENTAL CONCERN AND SUSTAINABILITY ON REVISIT INTENTION WITH ENVIRONMENTAL AWARENESS AS A MEDIATING VARIABLE
Zainal Abidin, Budi Setiawan, A. Wahib Muhaimin, A. Shinta and H. Islamiyah

A STUDY ON THE GUILD INTERACTION OF PREDATOR NATURAL ENEMIES IN A RICE FIELD
Gobinda Chandra Roy, Kaushik Chakraborty and Siddharthasankar Banerjee

ORIGIN OF THE GYPSUM-BEARING HORIZON OF CALCIC CHERNOZEMS IN THE SOUTH OF RUSSIA
O.S. Bezuglova, E.N. Minaeva, I.V. Morozov, S.S. Mandzhieva, V.D. Rajput and V.E. Boldyreva

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Identification of oxygen production and oxygen demands in parks and green paths as an environmental sustainability effort in Selong area, Jakarta, Indonesia

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ABSTRACT

The availability of land for parks and green paths in the city of Jakarta is increasingly limited, so we need green open space that provides maximum value for the city community and surrounding communities.The purpose of this study is to identify how much oxygen is produced by the Parks and Green paths to the oxygen demand of residents and vehicles in the Selong Area. The method used in this study is an evaluative analysis method (calculating oxygen production from vegetation based on the number and type of trees; calculating the oxygen needs of residents and vehicles) and efforts to increase oxygen production. The study was conducted in 12 parks and 18 green paths in Selong area. The calculation results show that a park planted with many trees does not guarantee that more oxygen will be produced if the selection of tree species is not right. Characteristics of trees that are broad-crowned, leafy and pile more produce oxygen. This research is expected to increase government and community awareness of the importance of the existence of green open space for the sustainability of oxygen availability in urban areas and can be a reference for park development.

Key words: *Oxygen needs, Oxygen production, Parks and green paths, Sustainability*

Introduction

The lack of availability of green open space compared to build space is one of the basic problems that are common in urban area. Selong area occupies an area of 1.40 km with a population of 3,369 people (BPS, 2019). The area of green open space in the form of parks that is currently recorded is 26,463 m^2 and green paths 17830,653 m^2 (Suku Dinas Kehutanan Jakarta Selatan, 2019). The ratio of parks and green paths is 3.02% of the total area of Selong (Daroyni, 2010) asserted that the DKI Jakarta government has reserved 13.94% of its area to become a green space area as stated in the 2000-2010 Jakarta Regional Spatial Plan (RUTRW), but in 2003 DKI Jakarta's green space area was 9.12% and in 2007 it was estimated to remain 6.2% because all remaining space has been commercialized. Ideally, the area of green open space is 30% (Joga, 2011).

Urban green open spaces in the form of parks, green paths affects the improvement of microclimatic conditions in urban areas (Georgi, 2010); as producers of oxygen and absorbers of rainwater; in the long run are intangible to maintain the availability of groundwater (Peraturan Menteri Pekerjaan Umum, 2008) and water is a source of life (Arsyad,

2006); The main focus of the role of urban forests is on environmental services (Kuchelmeister, 2000; Tyrvainen, 2005; Schwab, 2009). The role of urban forests is the main focus on environmental services Park as part of the urban forest is defined as a stretch of green area with a minimum area of 0.25 ha located in urban areas with various types of trees, free-crowned, deep root system, plant spacing of canopy structure with a height above 3 meters (Subarudi, 2015). The vegetation effects outdoor microclimate in terms of thermal environment and comfort in the urban environment (Yang, 2019). Trees in cities have been shown to play a role in the formation of a microclimate, in improving air quality and reducing carbon dioxide, and in protecting the city's water supply (Akbari, 2001; Nowak, 2006); Lafortezza, 2009; Biao, 2010). Thus, the 3.02% available land is expected to be able to produce oxygen as needed to maintain environmental sustainability. Furthermore, green open spaces such as parks and green paths can function as the lungs of the city because they are oxygen producers whose function has not yet been replaced. According to Muis (2020) the role of oxygen is vital for humans because its function is so important, lack of O2 will have a serious impact on health. Humans need O2 from the air as much as 600 L/day equivalent to 864 g/day to produce energy in the body and emit 480 L of carbon dioxide (CO_2). The aim of this research is:

1. Calculating the oxygen needs of the population and vehicles passing
2. Calculating the oxygen productionability of city parks and green paths.

The results of the analysis of production and demand for oxygen are important for evaluating the selection of vegetation types and policies in managing parks and green paths.

Methods

This research was conducted in 12 Parks and 18 Green paths, located in the Selong area, Kebayoran Baru, South of Jakarta. The study was conducted from March to July 2019. The research was conducted with the stages of collecting primary data and secondary data after which data analysis was carried out. Primary data is taken from the field while secondary data is taken from related agencies. The data used in this study include data on the number of residents, the number of motorized vehicles that cross the Selong area, parks, green paths, the number and types of trees used therein. The data was obtained from the Dinas Kehutanan DKI Jakarta (Forestry Service agency and the South Jakarta City Administration's Forestry Service Department, counting trees and tree species conducted in the field. After that, an analysis is carried out to get the oxygen needs of the population, motorized vehicles and oxygen production in the parks and green paths.

Oxygen is needed in human respiration as well as in the combustion process of vehicle fuel. The detailed requirements for humans and vehicles are as follows:

a. Human Oxygen Needs

The average human needs 600 liters of oxygen to breathe every day, 1 kg of oxygenis equivalent to 0.00144 liters of oxygen (Wisesa, 1988). Oxygen needs of every human being are assumed to be the same under normal conditions, so the calculation according to Wisesa (1988) is:

Oxygen needs (kg/day) = total population x 0.864 kg/day

Oxygen needs (tons/year) = total population x 0.3154 tons/year

b. Vehicle oxygen demand

The calculation is done with the assumption that in 1 kg of gasoline requires 2.77 kg of oxygen and in 1 kg of diesel requires 2.88 kg of oxygen (Muis, 2020). Thus, the calculation can be made as follows:

Gasoline mass (kg) =volume of gasoline (liters) x 0.7

Gasoline oxygen Needs (kg) = mass of gasoline x 2.77

Calculation of the number of passing vehicles is obtained from the average of vehicles passing through the morning and evening assuming the fuel consumption of each car is 0.1 L/km. In this study, it is assumed that vehicles passing by use gasoline.

c. Oxygen Production Ability

Oxygen production ability calculation is done by inventorying trees to find out the number and species of trees contained in the study site, without using the oxygenproduction ability of each tree species. Selected trees with criteria of stem diameter at breast height or Diameter at Breast Height (DBH); tree height; header model; and the physical condition of the tree. Calculation of oxygen production capability in trees is as follows: oxygen production ability of protective trees = number of trees x 1.2 kg/

day (Kusminingrum, 2008).

Results and Discussion

Basically, all life activities require oxygen (O2). Of all types of consumers, those who consume a lot of O2 are humans, motor vehicles and livestock. Humans consume O2 to burn food substances in the body, while motor vehicles require O2 to burn fuel. Apart from that O2 for livestock is used for metabolism in the body.Analysis of oxygen demand of the population and vehicles can be seen in the following Table.

From Table 1. the results of the calculation of oxygen demand for human breathing in 2019 and oxygen demand for the fuel combustion process in vehicles was 13,429.94 kg/day. So, the average total daily oxygen demand in the Selong area for humans and the vehicles in 2019 was 16,340.75 kg/day. Oxygen demand will increase along with the increase in population and vehicles. Based on Table 1, oxygen demand is the most widely used for vehicle.

The need for oxygen for combustion of vehicle engines is very dependent on the type of vehicle, the type of fuel used, vehicle power and the length of time the vehicle is used. The types of motorized vehicles that are taken into account in the study of green space requirements based on oxygen fulfillment consist of: (a) Passenger vehicles, including sedans, jeeps and the like, ambulances and other small passenger cars, (b) Load Vehicles, included in this category are trucks, dump trucks, small trucks, tanker cars, tractors, tow trucks and other types of commercial vehicles, (c) Bus Vehicles, this type includes large size buses, medium size buses and other heavy passenger vehicles, and (d) Motorcycles, in the form of two-wheeled vehicles, tricycles and the like.

O2 production capability of the parks

Basically, oxygen is a gas type which is free in the atmosphere, it can pass everywhere when no one is limiting. So that, the study assumes that Selong area is a closed environment, no O2 either coming in or out as well as produced only from green open space in research area. Green open space is an area in the earth surface looking at 2D which is covered by plants whether floor types or even height trees. The ability of trees in production can be calculated from the number of protective trees in parks and green paths. The calculation of oxygen production produced by a tree is obtained from the number of trees multiplied by the ability of a protective tree to produce oxygen which is 1.2 kg/day. Measurement of the ability to produce oxygen is carried out in 12 parks and 18 green paths in the Selong area managed by the the DKI Jakarta Forestry Service agency. The ability and number of trees to produce oxygen in the Park and Green paths in Selong Village can be seen in Table 2 and 3.

Table 2 shows the ability of oxygen production in the park which is an average of 1.01 kg/day. Trees with the highest average oxygen production found in Sriwijaya Park, which is 1.2 kg/day; are the results of 69 trees that produce 82.80 kg/day. The tree species in Sriwijaya Park are dominated by wide-crowned trees such as Mahogany, Beringin, Glodokan, and Tanjung. The tree with the lowest average oxygen production is Taman Empu Sendok which is 0.75 kg/day, resulting from 43 trees that produce 32.40 kg/day. There are small leafy and not-crowned tree species such as Coconut, Palm and

Table 1. Oxygen demand for population and vehicle

No	Location (street) in Selong Area	Vehicle			Population in Selong Area	
		Amount	The mass of gasoline (kg)	Oxygen demand (kg)	Amount	Oxygen demand(Kg)
1	Trunojoyo St	10,586	741.02	2,052.62		
2	Pattimura St	9,294	650.58	1,802.1		
3	Sisingamangaraja St	23,178	1,622.46	4,494.21		
4	Raden Patah St	7,265	508.55	1,408.68		
5	Kertanegara St	9,527.4	666.91	1,847.36		
6	Gunawarman St	6,505.8	455.4	1,261.47		
7	Senopati St	2,906	203.42	563.47		
	Total	69,262.2	4,848.34	13,429.91	3,369	2,910.81

(*Source:* Private. 2019)

Cambodia. Overall, the highest oxygen production was produced in Mataram Park in the amount of 151.20 kg/day while the lowest in Taman Rajasa 1 was 25.20 kg/day.

Table 3 shows that the results of the calculation of the ability of oxygen production in the green paths are on average 1,199 kg/day, greater than the production of parks. The use of Mahogany tree with a wide diameter of 5-6 meters with a height of 6-10 meters is dominant in the green paths. In quantity, the number of trees in the green paths is greater than in the parks.

Table 4, shows that there are 32 species of 714 trees in the park, only 661 trees which according to character can produce oxygen 672 kg/day. Compare this with the green paths having 7 types of trees from 4273 trees producing 5125 kg of oxygen/day. In the park, it was found that the utilization of

Table 2. Parks, number of protective trees and paths production capability

No	Park	Size (m^2)	Number of Protective trees	O2 production (kg/day)
1.	Jenggala Park	1800	54	44.40
2.	Sanjaya 1 Park	1900	71	78.00
3.	Sanjaya 2 Park	2400	42	46.80
4.	Daha Park	1213	30	34.80
5.	Sriwijaya Park	1500	69	82.80
6	Mataram Park	3490	154	151.20
7	Prudensial Park	4089	80	91.20
8	Cemara Park	1635	34	36.00
9	Mpu Sendok & Mpu Sendok Dalam Park	1110	43	32.40
10	Rajasa 1 Park	700	28	25.20
11	Rajasa 2 Park	2846	56	49.20
12	Gunawarman Park	3780	56	58.80
	Total	26463	661	672.00

(*Source:* Private. 2019)

Table 3. Size, number of trees, oxygen production capability of Green path

No	Green path Name	Size (m^2)	Number of Protective trees	Oxygen production (kg/day)
1.	Adityawarman	900	160	192
2.	Purnawarman	540	60	72
3.	Pattimura	10,653	1,200	1,440
4.	Gunawarman	5,031	470	564
5.	Galuh	1,600	240	288
6.	Rajasa	700	20	24
7.	Sriwijaya	1,875	470	564
8.	Sriwijaya I & II	900	60	72
9.	Raden Patah	2,309	490	588
10.	Kertanegara	835	600	720
11.	Senopati	2,575	500	600
12.	Gunawarman – Belitung st	7	-	0
13.	Gunawarman – Erlangga st	5	-	0
14.	Gunawarman – Kertanegara st	20	1	1.2
15.	Gunawarman - Daksa IV st	34	-	0
16.	Gunawarman – Senjaya st	8	-	0
17.	Senopati – Suryo st	462	2	0
18.	Senopati – Bakti st	19	-	0
	Total	28,473	4,273	5,125.2

(*Source:* Private. 2019)

Table 4. Types and numbers of trees in Park and Green path

No	Types of Trees	Parks	Green paths
1	Tanjung / *Mimusopselengi*	159	60
2	Pete /*Parkiaspeciosa*	8	
3	Glodokan /*Polyalthialongifolia*	159	160
4	Palem /*Dypsislutescens*	27	
5	Angsana /*Pterocarpus indicus*	31	3
6	Kelapa / *Cocos nucifera*	12	
7	Saputangan /*Maniltoa grandiflora*	1	
8	Ketapang /*Terminalia catappa*	13	
9	Jati / *Tectonagrandis*	7	
10	Kamboja/ *Plumeria alba*	13	
11	Tabebuya /*Tabebuia sp*	24	
12	Cemara / *Casuarina sumatrana*	1	
13	Nangka /*Arthocarpusheterophyllus*	2	
15	Palem kipas / *Livistonasaribus*	22	
16	Mahoni /*Sweteniamahogani*	152	3,970
17	Flamboyan /*Delonix regia*	1	
18	Sawo kecik/*Manilkarakauki*	10	
19	Beringin / *Ficusbenyamina*	20	2
20	Salam /Syzygiumpolyanthum	5	
21	Jamblang /*Syzigiumcumini*	1	
22	Trembesi / *Samaneasaman*	11	20
23	Sikat botol /*Callistemon viminalis*	8	
24	Akasia /*Acasiamangium*	1	
25	Kiara Payung/ *Felliciumdecipiens*	4	58
26	Mangga/ *Mangiferaindica*	8	
27	Dadap/ *Erythrina cristagalli*	1	
28	Mengkudu/ *Morindacitrifolia*	1	
29	Kersen / *Muntingiacalabura*	1	
30	Bambu / *Bambusasp*	2	
31	Karet / *Heveabrasiliensis*	1	
32	Kayu putih/*Melaleuca leucadendra*	7	
	Total	714	4,273

(*Source:* Private. 2019)

fine and small leafy trees, while in the green paths was dominated by wide-canopy, dense leafy trees and optimal growth.

Conclusion

The calculation results show that parks planted with many trees does not guarantee that more oxygen will be produced if the selection of tree species is not right. Characteristics of trees that are broad-crowned, leafy and pile more produce oxygen. Need to add the right trees as an optimal oxygen producer in the park. The selection of tree species that are not in accordance with the objectives and functions. The selection of fast-growing and aesthetic species is a priority regardless of the ability of trees to produce optimal oxygen. Integrated planning, management, and maintenance are needed in one agency. Further research is needed to model a development of vegetation that can optimize oxygen production.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15