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Editorial Notes

Planning in the Era of Disruption: The Needs for Reflective and Responsive Planners, Challenges for Planning Education in Indonesia

One important lesson we have to note in this continuing pandemic Covid-19 is that we are now living in the era of 'disruption.' Although we enjoyed much progress and wealth in the past three decades of development and economic growth, we also witnessed turbulences and so many unpredicted socio, economic and environmental changes, including natural disasters on this small planet. The economic crisis happened in the late 1990s, the 2004 Tsunami in Aceh, earthquake in Central Java in 2006, and Mount Merapi Eruption in Yogyakarta in 2010, forest fires in Sumatera and Kalimantan in 2016-2017, earthquake in Lombok in 2018, and the earthquake and tsunami in Palu in 2019, brought so many losses, and other dynamic socio-economic changes and natural disasters in Indonesia. This series of events made us realize that we are facing a situation of uncertainties, complexities, turbulences – a disruption era. Such an era or situation may frustrate us, planners trained to predict, forecast, and prescribe the future. We are told that we, planners, are the only profession with the capacity, autonomy, and luxury to plan and determine the future. With such assumption, planners are considered master builders who have the authority to prepare 'the blueprint' for our cities and settlements in the future.

However, since the Covid-19 pandemic started in early 2020, which is still happening, we understand that we are already in the era and disruption. As explained by several authors, the era is characterized by VUCA: Volatile, Uncertainty, Complexity, and Ambiguity (Kasali, 2017). Yes, we have already experienced some of those four characteristics of the disruption era, but the Pandemic Covid-19 made us realize that such era is real and penetrates our regular way of life into something we never experienced before – including in planning and governing our cities and regions. In this era of very complex, dynamic, and uncertain socio, economic changes, I would argue that planners need to critically rethink their fundamental principles, assumptions, and therefore their works and practices.

The traditional practice of very deterministic, top-down, technocratic planning needs to be critically examined as such practices do not always work and benefit all societies. As Schon (1991) has argued, the planning model of 'technical rationality' has never been particularly good. He asks for 'critical-reflective practitioner/planner' – planners who have the capacity to reflect on action so as to engage in the process of continuous learning. In other words, Schon questions the current planning practices that are too deterministic and unable to respond to a very dynamic situation. He advocates the importance of reflecting

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on what we are doing - the cultivation of the capacity to reflect IN action and ON action has become important. Drawing from the lessons from Pandemic Covid-19, we understand that there is a need to change the way planners think and act. It calls for planners to be more critical, reflective, and responsive, able to help communities knit their social and physical capitals – reflective planners who always learn and innovate in their everyday practices.

It is crucial for planning education to change or even transform their already conventional businesses in producing reflective planners. As argued by Caves and Wagner (2018), to be more practical, planning education should continually be open to and reflect the need of practitioners. Particularly in the era of very dynamic changes, continued inputs from practitioners will guarantee planning education to produce reflective planners and practitioners.

Such argument is also in line with Schon's (1991) views on higher education – how to produce "reflective practitioners" –who are always critical and continue to learn in their real practice after graduating from university. Universities, according to Schon (1991), are no longer the only source of learning. Universities are also not always developing sciences and knowledge as fast as the rapid changes in the real world. In this condition, the most appropriate educational approach is how to make sure students/ graduates are not only equipped with the knowledge but also their ability to attain "long-life learning,' which is a concept to help students to be critical and to reflect on what they do in the real world. Reflective practitioners, including planners, continue to learn and be able to respond to various dynamics and unpredictable changes and developments.

Schon (1991) has reminded us that our society and its institutions are in continuous processes of transformation and uncertainty. Therefore, we must learn to understand, guide, influence, and manage these transformations and uncertainty. We must make the capacity to undertake them integral to ourselves and our institutions. In brief, he argues that we must become adept at learning. In addition, we must invent and develop institutions that are 'learning systems,' systems capable of bringing about their own continuing transformation.

Planning education in Indonesia had started in 1959 when the first planning school was established at Bandung Institute of Technology/ITB (Setiawan, 2018). After more than six decades since its foundation, planning education in Indonesia has grown more mature. Planning education in Indonesia is increasingly demanded to make a more tangible contribution to planning practice in the country. Planning education in Indonesia needs to change its approach, direction, and orientation. One of them is to step out of this traditional role of simply transferring knowledge and planning skills to students and inspiring and ensuring students adopt a variety of perspectives and more critical planning approaches.

In addition, planning education in Indonesia is not yet fully ready for a new era colored by the development of information and technology, disruption, and innovation. Despite these efforts, they have not been optimal and systematic in general. This is an important challenge of planning education in Indonesia in the future. Reforming the goals, curriculum, and learning methods more suitable to millennial students should also be the direction of planning education in Indonesia, particularly to respond to the era of disruption.

The experience during the Covid-19 pandemic since March 2020, when all planning educations in Indonesia had to transform to the online education model, can be the beginning of the transformation process and even an important step to bring planning education in Indonesia to the next stage – the era of digital society, disruption, and innovation. Planning has the spirit and essence of achieving a better future. Planning is a field of science and technology that contributes to providing prescriptions or solutions, both on current and future issues. Planning education should result in future-oriented planners and optimistic to provide solutions and realize a better future, even in the disruptions era and innovation.

Prof. Ir. Bakti Setiawan, MA, Ph.D.

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Research Paper

Youth Awareness Level towards Sustainable Development Goals (SDGs) in Greater Kuala Lumpur

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ABSTRACT

In 2015, the United Nations initiated the Sustainable development goals (SDGs) to address the global changes while ensuring better and sustainable actions for the future. Among Asian countries, Malaysia has also made an effort to integrate the SDGs into its national development plan. In this study, the awareness level of youth from high schools in Greater Kuala Lumpur towards Sustainable Development Goals has been assessed through questionnaires with 60 questions given to 421 respondents. Sufficient levels of feedbacks for the whole population were acquired (Confidence level: 95%, Margin of error: 5%). Five schools were selected and grouped into 3 types: high performance school (national merit of excellence), cluster school (state level merit of excellence), and daily school (normal achievement). The results of the Spearman Rho correlation showed a significant but weak relationship [r= 0.435] between attitude and practice for all schools. Interestingly, the statistical test showed a negligible relationship between knowledge and attitude, and knowledge and practice, indicating a low attitude to practice SDGs amongst youth although equipped with adequate knowledge. The study also found that high performance schools showed the highest score for all knowledge, attitude, and practice.

Keywords: *sustainable development goals, environmental sustainability, youth, Asian, awareness*

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1. Introduction

Sustainable development definition is the effort to meet current needs without affecting future generations' ability to do the same (Ideland and Malmberg, 2014). As our environment is rapidly deteriorating, we need to adjust our lifestyle and everyday routines to rectify this issue collectively. This is very much aligned with the initiative by the United Nations; the Sustainable Development Goals (SDGs).

Before SDGs were initiated, the Millennium Development Goals (MDGs) kicked off the attempt to improve our world. From 2000 through 2015, the Millennium Development Goals (MDGs) aided in producing evidence to track and monitor poverty. Achieving the MDGs indicates success in taking measures to eradicate poverty and environmental damage (Sachs, 2012). Some emerging nations accomplished their 8 objectives of MDGs and even improved. As a consequence, the MDGs have inspired nations across the globe to develop and provide better planning for the future generation (Carant, 2017).

Due to the fact that most countries want recognition in the area of environmental, economic, and social aspects, SDGs have become a focal point (Sachs, 2012). There is an urgent need for increased visibility and change in the process of developing global goals for the majority of countries, as they are all confronted with environmental and socioeconomic concerns. In general, the economy is highly dependent on the environment, to the point that environmental difficulties can lead a country to lose revenue from investment, hence lowering the standard of living for its population (Kristensen and Mosgaard, 2020).

Malaysia's population is expected to reach 80% urbanization by 2030. The objectives of promoting green cities and providing high-quality services to residents should be achieved by then. Malaysia is projected to catch up and boost the economy through improved communication and high-end technologies (Hamid, 2013). Efforts to link the 11th Malaysia Plan with the Sustainable Development Goals were made to ensure that Malaysia is capable of achieving those goals by 2030 (Nazry, 2021).

Malaysia ranked 55th out of 156 countries in the SDG index report 2018, scoring 70 (Hamid, 2013). The SDGs are more specific than the Millennium Development Goals, with 17 goals and 169 indicators for each goal. In 2016, the government and commercial sector collaborated to connect the SDGs with the 11th Malaysia Plan. Promisingly, Malaysia has made positive progress on eight of the Sustainable Development Goals (SDG1: Poverty reduction, SDG2: Ample food supply, SDG3: Health and sanitation, SDG5: Gender balance, SDG9: Resilient infrastructure, SDG14: Marine conservation, SDG15: Life on land, SDG17: Global partnership). According to Malaysia's Voluntary National Review of the Sustainable Development Goals for 2017, the country has achieved considerable strides in economic development, particularly in rural regions, alleviating poverty (Ang, 2021).

Malaysia is firmly committed to the Sustainable Development Goals objectives and our 2030 global transformation goals, as evidenced by related policy and planning. As a result, the Economic Planning Unit produced the Sustainable Development Goals Roadmap for Malaysia in order to incorporate the 2030 Agenda into the Eleventh Malaysia Plan (Lee & Chew-Ging, 2017). The 11th Malaysia Plan's theme, "Anchoring growth on people," fits well with the SDG concept of " leaving no one behind." Three objectives have been established under the theme; people are the nation's bedrock, people are prepared for the future, and everyone benefits from growth and development.

Malaysia's SDG roadmap was then categorized into three phases which are (Nazry, 2021):

- Phase 1 (2016-2020) – Prioritizing SDG according to 11 MP
- Phase 2 (2020-2025) – Focus on post-2020 goals and targets
- Phase 3 (2025-2030) – Pursuing targets in line with Malaysia's capability and capacity

Therefore, aligned with the current roadmap to achieve the targets by 2030, it is interesting to evaluate the awareness towards SDGs amongst the youth in Greater Kuala Lumpur, which is a term that determines the geographical boundaries of Metropolitan Kuala Lumpur, covering 2793 square kilometers (Yap et al., 2021). The main purpose of this study is to evaluate the level of youth awareness regarding SDGs to benchmark the current condition and formulate policy planning to ensure that the action plan made could be directly strategized in realizing the Sustainable Development Goals Roadmap for Malaysia by 2030. The strategies are oriented on students' knowledge, attitudes, and practices with the goal of instilling a sense of responsibility for environmental, economic, and social challenges.

1.1 Reflections on the Global Goals

Previously, in 2000, the United Nations established The Millennium Development Goals (MDGs), a set of eight goals that focused on the public's attention worldwide. MDGs track each country's progress toward achieving them; some countries accomplish more, while others achieve less. Because it was not a legally binding agreement, it placed a greater emphasis on each country's capacity to accomplish those eight goals. They learned via the MDGs that participation from affluent nations is necessary to provide financing for those developing countries, as the MDGs are more focused on poverty alleviation. Additionally, the MDGs are being promoted to the general public, including non-governmental organizations and students at all levels (Sachs, 2012).

In 2012, the United Nations sought to continue the effort of encouraging countries to cooperate by establishing a new set of goals known as the Sustainable Development Goals (SDGs). All countries are encouraged to participate in these ultimate aims. Even while those wealthy and developed countries have a higher standard of living, they must be aware that certain individuals are being left behind. These global aims encompass the environment, the economy, and society. These factors are interconnected in order to attain a more favorable future in 2030. (Sachs, 2012). SDGs are being hailed as a transformational instrument capable of altering the course of human history. Sachs (2012) also stated that the SDGs will not be achieved by a top-down strategy but would require critical thinking and maximal collaboration from all organizations, including educational institutions and, of course, the young people who will need empowerment to survive the tough period.

Although the SDGs have been described as a transformational instrument capable of changing the world, there are also obstacles associated with its implementation, including data scarcity, target prioritization, and accountability. Each SDGs has its own metrics for tracking progress, which necessitated the collection of essential data. Unfortunately, the World Bank did not have poverty estimates for half of the 155 nations it watched and tracked (Afroz & Ilham, 2020). Without full data, we are unable to evaluate progress and decide which policies work best. Working concurrently on 17 goals would be challenging, but determining which ones should be prioritized would be more difficult. However, each country must recognize that the objectives are inextricably linked. Concentrating greater focus on any one of the objectives that were the source of the issues may result in improvements to the other goals as well. For instance, reducing poverty may have a beneficial effect on one's health and well-being. Finally, the SDGs lack a structured accountability mechanism. In this instance, developing nations may benefit from the implementation of Public-Private Partnerships, as these organizations would be beneficial in managing public resources. By utilizing this method, the private sector will become more conscious of their activities and will begin to be more accountable for their acts, which will alleviate the load on government, particularly in terms of cost.

1.2 Sustainable Development Goals and Education

Education is the necessary approach for guiding our thinking and behaviour. It is also a means of disseminating knowledge via teaching and learning. To strike a balance between the desire for a better future and the need for education, Education for Sustainable Development (ESD) was created. ESD served as a vehicle for imparting and acquiring the necessary information to individuals of this age in order to meet new problems. Additionally, it develops a more responsible human being by increasing their awareness of their everyday activities and their influence on the social, cultural, economic, and environmental spheres.

Prior to 1992, ESD was recognized at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, and the 2012 United Nations Conference on Sustainable Development (UNCSD) in Rio De Janeiro, Brazil. Individuals also learn to solve problems through ESD by offering ideas through collaboration, inter- and transdisciplinarity, and formal and informal learning integration. The establishment of an ESD route would enable a varied collection of individuals to support sustainable development (Isa, 2017).

As Sachs (2012) noted, cooperation at all levels of the community is necessary to accomplish the SDGs. Exposure and education on global goals should be provided to young people in particular since they will become the experts and leaders of the future. As a result, their present degree of awareness and understanding regarding these 17 objectives should be determined.

As the Sustainable Development Goals 2030 encompass the environment, social development, and economic development, each of these areas should be thoroughly explored and exposed to our children. On the environmental front, Aminrad et al. (2013) discussed how our kids lack environmental awareness, knowledge, and attitudes as a result of inadequate exposure in the curriculum. In general, they discovered that pupils had a considerably more favorable opinion of environmental concerns. They also compared their findings to those from other nations such as America and Singapore, demonstrating that Malaysians have a strong grasp of environmental concerns.

While in Malaysia, our study is more focused on environmental sensitivity. Hassan et al. (2010) performed a study on secondary school students to ascertain their level of environmental knowledge with regards to the idea of sustainable development. Although the students demonstrated a high level of environmental awareness, they were unable to connect it to other components of sustainable development. Their findings indicate that there is a very tenuous link between environmental awareness and sustainable measures. Their level of awareness makes little difference in terms of taking action to improve their surroundings. Additionally, research from Balikesir, Turkey, concluded that a high degree of environmental knowledge did not translate into active environmental involvement (Altin et al., 2014).

A comparison was made between students enrolled in the science stream and those enrolled in the arts stream, as well as between urban and suburban students. Students in the science stream demonstrated a greater level of environmental awareness than students in the art stream, owing to their exposure to some environmental themes during biology lessons. Additionally, urban students had a greater level of environmental awareness than suburban students, which might be explained by their socioeconomic status, affluence, and education (Hassan et al., 2010).

While in Balikesir, Turkey, another study was conducted on environmental consciousness, focusing on the link between money and awareness. The study discovered that the higher a family income, the higher its Environmental Awareness and Active Participation Scale score. Interestingly, they connect it to their mother's previous education, implying that their mother has a greater effect on their children's views and behaviors. Additionally, this study found that children from urban areas have a greater level of environmental awareness than students from suburban areas.

In 2014, research in Sweden examined the sustainability consciousness of upper secondary pupils. Numerous schools in Sweden include sustainable development into their curricula by establishing an environmental policy to mitigate adverse environmental impacts and educate pupils about human rights and gender equality (Berglund et al., 2014). They chose respondents from schools with a focus on sustainable development and schools without a focus on sustainable development in their profiles, as well as students from the two most prevalent majors, science and social science. They discovered substantial disparities in sustainability consciousness between students from environmentally sustainable development schools and pupils from traditional institutions.

According to Hassan et al. (2010), kids should have broad access to reading materials on sustainable problems since they may act as a conduit for knowledge to their family and community. Education curricular should be enhanced to include models of environmental attitudes and behaviors.

1.3 Sustainable Development Goals and Youth

According to the United Nations, there are 1.8 billion individuals between the ages of 10 and 24 years old (Borges et al., 2017). These individuals should be empowered for the greater good since they may act as agents of change to enhance human lives and the environment. Even the United Nations offered a venue for these young people to speak and discuss their thoughts about how to translate global aims into local ones. Additionally, the UN announced the 17 Young Leaders in September 2016 to urge them to get involved with the SDGs and to recruit additional young people to the cause. According to the United Nations, youth are critical thinkers, change agents, innovators, communicators, and leaders (Borges et al., 2017).

Through the SDGs, youth may get valuable experience and may develop into the 21st Century's future leaders (Borges et al., 2017). Pupils or kids who form their own groups are able to mobilize and enhance other students. It is similar to a ripple effect, which will result in more effort toward better serving the globe, beginning locally.

1.4 Malaysia and Sustainable Development Goals 2030

Malaysia was placed 55th out of 156 nations in the SDG 2018 Index and dashboard report, earning a score of 70 for the SDG index (Hamid, 2013). The SDGs are more comprehensive than the Millennium Development Objectives, with 17 goals and 169 indicators for each target. In 2016, the government and corporate sectors collaborated to connect the SDGs with the 11th Malaysia Plan. Malaysia has achieved progress on eight of the Sustainable Development Goals, as previously highlighted at the 2017 High-Level Political Forum:

- Goal 1: End poverty in all its forms everywhere
- Goal 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
- Goal 3: Ensure healthy lives and promote well-being for all at all ages
- Goal 5: Achieve gender equality and empower all women and girls
- Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
- Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Goal 15: Protect, restore and promote sustainable use of territorial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Goal 17: Strengthen the means or implementation and revitalize the global partnership for sustainable development

According to Malaysia's Voluntary National Review of the Sustainable Growth Goals for 2017, our country has achieved tremendous strides in economic development, particularly in rural regions, alleviating poverty. As our former Prime Minister, Dato' Seri Najib Tun Razak, promised, "Malaysia is fully committed to the Post 2015 agenda - the Sustainable Development Goals and our goal to transform the world by 2030." As a result, the Economic Planning Unit established the Malaysian SDG Roadmap to include the 2030 Agenda into the Eleventh Malaysia Plan. The 11th Malaysia Plan (MP) theme is "anchoring grown on people," which aligns with the Sustainable Development Goals (SDG) concept of "leaving no one behind." Three objectives were established for the theme:

- Objective 1: People are the bedrock of the nation
- Objective 2: Preparing people for the future
- Objective 3: Everyone enjoys growth and development

In addition, the SDG roadmap Malaysia were divided into 3 phase which are (Nazry, 2021):

- Phase I (2016-2020) – prioritising SDG according to 11 MP
- Phase II (2020-2025) – focus on post 2020 goals and targets
- Phase III (2025-2030) – remaining goals and targets in line with Malaysia’s capacity and global role

Malaysia funding for SDG programs and projects are focused on 9 priority goals which are listed below;

- Goal 3: Good health and well being
- Goal 4: Quality education
- Goal 7: Affordable and clean energy
- Goal 8: Decent work and economic growth
- Goal 9: Industry innovation and infrastructure
- Goal 11: Sustainable cities and communities
- Goal 14: Life below water
- Goal 15: Life on land
- Goal 16: Peace, justice and strong

For the first phase of implementation (2016-2020), most SDG objectives were included in Malaysia's 11th Malaysia Plan, and Malaysia remains committed to addressing the remaining targets through the next Malaysia Plan (Nazry, 2021). Although Malaysia has matched the 11th Malaysia Plan with the SDGs and made significant progress toward each of the objectives, several remain dormant. According to the 2018 SDG Index and Dashboard report, the following SDGs remained stagnant: zero hunger (SDG 2), sustainable cities and communities (SDG 11), life on land (SDG 15), and partnership for the goals (SDG 17).

2. Methodology

2.1 Target Community and Participants

Greater Kuala Lumpur encompasses the Kuala Lumpur city and some sections of the Selangor Darul Ehsan state. It is a metropolitan area that is densely populated by Malaysian residents, industries, and commerce. The study examined selected secondary schools with pupils ranging from Form 1 to Form 5. (13 to 17 years old). Five high schools were identified in this area, including two cluster schools, two daily high schools, and one high-performance school (Table 1). These schools were chosen for their partnership with Universiti Malaya (Kelab Sahabat) and their willingness to engage in this study. All schools participating in the study have ethically consented and have already taken steps toward establishing a sustainable practice in their schools. 500 questionnaires were delivered to randomly selected respondents. The return rate of respondents was calculated to be 84.2 percent, based on 421 questionnaires collected from students.

Table 1. Selected high schools in Greater Kuala Lumpur as the target community

No.	School	High School Type	Location Coordinate
1	SMK Damansara Damai 1	Daily	3° 11' 29.796'' N 101° 35' 32.532'' E
2	SMK Seksyen-10 Kota Damansara	Daily	3° 10' 9.84'' N 101° 34' 47.316'' E
3	SMK Damansara-Utama	Cluster	3° 8' 13.632'' N 101° 37' 31.512'' E
4	SMJK Katholik	Cluster	3° 6' 27.18'' N 101° 39' 7.308'' E
5	SMK (P) Sri Aman	High Performance	3° 6' 7.776'' N 101° 37' 41.556'' E

2.2 Research instrument

The research was conducted utilizing a questionnaire to collect data, and it incorporates all 17 SDGs. It consists of 51 closed-ended questions that span a range of current social, economic, and environmental topics. Figure 1 depicts several key SDGs actions occurring in schools. Although these questions confine students' responses to the challenges, they will aid them in gaining insight into the SDGs (Stoet, 2017). Additionally, it assists pupils in responding appropriately to questions. The questionnaire included 3 parts: knowledge (16 Yes or No questions), attitude (17 statements), and practice (18 statements), as adapted from Jamaludin et al. (2020). The questions for each section are coded as stated below:

Part A: Students' Background

- Q1: Gender
- Q2: Age
- Q3: Race
- Q4: Schools' name
- Q5: Schools' location

- Q6: Type of school
- Q7: Form
- Q8: Academic streaming
- Q9: Are you involved in environmental association club?

Part B: Knowledge

- K1 Women and man were not given the same opportunity in workforce.
- K2 Climate change affects agriculture.
- K3 Use of plastics pollute the sea
- K4 Straw and plastic bottles can be substituted to other substances
- K5 Poor citizens are being left behind.
- K6 Financial aid for the poor citizens is not enough.
- K7 Water is important for all living.
- K8 Waste separation is important to reduce the use of original resources.
- K9 Cooperation from various organization is important to preserve biodiversity.
- K10 Formal education is important for children from all over the world.
- K11 Number of HIV and AIDS diseases cases reduced.
- K12 Clean water sources are still inaccessible for some of the world citizen.
- K13 Forest areas in Malaysia must be protected to ensure the habitat of animals and act a carbon storage.
- K14 Job opportunity depends on the condition of the country's economy.
- K15 Relationship with various countries is important to preserve peace.
- K16 Farming activity depends on surrounding weather.

Part C: Attitude

- A1 I believe that women and men must be given the same opportunity in workforce.
- A2 In my opinion, climate change affects agriculture.
- A3 I supported the banning of the use of straw to save turtles.
- A4 I am ready to use aluminum bottles to bring to school.
- A5 I pitied those poor people who were left behind.
- A6 I am ready to donate to help poor people.
- A7 I feel that clean water is very important for daily use.
- A8 I support waste separation activity especially separating plastics.
- A9 In my opinion, the politicians have to focus on the sustainable needs of the community.

- A10 I am happy to come to school and learn.
- A11 I believe that citizens that are free from HIV and AIDS diseases can help in developing a better future.
- A12 I want the individual who pollutes the river to be fine.
- A13 I feel that forest is a peaceful place and important for humans and animals.
- A14 Online shop reduces the need for a space to be developed.
- A15 I believe that peace can be achieved by protecting the relationship between countries.
- A16 Future of foods depends on current weather.
- A17 Online shopping helps reduce carbon footprint.

Part D: Practice

- P1 I work hard in a field if I like it.
- P2 I actively plant trees because I want a cooler environment.
- P3 I did not use plastic straw.
- P4 I eat at fast food restaurants less often.
- P5 I and my family give used clothes to the needy.
- P6 I used boxes or used items to create something.
- P7 I collected rainwater for outdoor used.
- P8 I separate my waste like plastics, paper, tin and food waste.
- P9 I watch television less often.
- P10 I dreamed of being a leader to the community.
- P11 I involved with selling activity.
- P12 I pick up rubbish in front of me.
- P13 I would rather walk or cycle to school if I did not live too far.
- P14 I help people with disabilities.
- P15 I respect my friends with different religion.
- P16 I only buy things that I need.
- P17 I used social media to spread awareness of the environment.
- P18 I buy things online.

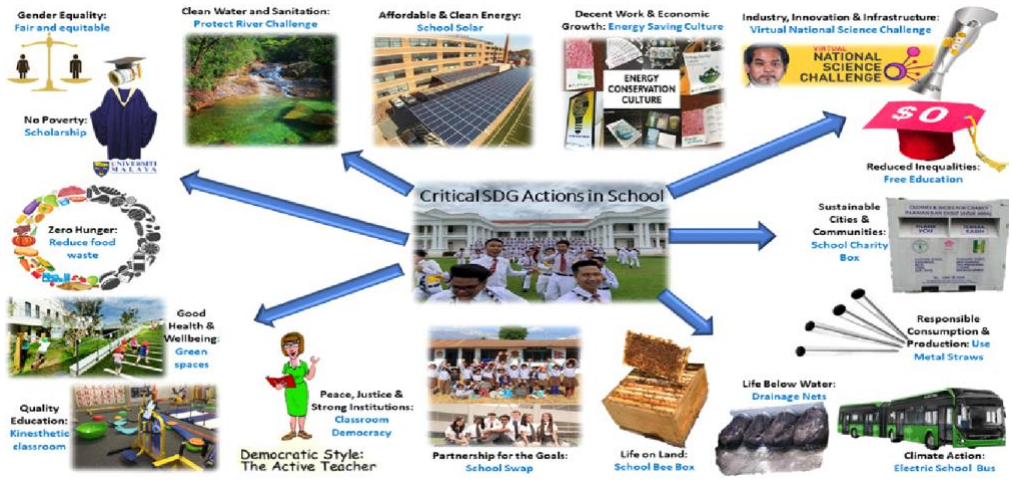

Figure 1. Critical SDGs actions in schools

2.3 Scoring, Coding, and Statistical Analysis

The test included 3 parts: knowledge, attitude, and practice. The first part, knowledge, has 16 items that evaluate SDG knowledge and are scored as "Yes" or "No". The second part is attitude, which includes 17 questions rated on a Likert scale of 5-points.As commonly utilized, the scale of 1 represents strong disagreement, 2 for normal disagreement, 3 for neutrality, 4 for normal agreement, and 5 for strong agreement. The last part, Practice, has 18 assertions which is also Likert 5-point rated, with 1 representing never, 2 depicting seldom, while 3, 4 and 5 represent once, twice, and often, respectively.

The collection of data was then analyzed using SPSS (version 20). SPSS employed a descriptive, frequency, and correlation analysis. The mode of Spearman Rho correlation was utilized to examine the association amongst the variables of knowledge, attitude, and practice. On the other hand, the test Kruskal-Wallis was utilized to determine the significance of differences between groups. The questionnaire was subjected to a reliability test, and its reliability was certified using the Cronbach Alpha coefficient (Table 2). According to the reliability test, all variables indicating knowledge, attitude, and behavior related to SDGs have a high level of internal consistency, with a Cronbach Alpha coefficient of 0.814. Table 3 illustrates the coding used to reflect each statement from the knowledge, attitude, and practice domains.

Table 2. Cronbach coefficient alpha for reliability level determination

Cronbach alpha (a) coefficient	Reliability
<0.65	Not acceptable
0.65 – 0.95	Acceptable
>0.95	Redundant

3. Results and Discussions

3.1 Demographic profile of respondents

From the 8575 total population in the selected schools, 421 responses were acquired. The quantity of feedbacks was calculated using a 95% threshold of significance and a 5% margin of error. The precise aim for a minimum sample size of 381 respondents is 381 respondents.

Figure 2 illustrates the percentage of respondents who belong to various demographic groups based on their gender, school type, academic stream, student maturity (as measured by form), and environmental club. The majority of respondents (65.3 percent) were female, while 34.7 percent were male. Respondents were selected at random from five schools and divided into three types: daily, cluster, and high-performance. Figure 2 (iii) shows how respondents' background studies were categorised based on their academic level (form). The biggest percentage of responders (31.6%) comes from Form 2, while the lowest percentage (10.7%) comes from Form 3. The majority of respondents are from Forms 1, 2, and 3, and do not belong to any academic stream. There is a little percentage discrepancy between answers from the science and art steams. Finally, only 12.8 percent of respondents were members of an environmental club, whereas the majority were not.

Table 3. Coding for knowledge (K), attitude (A) and practice (P)

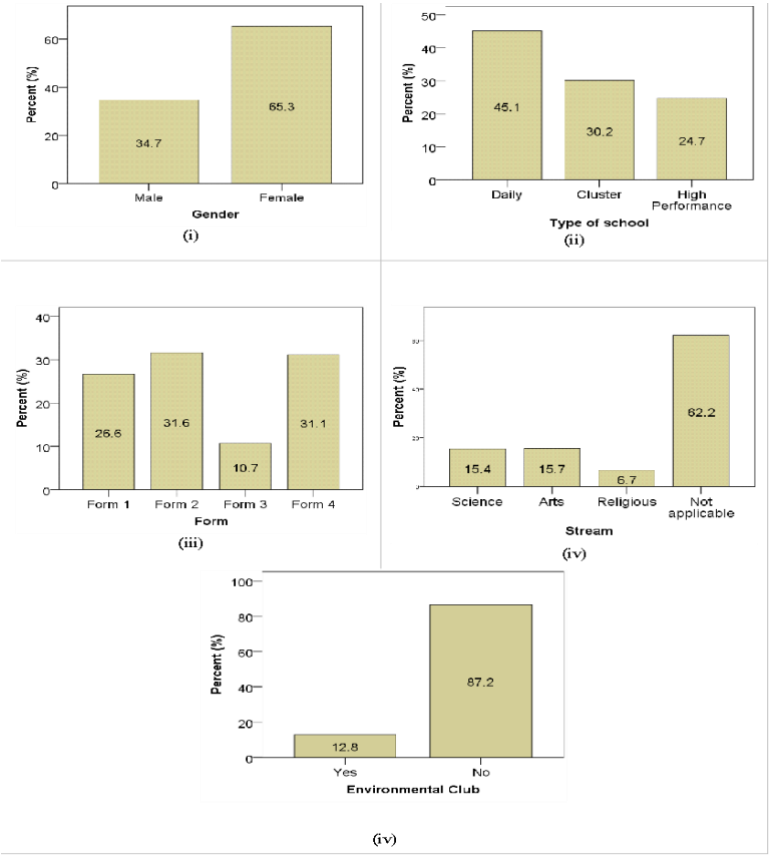

Figure 2. Respondents' demographic profile i) Gender ii) High school type iii) Form (iv) Academic streaming (v) Environmental club participation

3.2 Youth Awareness Level

As shown in Table 4, the greatest percentages of respondents agreed with the statement "women and men did not have equal chances in the workforce," while a larger percentage of respondents disagreed with the statement "number of HIV and AIDS illness cases reduced." This finding shows that the vast majority of respondents had a firm grasp of the Sustainable Development Goals. The highest proportion of respondents who responded 'Yes' to the statement 'water is essential for all life' was 98.6 percent, showing that respondents are worried about water quality.

Table 4. Respondents' awareness of the SDGs in knowledge section

	Goal	Knowledge (K)			Attitude (A)			Practice (P)		
1	No Poverty	5	6	5		6		5		
2	Zero Hunger	2	16	2		16				
3	Good health and well being	11		11				4	13	
4	Quality education	10		10						
5	Gender equality	1		1						
6	Clean water and sanitation	7	12	7				7		
7	Affordable and clean energy			17				8	9	13
8	Decent work and economic growth	14		17				11	18	
9	Sustainable infrastructure	4		12	14	17		6	11	18
10	Reduced inequalities	5		5				14	15	
11	Sustainable cities and communities	8		14				12	13	18
12	Responsible consumption and production	4		3	4	8	12	3	8	16
13	Climate action	2	16	2	16	17		2		
14	Life below water	3	9	3	12			12		
15	Life on land	9	13	13	14			2	12	
16	Reliable institutions	15		9	12	15		10	15	
17	Partnerships for the goals	9		15				10		

	Knowledge (K)	Likert scale percentage (%)	
		Yes (1)	No (2)
1	Women and men did not have equal opportunities in the workforce.	43.7	56.3
2	Agriculture is impacted by climate change.	95.7	4.3
3	Plastic pollution in the sea is a result of the use of plastics.	94.3	5.7
4	Straw and plastic bottles may be replaced with alternative materials.	87.9	12.1
5	The poor people are being left behind.	64.8	35.2
6	Financial assistance to poor people is insufficient.	77.4	22.6
7	Water is necessary for all life.	98.6	1.4
8	Waste separation is critical for conserving natural resources.	92.9	7.1
9	Collaboration between diverse organizations is critical for biodiversity conservation.	94.3	5.7
10	Formal education is critical for children everywhere.	93.3	6.7
11	The number of HIV and AIDS cases has decreased.	41.3	58.7
12	For some global citizens, clean water sources remain unavailable.	91.9	8.1
13	Malaysia's forest lands must be preserved to provide animal habitat and function as a carbon sink.	95.5	4.5
14	Job opportunities are contingent upon the state of the country's economy.	79.3	20.7
15	Relationships with different nations are critical for maintaining peace.	97.1	2.9
16	Agriculture is weather-dependent.	94.5	5.5

The Likert scale with 5 points measures respondents' agreement with a statement about their attitude toward sustainability (**Table 5**). Scale 1 indicates significant disagreement, whereas scale 5 indicates great agreement. By and large, respondents have a favorable attitude toward sustainable living, as seen by the high proportion on the fifth scale. This indicates that respondents at the chosen schools have a favorable attitude toward sustainable development.

In previous research by Afroz and Ilham (2020), they reported a high level of awareness towards SDGs among university students, shown by a significant number of students who possess high knowledge with a positive attitude. Their study involved 382 students from a prominent university in Kuala Lumpur, Malaysia. However, their level of SDGs practice is low. It revealed a minor negative association between student knowledge and practice, indicating that while university students have a high level of knowledge about the SDGs, their practice level is slightly lower. According to the researchers, this can be increased through strategic approaches and intervention programs by the university. Nonetheless, there is a strong positive connection between student attitude and practice proficiency. This showed that by having a positive attitude, students would be more driven towards practicing actions aligned withSDGs.It should be noted that environmental approaches vary between institutions, and thus students may have different levels of awareness towards SDGs.

According to another study conducted by Jamaludin et al. (2020), the majority of students had a favorable attitude toward SDGs activities. Regrettably, more focus and attention should be given to students from non-science educational streams and those from the lower socioeconomic income categories in order to help them better understand the SDGs.

Table 5. The attitude of respondents towards SDGs

Attitude (A)		Likert scale percentage (%)				
		1	2	3	4	5
1	I think that women and men should have equal access to the workforce.	2.9	4.0	13.1	26.8	53.2
2	Climate change, in my view, has an effect on agriculture.	1.0	3.6	12.1	39.4	43.9
3	I voted in favor of prohibiting the use of straw in order to preserve turtles.	5.5	5.5	13.1	20.0	56.1
4	I am prepared to carry an aluminium bottle to school.	11.2	10.9	34.6	20.9	22.3
5	I felt pity for those who had been abandoned.	1.9	2.4	11.2	25.7	58.9
6	I am willing to make a donation to assist the needy.	1.9	0.7	13.1	29.9	54.4
7	I believe that safe drinking water is essential for everyday usage.	1.7	1.7	2.9	10.2	83.6
8	I favour trash separation activities, particularly those that separate plastics.	2.6	2.6	12.4	30.4	52.0
9	Politicians, in my view, must prioritise the community's long-term requirements.	1.7	3.6	17.3	27.6	49.9
10	I'm delighted to attend school and study.	3.8	3.1	29.7	27.3	36.1
11	I think that people who are HIV- and AIDS-free may contribute to the development of a brighter future.	3.3	4.5	18.8	26.1	47.2
12	I want the person responsible for polluting the river to be punished.	4.3	2.9	8.8	22.3	61.7
13	I believe that forests are a tranquil area that is necessary for humans and animals.	1.9	3.6	9.0	25.4	60.1
14	Online stores eliminate the requirement for a physical location to be established.	2.4	5.5	30.2	29.2	32.8
15	I think that peace may be achieved through safeguarding bilateral ties.	1.0	2.4	8.3	28.5	59.8

Attitude (A)		Likert scale percentage (%)				
		1	2	3	4	5
16	The future of foods is conditional on the present weather.	4.5	8.1	29.9	30.2	27.3
17	Online purchasing contributes to the reduction of carbon emissions.	2.6	7.6	40.9	25.7	23.3

1 – Strongly disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 – Strongly agree

For practice, scale 1 means 'Never' and scale 5 means 'Always'. Table 6 shows how practice distribution varies by size in respect to SDGs. On scale 5, the most frequent claims are 5. It showed that respondents always work hard in a profession they love, give clothes to the poor, prefer to walk or bike to school if they live nearby, value friends of various faiths, and buy just what they really need. Overall, respondents' dedication to sustainable development remains low. Overall, respondents' attitudes toward sustainable development are comparable to those of university students in Malaysia (Afroz & Ilham, 2020).

Table 6. Respondents' practice towards SDGs

Practice (P)		Likert scale percentage (%)				
		1	2	3	4	5
1	If I like a field, I work diligently in it.	3.8	10.0	7.4	27.6	51.3
2	I'm aggressively reforesting in order to create a cooler atmosphere.	20.2	26.6	27.6	16.4	9.3
3	I did not use a straw made of plastic.	13.1	37.3	16.2	21.4	12.1
4	I dine out less often at fast food restaurants.	8.3	36.3	13.1	25.4	16.8
5	My family and I donate gently worn clothing to the less fortunate.	8.8	16.6	15.0	26.4	33.3
6	I created something using boxes or found objects.	12.6	24.0	20.0	26.8	16.6
7	I gathered rainwater for use in the garden.	39.0	18.8	18.0	12.4	11.9
8	I sort my trash into categories such as plastics, paper, tin, and food waste.	19.2	26.6	14.3	20.9	19.0
9	I watch less television.	18.3	29.0	11.6	17.3	23.8
10	I aspired to be a community leader.	35.6	13.1	17.8	16.6	16.9
11	I'm engaged in the selling process.	24.7	16.4	24.7	20.2	14.0
12	I clean up the area in front of me.	4.0	28.3	11.1	30.4	26.1
13	I'd like to walk or bike to school provided it wasn't too far.	11.4	12.4	7.6	20.9	47.7
14	I assist those with impairments.	6.4	18.1	20.9	27.5	27.1
15	I respect my friends who practice other religions.	1.2	5.2	7.1	15.4	71.0
16	I purchase just what I need.	4.8	20.9	12.8	30.6	30.6

Practice (P)		Likert scale percentage (%)				
		1	2	3	4	5
17	I utilized social media to raise environmental awareness.	27.1	24.9	20.9	14.0	13.1
18	I make purchases online.	20.0	22.6	16.6	18.8	22.1

1 – Strongly disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 – Strongly agree

Additional statistical analysis using Spearman Rho correlation data in **Table 7** demonstrates a significant and robust association between practice and attitude (r= 0.435, with a significance level of p0.01). Apparently, a minimal correlation exists between knowledge, attitude, and practice. The inverse relationship between knowledge, attitude, and practice shows that the students' level of knowledge had no impact on their attitudes and behaviors toward sustainability. (Zulkifli et al., 2018).

Table 7. Knowledge, attitude and practice on SDGs correlation

			Knowledge (K)	Attitude (A)	Practice (P)
Spearman's Rho	Attitude (A)	Coefficient of Correlation	-.331**	1.000	.435**
		Sig. (2-tailed)	.000	.000	.000
		N (Respondents)	421	421	421
	Practice (P)	Coefficient of Correlation	-.267**	.435**	1.000
		Sig. (2-tailed)	.000	.000	.000
		N (Respondents)	421	421	421
	Knowledge (K)	Coefficient of Correlation	1.000	-.331**	-.267**
		Sig. (2-tailed)	.000	.000	.000
		N (Respondents)	421	421	421

In statistical analysis, (**) is the sign that represents that the results are statistically significant. Negative values showed that the data is negatively correlated with each other.

3.3 Theoretical Implications

This study adds theoretically to the body of research on the connection between students' knowledge, attitude, and practice (KAP) of the Sustainable Development Goals (SDGs). The findings indicated that all variables had a favorable direct effect on contributing to the achievement of the SDGs. Even though the hypotheses produced were not completely reliant on the theory's model, the results may implicitly contribute to the existing literature on KAP theory. This aligns with Isa (2017), who utilized KAP theory rather than the Theory of Planned Behavior (TPB) to assess sustainable campus awareness. The findings supported the KAP theory by demonstrating that students' knowledge shapes their attitudes, which in turn results in planned behaviors that support SDGs.

Commitment on behalf of the students is critical to establishing a positive practice. This is critical since it has been demonstrated that when individuals lack dedication to a cause, they prefer to overlook the negative consequences of their actions (Liu & Lin, 2015). Additionally, it is critical to examine the relationship between knowledge, attitude, and practice related to achieving the SDGs. This will help to

emphasize the critical role of knowledge in fostering an attitude that promotes individuals' activities that contribute to environmental sustainability (Chen & Tsai, 2016). This study demonstrates that persons with a greater degree of knowledge are more likely to exhibit a sustainable attitude and engage in SDG-related activities. As a result, once individuals get a high level of understanding, they will demonstrate a strong attitude and practice toward achieving the SDGs.

This research adds to the existing SDG literature by focusing on high school pupils in Greater Kuala Lumpur, Malaysia. The intensification of awareness and education in support of the SDGs has sparked renewed interest in recent years, particularly in pro-environmental practices (Yusliza et al., 2020). This study concentrated on high school students because they are the primary group that will establish and adopt a long-term sustainable lifestyle. Additionally, it is worthwhile to improve students' awareness of the actions that responsible students must take to ensure sustainability. Zamora-Polo et al. (2019), in their study in Spain, also found that in order to inculcate the knowledge about SDGs, special training is needed, and the information must be embedded in the education curriculum as part of the Education for Sustainable Development (ESD) approach.

On the other hand, this study made significant practical contributions. Although this study was conducted at secondary schools in a Greater Kuala Lumpur urban region, it may have significant implications for educational institutions nationwide, including schools, training institutions, and universities. The rationale is based on the idea that educational institutions can accomplish the SDGs by providing students with relevant information, skills, and experiences (Yusliza et al., 2020).

As a consequence, educational institutions must offer emotional rather than cognitive sustainability-focused topics and activities to all learners. This research also helped senior management realize the need for appropriate and ongoing evaluation mechanisms to evaluate and monitor students' effects on sustainability activities required to achieve the SDGs. Another important feature of this research is that it may help governments and commercial groups create sustainable plans and strategies for business operations.

3.4 Practical Implications in Sustainable Campus Planning

Cortese (2003) suggested a sustainable campus model called 'Higher Education Modelling Sustainability as a Fully Integrated System.' The concept emphasizes that higher education institutions should act as mentors and give knowledge and information to students and the surrounding community to help achieve sustainability. According to Cortese (2003), a campus's sustainability requires integration and collaboration between teaching, research, operations, and the campus community's ties with the surrounding community. This includes everyday campus operations, including building operations that promote soft landscaping, energy-efficient building systems, and efficient use of water and other resources.

The development of a sustainable campus should include both the physical and environmental aspects of the campus, such as traffic, land use, and infrastructure (Burton, 2000), and the socioeconomic aspects such as curriculum, research, and scholarships (Libunao & Peter, 2013). Many campuses now approach sustainability concerns in silos. According to McMillin and Dyball (2009), sustainable education is typically separated from sustainable research. Similarly, campus sustainability programmes and operations frequently have their own goals and techniques without integrating with other components (McMillin & Dyball, 2009). McMillin & Dyball (2009) developed a sustainable campus concept based on complete sustainability principles. They emphasized that this strategy maximizes universities' role as change agents for sustainability. Students should be active in sustainability research and operations on campus and in specific academic disciplines.

The movement towards a sustainable campus was inspired by the 1990 Talloires Declaration, adopted during an international meeting in Talloires, France. A multidisciplinary approach was stressed for the creation of a sustainable campus. In order to assist sustainable development, academics, university administrators, and industry environmental practitioners must collaborate to establish curriculum, research projects, operations, service activities, and community, national, and worldwide outreach. A sustainable campus should also improve partnerships with elementary and secondary school administrations to foster interdisciplinary teaching about population, environment, and sustainable development. A sustainable campus should be able to reach out nationally and internationally.

Collaboration with external groups is critical to promoting global university initiatives toward a sustainable future (Isa, 2017).

Conclusions

There has been a rise in global interest towards SDGs recently. The present study adds to the increasing body of information on sustainability planning. This study's goal was to see whether students' involvement in SDG activities correlated with their knowledge and attitudes about the goals. It is justified by prior research on the link of knowledge, attitude, and practice to the SDGs. Our results show that students are aware of the SDGs' elements, have a positive perception about them, and implement them often. Overall, the degree of awareness is adequate. There was no link between knowledge, attitude, and practice. We found a small but significant relationship between attitude and practice (r = 0.43). Surprisingly, students showed high levels of sustainability knowledge and comprehension and a significant willingness to engage in SDG activities. Students are more aware of and attentive to sustainability-related activities due to their personal knowledge or the high schools' comprehensive approach to curriculum and direction. School type [r = -0.239] and academic stream [r = -0.209] showed weak and negative correlations with knowledge, whereas student maturity had a substantial but negative connection with knowledge [r = -0.300]. It is suggested that students get familiar with SDGs in order to encourage them to practice their new knowledge. Additionally, students need to be exposed to more global goals-related activities, and the SDGs must also be incorporated into non-science subjects in a comprehensive curricular of Education for Sustainable Development (ESD).

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Research Paper

The Influence of Father and Mother's Joint Decision Making on Children's Basic Immunization

Empirical Research on Indonesia's Demographic and Health Survey 2017

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ABSTRACT

The 2017 diphtheria outbreaks in Indonesia shows the downside of inadequate immunization for certain group that could endanger public health. Despite years of government intervention on this vaccine-preventable disease, insofar mandating basic vaccination for children from an early age, ultimately, it is parents that will decide on having their children being immunized. Utilizing the 2017 Indonesia Demographic and Health Survey, this study aims to uncover the association between parents' decision-making processes and their demographic variables to their children's immunization completion status. Logistic regression suggests discussion between parents in household's major purchases, more likely to result in complete basic immunization for their children. Additionally, mothers' traits, which are education, frequency of access to mass media, and exposure to medical professionals, are positively associated with compliance with basic vaccines administration. Differences in compliance can also be observed in children's gender and order of birth.

Keywords: health, demographic, vaccination, DHS, Indonesia

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1. Introduction

Children are the assets of a family and, by extension, the nation. The future livelihood of the society rests on their hands. Failure to guard their wellbeing means arresting their progress and development, wasting away these assets, and jeopardizing the nation's future. Vaccination is one of the ways to protect human beings from illnesses. This brings about results that contribute immensely in controlling infections such as polio, measles, and smallpox, among others (World Health Organization [WHO], 2013b).

Currently, there are children who have not received complete immunization, and some have never received immunization since birth. Indonesia's Ministry of Health data suggests that from 2014 to 2017, as much as 8.88% of children between 12 to 23 months old have not received basic immunization or have not been fully immunized (Ministry of Health, 2017b). Based on Indonesia's Ministry of Health decree (Ministry of Health, 2017a), children aged 1-year old ought to have already completed their basic immunization (hepatitis B, BCG immunization, DPT and polio 1, DPT and polio 2, DPT and polio 3, and measles) in a certain order. Basic immunization consists of immunization against hepatitis B (recommended vaccine administration time: month 0 since birth), BCG (month 1), poliomyelitis (month 1 for the first shot, and the next 3 subsequent months for the last 3), tuberculosis (month 2 for the first shot, and the next 2 months for the last 2), diphtheria (month 2 for the first shot, and the next 2 months for the last 2, and month 18), pertussis (month 2 for the first shot, and the next 2 months for the last 2, and month 18), tetanus (month 2 for the first shot, and the next 2 months for the last 2, and month 18), pneumonia and meningitis caused by Hemophilus Influenza type b (month 2 for the first shot, and the next 2 months for the last 2), and measles (month 9).

Studies on children vaccination often focused on determinants of complete immunization. These factors include external household factors, the medical professional's presence during labor, and a high association with children's vaccination completion (Efendi et al., 2020). The study also found notable differences among children with complete and incomplete basic vaccination in terms of parents' education level, socioeconomic status, and residential region (Efendi et al., 2020). Another determinant, a household health handbook, plays a role in childhood vaccination, as it gives a home-based record and health information to both family and health worker (Osaki et al., 2009). Nonetheless, there is no new information on new factors associated with complete vaccinations, aside from what has already been confirmed in other similar studies.

On the other hand, as children are not able to decide for themselves, whether they will get a vaccination or not is the responsibility of their parents (Pearce et al., 2008) as their current primary caregivers. Internal and external factors may influence outcomes in every family decision, including immunization issues. Safety concerns (MacDonald et al., 2018; Smailbegovic et al., 2003; Smith et al., 2004) and religious beliefs (Choudhary et al., 2019; Dubé et al., 2014; Paterson et al., 2018) often influence a family decision in taking the vaccine. Parents' attitudes also influence children's vaccination coverage (Esposito et al., 2014). Moreover, the mother's perception of the dangers of communicable diseases could prove to be the key in determining immunization (Houtrouw & Carlson, 1993). In the rise of vaccination disinformation that could affect vaccination hesitancy (Syiroj et al., 2019), young–parents with only primary education degrees are more concerned about the safety of the vaccines (Yufika et al., 2020). As mothers are more concerned about vaccines safety than fathers are (Yufika et al., 2020), these disparities can result from the unequal quality of information between parents. Discussions between the father and mother are argued to reduce the gap in severity perception, as this factor is associated with parents' vaccination acceptance (Boes et al., 2017), which could potentially lead to better compliance. This dialogue process is also reflected in other issues not limited to children's healthcare.

In relation to this, the current study aims to explore the dynamic between parents as a new determinant for immunization completion. As it stands, the decision for children to be immunized is motivated by parenting strategy on their beliefs, benefit to their livelihood, barriers, and associated risks. These elements are thought to result from knowledge accumulation and other external factors during the period before the decision to vaccinate takes place. In relation to that, a dialog between parents could be a medium for an argument, an exchange of information, reinforcements of personal beliefs, and risks perception associated with it. Existing household decision-making structures could indicate whether such discussions often occur in the family. If one party has a better understanding of the issue, positive conceptions could then be transferred, increasing the chance of encouraging results, such as the decision to immunize. Additionally, the ability to meet the immunization requirements for the children can be

reflected through its completion status. It is hypothesized that when a joint decision exists in the family, the dialogue about children's immunization before the final verdict occurs.

Thus, this study tries to make a case of whether there is an association between vaccination completion on children and the way their parent decides on household issues. Other parents' demographic factors, which represent their supposedly knowledge and beliefs on immunization from previous studies, will also be considered. The age range for the children will be 12–35 months, as they supposedly have already taken the national mandatory basic immunization (Ministry of Health, 2017a) at the age of 12 months. Additionally, the vaccination section on the main data for this research, the 2017 SDKI, collect vaccination information of children aged 0 to 35 months. Despite the age span of 12 to 23 months being the common unit analysis in preschool vaccination studies, the allowance for catching up to the delayed vaccinations (WHO, 2019a) gives way to assess completion that compensates immunization delay to older age groups. This catch-up strategy was used previously in Indonesia, targeting school students (WHO, 2007). Africa also had been the subject of this method to reduce mortality rates due to measles, targeting children from 9 months to at least 5 years old, and had achieved a decline in measles prevalence (Arevshatian et al., 2007). Furthermore, older children tend to have up-to-date vaccination compared to younger ones (Koïvogui et al., 2018). The resulting outcome of this study is thought to be useful for relevant stakeholders in understanding vaccination completion factors in more diverse target populations. Moreover, identifying more characteristics to better define the health policy's focus could improve the national immunization program.

Literature Review

Despite its apparent effectiveness, recent development suggests that there are widespread anti-vaccination sentiments. The reasons range from the old false beliefs that vaccines cause autism to serious complications that vaccinations may cause (Żuk et al., 2019). False information (Deer, 2011) is proven to affect the immunization rate of children (Doucleff, 2014). This situation might have led to a decrease in vaccination coverage, endangering the immunization's progress.

Conversely, the 2019 World Health Organization (WHO) global situation report suggests that outbreaks or mortality from vaccine-preventable diseases are still happening. Hepatitis B resulted in 887,000 estimated deaths in 2015 (WHO, 2019b). Therefore, health bodies suggest early age vaccination against several illnesses to have optimal protection (Centers for Disease Control and Prevention [CDC], 2020) as diseases can strike anytime and anywhere. An estimated 2 to 3 million deaths could be prevented each year due to the provision of diphtheria, tetanus, pertussis, and measles vaccines (WHO, 2019c).

WHO acknowledges the need for early protection against preventable diseases laid out commendations for routine immunization (WHO, 2019c). While infants may already have received fractional protection from their mothers' passive transference of antibodies, their eventual waning is expected; thus, further active immunization for infants is needed. Moreover, vaccine administration must follow a certain order as all the shots could not be administered all at once. Nonetheless, WHO also acknowledges that certain physical conditions could prevent children from getting complete immunizations.

Through its decision-making body, World Health Assembly, WHO also had provided a framework with Global Vaccine Action Plan in 2012 to ensure universal access to immunization (Daugherty et al., 2019; WHO, 2013a). The outline contains targets such as 90% national immunization coverage for all injections, allowing certain proportions of the population not to have a complete vaccination. Herd immunity targeted program can save costs while still decreasing the incidence of diseases (Ortega-Sanchez et al., 2008).

In accordance with WHO's recommendations, Indonesia's Ministry of Health has enacted a vaccination-specific Ministerial Decree (Ministry of Health, 2017a). Children from zero to 12 months are the subject of mandatory basic immunization. The administration consists of Hepatitis B, Poliomyelitis, Tuberculosis, Diphtheria, Pertussis, Tetanus, Pneumonia, Meningitis, and Measles. This set is a part of the national immunization program, along with advanced, additional, and specific ones, covering a broader age range.

Nevertheless, cases as in Korea measles outbreak in 2013 (Park et al., 2013) and Indonesia's diphtheria outbreaks in 2017 (Tosepu et al., 2018) still occur. Thus, it is argued that vaccination hesitance is still prevalent in society. People believe that vaccination has an adverse effect on them and can be associated

with vaccination compliance (Lyn-Cook et al., 2007), while acceptability is related to perceived susceptibility, benefits, and barriers (Marlow et al., 2009).

Health Belief Model (HBM) was developed by psychologists in the 1950s and tried to explore people's attitude towards rejection of preventive methods, which was the direction that public health services shifted to in that era (Becker, 1974; Glanz et al., 2008). HBM proposed several constructs that revolve around beliefs that influence humans before they sprang into health-related action. Personal probability of contracting diseases and their severity are threat factors. The later parts are possible benefits of impending behavioral change that individuals could earn, perceived barriers to change, and self-confidence. These factors, combined with socioeconomic and demographic characteristics and hard-to-generalize cues to action, will eventually change individual behaviors (Glanz et al., 2008).

On the other hand, the Theory of Planned Behavior (TPB) (Ajzen, 1991) can also be utilized to give another point of view regarding vaccination. The intention is influenced by attitudes toward behavior, subjective norms, and perceived control over behavior. Alternatively, the provider's positive attitude and confidence in self-efficacy could give credence to the success of the vaccination program (McCave, 2010). Non-compliance to vaccination, which can be considered unhealthy, could also be explained by the protection motivation theory (PMT). The model is based on people's intention to protect themselves (Rogers, 1975).

These two models had been used to explain children's vaccination status based on their parent's internal factors. As one of the main drivers for immunization is prevention, the probability of childhood vaccination is also greatly affected by beliefs and perception (Flood et al., 2010, pp. 1448–1467). When parents become wary (Wang et al., 2014) or perceived threat trumps vaccine's efficacy and safety, their children will likely be vaccinated (Flood et al., 2010).

Children might be the subject of early vaccination programs by relevant governmental health bodies. Presently, the latest Indonesia Demographic and Health Survey 2017 (National Population and Family Planning Board et al., 2018) indicates that approximately 35% of children between 12 to 23 months have not been getting complete basic immunization, even after the Ministry of Health had targeted in 2014 (Ministry of Health, 2015) that at least 90% of children should have been fully immunized. The figures show that despite the government intervention, ultimately, their parents will decide on having them immunized or not.

Hisnanick and Coddington (2000) adopted Becker's (1991) altruism utility theory that parents' utility is reflected on their children's utility, which is driven by their current and future wellbeing, represented by the decreasing chances of their morbidity. Vaccination is thought to be one way of investing in children's wellbeing (Hisnanick & Coddington, 2000). Nonetheless, despite its apparent effectiveness, the sentiment of vaccine hesitancy continues to grow (Luthy et al., 2009). As vaccine providers can attest, parents with negative perceptions of immunization could also hinder the children's vaccination (McCave, 2010). In some cases, couples have decided on vaccinations even before their child is born (Glanz et al., 2013). However, vaccination decision is not definite and rest on a combination of the sources of parents' knowledge (Weiner et al., 2015), perception, and trust in the vaccine provider (Larson et al., 2011).

As suggested by the TPB, societal norms could play a role in human behavior. These customs work by shaping the parent's perceptions on the necessity of vaccination (Wang et al., 2014), in the form of medical professionals (Lau et al., 2013), social pressure (Wang et al., 2015), or even partners/spouses (Wang et al., 2014). Spouse pressure is believed to be the closest part to when vaccination decision about to happen, occurring during joint discussions that the parents had before making the immunization decision for their children. The model's combination can be utilized to gather more information. A study in Canada attempted to use both TPB and PMT to investigate vaccination intention in several groups with differing access to vaccines. The end products combine different determinants that influence the intention to vaccinate in each group (Gainforth et al., 2012). The result gives an indication that the joint model is useful in understanding various demographics in the population and opens possibilities for tailored interventions.

The decision for children to be immunized is motivated by parenting strategy on their beliefs, benefit to their livelihood, barriers, and associated risks. These elements are thought to result from knowledge accumulation and other external factors influencing the period before the decision to vaccinate takes place. In relation to that, a dialog between parents could be a medium of an argument, an exchange of information, reinforcements of personal beliefs, and risks perception associated with it. Existing household decision-making structures could indicate whether such discussions often occur in the family.

If one party has a better understanding of the issue, positive conceptions could then be transferred, increasing the chance of encouraging results, such as the decision to immunize. Additionally, the ability to meet the immunization requirements for the children can be reflected through its completion status.

Based on Figure 1, children's immunization accomplishment status will then be examined. Its completeness is measured through whether the children have completed their age-appropriate mandated vaccination. Moreover, according to problem formulation, research objectives, and empirical studies, it is hypothesized that when a joint decision exists in the family, the dialogue about children's immunization before the final verdict occurs. Lastly, it is hypothesized that basic vaccination will be completed if the child lives in rural areas, from well-off households, is female, and firstborn, parents with a high educational degree; with the mother having frequent access to newspaper, radio, or internet at least once a week, and is also being assisted by medical professionals in both antenatal care and birth delivery; and in possession of a health/vaccination card.

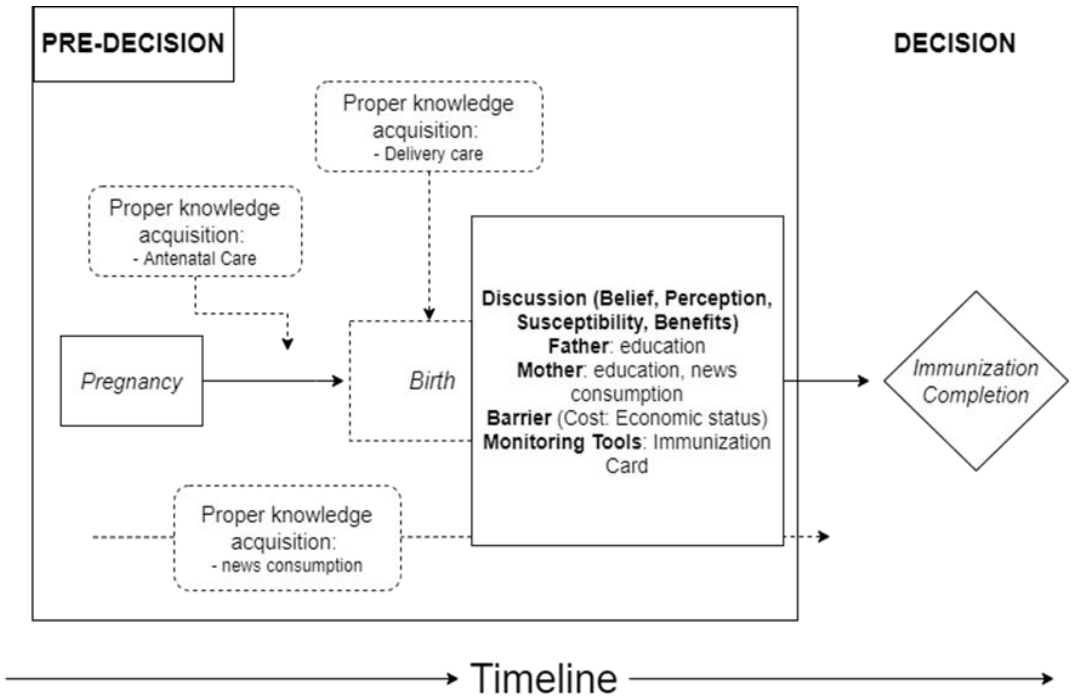

Figure 1. Research Framework

2. Methodology

2.1 Data Source

This research uses the National Health and Demographic Survey (Survei Demografi dan Kesehatan Indonesia, SDKI). The survey's microdata for this study is obtained from The DHS Program website (The Demographic Health Survey [DHS] Program, 2020).

The main goal of the SDKI is to provide the latest estimates on basic demographic and health indicators. The survey stipulates an illustrative picture of the population and both maternal and child health in Indonesia. Furthermore, the other objectives are to measure national targets on health programs and participation and use of health services by men and their families.

Information about children's immunization in Indonesia is also available in the National Socio-Economic Survey (Survei Sosial Ekonomi Nasional, SUSENAS), which is also being conducted by BPS-Statistics Indonesia (BPS), the national statistics agency. However, the SUSENAS provides limited vaccination information, such as basic information of when immunization was taken, with no ways to pair mothers and their respective children, despite living in the same household.

On the other hand, the pairing in the SDKI is possible regardless of the mother's relationship status to the head of households where they lived. Furthermore, couples residing in the same dwelling could be identified conveniently in the SDKI, providing more information on characteristics and dynamics between the pair than the SUSENAS. These distinct attributes are the SDKI's

advantages over the SUSENAS, which could be used to examine their associations to numerous health-related information in the dataset.

The objective of the SDKI is to provide the latest estimates on basic demographic and health indicators, which can be used to measure national targets on health programs and participation and use of health services by men and their families. Couples residing in the same dwelling could be identified and paired, along with their offsprings, providing more information on families' characteristics and dynamics, enabling examination of their associations to numerous health-related information in the dataset.

2.2 Data Strategy

The 2017 SDKI was funded by Indonesia Government and jointly conducted by the BPS, Indonesia's National Population, Family Planning Board (BKKBN), and Ministry of Health Indonesia. The latest field survey takes place from July 24 to September 30 in 2017, with prior surveys done in 1987, 1991, 1994, 1997, 2002 to 2003, 2007, and 2012. On the technical level, the ICF International, a publicly-traded consulting and technology services company, assisted through the Demographic and Health Surveys (DHS) Program, a program by the United States Agency for International Development (USAID). The dataset used in this study was obtained from The DHS Program website (The DHS Program, 2020). This independent agency within the US federal government is known for providing funding and technical assistance in conducting population and health surveys in many developing countries. Despite using the template from the DHS model, not all questions were included in the 2017 SDKI, as the local context was important to be considered.

The 2017 SDKI was conducted in all provinces in Indonesia (34 provinces). Using two-stage stratified sampling, the survey covered 1970 census blocks drawn from the 2010 Indonesia Population Census. The first stage systematically and proportionally selected census blocks to their household size, which were ordered by wealth index category and stratified by place of residence, urban and rural. Next, the blocks' household content was updated, followed by systematically selecting 25 households from each block. This process was expected to bring about 49,250 household samples. Around 59,100 women respondents from 15 to 49 years old and approximately 24,625 males from 15 to 24 years old were anticipated to be interviewed. On the other hand, a further similar systematic selection process was made to select eight households to get around 14,193 married men between the ages 15 to 54 which would also then be interviewed.

Out of the available questionnaires used in the 2017 SDKI, this study makes use of the information coming from the Woman's and Household Questionnaire. Other forms are the Married Man and the Never Married Man Questionnaire. The team of BPS officers used the face-to-face interview method, comprising a supervisor, a field editor, two male and four female interviewers, and respondents. This formation was used to better extract information from the respondents due to the sensitive nature of the questions.; private information is being one of them. Women from 15 to 49 years old provided children specific information and were asked about their birth history in the past 5 years from the moment questions were asked. Based on the information of all live births, more detailed information was questioned for their last two children.

After the field interview was conducted, the questionnaires were then sent to the BPS-Statistics central office for data entry processing. The results of which were then sent to the BKKBN. The final process for the microdata was done by the DHS Program, where the original variable names in the 2017 SDKI were recoded into new files with new codenames to facilitate comparison to other countries (The DHS Program, 2020). From the original 4 forms, Woman, Household, Married Man, and Never Married Man Questionnaire, the new data sets were generated, in which each of those comprises of combinations of variables taken from the 4 forms. The new datasets are:

1. IDPR71FL IDPR71SV Household Member Recode,
2. IDBR71FL IDBR71SV Births Recode,
3. IDCR71FL IDCR71SV Couples' Recode,
4. IDHR71FL IDHR71SV Household Recode,
5. IDIR71FL IDIR71SV Individual Recode,
6. IDKR71FL IDKR71SV Children's Recode, and
7. IDMR71FL IDMR71SV Men's Recode.

Out of all of the available questionnaires used in the 2017 SDKI, this study uses the main information coming from the Woman's and Household Questionnaire, specifically the **IDKR71FL IDKR71SV Children's Recode** dataset.

Women from 15 to 49 years old provided children specific information and were asked about their birth history in the past 5 years from the moment questions were asked. The dataset for this study comprises vaccination data on children and their mother's characteristics from the Woman's Questionnaire and the wealth index data from the Household questionnaire. In total, 6,942 children from 12 to 35 months of age were able to be identified. Missing values were then dropped, resulting in 6,135 cases of children aged 12 to 35 months, along with their respective mother's information, that were be used in this study.

2.3 Data Analysis

This research used Logistic Regression to obtain Odds Ratio at 95% Confidence Interval and to determine whether parents' decision making on specific issues, along with children's and their parent's other characteristics, have relation to the completeness of their children's basic vaccination. The regression is a binary classification model to estimate chances of observation with specified characteristics whether it would fall into one of two available categories based on their predicted likelihood. Additionally, the data cleaning, calculation, and statistical procedure were performed using the SPSS 13, Statistical Package for the Social Sciences software.

Children's completeness of vaccination is then divided into two outcomes, uncompleted and completed immunization. Disregarding the degree of overall completeness, if at least one immunization has not been administered after the children reached the age of 12 months, the sample will be categorized as uncompleted vaccination. This decision emphasizes that in the event the children miss one of the basic immunizations, even though all other prior immunization has been taken, whether timely or not, they are considered a hazardous agent, posing a danger not only to themselves but also to their surroundings. Therefore, it is fitting to use the Logistic Model instead of Regression, as the predicted probabilities are limited to around numeric value 0 or 1, representing uncompleted or completed vaccination, rather than any values between the two figures.

The unit of analysis is children between 12 to 35 months, covering children who supposedly have already taken the national mandatory basic immunization (Ministry of Health, 2017a) at the age of 12 months. The author hypothesizes that the completeness of childhood immunization is closely related to how parents make decisions in the family. Immunization completion became the dependent variable and was measured as complete and incomplete. Whenever a child between 12 to 35 months has completed all those vaccinations, they will be marked as having completed basic vaccination, regardless of when they do it. Conversely, missing even one vaccination will flag the child as not having completed their basic vaccination. The vaccination history was taken either from their health/vaccination card or mothers' confession.

Therefore, the dependent variable for this study is immunization completion, measured as complete and incomplete. The variable is taken from the Women Questionnaire, which also contains information for children aged 12 to 35 months regarding their history on the nine-basic vaccination. The vaccination history was taken either from their health/vaccination card or mothers' confession.

This study's main independent variables are decision-makers in the family on certain issues in the 2017 SDKI. Since there were no items that directly portray the actual decision-making being done in the family, proxy variables are used. The selected two questions represented health and monetary decisions and issues that are thought to be important in every family. Discussion between parents on those issues in the family embodies the primary hypothesis that the existence of dialogue between children's parents will yield improved decisions for children, and mandatory immunization injections are one of them. The queries in the questionnaire are:

1. (When the children got sick) Who makes the final decision on whether the child should be taken for medical treatment? (Code name: *decMEDKID*, gotten from Woman's Questionnaire, number 948B; the variable name S648B)
    a. Respondent/the children's mother (coded as 0 (ref class)),
    b. Husband (coded as 0 (reference class)),
    c. Jointly by respondent and husband (coded as 1),
    d. Jointly by husband and someone else (coded as 0 (reference class)),

e. Jointly by respondent and someone else (coded as 0 (reference class)),
f. Other (coded as 0 (reference class)),

2. Who usually makes decisions about making major household purchases? (Code name: *decPURCH*, gotten from Woman's Questionnaire, number 923; the variable name V743B)
   a. Respondent/the children's mother (coded as 0 (ref class)),
   b. Partner/husband (coded as 0 (reference class)),
   c. Jointly by respondent and partner/husband (coded as 1),
   d. Someone else (coded as 0 (reference class)),
   e. Other (coded as 0 (reference class)),

Both queries are accessible in the Woman's Questionnaire, with the informer being women aged 15 to 49 years old. The next step is making a group out of the provided answers. The option of joint discussion between spouses was recoded into 1, while any other answers were given 0; thus, the data type is nominal. The main take for this grouping is that joint discussion between a partner in the family will represent the main hypothesis; the presence of discussion between parents of the children will result in better results, one of which is basic vaccination uptake.

Controlled variables in this study represent characteristics of the family, parents, and children. Previous studies noted socioeconomic and demographic traits being the major determinants in completing children's immunization. Socioeconomic status and knowledge function were thought to influence each parent's personal beliefs, risk perception, and barrier overcoming ability. Moreover, children's own characteristics can be another determinant of their vaccination uptake. These factors are thought to contribute to the joint discussion between spouses in the family to a certain extent. Those variables, along with their respective recoded answers, are:

1. Gender of the child (variable name in the new dataset: *childGEN*), recoded by the author from the Woman's Questionnaire, question number 213; variable name in the **IDKR71FL IDKR71SV Children's Recode** data set is B4.
   a. female, coded as 0 (reference category),
   b. male, coded as 1.

   Order of the childbirth in the family (*childORD*), recoded by the author from the Woman's Questionnaire; question number 212; variable name in the data set is BORD.
   a. 1st child, coded as 0 (reference category),
   b. 2nd children, coded as 1,
   c. 3rd children, coded as 2,
   d. 4ths to highest children, coded as 3.
2. Possession of health/vaccination card (*childCARD*) recoded by the author from the Woman's Questionnaire, questions number 504A, 505A, 506A, and 507A; variable name in the data set is H1/H1A.
   a. Does not have/no longer in possession, coded as 0 (reference category),
   b. In possession, coded as 1.
3. Place of residence (*famRESIDE*) recoded by the author from the Woman's Questionnaire, question number 5; variable name in the data set is V102.
   a. Rural, coded as 0 (reference category),
   b. Urban, coded as 1.
4. Mother of the children's formal education attainment (*momEDU*) recoded by the DHS Program from the Woman's Questionnaire, question number 108; variable name in the data set is V106.
   a. No Education (never attended school), coded as 0 (reference category),
   b. Primary (has completed primary high), coded as 1,
   c. Secondary (has completed junior and or senior high), coded as 2,
   d. Higher (has completed higher education), coded as 3.
5. Father of the children's formal education attainment (*dadEDU*) recoded by the DHS Program from Woman's Questionnaire, question number 904; variable name in the data set is V701.

a. No Education (never attended school), coded as 0 (reference category),
b. Primary (has completed primary high), coded as 1,
c. Secondary (has completed junior and or senior high), coded as 2,
d. Higher (has completed higher education), coded as 3.

6. Antenatal care during the children pregnancy (*momANTECARE*), recoded by the author from the Woman's Questionnaire, question number 408 and 409; variable name in the data set is M2A, M2B, M2C, M2D, M2E, M2F, M2G, M2H, M2I, M2J, M2K, M2L, M2M, and M2N.
   a. Non-medical professional, coded as 0 (reference category),
   b. Medical Professional coded as 1.
7. Mother's assistant to the children delivery (*momDELIVER*), taken from the Woman's Questionnaire, question number 429; variable names in the data set are M3A, M3B, M3C, M3D, M3E, M3F, M3G, M3H, M3I, M3J, M3K, M3L, M3M, M3N.
   a. Non-medical professional, coded as 0 (reference category),
   b. Medical Professional coded as 1.
8. Mother's frequency of access to newspaper, radio, television, and the internet (*momMEDIA*), recoded by the author from the Woman's Questionnaire, question number 113, 114, 115, 119, 120, and 121; variable name in the data set are V157, V158, V159, V171A, and V171B.
   a. Not at all/ Less than once a week, coded as 0 (reference category),
   b. At least once a week, coded as 1,
   c. Almost every day, coded as 2.
9. Wealth Index (*famWEALTH*), given as a continuous number in the dataset, was calculated by the DHS Program dataset to each household sample. The calculation is based on socioeconomic variables in the Household Questionnaire, which are characteristics of the housing unit such as the source of drinking water, type of toilet facilities, construction materials of the floor, roof, outer walls of the house, and ownership of various durable goods. The resulting continuous variables are a composite measure of a household's cumulative living standard presented as 5 categories in the dataset by the IDHS. The author classifies given answers to:
   a. Poorest and poorer, coded as 0 (reference category),
   b. Middle, coded as 1,
   c. Richer and richest, coded as 2.

Additionally, if an observation has certain characteristics given by independent variables, the model explanation would be how likely each sample results in uncompleted or completed vaccination. Furthermore, the goodness of fit measures would be based on the percentage of cases the overall proposed model correctly classifies by total samples available relative to the dependent variable.

The proposed model used in this study and its explanation will be if an observation has certain characteristics given by independent variables, how likely each sample results in uncompleted or completed vaccination:

$$log_b \frac{completed\ basic\ vaccination.}{incomplete\ basic\ vaccination} = \beta_0 + \beta_1.decMEDKID + \beta_2.decPURCH + \beta_3.childGEND + \beta_4.childORD + \beta_5.famRESIDE + \beta_6.childCARD + \beta_7.momEDU + \beta_8.momANTECARE + \beta_9.momDELIVERY + \beta_{10}.momMEDIA + \beta_{11}.dadEDU + \beta_{12}.famWEALTH$$

The complete regression procedure done in the SPSS software would initially incorporate all the proposed variables in the Logistic Regression function. Afterward, the result would then be inspected to identify variables that do not significantly contribute to the model. Next, these variables are carefully being removed from the procedure, one by one, until all contained predictors have a significant contribution to the formula, is found. For simplicity, the backward stepwise selection function in the SPSS was used to reduce the number of models' independent variables, with the p-value used as removal criteria.

3. Results and Discussions

Descriptive Analysis Results

This first part of this chapter will examine the cross-tabulation of mandated immunization status with the planned explanatory variables and other traits from the 2017 SDKI. Vaccination status is classified as completed and uncompleted.

Table 1. Children's Group of Age and the Status of Vaccination, by Indonesia's Region (row percentage)

Provinces in Indonesia	Children's Group of Age (months)					
	12 to 23 (%)		24 to 35 (%)		12 to 35 (%)	
	Complete	Incomplete	Complete	Incomplete	Complete	Incomplete
Aceh	43.29	63.78	37.01	62.99	36.58	63.42
North Sumatera	51.52	56.71	51.33	48.67	47.13	52.87
West Sumatera	43.48	48.48	58.62	41.38	54.84	45.16
Riau	68.29	56.52	61.04	38.96	52.74	47.26
Jambi	52.50	31.71	62.16	37.84	65.38	34.62
South Sumatera	38.64	47.50	60.66	39.34	56.03	43.97
Bengkulu	71.05	61.36	63.04	36.96	51.11	48.89
Lampung	75.86	28.95	66.23	33.77	68.63	31.37
Bangka Belitung	64.79	24.14	86.11	13.89	79.79	20.21
Riau Islands	66.96	35.21	67.80	32.20	66.15	33.85
Jakarta	59.82	33.04	70.37	29.63	68.37	31.63
West Java	77.00	40.18	62.24	37.76	60.94	39.06
Central Java	27.78	23.00	82.01	17.99	79.35	20.65
Yogyakarta	70.30	72.22	38.46	61.54	32.26	67.74
East Java	51.38	29.70	75.98	24.02	72.97	27.03
Banten	78.79	48.62	59.30	40.70	54.87	45.13
Bali	78.00	21.21	94.12	5.88	88.10	11.90
West Nusa Tenggara	72.19	22.00	75.90	24.10	77.05	22.95
East Nusa Tenggara	58.46	27.81	72.67	27.33	72.40	27.60
West Kalimantan	44.74	41.54	59.46	40.54	58.99	41.01
Central Kalimantan	80.00	55.26	59.38	40.63	51.43	48.57
South Kalimantan	68.24	20.00	77.78	22.22	78.70	21.30
East Kalimantan	79.07	31.76	77.38	22.62	72.78	27.22
North Kalimantan	72.97	20.93	76.60	23.40	77.78	22.22
North Sulawesi	56.79	27.03	61.76	38.24	67.61	32.39
Central Sulawesi	61.82	43.21	60.00	40.00	58.33	41.67
South Sulawesi	66.67	38.18	71.74	28.26	66.34	33.66
Southeast Sulawesi	75.00	33.33	69.77	30.23	68.00	32.00
Gorontalo	54.72	25.00	75.86	24.14	75.32	24.68
West Sulawesi	50.65	45.28	55.56	44.44	55.12	44.88
Maluku	33.77	49.35	58.62	41.38	54.07	45.93
North Maluku	62.50	66.23	51.52	48.48	41.96	58.04
West Papua	38.78	37.50	71.43	28.57	67.07	32.93
Papua	59.93	61.22	55.26	44.74	45.98	54.02
Total	43.29	40.07	65.25	34.75	62.41	37.59

Source: IDHS Indonesia 2017, author's own calculation.

Based on Table 1, nationally, as much as 62.41% of children from 12 to 35 months old have been received all basic vaccination mandated by Indonesia's Ministry of Health. Breaking it down to age groups, the proportion of total completion for children from 12 to 23 and 24 to 35 months old is 59.93% and 65.35%, respectively. Furthermore, a look into the regional numbers and smaller age groups draws the same conclusion. No provinces managed to achieve the commended percentage for the targeted population of children from 12 to 23 months old. Less than a third of regions consistently achieved more than 70% basic vaccination completion for preschool children. Despite yielding the worst vaccination coverage in the lowest age group, Central Java shows improvement up to around 80% in older groups. Nonetheless, the same case cannot be applied to Aceh as it registers consistently low coverage across all

age groups. Additionally, Maluku is also among the provinces with the worst vaccination coverage for the targeted age group.

Table 2. Household Economic Status and Residential Area by Children's Aged Group and Vaccination Status (row percentage)

	Children's Age Group (%) in months				12 to 35	
	12 to 23		24 to 35			
	Complete	Incomplete	Complete	Incomplete	Complete	Incomplete
Poor	53,20	46,80	59,84	40,16	56,32	43,68
Middle	62,37	37,63	66,91	33,09	64,56	35,44
Rich	67,47	32,53	71,83	28,17	69,45	30,55
Rural	56,32	43,68	62,51	37,49	59,19	40,81
Urban	63,66	36,34	68,03	31,97	65,71	34,29
Total	59,93	40,07	65,25	34,75	62,41	37,59

Source: IDHS Indonesia 2017, author's own calculation.

The economic status shows different completion rates for children's vaccination status in the table above. Across all age groups, better economic status results in higher coverage for children's basic immunization. Moreover, overall compliance across all ages in urban areas is also higher than children in rural areas.

As shown in Table 3, the coverage for Hepatitis B recommended being administered within 24 hours of birth reached an 84.35% completion rate. Nevertheless, despite the higher compliance at around 90% for the first set of mandatory vaccines one month after birth, the subsequent set of injections gradually declined by approximately 10 to 15% for the DPT, Hepatitis B, HiB, and Polio.

Table 3. Completion Status of Recommended Vaccines for Children aged 12 to 35 months old (row percentage)

Commended schedule (at children's age)	Vaccines	Vaccine injection status (in %)	
		Yes	No
Month 0	Hepatitis B	84.35	15.65
Month 1	BCG	90.55	9.45
	(1st) POLIO	91.26	8.74
Month 2	(1st) DPT	88.93	11.07
	(1st) Hepatitis B	88.93	11.07
	(1st) HiB	88.93	11.07
	(2nd) POLIO	89.32	10.68
Month 3	(2nd) DPT	84.19	15.81
	(2nd) Hepatitis B	84.19	15.81
	(2nd) HiB	84.19	15.81
	(3rd) POLIO	83.54	16.46
Month 4	(3rd) DPT	77.25	22.75
	(3rd) Hepatitis B	77.25	22.75
	(3rd) HiB	77.25	22.75
	(4th) POLIO	73.56	26.44
Month 9	MEASLES	81.65	18.35

Source: IDHS Indonesia 2017, author's own calculation.

Table 4 displays mothers' exposure to a medical professional before and during children's birth and the corresponding vaccination status of their last children aged 12 to 35 months. For prenatal care, children of mothers whom non-medical professionals helped have only 17.14% basic vaccination completion, whereas mothers assisted by medical professionals result in a significantly better 63.74% compliance rate. Similar results are also clearly shown in non-medical and medical professional attended deliveries, with the latter having a 65.57% completion rate of mandatory immunization for the children, as opposed to only 31.94 % for the former. In addition, the importance of the card is proven by the 67.09% completion rate of basic vaccination for children who have it, as opposed to only a 31.30% compliance ratio for those who have lost or do not possess it.

Table 4. Mother's interaction with medical professionals by Vaccination Status for Children aged 12 to 35 months old (row percentage)

Pregnancy Stages & Card Ownership	Assistant/Ownership Status	Immunization Status (%)	
		Complete	Incomplete
Prenatal care	No-Prof	17.14	82.86
	Med Prof	63.74	36.26
Birth delivery of the children	No-Prof	31.94	68.06
	Med Prof	65.57	34.43
Possession of Health/Vaccination Card	Have	31.30	68.70
	In possession	67.09	32.91

Source: IDHS Indonesia 2017, author's own calculation.

Figures in Table 5 illustrate the relation of knowledge variables to children's vaccination completion. Mothers who do not/rarely access various information sources, such as newspaper, radio, television, and the internet, have children aged 12 to 35 months with completion to basic vaccination as low as 47.37%. The more frequent media consumption for the mother, the higher the immunization compliance rate; those who access it at least once a week or more have more than a 60 % ratio of vaccination completion. Similar results can also be said for mothers and fathers with formal educational attainment. The higher the education level of both parents, the better percentage for their children's status of vaccination completion becomes, reaching almost 70% in overall compliance.

Table 5. Mother's exposure to medical professional by Vaccination Status for Children aged 12 to 35 months old (row percentage)

Access to Information & Education Achievement	Frequency/Degree	Vaccination Status (%)	
		Complete	Incomplete
Mother's regularity in accessing mass media	Not at all/Less than once a week	47.34	52.66
	At least once a week	61.99	38.01
	Almost every day	69.33	30.67
Mother's formal education achievement	No Education	42.47	57.53
	Primary	53.17	46.83
	Secondary	64.48	35.52
	Higher	69.51	30.49
Father's formal education achievement	No Education	50.72	49.28
	Primary	56.13	43.88
	Secondary	63.72	36.28
	Higher	69.21	30.79

Source: IDHS Indonesia 2017, author's own calculation.

As is shown in Table 6., when a joint decision was made in the family for certain issues, the completion rate for children vaccination is better than a single person or persons outside the family.

Table 6. Decision Maker on certain issues in the family by Vaccination Status for Children aged 12 to 35 months old (row percentage)

Issues	Decision Maker	Vaccination Status (%)	
		Complete	Incomplete
(When the children got sick) Who makes the final decision on whether or not the child should be taken for medical treatment?	Mother/Father/Others	61.63	38.37
	Joint decision by Mother and Father	63.17	36.83
Who usually makes decisions about making major household purchases?	Mother/Father/Others	59.78	40.22
	Joint decision by Mother and Father	64.08	35.92

Source: the 2017 SDKI, author's own calculation.

On the question of "*(When the children got sick) Who makes the final decision on whether or not the child should be taken for medical treatment?*", children's vaccination completion rate is 63,17% for decisions conducted jointly by the parent. This number is slightly higher 61,63% when the same issue is decided by the mother or father alone, or by other than parents. The same result goes for the information on "*Who usually makes decisions about making major household purchases?*". Families with both parents

had the final say on immunization achieved around 64% completion rate while families other than parents or either father or mother alone made the decision only achieved approximately 59% of complete immunization.

On the other hand, the final decision on vaccination could be different for each child. Based on their characteristics in Table 7, female children have a slightly higher basic vaccination compliance rate at 63.66% and 61.20% for male children. The difference in completion based on the birth order is also apparent as the highest compliance to mandatory immunization, around 66%, is shown for second-born children.

Table 7. Children's Characteristics by Vaccination Status for Children aged 12 to 35 months old (row percentage)

Gender, Birth Order, and Ownership of Vaccination/Health Card for Children	Category	Immunization Status (%)	
		Complete	Incomplete
Gender	Female	63.66	36.34
	Male	61.20	38.80
Birth Order	1st born	64.71	35.29
	2nd born	66.32	33.68
	3rd born	61.20	38.80
	4th born or higher	51.82	48.18

Source: IDHS Indonesia 2017, author's own calculation.

In addition, the incompleteness in basic vaccination rises for each child in the family. That is 38.80% for the third child, to 48.18% for the fourth child and after.

Logistic Regression Results

In determining completion vaccination status, logistic regression is used to measure the effects of family decision making on children's medical treatment and major household purchases; children's gender, birth order, and health/vaccination card ownership; mother's education, assistance on prenatal and birth delivery, and mass media exposure; father's education; and family's residential area and economic status.

Table 8. Logistics Regression Results (initial step)

Independent Variables (initial step)	B	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
				Lower	Upper
decision-maker on children's emergency medical condition					
mother/father/other (ref)					
joint mother and father	0.059	0.304	1.060	0.948	1.186
decision-maker on household's major purchase					
mother/father/other (ref)					
joint mother and father	0.120	**0.038**	1.128	1.006	1.264
children's gender					
female (ref)					
male	-0.112	**0.045**	0.894	0.801	0.997
children's birth order					
firstborn (ref)		**0.001**			
2nd born	0.148	0.038	1.159	1.008	1.333
3rd born	-0.041	0.612	0.959	0.818	1.126
>= 4th born	-0.186	0.035	0.831	0.699	0.987
possession of health/vaccination card					
doesn't have/not in possession	(ref)				
in possession	1.305	0.000	3.687	3.116	4.363
family's place of residence					
rural (ref)					
urban	-0.026	0.682	0.974	0.859	1.104
mother's education attainment					
no education (ref)		0.056			
primary	-0.169	0.560	0.845	0.479	1.489
secondary	0.010	0.974	1.010	0.571	1.786
higher	0.106	0.726	1.112	0.613	2.017
mother ante natal care's assistant					
non-professional (ref)					
medical professional	0.941	0.000	2.562	1.657	3.961

Independent Variables (initial step)	B	Sig.	Exp(B)	95.0% C.I. for EXP(B) Lower	Upper
mother delivery's assistant					
non-professional (ref)					
medical professional	0.977	0.000	2.657	2.167	3.258
mother's frequency of access to mass media					
not at all/less than once a week (ref)		**0.039**			
at least once a week	0.227	0.014	1.255	1.048	1.504
almost everyday	0.263	0.023	1.300	1.036	1.632
father's education attainment					
no education (ref)		0.839			
primary	-0.252	0.381	0.777	0.442	1.366
secondary	-0.248	0.390	0.780	0.443	1.374
higher	-0.222	0.464	0.801	0.442	1.451
household wealth index					
poor (ref)		0.062			
middle	0.077	0.341	1.080	0.922	1.266
rich	0.192	0.019	1.212	1.032	1.422
Constant	-2.386	0.000	0.092		

Source: IDHS Indonesia 2017, author's own calculation.

Table 8 shows all proposed independent variables incorporated into the logistic regression model, with its respective coefficient, the p-value for Wald statistic, and the odds ratio. Based on the significance of Wald chi-square to test whether each variable constant equals 0 as its null hypothesis, against the critical p-value of .05, this hypothesis is rejected for several variables. The overall result suggests that decision-maker on major household purchase, children's gender and birth order, possession of health/vaccination card, mother's educational attainment, mother's assistant during prenatal care and delivery, mother's frequency of access to mass media, and household economic status are associated with children's vaccination completion. Nevertheless, the rest predictor variables provide no sufficient indication to reject the null hypothesis. Among others is the decision-maker on children's emergency medical condition; there is no sufficient evidence to associate them with children's vaccination status once the other variables were controlled for.

The next step is to remove the independent variable with a p-value that gives each of those respective variables a non-significant verdict. The SPSS software provides a backward stepwise likelihood ratio function, which processes initial models and subsequent variables removal, all in one go.

Table 9. Logistics Regression Results (final step)

Independent Variables	B	Sig.	Exp(B)	95.0% C.I. for EXP(B) Lower	Upper
decision-maker on household's major purchase					
mother/father/other (ref)					
joint mother and father	0.132	**0.020**	1.142	1.021	1.277
children's gender					
female (ref)					
male	-0.111	**0.047**	0.895	0.802	0.998
children's birth order					
firstborn (ref)		**0.001**			
2nd born	0.148	0.037	1.160	1.009	1.334
3rd born	-0.041	0.616	0.960	0.818	1.126
>= 4th born	-0.186	0.034	0.830	0.699	0.986
possession of health/vaccination card					
doesn't have/not in possession	(ref)				
in possession	1.305	**0.000**	3.687	3.116	4.362
mother's education attainment					
higher (ref)		**0.022**			
secondary	-0.060	0.835	0.942	0.534	1.660
primary	-0.291	0.004	0.748	0.615	0.910
no education	-0.114	0.163	0.892	0.761	1.047
mother ante natal care's assistant					
non-professional (ref)					
medical professional	0.941	**0.000**	2.563	1.658	3.962
mother delivery's assistant					
non-professional (ref)					

Independent Variables	B	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
				Lower	Upper
medical professional	0.971	**0.000**	2.641	2.156	3.237
mother's frequency of access to mass media					
not at all/less than once a week (ref)		**0.049**			
at least once a week	0.218	0.017	1.244	1.039	1.489
almost everyday	0.249	0.029	1.283	1.026	1,603
household wealth index					
poor (ref)		0.062			
middle	0.066	0.401	1.069	0.915	1.248
rich	0.181	0.019	1.199	1.031	1.394
Constant	-2.587	0.000	0.075		

Source: IDHS Indonesia 2017, author's own calculation.

The above table shows reduced predictor variables for vaccination completion. The surviving variables are decision-maker on the major household purchase being the sole variable of interest, controlled by children's characteristics, which are gender, birth order, and health/vaccination card possession; mother's trait, comprised education attainment, mother's assistant during prenatal care and delivery, mother's frequency of access to mass media; and lastly, household economic status. For the mother's educational background, the reference category is then reversed, as the initial model gives the reference category a significant result, but none of the other education classifications yields the same result.

The reading for the final logistic regression model would be that families with joint-decision-making in major household purchases are 1.142 times more likely to have their children complete their basic vaccination than families with only the father or the mother or other people being the sole decision-maker on the issue. Compared to female preschool children, its male of the same age group are 0.895 times less likely to have completed mandated basic immunization. The same can also be said for vaccination card possession, with a high 3.687 odds ratio for those who have it. Infant second-born children are more likely to administer all basic vaccines, with the odds of 1.160 times greater than the firstborn. Conversely, compared with the same child, fourth children or higher's likelihood to mandated vaccination completion are 0.830 times less.

Another associated factor in better vaccination status for children is whether their mothers are being cared for by a medical professional during antenatal care and birth delivery. In the former, the likelihood of children's immunization completion is 2.563 times more compared to being taken care of by a non-medical professional. The same can also be said to the latter, with the difference only in odds ratio, which is 2.641.

Mothers' frequency of accessing mass media such as newspapers, radio, tv, or the internet, could lead to the completeness of their children's vaccination. The odds are more than 1.2 times higher than the vaccination completion likelihood for children with mothers who never or rarely access said media. On the contrary, for other knowledge functions that are educational attainment, children of mothers with primary school degrees are 0.748 less likely to have finished all mandated immunization than those with mothers with diplomas or higher educational backgrounds. Lastly, children in middle and upper economic level households are 1.069 and 1.199 more likely to have completed their mandated vaccination than they who reside in poor household.

Discussion

This study found indication that joint decision by parents of children aged 12 to 35 months old on major household purchases is associated with the completion of basic vaccination for their children, compared to families who decide on the issue solely by father, mother, or family outsiders. This brings about the idea that dialogue between parents also happens on other topics, such as health issues, particularly in children's vaccination. Other studies find that when there is only one or no adult in the household, which could mean that every decision on domestic issues was being done solo, decrease the odds for children to be immunized (Qiu-Shultz, 2013). As the theory of planned behavior suggests, the pressure from people's social networks, with spouses or partners among them, could influence decisions on health issues (Kahn et al., 2008; Brunson, 2013). The presence of discussion between parents is believed to lead to positive attitudes on immunization.

On the other hand, this research also shows that there is not enough evidence to suggest how parents decide in the case of emergency medical conditions for children aged 12 to 35 months old to be associated

with completing basic vaccination. There are other intricacies involved in deciding health care for children, as living with partners can also lead to vaccine hesitancy (Bocquier et al., 2018). This might be related to the time when the result will occur as the consequences of the decision. Emergency medical conditions need immediate attention as medical procedures also need to be immediately done. Often, parents need to react promptly, being given limited time to consider and no incentive to delay the decision. Issues such as major household purchases allow parents to ponder every related aspect, such as currently available resources, before concluding. Its deadline is not immediate and can be extended given budget and other constraints. The same assumption can be applied to vaccination. Parents have much more time to consider despite a fixed schedule, which is relative to childbirth.

Additionally, family economic status contributes to parents' attitudes towards children's vaccination. Families that reside in economically privileged households are more likely to have children with complete basic vaccination than those who live in poor households. Socioeconomic factors are argued to play a much stronger role (Danis et al., 2010) in shaping parents' perception and beliefs, as it influences the parent's degree of access and exposure to various knowledge sources. Although the government has provided the vaccines for free (Ministry of Health, 2017a), vaccination seems to be underappreciated as vaccine-preventable diseases still contribute to child deaths, mainly in the middle to low-income countries (Black et al., 2010), suggesting less than expected demand for it. This study finding is similar to Australia, that partial vaccination is prevalent among the disadvantaged groups despite the existence of a free national immunization program (Fielding et al., 2017). Those in better economic status have higher percentage of children who completed basic vaccination.

The Australian study mentions that additional costs that have to be covered by the households, such as transportation, are deemed the reason for partial immunization. This research shows that a higher percentage of completed basic immunization happens to those in urban areas compared to those in rural areas. These findings provide evidence that a physical accessibility factor contributes to an increase in monetary spending, thus, the ability to get into basic children's vaccination. These inferences show that healthcare barriers go beyond covering only the medical fee, as residential characteristics will further increase the monetary cost incurred to the household in the targeted population. Also, the administration of the complete set of basic vaccinations for children is done all at once. Repeated travel to the vaccination center to complete all sets of immunization is needed, which may increase the overall cost from the household side. Thus, compliance for each vaccine could also be varied. Time factor could come into play as each subset of vaccines has a different time schedule.

As noted from this study, the compliance rates for all basic vaccination are not uniform between schedules. The reasons could be different access barriers across months of vaccination or families not feeling the urge to push for immunization completion. Therefore, aside from minimizing economic hindrances and geographical barriers, proper knowledge dissemination is a practical measure to help seedling immunization urgency to the families. Information on the importance of more vaccine administrations beyond the months close to the children's birth must be accentuated, especially when the children have not reached 12 months old. In order to do that, one way is to make the most of the mother's visits to health facilities by informing them while having a monitoring tool in place.

This research also found that mothers helped by a medical professional during prenatal care or childbirth are significantly associated with their children having complete basic immunizations. Additionally, the mother's visitation to medical professionals before and after the births yields a high completion rate for basic vaccination. This finding is similar to the Afghanistan study, which proved that antenatal care visits to health facilities by the mother (Shenton et al., 2018) are associated with the increase of likeliness to complete immunization. The interaction with the medical professionals likely alters parents' negative beliefs on immunization as vaccination plans before pregnancy and delivery often lead to refusal or delay in vaccine administration (Glanz et al., 2013). In addition, the direct interaction is also found to improve vaccination knowledge and advance vaccination status (Kaufman et al., 2018). These moments can be utilized by medical professionals in sharing reliable health knowledge to the families, with mothers, in particular, being the agent of information in between.

In addition, this study also gives credence that possession of health/vaccination cards provided by the health institution can make a difference in vaccination completion. This study finds that having health/vaccination cards is more likely to lead to children in the family having a complete basic vaccination. The outcome is consistent with Brewer's (2017) finding that parents' behavior on keeping immunization records could increase vaccination for children. The cards could be some sort of reminder

for parents of the importance of giving children protection to preventive diseases. As shown in the past, the high risk of delayed vaccination occurred when families had no idea when their children's next immunization is due (Lieu et al., 1994). Moreover, this card could also serve as a monitoring tool to the visited healthcare facilities to give relevant information on a particular vaccine that should be administered to the infant at any given time. Medical professionals could give information on the benefits of and official schedules of mandated basic vaccination for children, paving the way for mothers' inclination to vaccines conformity. The mother is thought to gain better insight and ensure that their preschool children are completely protected from most vaccine-preventable illnesses. Nevertheless, similar knowledge can be sought from other sources, as more educated people will want to look for more information to reinforce their beliefs on the benefits of vaccination to children's wellbeing.

There is an indication that mothers accessing newspaper, radio, television, or the internet at least once a week is more likely to result in children's vaccination completion, compared to mothers who do not or rarely access any mass media at all. The same can be said for mothers with high education which is associated with their children having better basic immunization compliance. The higher the mother's formal educational degree and their frequency of exposure to other knowledge sources, the higher the basic immunization completion rate becomes. The former finding is in sync to other studies that find educational attainment of the mothers are positively correlated to the immunization coverage as it leads to the low likelihood of having their children unimmunized at all ages (Bobo et al., 1993; Ekouevi et al., 2018; Ntenda, 2019).

Extra caution should be taken despite this positive finding as there is a rise in vaccination conspiracies in the internet and social media (Stein, 2017). Extra effort is needed from the medical worker side, as apparently their trustworthiness affects parents' acceptance of vaccination (Glanz et al., 2013). One of the reasons is the pediatrician's inclination to speak more regarding the benefit than the risk (Glanz et al., 2013). This could lead to parents, especially those who are still on the fence over-vaccination, to seek more information outside medical circles, such as their social circles. Research in Canada found that internet searches on vaccination are an important factor in vaccine safety perception (Tustin et al., 2018). Mass media, such as television, exposes women to positive knowledge (Betsch et al., 2018). Positive knowledge that could influence beliefs is needed to assist well-informed vaccination decisions because parents also tend to delay information due to the lack of information (Glanz et al., 2013). However, it should be known that large portions of the vaccine-related video information on the internet discourage vaccine use (Basch et al., 2017). Therefore, taking control of the information narrative should be done by continuously promoting vaccination by any means possible. Moreover, the information should also address issues and concerns regarding the benefits and parents' obligation to vaccination and the risks of it. When parents think of low-risk perceptions for such disease or doubt vaccine effectiveness, they tend to under-vaccinate or even refuse to vaccinate their children (Dunaway, 2018).

On the other hand, vaccination decisions are different among children in the same family. Male is less likely to get the complete set of basic vaccines administration in comparison to female. Moreover, in comparison to the firstborn, the fourth children in the family are less likely to have complete mandated immunization, while the second-born indicates the opposite. Additionally, the increasing percentage of basic immunization completion increases until the second child and then drops afterward. The former result contradicts findings in India that female children tend to be under-vaccinated compared to their male counterparts (Rohit et al., 2018). Additionally, the fourth or higher-order number of children is less likely to complete mandatory vaccination than the firstborn. This result is consistent with other studies in the US describing that the odds of immunization for children decreased when there were four or more children in the household (Qiu-Shultz, 2013). These differences in treatment are thought to be related to how parents value each of their children differently. Another study in India concluded that religion significantly influences vaccination status (Lakshmanasamy, 2021). Additionally, races also play a part in differing perceptions on immunization (Chen et al., 2007). In this case, it could be assumed that the religion or cultural context plays a role, with one society valuing a certain gender higher than the other.

Moreover, differing risk perceptions are also probably assigned to each child, resulting in different healthcare treatments. After all, decision-making on health is not consistent over time and is an evolving process (Glanz et al., 2013). Furthermore, there is also a possibility that an increase in the number of family members decreases the time and resources dedicated to each child (Blake, 1989; Becker, 1991). Other research also produced similar outcomes, as more children in the family increase the risk of delayed immunization (Lieu et al., 1994; Shono & Kondo, 2015). Therefore, external intervention on these parents'

resources should be devised since public health is also at greater risk when there is a possibility of disease dispersion from unvaccinated children.

As shown in the basic vaccination status in Indonesia, numbers from provinces and age groups show the need for urgent interference. No provinces managed to achieve the 90 % commended percentage for the targeted population of children from 12 to 23 months old. Less than a third of regions consistently achieved more than 70% basic vaccination completion for preschool children. Aceh, a religiously conservative area, governed under strict sharia law, registers consistently low coverage across all age groups. This issue might be the reason for the low vaccination coverage, as religious believers are often associated with groups that refuse vaccination (Pierik, 2017; Ruijs et al., 2013). Maluku is also among the provinces with the lowest vaccination coverage for the targeted age group. Going by the fact that this province is also among the provinces with the lowest Gross Regional Domestic Product (GRDP) in Indonesia (Badan Pusat Statistik [BPS] Indonesia, 2018), the weakness in the regional government's monetary power might contribute to poor implementation of basic health care deliverance for its people. Nevertheless, Central Java, despite yielding the worst vaccination coverage in the lowest age group, shows improvement in older groups, up to around 80%. This number makes a case for the effectiveness of catching up vaccination program.

Conclusions

There is a hint that the existence of dialogue between parents in the family can be associated with better compliance in basic immunization. Nevertheless, more parents' background information needs to be observed as traits such as religion and race are not available in the data used in this research. These characteristics can play a role in understanding the thought process and beliefs of the main actors on vaccination decider.

Additionally, as each vaccine is administered not all at once, its compliance varies. Thus, vaccination completion can be further examined in finding the determinant of specific inoculation. Despite completeness of basic immunization being used as main metrics in national programs in various countries, vaccination coverage does not assess the degree of postponement. Age-specific children's exposure, for example, 24 months and under, provides no clues of indication whether there were delayed vaccine-injection that is also critical in providing maximum immunity against the targeted diseases (Frieden et al., 2011). On the other hand, premature vaccinations with a decreased interval between inoculations could cause a less-than-optimal immunity, giving a misleading sense of health security. Thus, during the period that children stay under-vaccinated, the amount and extent of delayed vaccination could then be studied to better indicate vaccination status and public health.

Lastly, all proposed variables for children's mothers show significant result in determining children's vaccination. In relation to national programs of basic immunization, more specific policies targeting mothers can be devised to improve its result. Pregnancy and children delivery is a crucial time for a vaccination-related intervention. As reliable sources of health-related knowledge, health professionals could be mandated to proactively educate the mothers and community, not only about the benefits of vaccination but also the risks involved, whenever possible. Information dissemination on vaccination needs to be continuously done in every way possible, such as traditional news sources, which can be complemented with proper use of the internet. In addition, the balance, validity, and delivery of the information should also be considered. Well informed-based discussion could potentially lead to positive results, particularly in perception and decisive actions on childhood vaccination.

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Research Paper

Public Works and Housing Infrastructure Planning using Environmental Carrying Capacity Consideration

Case Study on Planning Dam Development in Kalimantan Island, Indonesia

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ABSTRACT

This article aims to explain how the environmental carrying capacity indicators could benefit public works and housing infrastructure planning. Law No. 32/2009 about environmental protection and management stated that the government is obliged to implement the Strategic Environment Assessment (SEA/KLHS) in the preparation of policies, plans, and/or programs that have the potential to cause environmental impacts and/or risks. This research aims to understand the process of using ecosystem services as part of the environmental carrying capacity. This approach would be relevant to the public works and housing infrastructure planning and is related to the National Medium Term Development Plan (RPJMN) goals in considering the environmental carrying capacity. This means that if the development of infrastructure does not meet the criteria of the environmental carrying capacity, it will cause negative impacts that could lead to futile infrastructures. The process of considering the environmental carrying capacity will be explained in quantitative methodology as an analysis process with a matrix as an overlay result. The overlay result will be interpreted as the basic information on whether a building in that location is feasible or not for carrying capacity conditions. The overlay result will be used as a basis for providing suggestions and recommendations.

Keywords: public works and housing infrastructure, strategic environment assessment, environmental carrying capacity, ecosystem services, mitigation and adaptation

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1. Introduction

The United Nations, through the General Assembly held on September 25 2015, constructed the 2030 Agenda for Sustainable Development known as Sustainable Development Goals (SDGs). Seventeen goals should be implemented by all members of the United Nations, including Indonesia. One of the goals is to take urgent action to combat climate change and its impact. A growing body of knowledge and evidence suggests that sustainable development goals cannot be achieved without integrating environmental sustainability goals (Silori, 2015).

One of the priorities within the development agenda, as stipulated in the Presidential Decree No.18/2020 about National Medium Term Development Plan (RPJMN) for 2020-2024, is a regional development that focuses on decreasing inequality and increasing equality (Ministry of National Development Planning/National Development Planning Agency, 2020). This agenda can be achieved by enhancing environmental carrying capacity and developing disaster and climate change resilience.

Under the National Medium Term Development Plan, 2020-2024, and Sustainable Development Goals, the Strategic Environment Assessment (SEA/KLHS) was crucial for infrastructure development. This aspect is also stated in Law No. 32/2009 about environmental protection and management, where the government needs to prepare the SEA/KHLS document, together with the preparation of policies, plans, and/or programs. If the result of SEA shows that the environmental carrying capacity in the area has reached the threshold, the policies, plans, and/or programs should be adapted with the suggestion and recommendation from SEA (Silalahi, 2018). All activities recognized as damaging the environmental carrying capacity should be eliminated. Carrying capacity is an ecological concept that expresses the relationship between a population and the natural environment on which it depends for ongoing sustenance. Carrying capacity assumes limits on the number of individuals that can be supported at a given level of consumption without degrading the environment and, therefore, reducing future carrying capacity. Thus, carrying capacity addresses long-term sustainability (Abernethy, 2001).

Our ecosystem has limitations in supporting all activities. Nonetheless, the carrying capacity concept is clearly of heuristic value given the fundamental truth that no population can grow without limit especially given that many human societies have behaved as if no limits exist (Hixon, 2008). The Ministry of Environmental and Forestry's illustration about overused natural resources as an impact of development in an area affecting the environmental carrying capacity is shown in Environmental Protection and Management Plan Documents (RPPLH) 2015 – 2045. This document showed the scenario for reaching the target of national carrying capacity recovery in Indonesia until 2045. For the year 2015-2025, the condition of using natural resources in Indonesia will reach the maximum of existing carrying capacity. Thus, a scenario must be prepared to recover the carrying capacity, and hopefully, the maximum carrying capacity will decrease by implementing this scenario. The illustration of this scenario can be observed in Figure 1.

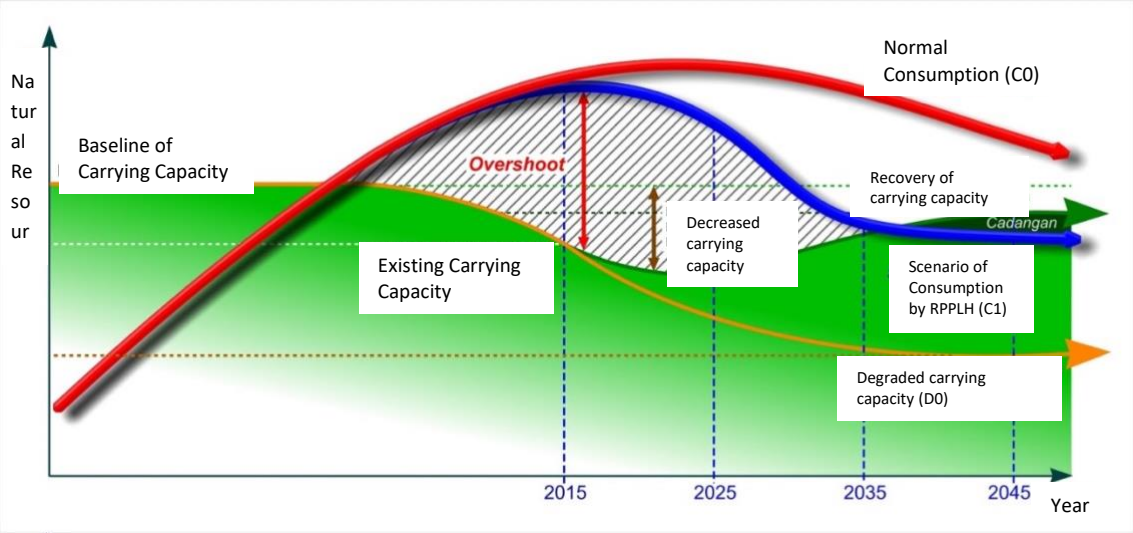

Figure 1. Scenario for environmental protection and management plan for the year 2045 (document of environmental protection and management plan for the year 2045)

It is an established point, however, that a nation without adequate infrastructure cannot compete effectively. The economy is bound to be inefficient or unproductive and will eventually lack sustainability (Jolaoso et al., 2013). The challenges are how to develop the infrastructure to be sustainable. The development of infrastructure is still being done without further consideration of the environmental carrying capacity. Still, there is some hesitation whether the infrastructure development is feasible to carry capacity in an ecological perspective. Avoiding this issue could lead to an impact where this development might damage the environment and trigger various disasters in the area.

We often hear in the news that natural disasters ruin some infrastructure projects. One of the examples was the flash flood incident in Luwu Utara, South Sulawesi Province, in July 2020. It destroyed the settlements and various main infrastructures like bridges and roads. On the other hand, Luwu Utara is also widely known as an area with a high potential for flooding because of the high intensity of rain. Furthermore, people had made even worse destruction due to deforestation, littering into the river, ad building houses or massive buildings close to the riverbank area (Pebrianto, 2020, November 24).

The other example is liquefaction in Palu, Central Sulawesi Province, which happened in September 2018 and was triggered by an earthquake and tsunami. Many researchers have been trying to find out the leading causes of the disaster. One study mentioned that the carrying capacity of water flows is low in this area. Thus, when the earthquake occurs, it will trigger a liquefaction beacon. The liquefaction has drowned many houses. The houses were not built to withstand high potential liquefaction (Likuifikasi, 2018. October 2).

From these two examples, we can see that infrastructure must consider the conditions of the environment. Infrastructure development should consider the environmental carrying capacity to achieve sustainable infrastructure. Sustainable infrastructure is defined as an interrelationship of organized principles that create a favorable built environment that meets the present needs without degrading the ecological sustainability and jeopardizing the ability of the future generations to meet theirs (Munyasya & Chileshe, 2018). Considering environmental carrying capacity in the planning process is mentioned in Government Regulation No. 13/2017 about the Revision of Government Regulation No.26/2008 regarding National Spatial Planning. Article 8, Paragraph 1 stated that controlling the development of cultivation activities should not exceed the carrying capacity of an environment. It is stated that the assessment of the environmental carrying capacity is done through the ecological footprint. It means that the analysis will be carried out by looking at the Land Capability Unit (SKL). Hence in 2016, the Center for Ecoregion Development Control (P3E), Ministry of Environment and Forestry, issued reports of the carrying capacity of an environment in ecoregion in several islands in Indonesia as a new approach in assessing the environmental condition.

The progression of carrying capacity has gradually attached the importance of human activity on the carrying capacity. The evaluation object has gradually shifted from a single resource and environmental element to the carrying capacity for multiple or comprehensive elements. Nowadays, carrying capacity is widely employed in urban planning, resource, and environmental management and becomes the key indicator to measure sustainable development (Bao et al., 2020).

The Government Regulation No. 46/2016 about Procedure to Prepare Strategic Environment Assessment, Article 13, Paragraph 1 mentions that several aspects should be fulfilled in analyzing and preparing the strategic environmental assessment of policies, plans and/or programs. It includes carrying capacity for development, prediction of impact and risk for the environment, the performance of ecosystem services, the efficiency of natural resources, level of vulnerability and capacity of climate change adaptation, level of resilience, and potential biodiversity (Umam, 2021). Moreover, the condition of ecosystem services will become an important indicator in preparing Strategic Environment Assessment (SEA/KLHS).

Millennium Ecosystem Assessment (MEA) explains that ecosystem services are viewed as benefits from the ecosystem to be obtained by society. How ecosystems are affected by human activities will have consequences on the supply of ecosystem services such as food, freshwater, fuelwood, fiber, diseases prevalence, the frequency and magnitude of floods and drought, and local and global climate.

MEA itself is an international institution founded in 2001. They published "Ecosystems and Human Well-being: A Framework for Assessment". It was launched by Secretary-General of PBB, Kofi Annan, in July 2001 and was distributed in 2005. MEA also classified the ecosystem services into four main functions, provisioning, regulating, supporting, and cultural services. Each function consists of ecosystem services related to each other, as shown in Figure 2.

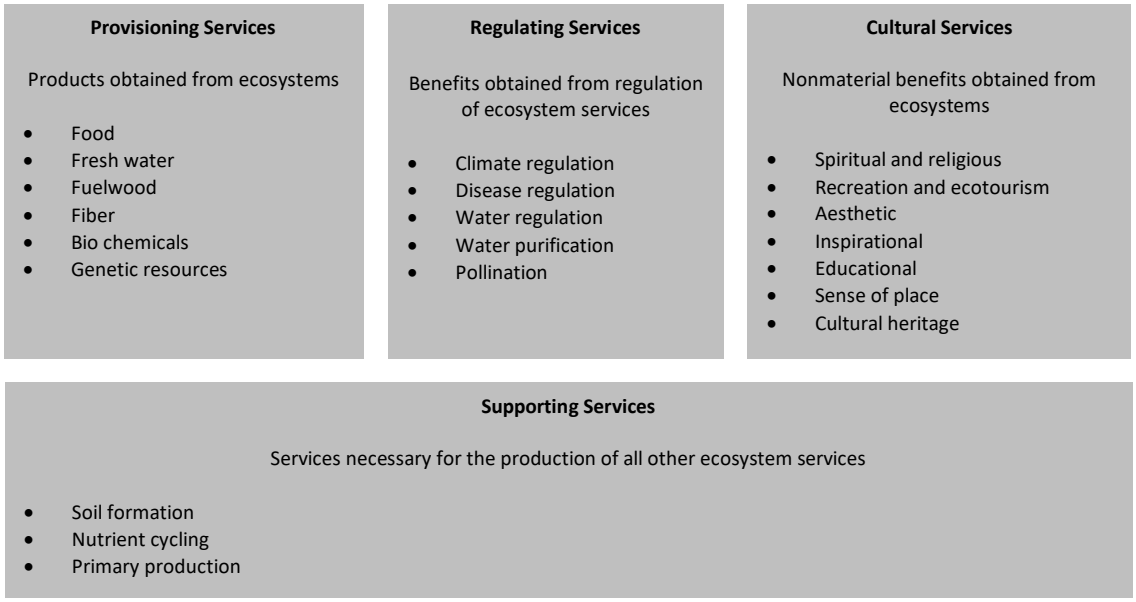

Figure 2. Relation between Function and Ecosystem Services (Ecosystems and Human Well-being: A Framework for Assessment)

Although ecosystem services have been classified into four main functions, they have specific relations with each other. Some ecosystem services are compatible with one another (e.g., a natural wetland habitat can also be used as a recreation area); others exclude each other (e.g., draining a fen for crop production destroys the former habitat services). These complex relationships between different ecosystem services may have fatal effects if humans focus only on a certain ecosystem service (e.g., the carrier service) without paying attention to the natural prerequisites for other ecosystem services (Tobias, 2013). Thus, the analysis process shall not only use one ecosystem service but also consider each ecosystem service's dependability.

Since P3E established a carrying capacity report of the ecoregion in several Indonesian islands in 2016, the strategic environmental assessment should consider ecosystem services data as a part of that report. It should be included in the development of the infrastructure planning process by considering the environment's carrying capacity.

When P3E studied the carrying capacity of several ecoregions in Indonesia, they had considered the previous study on carrying capacities, such as an international study from MEA and local study by the Research Center for Environment University of Gadjah Mada (PSLH-UGM). These studies explained the process in the ecosystem services index and map in the ecoregion. However, the current study will not explain the ecosystem services in every ecoregion, but they will be used as an indicator in the analysis process.

Ecosystem service definition is the service of ecological systems. The natural capital stocks that produce them are critical to the functioning of the Earth's life-support system. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet (Costanza et al., 1997). It is far cheaper to maintain ecosystem services than to invest in more expansive and often less effective alternatives (Silori, 2015).

The use of ecosystem services as an indicator to assess the effect of changing carrying capacity as the result of infrastructure development has not yet been fully understood. Therefore, this research aims to give detailed steps on how the ecosystem services could be used as the basic information of environmental carrying capacity. In particular, the indicators stated in the ecosystem services could help the infrastructure planning process.

This research seeks to learn how the carrying capacity environment could be used in the infrastructure planning process, especially for public works and housing infrastructure, to reduce environmental damage. The result analysis could be used to provide suggestions and recommendations towards the mitigation and adaptation actions that should be prepared once the development of infrastructures is initiated.

2. Methodology

The methodology explains the data collection and analysis process using the quantitative approach that supports by data of ecosystem services and information on planning infrastructure. The quantitative process was performed by measuring each data and making an evaluation resulting in an overlaid matrix. The evaluation process was executed by overlaying the spatial data of ecosystem services and spatial data of planning infrastructure via ArcGIS application to produce a map and an overlaid result matrix.

Furthermore, the suggestions and recommendations were produced by evaluating the result from overlaid matrix and map. These suggestions and recommendations would be helpful in infrastructure development.

Since the case of the study is in East Kalimantan Province, all the data analyses are related to the locus of study. Dam planning in East Kalimantan Province was selected due to the impact on the environment and the availability of water sources. Additionally, the Sepaku Semoi Dam will be constructed in East Kalimantan Province-making the locus selection even more suitable. The dam will provide water supply for the New Capital of Indonesia as it will be relocated to East Kalimantan Province.

2.1 Data

Relevant data is needed in the first step of the analysis. Data being used in this study was compiled from the previous study conducted by P3E. The study was about the environmental carrying capacity of the ecoregion in Indonesia. The data was obtained from the planning of "Sepaku Semoi" dam located in the East Kalimantan province.

The carrying capacity report by P3E provides some information about several ecosystem services in every ecoregion. Ecosystem services as the content of carrying capacity in the ecoregion are described. Ecosystem services located in one ecoregion can be different from other ecoregions. It depends on the strategic issues and its characteristic.

Researchers were looking for a relation between ecology and the character of the area. Understanding the factors that determine where an ecological boundary is located and how it influences our understanding of ecological processes is a fundamental issue that ecologists and land planners face (Wiens et al., 1985). It is generally accepted that ecological zones should be hierarchical. Their sizes are dependent upon the scale of the study, and their boundaries are based on semi-permanent landscape components (Bailey et al., 1994). This basis allows recognition of an ecological unit regardless of the current land use or successional status of the vegetation (Wright et al., 1998).

The scope of the ecoregion has been described differently. Some researchers saw the ecoregion as a single-purpose framework of a particular characteristic that is believed to be important in causing ecosystem quality. The most commonly used single-purpose framework has been potential natural vegetation, physiography, hydrology, climate, and soils. One reason for using a single-purpose framework is that a scientifically rigorous method for defining ecological regions must address the process that causes components to differ from one place to another (Omernik, 1995).

In general, the P3E report mentions twenty-two ecosystem services classified into four main functions (similar to MEA's classification illustrated in Figure 2). The following are the ecosystem services affecting the ecoregion in Kalimantan Island as a part of the P3E report (with the letter and number as a code of each ecosystem service used for the analysis process):

- ecosystem service for provision of food (P1)
- ecosystem service for provision of water (P2)
- ecosystem service for provision of fiber (P3)
- ecosystem service for provision of energy (P4)

- ecosystem service for provision of genetics resources (P5)
- ecosystem service for regulating climate (R1)
- ecosystem service for regulating water management and floods (R2)
- ecosystem service for regulating disaster prevention and protection (R3)
- ecosystem service for regulating water purification (R4)
- ecosystem service for regulating processing and decomposition of waste (R5)
- ecosystem service for regulating preservation air quality (R6)
- ecosystem service for regulating natural pollination (R7)
- ecosystem service for regulating pest and disease (R8)
- ecosystem service for cultural related shelter and place to live (C1)
- ecosystem service for cultural related recreational and ecotourism (C2)
- ecosystem service for cultural related aesthetic and natural beauty (C3)
- ecosystem service for supporting the formation of layers and soil fertility (S1)
- ecosystem service for supporting nutrient cycle (S2)
- ecosystem service for supporting primary production (S3)
- ecosystem service for supporting biodiversity (S4)

P3E provides an index and map for each ecosystem service in the carrying capacity report. Muta'ali (2019) stated that previous indexes and maps used the data and inputs from experts. The data are maps of the ecoregion and land coverage. These data sources were obtained from satellite imagery and taken with the ArcGIS application. Furthermore, the expert provided input by giving opinions, scoring, and pairwise comparison with Analytic Hierarchy Process (AHP) (Muta'ali, 2019). The index and maps of ecosystem services have been generated based on these resource data (Hsb, 2017). However, the current study will not explain the index and maps of ecosystem services from the previous survey.

The index of ecosystem services has several classifications, divided into five categories:

- index 0 – 0,1 is very low carrying capacity, symbolized with red color,
- index 0,1 – 0,23 is low carrying capacity, symbolized with pink color,
- index 0,23 – 0,4 is medium carrying capacity and symbolized with yellow color,
- index 0,4 – 0,7 is high carrying capacity and symbolized with green color, and
- index 0,7 – 1,0 is very high carrying capacity and symbolized with dark green color.

Each ecosystem service provides information about the average index in every province. From Table 1, the East Kalimantan Province has the highest index in ecosystem services for energy provision. It means that some of the areas in East Kalimantan have the potential to provide energy resources. The ecosystem services index also provides information about the type of ecoregions and land covering in each ecosystem service.

Table 1: Index of Ecosystem Services in Ecoregion Kalimantan.

Province	Index of Ecosystem Services																			
	P1	P2	P3	P4	P5	R1	R2	R3	R4	R5	R6	R7	R8	C1	C2	C3	S1	S2	S3	S4
West Kalimantan	0.31	0.33	0.69	0.62	0.51	0.47	0.49	0.55	0.4	0.61	0.43	0.46	0.5	0.38	0.42	0.41	0.49	0.43	0.45	0.52
South Kalimantan	0.32	0.28	0.57	0.53	0.43	0.38	0.41	0.44	0.33	0.49	0.35	0.36	0.42	0.34	0.38	0.38	0.45	0.34	0.36	0.44
Central Kalimantan	0.28	0.34	0.71	0.58	0.54	0.42	0.5	0.54	0.39	0.55	0.41	0.44	0.45	0.38	0.42	0.38	0.48	0.41	0.42	0.55
East Kalimantan	0.24	0.41	0.67	0.61	0.57	0.5	0.54	0.59	0.44	0.64	0.48	0.8	0.52	0.36	0.49	0.49	0.5	0.45	0.48	0.57
North Kalimantan	0.24	0.48	0.73	0.79	0.62	0.77	0.79	0.64	0.6	0.77	0.66	0.7	0.71	0.35	0.66	0.63	0.55	0.61	0.69	0.59

Source: Carrying Capacity of Kalimantan Island, 2016.

Besides the index, the carrying capacity report also offers maps of each ecosystem service shown in spatial data and drawn with a different color to indicate the classification of ecosystem services (Center for Controlling Ecoregion Development of Kalimantan, 2016).

As stated before, the object study is planning of "Sepaku Semoi" dam in East Kalimantan province, so the ecosystem services for the provision of water in Kalimantan Island will be chosen as sampling data ecosystem services. Map of ecosystem services for the provision of water as one of the ecosystem services in ecoregion Kalimantan gives information about spatial data included in the picture of each classification ecosystem service. From the map in Figure 3, the ecosystem services for the provision of water with a very high classification-as the highest carrying capacity-is located in the north part of Kalimantan Island, and in some parts of South Kalimantan is where the lowest classification of ecosystem services for the provision of water located.

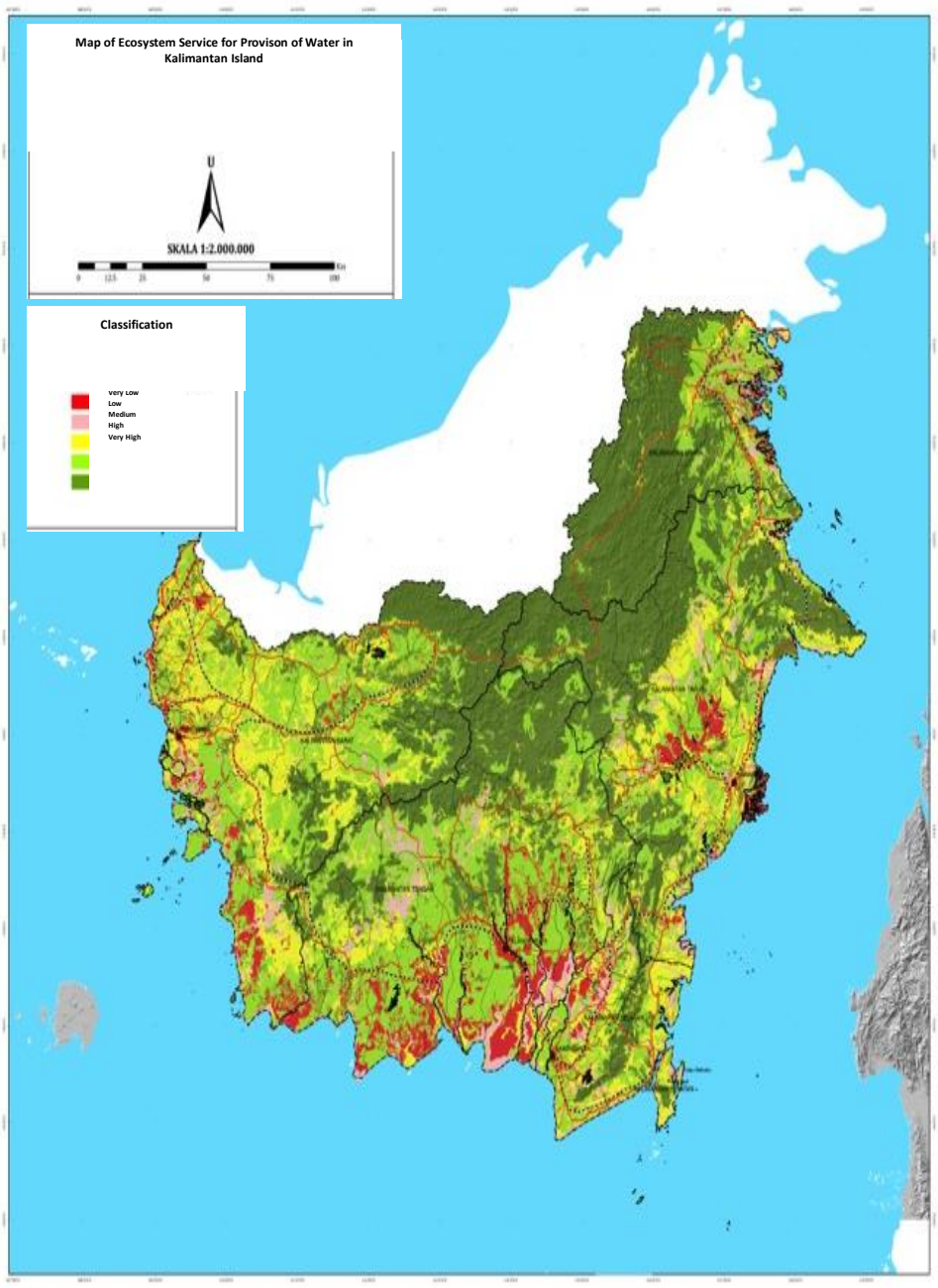

Figure 3. Map of ecosystem service for provision of water in ecoregion Kalimantan Island (Carrying Capacity Report of Kalimantan Island, 2016)

The map of ecosystem service generated in the P3E report is on a scale of 1:250.000. According to Government Regulation No. 8 of 2013 about the accuracy of spatial planning map, Article 14, the map must be made with a scale of 1:250.000 for spatial planning of province. In Article 15, a more detailed map with a scale of 1:50.000 must be used for spatial planning of the city/district region. Therefore, the Ministry of Environment and Forestry assigned the local planning and development agency (Bappeda) in the city or district region to develop an ecosystem service map on a scale of 1:50.000. This will be useful for development planning in their area.

Furthermore, ecosystem service also provides information about the total distribution area of each classification. A sample distribution of ecosystem services for water provision in each province in Kalimantan Island is shown in Table 2.

Table 2: Distribution total area of ecosystem service for provision of water in each province in ecoregion Kalimantan Island.

Province	Very low - low		Medium		High – very high	
	Ha	%	Ha	%	Ha	%
West Kalimantan	1,414,829	2.64	3,742,717	6.99	9,565,913	17.86
South Kalimantan	638,483	1.19	1,127,911	2.11	1,946,228	3.6
Central Kalimantan	2,756,417	5.15	1,486,331	2.78	11,062,937	20.65
East Kalimantan	1,168,640	2.18	2,299,934	4.29	9,207,075	17.19
North Kalimantan	401,192	0.75	342,136	0.64	6,240,180	11.65
Grand total	6,379,569	11,91	8,999,032	116,8	38,022,334	70,99

Source: Carrying Capacity of Kalimantan Island, 2016.

As the basic human needs, the water resource is essential. Several areas in Kalimantan play an important role in providing water. Table 2 shows the total area of 38,022,334 Ha of water provision in Kalimantan, equal to 70,99 % of the index value of high-very high in ecosystem service of water provision. The table shows that Central Kalimantan has the highest percentage of the total area with high-very high value for water provision and the highest percentage of the total area with a very low-low value of the same ecosystem services. This happens because the Central Kalimantan is located on the highest mountain on Kalimantan island. The Bukit Raya, as the highest mountain, served as a recharge area for water provision. On the other hand, in some areas in Central Kalimantan province, there are also vegetation with low density such as bushes that created a higher runoff for water, reducing water availability and quality.

In the meantime, the plan data of dam construction was collected from several resources, such as the National Medium Term Development Plan (RPJMN) 2020-2024, Strategic Plan of Ministry of Public Works and Housing 2020-2024, and Masterplan of Public Works and Housing of Infrastructure in Kalimantan. Those data stated a total of 61 units of dam infrastructures which 18 of those are multifunction dams (Ministry of Public Works and Housing, 2020). The "Sepaku Semoi" dam in Penajam Paser Utara district, East Kalimantan province, is included in the dam-construction plan data. The “Sepaku Semoi” dam, supports the existing dams built in East Kalimantan such Manggar dam in Balikpapan (capacity 14,2 million m^3), Teritip dam in Balikpapan (capacity 2,43 million m^3), Aji Raden dam in Balikpapan (capacity 0,49 million m^3), Samboja dam in Kutai Kartanegara (capacity 5,09 million m^3), Kalhol intake in Mahakam river (capacity 0,02 million m^3) and Lempake dam in Samarinda (capacity 0,67 million m^3). The "Sepaku Semoi" dam produces 11 million m^3 of water which will be used for irrigation systems and water supply for Balikpapan city of 2,500 liters/second. In addition, the "Sepaku Semoi" dam will support the water supply for the new capital of Indonesia in East Kalimantan. The total area of dam development is 378 Ha, and 36 Ha is reserved for the dam's main building. These datas were obtained from surveys and maps of public works and housing infrastructure planning prepared by the Center of Data Resources and Technology Information, Ministry of Public Works, and Housing (Ministry of Public Works and Housing, 2019).

2.2 Analysis

After collecting all the data, the next step is the analysis process. The analysis process is carried out in several stages, as in Figure 4.

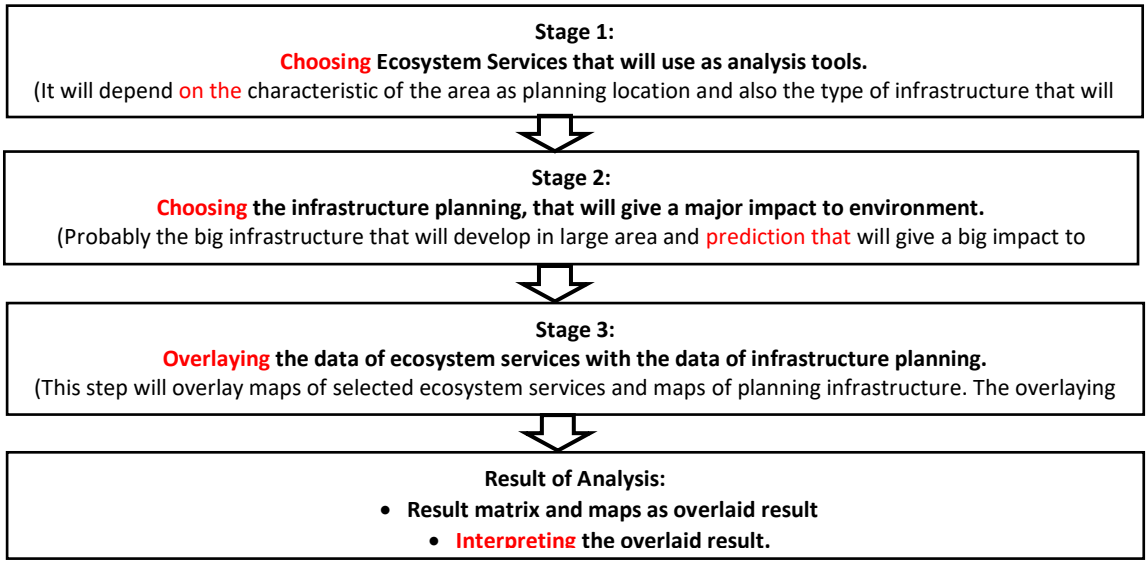

Figure 4. The Stages of Analysis Process of using Ecosystem Services until Develop a Result (Analysis result).

The first step is to choose ecosystem services that will be used as analysis tools. It will be chosen from the characteristic of the ecoregion and also from the type of infrastructure. The Environmental Protection and Management Plan document (RPPLH) for 2015 -2045 provides information about the issue and characteristics of each ecoregion in the big island in Indonesia and information about related ecosystem services with that ecoregion. For the ecoregion of Kalimantan island, there are ecosystem services that have a significant impact for the year 2015-2045, such as (Ministry of Environment and Forestry, 2015)

- ecosystem service for food provision (P1)
- ecosystem service for water provision (P2)
- ecosystem services for energy provision (P4)
- ecosystem services for the provision of genetics resources (P5)
- ecosystem services for regulating water management and floods (R2)
- ecosystem services for carbon saving

Furthermore, related to the type of infrastructure, some literature of study can be used as consideration for choosing the ecosystem services. For examples from "Ecosystems and Human Well-being: Policy Responses", chapter 7: Freshwater Ecosystem Services - Millennium Ecosystem Assessment by Aylward can be concluded ecosystem services that are affected to development of irrigation systems and dams, such as (Aylward, 2005):

- ecosystem service for provision of food (P1)
- ecosystem service for provision of water (P2)
- ecosystem services for regulating water management and floods (R2)
- ecosystem services for regulating disaster prevention and protection (R3)
- ecosystem services for regulating water purification (R4)
- ecosystem services for cultural related to recreational and ecotourism (C2)
- ecosystem services for cultural related to aesthetic and natural beauty (C3)
- ecosystem services for supporting primary production (S3)
- ecosystem services for supporting biodiversity (S4)
- ecosystem service for educational and science

The second stage is to decide the infrastructure that has the highest impact on ecosystem services and its potential to change the environment's carrying capacity. The chosen infrastructure will likely be a massive one and is usually stated in the National Medium Term Development Plan (RPJMN) and surely one will produce the highest impact on the environment. Defining the infrastructure considers the total area of infrastructure development. The development of infrastructure in the greater area provides more impact to the environment compared to otherwise.

The program development of "Sepaku Semoi" dam stated in RPJMN 2020-2024 became a National Strategic Project in Presidential Decree No. 109/2020 regarding the acceleration of National Strategic Project implementation. "Sepaku Semoi" dam will have a tremendous impact on the existing environment.

Subsequently, the data related to the selected infrastructure, such as the location detail of existing or planning infrastructure, service coverage of existing or planning infrastructure, and environmental issues, are considered. Infrastructure data use data of spatial planning of the same scale of ecosystem service map. The ideal scale for the map is 1:50.000 for the city/district area, as stated in Government Regulation No. 8/2013 regarding the accuracy of the spatial planning map. On the contrary, the ecosystem service map prepared by P3E, Ministry of Environment and Forestry, has only a 1:250.000 scale.

The third stage is to overlay the ecosystem service maps, and the existing or planning infrastructure maps. The overlaying process was executed using ArcGis application.

3 Results and Discussions

Figure 5 shows the map of "Sepaku Semoi" dam planning overlaid with ecosystem service of water provision for the ecoregion of Kalimantan. The overlaid process is done on a 1:250.000 scale due to the scale of the ecosystem service map at 1:250.000.

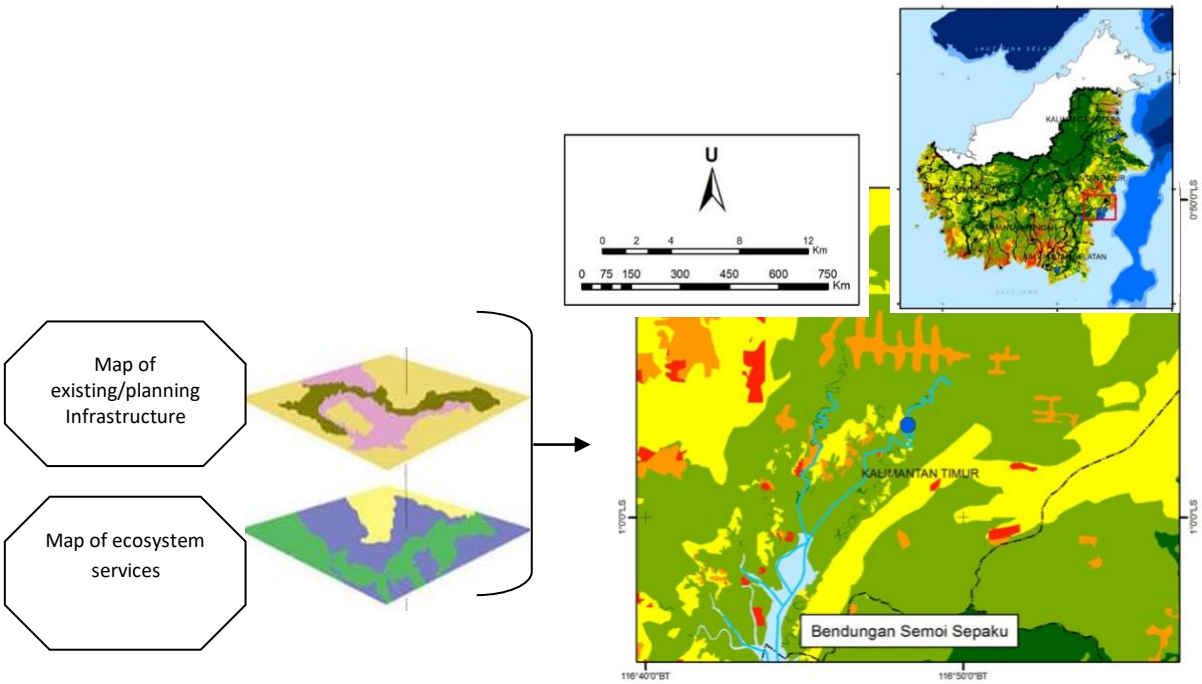

Figure 5. Process and result of overlaying a map of ecosystem service of water provision with a map of planning "Sepaku Semoi" dam in East Kalimantan province.

Besides the overlaying maps, there is also information about the index value of each ecosystem service, type of land cover, and type of ecoregion where the infrastructure will be developed. Table 3 shows the result of overlaying "Sepaku Semoi" dam with all ecosystem services.

Table 3: Result of overlaying as information about the type of land cover, type of ecoregion, and index of ecosystem services where the planning infrastructure is located.

Develop / Planning Infrastructure	Type of Land Cover	Type of Ecoregion	Ecosystem Services Index										
			P1	P2	P4	P5	R2	R3	R4	C2	C3	S3	S4
"Sepaku Semoi" Dam	Mangrove	Fluvio-marine	0.42	0.29	0.64	0.65	0.59	0.54	0.41	0.77	0.46	0.48	0.67

Source: Analysis result.

Table 3 shows that "Sepaku Semoi" dam will be located in a mangrove area and fluvio-marine ecoregion type. The type of area provides information about the important aspect in providing recommendations for protecting the existing ecosystem within the dam area. The mangrove area is one of the land cover types in Kalimantan, mostly located in the coastline area, and functioned to conserve the area and endemic creatures such as crabs and shrimps. The fluvio-marine area is formed by a joint of river and sea. The information about the type of land cover and type of ecoregion is really important, as a consideration to give suggestion and recommendation to maintain the existing environment condition including the habitat that lives in that area.

The next stage is to interpret the value of index ecosystem services of Sepaku Semoi's location plan. These interpretations are categorized into two values, "feasible" or "non-feasible". Feasible means that the development effect gives small or none to the environment. Non-feasible means that the development has a large impact on the environment.

Table 4 displays the procedures of interpretation as the correlation of the ecosystem service index-the interpretation value symbol.

Table **4**: Procedure for giving interpretation from the value of index ecosystem services.

Index of Ecosystem Services	Classification of Index of Ecosystem Services	Value of Interpretation	Symbol of Interpretation
0 – 0.1	Very low	Feasible	√
0.1 – 0.23	Low	Feasible	√
0.23 – 0.4	Medium	Non Feasible	x
0.4 – 0.7	High	Non Feasible	x
0.7 – 1.0	Very high	Non Feasible	x

Source: Analysis result.

Furthermore, Table 5 offers the result of interpretation.

Table 5: Result of interpretation of each index ecosystem service where the "Sepaku Semoi" dam will be located.

No.	Planning Infrastructure	Location	Ecosystem Services of Provisioning				Ecosystem Services of Regulating			Ecosystem Services of Culture		Ecosystem Services of Supporting	
			P1	P2	P4	P5	R2	R3	R4	C2	C3	S3	S4
1	"Sepaku Semoi" Dam	Penajam Paser Utama District	X	X	X	X	X	X	X	X	X	X	X

Source: Analysis result.

The interpretation in Table 5 shows the plan of the "Sepaku Semoi" dam located in an ecosystem service categorized as non-feasible. The index detail displays it as a medium to very high category. Even though it is non-feasible, we should not directly decide that dam location should be avoided, but we can use these results as strict cautionary guidelines to maintain the dam's condition. The guidelines are provided in recommendations and suggestions.

A further and detailed discussion with the experts of P3E of Kalimantan as the institution producing these ecosystem service data is compulsory. They will provide data on how to produce the perfect interpretation, recommendation, and suggestion to construct "Sepaku Semoi" dam in this specific location.

The hypothesis of this research confirms that the environment's carrying capacity has played an important role in planning the "Sepaku Semoi" dam. The purpose of carrying capacity data is to minimize the impact of infrastructure on the environment, indicated as feasible or non-feasible to develop the dam infrastructure.

Suggestion and Recommendation

Recommendations and suggestions are defined by the interpretation matrix in Table 5, as the discussion with experts and stakeholders is taken into account. The discussion increases the point of view to widen the options for the solution. For instance, the Ministry of Environmental and Forestry will review the conversation about conservation areas regarding the Land Coverage Map, Indicative Map, and Social Forest Area (Ministry of Environment and Forestry Regulation No. SK.744/MENLHK-PKTL/REN/PLA.0/1/2019). The local government will review the land ownership aspect, and the Directorate General of Water Resources of the Ministry of Public Works and Housing will review the technical aspect. All these results are intended to make the recommendation easily implemented.

The recommendations and suggestions are offered as mitigation and adaptation plan. As for the non-feasible interpretation, the recommendation and suggestion can be used as a mitigation plan. The recommendation and suggestion can be used for the adaptation plan for the feasible interpretation.

For instance, the general recommendation for "Sepaku Semoi" dam plan in East Kalimantan could be given as follows:

a. Human settlement should be considered as it is vital in keeping the water quality of dam from domestic pollutants.
b. The dam location should avoid earthquake-prone areas to maintain the dam's infrastructure. The warning for the condition must be included in the planning process.
c. The conservation land must be provided because the dam is located in the ecoregion mangrove area. These areas function as conservation.

The recommendation related to ecosystem service of water provision are:

a. The dam must consider a green belt area, which functions as a water catchment area. Conserving the green area will protect the water source and make it sustainable.
b. Managing the sediment into the dam will prolong the dam's function and infrastructure.

Furthermore, the general suggestion for the planning of "Sepaku Semoi" dam in East Kalimantan are:

a. The selection of dam location, regulated in Decision of Director General of Water Supply as Head of Dam Safety Commission No. 05/KPTS/2003 about a) Guidelines for Dam Safety Assessment, b) Guidelines for General Dam Design Criteria and c) Guidelines for Dam Safety Inspection and Evaluation.
b. The provision of mangrove area substitution should be located surrounding the dam location.

The suggestion related to ecosystem service of water provision:

a. The dam planning should take the location and condition of the watershed into account, which will function as the water source to the dam.
b. The dam plan needs to take the green belt area near the dam to function as a water catchment area so the green belt should be a conservation area.

The recommendation and suggestion of mitigation action are below:

a. The greenery of the area surrounding the dam includes compiling the regulation for deforestation, especially in the catchment area. It will function to conserve water resources.
b. Managing the sanitation system within the settlement area located nearest the dam to protect water pollution from domestic waste.
c. Managing the sedimentation using the method of dredging in the river to fend off sediment from entering the dam.
d. Conservation planning areas must be established to conserve the mangrove area replacement.
e. Avoiding the development of a dam in an earthquake zone.

By considering the infrastructure located in disaster-prone areas, the recommendation and suggestion are related to the mechanism of building back better (BBB) introduced by Sandeeka Mannakara in 2014. The BBB framework consists of three main categories, 1) Risk Reduction, 2) Community Recovery, and 3) Implementation. This framework, specifically on the aspect of risk reduction, has two principles: 1) Improvement of Structural Design, depicting improving structural designs and enforcing through revised building codes; and 2) Land use planning, representing the use of hazard and risk-based land-use plans to minimize risks (Erlinna et al., 2020).

The recommendation, suggestion, mitigation, and adaptation action, could be explained in more detail. They could refer to each ecosystem service that has been overlaid with the dam's planning and be an example for ecosystem service of water provision.

Conclusions

Overall, the research hypothesis has been justified using ecosystem service as an indicator in infrastructure planning, a solution in giving less impact or less damage to the environment. The steps of using ecosystem service have been clarified to formulate the result. The recommendation and suggestion should be taken afterward.

This research uses the environment carrying capacity data on a scale of 1: 250.000 due to the availability of the data. This might not be in detailed information, especially for planning infrastructure in a small area. Hopefully, the local government, especially the planning and development agency (Bappeda) of the city/district region, could prepare the data of ecosystem services on a more detailed scale at 1: 50.000.

The water catchment areas that function as water sources play a vital aspect in the dam infrastructure development. The river can be a water source. For instance, the "Sepaku Semoi" dam planning is closed to Mahakam River. Further research could look up the relationship between data of ecoregion ecosystem services with the character of river area affected by the development of dam infrastructure. Additionally, further research could assess ecosystem services in another planning object of public works and housing infrastructures such as road planning or waste management site planning.

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Research Paper

The Potency of *Cratoxylum arborescens* Blume (Geronggang) and *Combrecarpus rotundatus* Dans (Tumih) as Natural Regeneration in Degraded Tropical Peat Swamp Forest

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ABSTRACT

The massive forest fire disasters have left an enormous area of degraded peatland. This study aims to analyze the performance of two species, namely C. arborescens and C. rotundatus, as the natural regeneration post forest fires. This research was conducted in 5 different locations that experienced severe fires in 2006. We made a total of 25 plots for each location to measure biodiversity at four growth levels. We analyzed the data with vegetation analysis formulas from Magurran. The results show that at the tree growth level, C. rotundatus can withstand the fires in 2006 and is currently still growing in more significant numbers than C. arborescens. At the pole, sapling, and seedling growth levels, these species perform well as natural regeneration species with many individuals, but C. arborescens is a bit more dominant. Both species are suitable for natural regeneration after fires in degraded peat swamp forests based on survived and existing individuals. On the other hand, both species could not improve the vegetation diversity in the whole ecosystem. These two species can be the option for natural regeneration if there a limited budget and the degraded areas are in a very remote location.

Keywords: forest fire, natural regeneration, performance, peat swamp forest

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1. Introduction

Indonesia is a country blessed with the largest area of tropical peatlands in the world, where almost 70% of the total global tropical peatlands are in Indonesia, spread over the islands of Sumatra, Kalimantan, and Papua (Hooijer et al., 2012; Miettinen, Shi, et al., 2012; S. E. Page et al., 2007). Indonesia's tropical peatlands primarily consist of forested wetland areas and are called tropical peat swamp forests (Könönen et al., 2016). These fragile and unique ecosystems have vital roles for human life with various ecological, economic, and socio-cultural benefits. On the global scale, tropical peat swamp forests are highly concerned because of their high carbon stock inside (Ahirwal et al., 2021; Kimmel & Mander, 2010; Osaki & Tsuji, 2015), which means that they are associated with global carbon emissions, forest fires, and air pollution (Couwenberg, 2010; Hooijer et al., 2012; Murdiyarso et al., 2019). These ecosystems also have high biodiversity values , such as various species that are endemic, rare, and endangered (Posa et al., 2011; Symes et al., 2018; Yule, 2010), as well as a source of livelihood for local people (Chokkalingam et al., 2005; Silvius & Diemont, 2007; Taufik et al., 2019)

Central Kalimantan, Indonesia, is where most tropical peat swamp forests can be found (Miettinen, Shi, et al., 2012; S. E. Page et al., 2007). However, these unique and priceless ecosystems have been experiencing deforestation and degradation for various reasons until now. One of the causes of degradation and deforestation in peat forests is fire (Couwenberg, 2010; Dohong, 2016; Lestari et al., 2021; Pindilli et al., 2018). These forest fires are always accompanied by other impacts, such as converting peatlands into plantation and agricultural areas and the drought (Cole et al., 2021; Hooijer et al., 2010; Jauhiainen et al., 2014; Uda et al., 2020)

Degradation and deforestation of peat swamp forest due to fires caused a lot of neglected peat swamp forest. Therefore, the government must address this area immediately because it is prone to repeated forest fires with local and global impacts (S. E. Page et al., 2007; Wösten et al., 2008). The efforts to restore the peat swamp forest ecosystem after the fire are conducted through ecosystem restoration. This restoration consists of hydrological restoration, vegetation restoration, revitalization, or restoration of its economic and ecological functions (Dohong et al., 2018; Badan Restorasi Gambut Republik Indonesia, 2016; Giesen & Meer, 2009; Yuliani, 2017).

Restoration of peat swamp forest is a part of peatland restoration in a specific type of ecosystem, i.e., forest ecosystem. Several forest fires have caused large areas of degraded peat swamp forests (PSFs) and need to be restored (Hooijer et al., 2012; Jauhiainen et al., 2014; Koh et al., 2011; Könönen et al., 2018; Suding et al., 2015). Peatland ecosystem restoration consists of vegetation restoration, hydrological restoration, and revitalization.

Vegetation restoration is conducted by either revegetation/planting or natural regeneration, while the restoration on hydrology is undertaken by rewetting peatland. Management and restoration of tropical peat ecosystems is not a small and simple thing, with a carbon stock of 3000 mg C Ha-1. However, the loss rate is also high at around 20 Mg C Ha-1 due to various things, especially oil palm plantations and industrial forest plantations development, and continues to grow (Murdiyarso et al., 2019). As a result, accelerated degradation started in the last decade, even compared to tropical peatlands in other areas such as Peru in South America (Lilleskov et al., 2019). Therefore, various evidence-based policies and strategies are needed.

Ecosystem restoration must also involve local communities, especially in hydrological restoration, which are rejected or accepted by local farmers in the form of existing blocking canals. It affects their accessibility to the area, where canals are their transportation route. Better understanding is needed to improve restoration success (Ward et al., 2021)

On the one hand, during the Covid-19 era, the management and conservation of peat areas also have impacts and potential impacts such as air pollution, socioeconomic, livelihoods, and food security (Harrison, Wijedasa, et al., 2020). However, on the other hand, even planting project activities also encounter many obstacles; therefore, natural regeneration is an essential alternative for restoration at this time.

In particular, for vegetation restoration, two options are available, namely planting and natural regeneration. Natural regeneration, the spontaneous recovery of plant or animal species after damage or disaster, continues to be promoted as a low-cost strategy for large-scale forest restoration (Chazdon & Uriarte, 2016). This method is suitable because of the high cost associated with restoring peat swamp forest vegetation (Blackham et al., 2014), and the extent of neglected degraded areas after the forest and tropical peatland fires in Kalimantan (Cole et al., 2021; S. E. Page et al., 2007; Toriyama et al., 2014)

Vegetation restoration in the degraded peat swamp forest is challenging in many aspects as peatlands have unique characteristics in terms of geology and ecosystems. Previous studies on degraded land conditions have found that degraded peatlands pose many obstacles in natural regeneration and revegetation (Di Sacco et al., 2021; Wijedasa et al., 2020). Many degraded peat swamp forest areas are not in the right way to be restored naturally (Miettinen, Shi, et al., 2012). From ecological aspects, there are several limiting factors in the regeneration and revegetation of degraded peat forest areas, such as water level fluctuations, poor nutrient cycles, a remarkable change in temperature (Wösten et al., 2008)

The uncontrolled drainage systems, drought, and forest fires also stop natural regeneration by eliminating sources of seeds that have fallen to the ground (Graham et al., 2013). From a biological perspective, plant or tree species that are natural sources of seeds carried by wind and animals are also significant for natural regeneration in peat swamp forests. Still, the diversity of these seed-producing species is also low (Blackham et al., 2014).

Due to its geographical location, peat swamp forests located at the equator have high temperatures, especially in open areas due to conversion or fires (Miettinen, Shi, et al., 2012; Osaki et al., 2012). During the day at the end of the dry season, the temperature of the open area in peat swamp forest reaches 40 degrees, causing severe drying of seedlings planted for vegetation restoration purposes, thereby increasing seedling mortality (Lampela et al., 2018). High temperatures and drought also trigger repeated forest fires, killing the natural regeneration process and revegetation regeneration. Due to the distance from natural seed sources, regeneration is disrupted because the area will be dominated by shrubs and grasses (Graham et al., 2013; Könönen et al., 2018; S. Page et al., 2008)

Various NGOs have also carried out revegetation activities both in joint projects and independently. For example, in the peat swamp forest of Central Kalimantan, *Dyera polyphylla* (synonym: *Dyera lowii*) and *Shorea balangeran* have been planted (Giesen & Meer, 2009). These species were chosen because they are endemic to Central Kalimantan's peat swamp forest. *Dyera Polyphylla* was selected because it has high economic value as a sap producer. At the same time, *Shorea balangeran* is an endemic species most often found as the dominant species in the tree category in Central Kalimantan peat swamp forest (Mawazin & Subiakto, 2013; Tan et al., 2021; Tata, 2019). However, the area that has not been planted yet is massive. Therefore, natural regeneration is the choice to restore the vegetation diversity in degraded peat swamp forests after fires.

The study conducted by Lampela et al. (2017) found 21 species of peat swamp forest trees. The study also showed that *S. balangeran, A.pavonia, D. rostrate*, and *L. dasytachys* are the most suitable species for vegetation restoration. However, *A. pneumatophora* and *D. polyphylla* are still recommended with certain restrictions (Lampela et al., 2017).

The golden rule in vegetation restoration: select suitable species for restoration areas, use natural regeneration whenever possible, and select suitable species to maximize biodiversity(Di Sacco et al., 2021). Natural regeneration and assisted natural regeneration are the two recommended methods for ecosystem restoration after a fire (Scheper et al., 2021), considering that forest fires and land conversion usually produce different vegetation and soil microbial activity (Ahirwal et al., 2021).

The Previous study have found 59 challenges in tropical forest and peatland conservation: economic, legal, social, logistical, and research (Harrison, Ottay, et al., 2020). Ecologically, there are many barriers to various peat restoration techniques (Dohong et al., 2018). For example, logistical problems and high costs are common problems for vegetation or replanting (Blackham et al., 2014; Graham et al., 2013). Another problem is the vast area of degraded peatland because of fires (Koh et al., 2011; Miettinen, Hooijer, et al., 2012). Therefore, natural regeneration is one of the alternatives that researchers should study carefully to solve these barriers.

There has also been much research in Central Kalimantan on species and methods for peat restoration. Some also suggest paludiculture with three main species, namely Jelutung, Ramin, and balangeran, as woody plants (Budiman et al., 2020). Another study indicated that adapted agroforestry models are

recommended to attract local communities and investors (Applegate et al., 2021). However, this is for peat areas, not in forest areas located in rural areas.

With the many obstacles and challenges in carrying out revegetation in the form of planting the large area of land that has been degraded by forest and land fires, one of the cheapest and easiest alternatives is to rely on natural regeneration. Natural regeneration of the most common species is needed to measure whether these species are suitable and reliable as species for vegetation restoration.

Natural regeneration can be assessed by measuring species that are not planted but grow naturally in degraded peat swamp forest areas. This study was conducted to determine the performance of 2 species of woody species, namely *C. arborescens* and *C. rotundatus,* as the species for natural regeneration after the forest fire disaster in tropical peat swamp forest. These species grow most commonly in peat swamp forests in Central Kalimantan. The purpose of this research is to compare the performance of these two species for natural regeneration, namely *C. arborescens* and *C. rotundatus*, as the species for natural regeneration after the forest fire disaster in tropical peat swamp forest.

The study results on the performance of species post-fires will be beneficial in deciding the alternative option of vegetation restoration methods. For example, whether planting is necessary for all locations, enrichment planting is sufficient, or some species can be relied on in natural regeneration without planting with human assistance. The result would be significant as degraded peatlands are massive, and restoration requires a high cost, especially in the remote areas of peat swamp forest.

2. Methodology

This research was conducted in the peat swamp forest of Central Kalimantan, which administratively belongs to the Forest Management Unit (KPH) area, namely the Kapuas-Kahayan KPHL (formerly known as the Kapuas Model KPHL). Geographically, the research location is located at coordinates: 1̊ 47'37.8" SL-2̊ 13'48.6" SL 114̊23'28.1EL - 114̊43'5.1" EL, located in the former MRP area Block E and Block A to the right of the Kapuas River. The KPHL area has an area of 105,772 ha consisting of more than 94% of the peat swamp forest area. This research area is also a peat swamp forest area left over from the former 1 million Mega Rice Project in Peatland (MRP) in the 1990s.

This peat swamp forest area was chosen because it is a protected forest with characteristics as thick peatland with high degradation and degradation because of forest fires in 2006. Moreover, this area is an area that has implemented various ecosystem restoration techniques since the 2000s with three main activities: hydrological restoration, vegetation restoration, and revitalization. However, there were also the massive areas without any human-assisted revegetation and relied on natural regeneration with two main species, i.e., *C. arborescens and C. rotundatus.* The research map can be seen in the following figure.

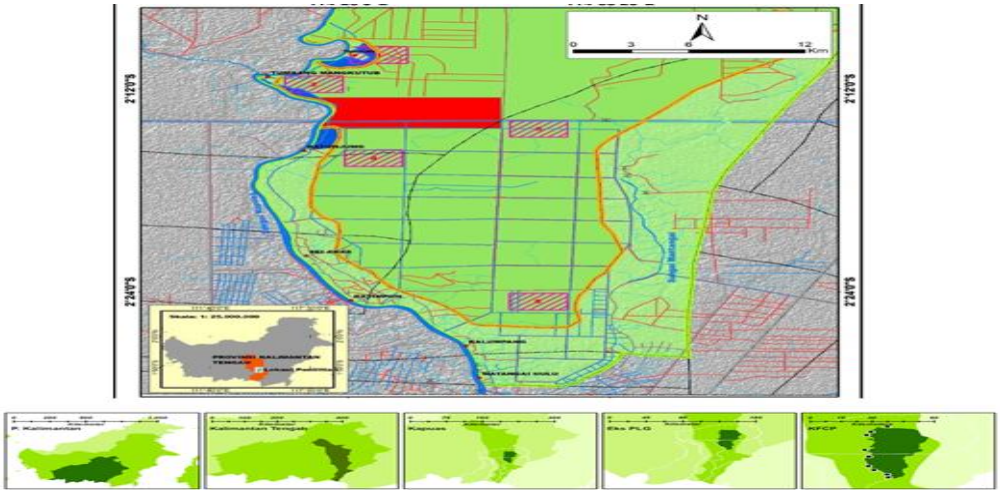

Figure 1. Research location

The plots were made in the main plot of 1 hectare for each location. In one hectare, the are 25 measuring sub-plots with different sizes as follows: 20 m x 20 m for tree growth level, 10 m x 10 m for pole growth level, 5 x 5m for sapling growth level, and 2 x 2m for seedlings ferns and understorey plants. Square plots are randomly placed on five different locations in the degraded post-2006 fires, where no replanting was conducted, and the whole vegetation depends on natural regeneration.

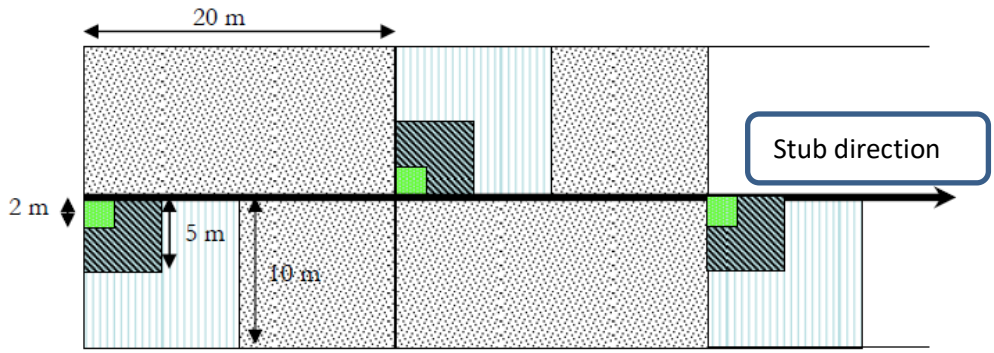

Figure 2: Plot design for seedling, sapling, pole, and tree

Data collected included species and number of plants and diameter for trees and poles. Data were analyzed by vegetation analysis to obtain important value index (IVI), Shannon diversity index (H'), species richness index (R1), and evenness index (E).

2.1 Analysis

Collected data consisted of the species name (botanical and local), a number of individuals in each plot for seedling, sapling, pole, tree, diameter, and height for pole and tree growth level. Analysis data was done after all data from the field was completed.

For data analysis, we used the following formulas from Magguran (Magurran, 2004; Magurran & McGill, 2011) and put the result on the table. The vegetation data analysis is as follows:

a. Important Value Index

The Important value index formulas are divided into two categories, i.e.:

For Pole and Tree growth levels:

$$IVI = RD + RF + RDm \quad (1)$$

For sapling, seedling, and understorey growth level

$$IVI = RD + RF \quad (2)$$

IVI = important Value Index

RD = Relative Density

RF= Relative Frequency

RDm = Relative Dominance

b. Shannon–Weiner diversity index (H'*)*

$$H' = -\sum_{i=1}^{n} \frac{ni}{N} \times log\ log\ \left(\frac{ni}{N}\right) \quad (3)$$

Where *ni* is the total number of species-i, *N* is the total number of all species in the plots

c. Richness Index

$$R1 = \frac{S-1}{log log\ N} \quad (4)$$

Where R1 is the richness index for a plot, S is the total number of species, and N is the total of individuals in the plot

d. Evenness Index

$$E = \frac{H'}{log\, log\, S} \quad (5)$$

Where E = Evenness index, H' is diversity index for a species, S is a total number of species found in the plot

3. Results and Discussion

3.1. Performance of C. arborescens and C. rotundatus in pole growth level

Vegetation diversity and vegetation analysis results for tree growth level for two species are presented in the following table.

Table 1: Species and values of IVI, H', R1 dan E for tree growth level

Location	Species	Local Name	NS	NI	IVI	H1	R1	E
A-1	*C. arborescens*	Geronggang	2	1	21,4	0,01	0,87	0,04
A-2	*C. rotundatus*	Tumih	2	13	278,6	0,08	0,87	0,26
B-1	*C. arborescens*	Geronggang	2	5	58,7	0,15	0,74	0,49
B-2	*C. rotundatus*	Tumih	2	17	241,3	0,09	0,74	0,29
C-1	*C. arborescens*	Geronggang	2	2	25,3	0,12	1,13	0,40
C-2	*C. rotundatus*	Tumih	2	12	274,7	0,06	1,13	0,19
D-1	*C. arborescens*	Geronggang	2	13	53,2	0,14	0,56	0,48
D-2	*C. rotundatus*	Tumih	2	12	246,8	0,18	0,56	0,28
E-1	*C. arborescens*	Geronggang	1	0	0	0	0	0
E-2	*C. rotundatus*	Tumih	1	13	300	0	0	0

A-B-C-D-E = plot locations (Tuanan, Mangkutup, Katunjung, Sungai Mantangai and Mantangai Hulu)
NS = number of species found on the plot
NI = Number of Individual
IVI = Important Value Index
H = Shannon Index of Diversity
R1 = Richness Index
E = Evenness Index

The research is located on the Protected Forest Managemen Unit of Kapuas Kahayan, especially in the area that burned with the heaviest damage in 2006. The observation plots size is 1 hectare containing 25 sub-plots which are placed in 5 different locations, namely in Tuanan (A), Tumbang Mangkutup (B), Katunjung (C), Sungai Mantangai D, and Mantangai Hulu (E). Observation plots are placed in areas where hydrological restoration (canal blocking) has been carried out without any human-assisted revegetation.

Observations at tree stages with a diameter of 20 cm up also showed fire-resistant species or survived the 2006 big fires. Of the eight most common species, only *C. arborescens and C. rotundatus* were found in this burned area. *C. arborescens* is found in 4 of 5 total plots, while *C. rotundatus* is found in all fields. Thus, it can be seen that *C. arborescens* and *C. rotundatus* are fire-resistant species.

Forest fires are indeed one of the leading causes of species loss in peat swamp forests. In general, the species of trees that survive after the fire is *C. rotundatus* or Tumih in the local language. This species has a much higher number of individuals than *C. arborescens*. However, the total number of trees in a one-hectare plot is minimal and far from a recovering forest. Peat swamp forests are also rich in species diversity in primary forest conditions; for example, in Sebangau National Park, with the same type of ecosystem as the research locations, 133 species consisting of 34 families have been found.

This species dominates the tree species that survived severe fires with an IVI value ranging from 141.4 to 300, a maximum of 300. It appears that *C. rotundatus* is a fire-resistant tree species that grows in damp

areas all year round. The community has never chosen this species as a species planted for peat ecosystem restoration. It is not a commercial species, low-quality wood, non-cylindrical wood shape, and is not a food-producing species for humans and wildlife.

Most of the ecosystem is dominated by various species of ferns and shrubs. The diversity index of these species ranges from 0.01 to 0.18. This range can be categorized as a shallow species richness index (H') and indicates that the area has a tiny number of species and a tiny number of individuals. This low richness index suggests that a few species survive after a forest fire in the peat swamp forest. These species were found next to the edge of small rivers and canals, indicating their roots in wet soil during the forest fire. From this H index indicator, it can be seen that forest fires in 2006 have eliminated almost all species where only two species remain.

Based on the richness index (R1), the values of R1 in locations A, B, C, D, and E are lower than 3.5, indicating species richness is also very low. This value means that the ecosystem has small numbers of species, and each species has a small number of individuals. Thus, the two surviving species in the degraded area after the fire are still inadequate for natural regeneration with a limited number of each species; however, these species are essential for producing seed for natural regeneration (see. Figure 3)

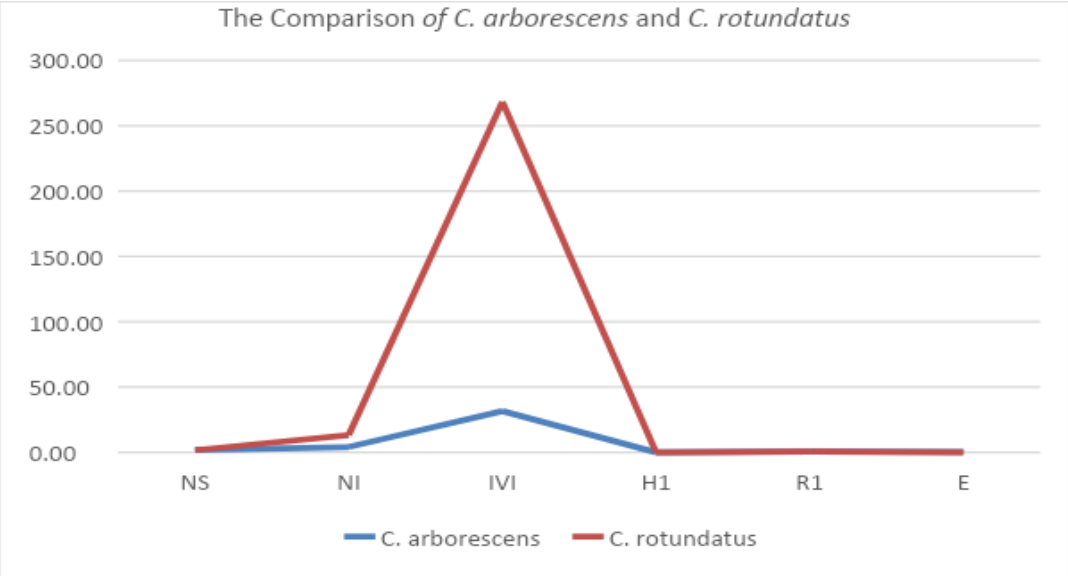

Figure 3. The Comparison of *C. arborescens* and C. *rotundatus* in tree level

Meanwhile, based on the evenness index (E), *C. arborescens* has a medium evenness index in 3 locations and a low evenness index in 2 areas. While for *C. rotundatus*, it was found that this species has a low evenness index at all locations. These common indexes mean that *C. rotundatus* tend to be more evenly distributed in all observation locations than *C. arborescens*, primarily concentrated in certain places. The evenness index describes how a species is dispersed in all the subplots in the observation plot. This low value indicates that the two species tend to be close in certain sub-plots and not in other sub-plots. Both species also tend to be found in inundated areas throughout the year or near canals/rivers.

Peat swamp forest in natural conditions that are not degrading is a unique forest area with high biodiversity. Previous studies have shown that forest and land fires cause degradation and deforestation because fire can wipe out various species. Still, forest fires that have occurred repeatedly since 1997 have a significant impact on biodiversity flora and leave many degraded regions. The number of trees recorded in the plot's observations shows the more fire-resistant species after forest and land fires. It was seen that only two species *C. arborescens* and *C. rotundatus*, can survive. Forest fires in 2006 showed that fires were the most destructive cause of degradation and deforestation in peat swamp forests, especially from the perspective of vegetation biodiversity. Vegetation does not always return naturally and reduces the chance of natural regeneration (Könönen et al., 2016). Forest fires also remove seeds that fall and are stored on the forest floor. It is a matter that must be considered in ecosystem restoration because usually, peat swamp forest burns to make the damaged area very large and far from parts of the forest. Forests

that contain seed-producing trees become an obstacle in the distribution of seeds for natural regeneration.

The tiny number of species and the tiny number of individuals indicate that the fires in 2006 were very severe. Forest fires, especially repeated forest fires, have long been a barrier to natural regeneration and revegetation. The previous study in degraded but unburned areas of peatlands in Sumatra also showed the loss of many species

3.2 Performance of C. arborescens and C. rotundatus in pole growth level

The vegetation analysis results for two species at pole growth level can be found in the following table.

Table 2: Species and values of IVI, H', R1 dan E for poles growth level

Location	Species	Local Name	NS	NI	IVI	H1	R1	E
A-1	*C. arborescens*	Geronggang	7	776	16,83	0,16	22,6	0,19
A-2	*C. rotundatus*	Tumih	7	728	117,84	0,16	2,26	0,19
B-1	*C. arborescens*	Geronggang	8	760	137,2	0,16	1,91	0,20
B-2	*C. rotundatus*	Tumih	8	600	99,8	0,16	1,91	0,21
C-1	*C. arborescens*	Geronggang	7	776	101,24	0,16	6,63	0,19
C-2	*C. rotundatus*	Tumih	7	728	98,66	0,16	6,63	0,19
D-1	*C. arborescens*	Geronggang	7	624	111,1	0,16	2,29	0,19
D-2	*C. rotundatus*	Tumih	7	668	118,8	0,16	2,29	0,19
E-1	*C. arborescens*	Geronggang	7	776	118,8	0,16	1,50	0,23
E-2	*C. rotundatus*	Tumih	7	728	114,0	0,16	1,50	0,23

A-B-C-D-E = plot locations (Tuanan, Mangkutup, Katunjung, Sungai Mantangai and Mantangai Hulu)
NS = number of species found on the plot
NI = Number of Individual
IVI = Important Value Index
H = Shannon Index of Diversity
R1 = Richness Index
E = Evenness Index

The pole growth level is a growth stage of woody species whose diameter is 10 cm to less than 20 cm. This growth level is well known as the "young tree." For this research location, pole growth level is essential because it shows the success of natural regeneration just after forest fires in 2006 as the species grow immediately after fires.

Seven species have been found in locations A, C, D, and E, while eight species have been recorded in Location B. This number of species shows that although the study locations are in various areas and separated, the vegetation condition after forest and forest fires has similarities in terms of species composition. For example, both species *C. arborescens* and *C. rotundatus* were found in all observation plots at all locations. These two species that appeared in all areas indicated the most common species growing naturally in peat swamp forests after the fire.

Vegetation conditions at the growth level of poles or young trees with a diameter of less than 20 cm indicate the success of natural regeneration after a fire. Therefore, in terms of diameter, it can be seen that this species is a species that grows right after the occurrence of forest and land fires.

Based on IVI (see Figure 4), *C. arborescens* or Geronggang has a slightly higher IVI than *C. rotundatus* or Tumih species, but the difference is tiny and insignificant. *C. arborescens* has an average IVI of 116.93% out of 300 from the 5 locations, while *C. rotundatus* or Tumih has an average IVI of 109.82 out of 300. Thus, these two species have an IVI of around 100 out of 300 or dominate 1/3 of the total species. If the

values of these two species are combined, it can be seen that both species dominate the entire vegetation in the ecosystem.

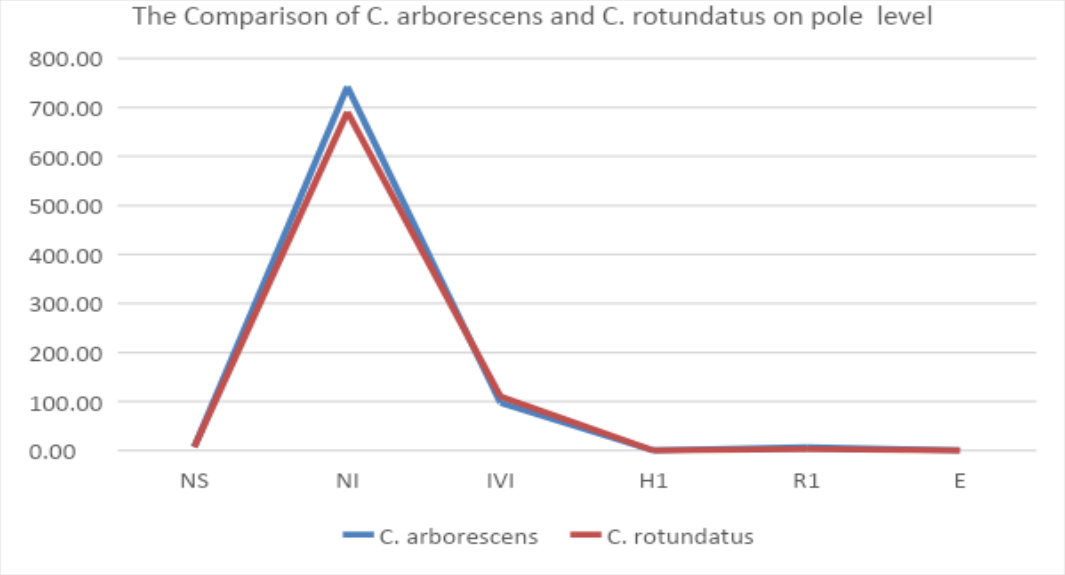

Figure 4. The comparison of *C. arborescens* and *C. rotundatus* on pole level

The IV value of these two species, which can be seen in Figure 4 at the pole stage, shows good performance as a reliable species in post-fire natural regeneration. These two species arise because few trees of these two species survive fires to produce seeds and grow. Therefore, the existence of trees as a source of seeds is vital for natural regeneration.

C. arborescens or Geronggang shows a reasonably good growth ability as a species of natural regeneration. This species usually has seeds spread by various animals such as birds; they can be found in measuring plots but have a low E index. In addition, these species tend to grow in clusters at specific fields, not evenly distributed.

Species richness index can be used as an indicator for a species performance in natural regeneration. Species richness indicates whether a species has a large enough number in the ecosystem. The observation and vegetation analysis results show that the species richness index (H') value is found between 0.01-0.16. This range of numbers indicates that all species in all locations have a low species diversity. The low species diversity index means that although they dominate in number, these two species still show a common species diversity index. This result is related to the unique condition of peat swamp forest, which has many barriers such as the fluctuation of the water table, high temperature, the scarcity of seed source, and the loss of soil seed bank because of forest fire for natural regeneration. This low diversity index of these two species can prove that natural regeneration needs a long time to be restored.

Based on the value of species richness (R1), it is found that in location A, B, D, and E, with a value of (1.5-2.9), species richness are very low to low, but in location C or Katunjung, the species richness is 6.61 or high. At locations A.B, D, and E, it can be seen that all species have small numbers, while at location C or Katunjung, it is otherwise. The low richness index proves that natural regeneration in this area had not restored species richness as a peat swamp forest ecosystem before it was burned.

Based on the species evenness index with a value of 0.01-0.19, all species in all conditions at A, B, C, D have a common species evenness index, meaning that these species tend to be unevenly distributed and concentrated in certain areas. Based on the vegetation analysis result, it can be seen that the two species *C. arborescens* and *C. rotundatus* can be relied on for natural regeneration with human assistance or hydrological restoration can be carried out at first. However, although both species show an encouraging performance, in terms of the biodiversity of the ecosystem vegetation, these two species are too dominant, so that the diversity value is low.

It should be underlined that the two species *C. arborescens* and *C. rotundatus*, have shallow evenness index values, meaning that these two species tend to cluster in one place and are not evenly distributed.

C. arborescens tends to have a high density in certain areas, while *C. rotundatus* is usually concentrated in wet places throughout the year.

Based on the number of individuals in one hectare, these two species can be relied on by comparing the success of revegetation according to the Ministry of Environment and Forestry, which requires a minimum of 500 woody plants per hectare for natural regeneration. However, the main prerequisite must be rewetting activities (canal blocking) to improve the hydrological conditions of the peat soil. In terms of species richness, both species were not successful in enhancing species richness in the ecosystem. Thus, natural regeneration with these two species remains reliable in natural revegetation.

The study plot, which is filled with ferns and some species, can be seen in Figure 5 below :

Figure 5. C. arborescens at pole growth level in degraded peat-swamp forest post fires

We also compared the two species in the ecosystem at pole growth level to make comparison easier between two species and the other species in the same Table 3:

Table 3. IVI of Species at Pole growth level in 5 location A, B, C, D, and E

Species	A	B	C	D	E	Total	Avarage
Shorea balangeran Burck	0	1,4	0	1,5	0	2,9	0,58
C. arborescens	**116,83**	**137,2**	**101,24**	**111,1**	**118,3**	**584,67**	**116,93**
C. rotundatus	**117,84**	**99,8**	**98,66**	**118,8**	**114**	**549,1**	**109,82**
Macaranga hypoleuca	42,14	39,4	58,13	52	44,4	236,07	47,214
Shorea oligunosa Foxw	1,41	1,4	2,6	1,5	1,4	8,31	1,662
*Stemonurus scorpiode*s Becc.	1,41	1,4	2,6	0	1,4	6,81	1,362
Dyera polyphylla Steenis	1,63	3,4	2,81	1,7	1,6	11,14	2,228
Alstonia scholaris	18,75	16	33,96	13,5	18,8	101,01	20,202
Total	300	300	300	300			

3.3. Performance of C. arborescens and C. rotundatus in Sapling growth level

The Vegetation diversity and vegetation analysis results at the sapling growth level can be found in the following table.

Table 4: Species and values of IVI, H', R1 dan E for Sapling growth level

Location	Species	Local Name	NS	NI	IVI	H1	R1	E
A-1	*C. arborescens*	Geronggang	8	1664	48,3	0,15	2,71	0,17
Location	Species	Local Name	NS	NI	IVI	H1	R1	E
A-2	*C. rotundatus*	Tumih	8	2000	53,8	0,16	2,71	0,18
B-1	*C. arborescens*	Geronggang	5	1888	66,5	0,16	1,60	0,23
B-2	*C. rotundatus*	Tumih	5	2096	70,7	0,16	1,60	0,23
C-1	*C. arborescens*	Geronggang	7	2144	65,3	0,16	6,61	0,19
C-2	*C. rotundatus*	Tumih	7	2032	63,4	0,16	6,61	0,19
D-1	*C. arborescens*	Geronggang	5	2192	61,2	0,16	1,53	0,23
D-2	*C. rotundatus*	Tumih	5	2160	60,7	0,16	1,53	0,23
E-1	*C. arborescens*	Geronggang	5	128	11,3	0,16	1,91	0,23
E-2	*C. rotundatus*	Tumih	5	768	68,8	0,15	1,91	0,23

A-B-C-D-E = plot locations (Tuanan, Mangkutup, Katunjung, Sungai Mantangai and Mantangai Hulu)
NS = number of species found on the plot
NI = Number of Individual
IVI = Important Value Index
H = Shannon Index of Diversity
R1 = Richness Index
E = Evenness Index

Subsequent observations were conducted at the sapling growth level. Sapling is a growth level for the woody species with a height of more than 150 cm to a tree with a trunk diameter of less than 10 cm. The sapling stage in locations A, B, C, D, and D relies on natural regeneration. The species found in location A are eight species, while the lower number of species, seven, are found in location C. The B, D, and E locations have five species. However, the two species *C. arborescens* and *C. rotundatus* were found as the two highest individuals comparing the other species. Both species have more than 100 individuals, but there is an anomaly at location E where all species, including these two species, are very few.

Based on the IVI value, *C. rotundatus* seemed to dominate all locations with an IVI value of 53.8-70.7. Therefore, the second rank was filled by *C. arborescens* except at location E, where *Macaranga hypoleuca* has more individuals. The comparison between the two species is presented in Figure 6.

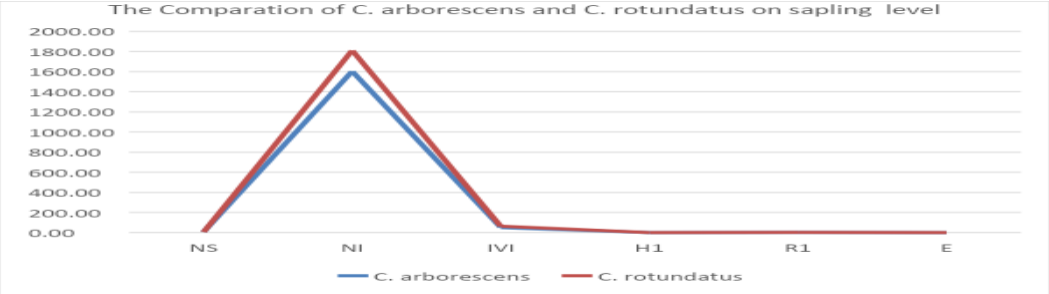

Figure 6. The Comparison of *C. arborescens* and *C. rotundatus* on sapling level

The diversity index value at the sampling stage ranged from 0.01 to 0.16. It can be seen that all species in all locations show low species diversity, meaning that only a few species are found in those areas. Even though the number of individuals from each species was quite large, the diversity index is still low. Low species diversity means that the high number of individuals does not reflect the species richness. On another aspect, the two species, *C. rotundatus,* and *C. arborescens* showed good regeneration ability on burnt areas but could not produce high species richness.

Another indicator that can be used to see the performance of various species on natural regeneration after heavy fires is the richness index. Observations found that species richness is low in locations A, B, D, and E (0. 53-2.71), but in C or Katunjung, the species richness is high (6, 61). A low richness index means that, in general, the majority of the ecosystems assessed show typical species richness. However, areas with high species richness, namely location C, located close to primary forest, estimated that this location are assumed to receive seeds from wind, water flow, or animals from nearby trees.

Species performance can also be assessed from the evenness index value; how often a species appears in each measurement plot. The results of observations at the sapling level show that the evenness indexes of all saplings and all locations are low (0.01-0.23). A low evenness index indicates that these species tend to be unevenly distributed and clustered a lot in specific measuring plots. The Low evenness index means that several species, including two species that focus on observation, tend to be concentrated in one place only.

3.4. Performance of C. arborescens and C. rotundatus in seedling growth

The vegetation diversity and vegetation analysis results at seedling growth level can be found in the following table.

Table 5: Species and values of IVI, H', R1 dan E for seedling growth level

Location	Species	Local Name	NS	NI	IVI	H1	R1	E
A-1	*C. arborescens*	Geronggang	14	4700	15,6	0,05	4,39	0,04
A-2	*C. rotundatus*	Tumih	14	4200	15,1	0,05	4,39	0.04
B-1	*C. arborescens*	Geronggang	14	4400	15,4	0,06	4,40	0,06
B-2	*C. rotundatus*	Tumih	14	5000	17,6	0,07	4,40	0,06
C-1	*C. arborescens*	Geronggang	16	4400	20,2	0,08	15,64	0,01
C-2	*C. rotundatus*	Tumih	16	2300	14,1	0,05	15,64	0,07
D-1	*C. arborescens*	Geronggang	16	3500	15,1	0,06	5,20	0,05
D-2	*C. rotundatus*	Tumih	16	4200	16,6	0,07	5,20	0,06
E-1	*C. arborescens*	Geronggang	8	2200	30,7	0,06	2,26	0,08
E-2	*C. rotundatus*	Tumih	8	1100	14,5	0,04	2,26	0,05

A-B-C-D-E = plot locations (Tuanan, Mangkutup, Katunjung, Sungai Mantangai and Mantangai Hulu)
NS = number of species found on the plot
NI = Number of Individual
IVI = Important Value Index
H = Shannon Index of Diversity
R1 = Richness Index
E = Evenness Index

We counted very woody flora less than 150 cm tall in this growth level, including all ferns and understorey species. Based on the number of species and the number of individuals, it can be seen that ferns are very dominant and invasive species in the burned areas post fires in tropical peat swamp forest in Central Kalimantan.

Three species of ferns dominated the area, *G. linearis*, *N. biserrate*, and *S. palustris*. *G. linearis* usually grows in the rarely flooded part and *N. biserrate* usually grows in wet and sometimes inundated areas. In contrast, *S. palustris* grows in the wet areas only.

On the other hand, according to Dohong et al (2017)., various dominant fern species threaten the successful restoration of vegetation. It is one of the main biological obstacles in the natural succession process of degraded ecosystems (Dohong et al., 2018). This study reinforces previous studies in peat swamp forests of Central Kalimantan and Sumatra, which found that ferns are the species that block woody plant species for natural regeneration due to competition for sunlight and nutrients (Blackham et al., 2014; van Eijk & Leenman, 2004). Based on IVI, it can be seen that these three species of ferns are too dominant over other types of ferns and shrubs, including seedlings of woody plant species.

The existence of ferns is very dominant because of the ability of the fern species to use N and P efficiently. This ability supports the rapid growth of ferns in N and P soils in the early stages of succession (Zhaojun et al., 2011). However, ferns are more likely to dry and flammable species in the dry season, thereby increasing the potential for repeated fires at the site. Once a fire occurs, natural regeneration will return to zero, and ecosystem restoration will become even more difficult. The high number of fern species is a significant challenge when planting and natural regeneration. The massive ferns make the tree seedlings hardly receive enough amount of nutrients and sunlight.

There are only three species with many seedlings for woody plants: *C. arborescens, C. rotundatus*, and *Macaranga hypoleuca*. These three species were found in all observation sites with small numbers compared to the number of ferns but constituted the top 3 of the number of woody plants. Based on IVI, these three species have values equal to and less than 20 out of a total of 200. However, this finding confirms that the two main species, namely *C. arborescens* and *Combrecarpus rotundatus*, grow together with pioneer ferns and can be used for natural regeneration. Furthermore, from the location, it can be seen that most of these woody species also develop around the primary forests. Still, regrowth species are dominated by a few abundant wind-dispersed species (particularly *Combretocarpus rotundatus*), and most other species were potentially dispersed by bulbuls (Pycnonotidae) and other small- to medium-sized birds (Blackham et al., 2014). However, species such as *Dyera polyphylla* have very light seeds and are spread by the wind, with low seedlings. This is possible because the areas studied are areas far from the natural forest where trees produce seeds. Therefore, distance and seed sources significantly affect the number of species that grow in degraded areas in the natural regeneration processes (Chazdon & Uriarte, 2016; Lestari et al., 2021; Wijedasa et al., 2020).

C. arborescens is a tree species (woody species) with the highest number of seedlings in all locations and has a higher IVI than all other species. This similar condition is also found at different levels of growth. These species also tend to be pioneers for natural regeneration (see fig 7.)

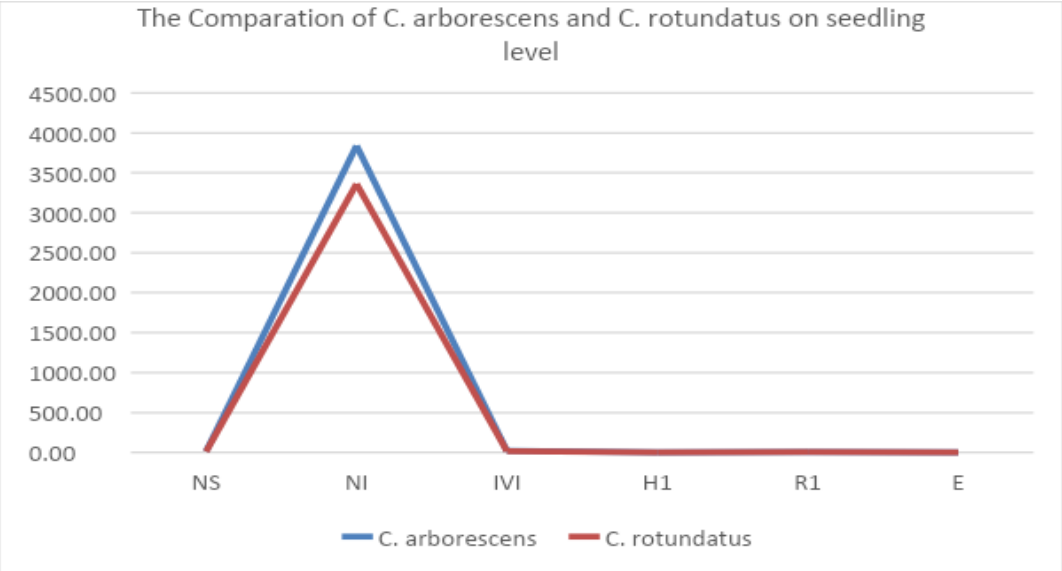

Figure 7. The Comparison of C. arborescens and C. rotundatus on seedling level

In addition to the number of individuals, *G.linearis, N. biserrate*, and *S.palustris* are the three dominant species with a much higher IVI than other species. At the same time, *C. arborescens* or Geronggang is a tree species having the highest IVI value than other tree woody seedlings.

Species performance at the seedling level can be seen from the richness of the species (see table 5). The calculations and vegetation analysis results show that the species richness index (H') in all location species ranges from 0.01 to 0.29. A low diversity index means that the species found are limited. This value proves that although many species were found, none of the species showed high species richness.

Based on the richness index of Magurran (2004) criteria, the value of R1 <3.5 indicates low species richness, R1 = 3.5 - 5.0 reveals moderate species richness, and species richness is high if it is> 5.0. Observations and vegetation analysis of 5 observation locations showed different results. Locations A, B, and E are three observation locations with a low wealth index. The number of species and the number of individuals of each species cannot make the ecosystem highly diverse. Surprisingly, a high species richness index was found at location D, which is located far in the middle of the region with a wealth index value of 5.20, which means that the number of species at this location is diverse numerous. At location D, which is next to the central-primary canal, it can be seen that the richness index is very high (15.64). However, this value is not the only indicator for richness because the ferns are vibrant and diverse.

The performance of species can be assessed from the evenness of these species growing in an ecosystem. The calculation results show that the species' evenness index value ranges from 0.01-0.25, indicating the evenness species is high: all species in all conditions show low evenness, meaning that these species tend to cluster in a few places. The lower the evenness index, the more unevenly a species is distributed in the ecosystem. Observations show that many species are very clearly concentrated in certain places**.**

Because ferns were very dominant in the early years of degraded land after the fire, revegetation or planting activities required maintenance by cleaning the planted area from ferns. However, if natural regeneration is not carried out without planting, cleaning activities would not be needed. Still, it would be essential to prevent repeated forest fires because ferns in the dry season are the massive and dangerous fuels for forest fire in peatlands.

Conclusions

C. rotundatus were found at all observation locations from five different and far apart locations, while *C. arborescens* at 4 locations except at location E (Sungai Mantangai) at the tree growth level. These areas were all badly burned, and either canal damming or hydrological restoration was carried out afterward. In general, these two species filled the tree level in the area degraded by forest fires in 2006. Indexes of species diversity, richness, and evenness also show insufficient individuals, meaning that these two species survived the 2006 fires.

C. rotundatus was the dominant species at tree and sapling growth levels with better performance than *C. arborescens* based on the number of survived and existing individuals. At the same time, *C. arborescens* has a better performance than *C. rotundatus,* with a slight difference in dominance at pole level growth and seedling level growth. However, Both species have a low diversity index and a low evenness index in an ecosystem with a low richness index. Still, there are differences in location C (Katunjung) with a high species richness index. The Low diversity index means that this species is individually abundant but is not evenly distributed with high density in certain places.

Based on the minimum number of individuals, both species are successful and suitable for natural regeneration post forest firest in peat swamp forest as long as the area is rewetted by hydrological restoration (canal blockings). Therefore, natural generation by these species is one option that can be selected for vegetation restoration, especially for the remote areas that need high cost. In general, *C. arborescens* has a bit better performance than *C. rotundatus* in degraded peatland post fires.

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Research Paper

Assessment of Knowledge, Attitude and Practices towards Gender Equality in Achieving SDG5

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ABSTRACT

This research was conducted to determine the awareness level of the students' at the University of Malaya (UM) towards gender equality in achieving SDG5. A set of survey questionnaire established on Knowledge, Attitude, and Practices (KAP) was distributed through an online Google survey form to all UM students', and 123 responses were collected to evaluate the awareness level (95% confidence interval with ± 5% margin of error). Data analysis was conducted through SPSS software. The results revealed that the respondents have a higher knowledge level with lower attitude and practices levels. Spearman's Rho coefficient correlation was used to evaluate the relationship level within variables (between knowledge and practices and attitude and practices). The results reported a weak positive correlation within knowledge and practice levels (r= .275, N= 123, p= .00) and a very strong positive correlation within attitude and practice levels (r= .789, N= 123, p= .00).

Keywords: gender equality, SDG5, women empowerment, university, students.

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1. Introduction

Gender equality is a position wherein the gender of a person will not decide their chances, possibilities, freedoms, and significance in life. Gender equality promotes gender balance where opportunities, allocated duties, assets, decision-making power are equally distributed between men and women. According to the United Nations Entity for Gender Equality and the Empowerment of Women [UN Women] (2019), "There is no nation wherein women have equivalent or higher level of freedoms, opportunities and assets than men." Only a few countries have made improvements towards gender equality. Additionally, challenges for being a woman, being of a different race, class and ability makes it more difficult for women to achieve equal treatment.

In September 2015, the 2030 Agenda for Sustainable Development Goals (SDGs) were accepted officially by the United Nations (UN) Sustainable Development Summit. According to the United Nations General Assembly, the SDGs are an assortment of 17 goals intended to be a diagram to accomplish a superior and more sustainable future for everyone. Achieving gender equality in our society is essential for propelling human advancement, the 'Sustainable Development Goal 5: Gender Equality.' The main objective of this goal is to "achieve gender equality and empower all women and girls." According to United Nations (UN), the advancement of gender equality is critical to all spheres of a civilized society, from lessening poverty to advancing the education, protection, health, prosperity and wellbeing of young boys and girls. This study focuses on the awareness level of university students regarding the global goal, which stands for "gender equality and empowering all women and girls." Results of the study are expected to contribute to raising awareness based on knowledge, attitude, and practices among university students' towards gender equality in achieving SDG5.

1.1 Background of the Study

Gender equality signifies that the interests, requirements, and needs of both men and women are being considered, perceiving the diversified communities and that all individuals are allowed to establish their own talents and settle on decisions without the restrictions set by the society based on their respective gender. In this paper, the theory of gender equality is specified as both men and women having equal privileges, obligations, and opportunities for accomplishments.

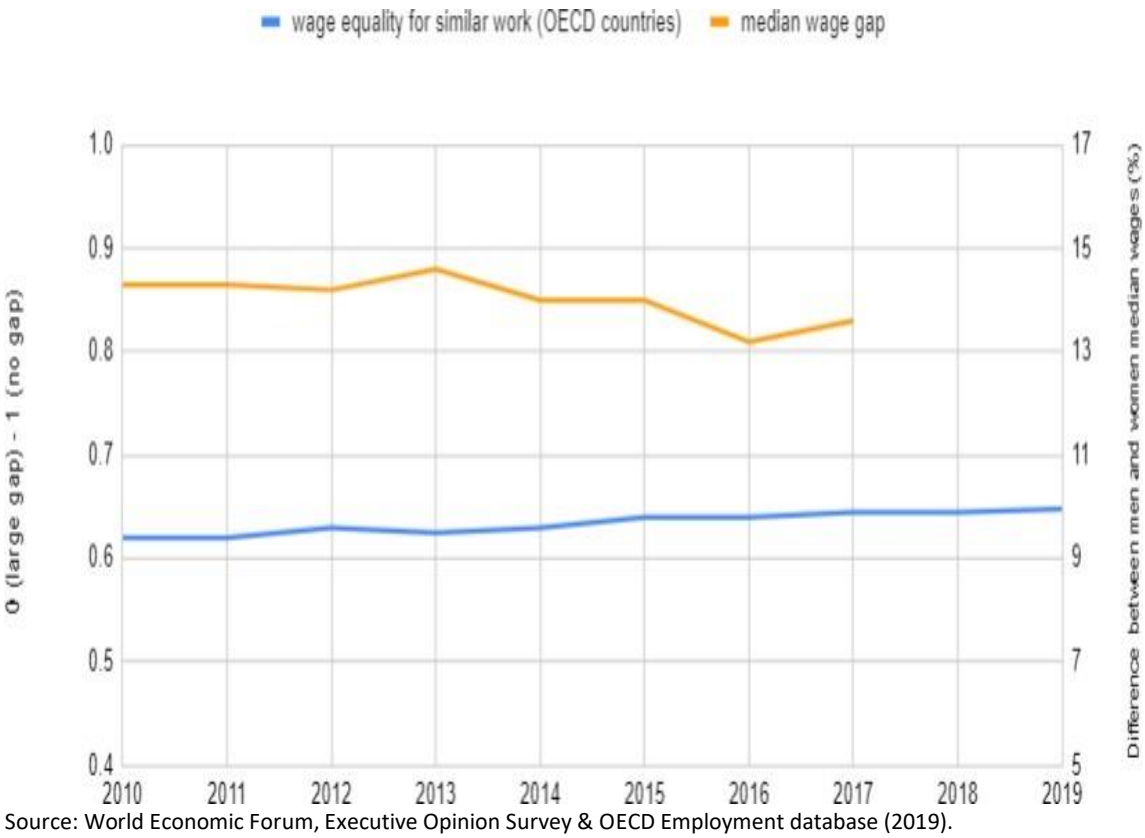
The study "Framed by gender: How gender inequality persists in the modern world?" by Ridgeway (2011) states, "The perception for gender inequality emerges from reading different social science literature, including economics. It establishes as hierarchical gender relations, with men above women, and women being objectified as inferior and less important exclusively based on their gender." Women are subjected to violence, gender discrimination, exploitation, domestic violence, unequal division of unpaid care, and unequal pay scale among men and women (Williams, 2017). Dasli & Saricoban (2016) stated that gender inequality is persisting globally, denying women and girls fundamental rights and possibilities. Studies show that every one out of five females aged 15 to 49 is subjected to violence, be it domestic or work-related, sexual harassment in public and workplaces. There are 49 countries that do not hold laws protecting women from sexual abuse and harassment. (Hook, 2010).

SDG5 aims to achieve gender equality and empower all girls and women. The primary target of this specific goal is to "end all structures of discrimination and violence against all women and girls." While this is creditable, there is no global overview of data on legal frameworks that end discrimination based on gender. So, there are no specific ways to define the progress of reaching this target. About 53 out of 231 SDG indicators refer to women, girls, and gender. UN Women found no globally established theories or techniques for 23 out of these 53 gender-related indicators. Gender inequality continues worldwide, depriving girls and women of their fundamental rights and possibilities. Still, in recent days, one in every three young girls has encountered female genital mutilation (FGM), and one out of five young girls are forced to get married while they are still kids. One out of four young girls aged 15 -19 years is neither educated, employed, nor trained compared to one out of ten young boys. Furthermore, young girls account for three out of four HIV infections among teenagers aged 10-19 years in developing countries. About four out of ten young girls are beaten by their husbands per year globally, and about 35% of women aged between 15-49 years have experienced physical and sexual brutality worldwide.

Gender equality is a fundamental human need, and at the same time, it is crucial to achieving global sustainable development. It is a pre-condition for poverty reduction and development advancement. Likewise, accomplishing gender equality is critical for global sustainable development. Among all spheres of social aspects, the jobs of men and women are socially formulated. However, in everyday lives, gender

inequalities obstruct the advancement of women in every sphere of their life. Women have been only an epitome of the family for decades, and they were tortured and ignored in most parts of the world and still are. Gender inequality represents the absence of women's empowerment in society and the mindset of people, which is a huge barrier to sustainable development. Education about gender equality and neutrality is crucial for the youth if a country wants to achieve sustainable development (Arora-Jonsson et al., 2019). This can be only be achieved if women do not suffer from discrimination and achieve opportunities. Approximately 1.4 billion girls and women are victims of inequality, violence, discrimination, and sexism, even if many governments claim to have taken action (Sen, 2019).

Figure 1 illustrates that the average wage gap in OECD (The Organization for Economic Co-operation and Development) nations are shutting yet at an extremely slower rate. A decade ago, it was 14.5% and currently is at 13.5%. Furthermore, it has diminished by only 1 percentage point in 10 years. This order is steady with Executive Survey trends, which found out that in OECD nations, the equal wage for comparable work has expanded by around 2 percentage points in 10 years. Gender parity is a factual measure that analyzes a specific indicator among women i.e. average pay, to a similar indicator among men. World Economic Forum (2019) stated that it would take about an additional 100 years (99.5 years to be exact) to achieve global gender parity. Moreover, about 10% of young girls globally aged between 15–24 years are uneducated. Focusing on illiteracy matter, the report depicts underdeveloped and developing nations where the educational enrollment of girls and women across the educational board is very low. Along the way, this has a critical impact on women's economic participation and opportunities.



Source: World Economic Forum, Executive Opinion Survey & OECD Employment database (2019).

Figure 1: Wage gap between men and women, OECD countries (2010-2019)

Compared to the previous Millennium Development Goals (MDGs), the present Sustainable Development Goals (SDGs) are more determined in opportunities and focus on global coverage. Millennium Development Goal-3 especially targeted on "promoting gender equality and empowering women." Numerous aspects of the targeted goals required further efforts. The SDGs eventually succeeded the MDGs and guided the worldwide way of sustainable development after 2015. The SDGs

were outlined to re-establish the MDGs as the global goals to handle social, political, financial, and environmental issues faced by people worldwide.

SDG5 is primarily centered on " achieving gender equality and empowering all women and girls." Rather than the hierarchical approaches of the MDGs, SDG5 focuses on securing more voices of women within the process of addressing gender-related issues. New perspectives like negligence of women's values, sexual and reproductive rights, sexual assaults, and domestic violence were brought to the limelight. Their focus was to end poverty, transform all lives, and protect the planet. The SDGs are a striving step to bring the view of sustainability upon the people in places that have never been achieved before, yet implementation of the changes among the people is a major concern.

Women empowerment is the first step to gender equality in achieving SDG5. Empowerment of women means giving them marital, cultural, and educational means that they can make their own decisions taking control of the fact that they have their own life. According to Gupta et al. (2019), the only way to achieve women empowerment is by reducing poverty, crisis prevention and recovery, democratic governance, and sustainable and environmental development. Women have an actual voice in all the institutions of governance, from civil service to the judiciary and even from the private sector to civil society (Subašić et al., 2018). Women can participate with men in public speaking and decision-making activities and influence others in society to speak up too. They are making societal changes that will determine the future of their nations and families (Vyas-Doorgapersad, 2018).

Empowerment also refers to empowering women politically, socially, and economically to achieve sustainable development goals. Women's economic empowerment is the equal distribution in the employment sector, administrative, and organizational between men and women and relative distribution in income and wages of women compared to men (Kitada & Bhirugnath- Bhookhun, 2019). Social empowerment indicates women and girls and their health aspects. It also includes the government proposals on women and girls' mental and physical health. According to Darmstadt et al., (2019), educational empowerment relates to mitigating unequal educational systems in any institution and government providing scholarships to girls and women. Economic empowerment has strengthened women to have a better livelihood without depending on the male gender and reduced the percentage of domestic abuse and violence on women by partners or non-partners (UN Women, 2019).

Figure 2 shows that UN Sustainable Development Goal-5 has nine targets and fourteen indicators. Every target and indicator of SDG5 tries to pursue the primary objective of genuine and sustainable gender equity among all parts of women's and girls' lives. The targets include eliminating gender discrimination, eradicating forced marriages, honor killings, sexual assaults, and domestic violence against women and girls and guaranteeing women's equivalent opportunities for participation in leadership and global sexual and reproductive rights. In Malaysia, the journey to sustainable development has initiated since the 1970s, along with the introduction of New Economic Policy (NEP). The main focus of this policy is to obliterate poverty and modify the social structure in order to restructure social imbalance.

However, the Malaysian Plans have portrayed various governmental plans and initiatives to attain sustainable development, especially SDG-5 or gender equality. Achieving gender equality and SDG5, society requires to empower women, not particularly in the educational or political sector alone, but as a whole, it is empowering women in every aspect of society possible. Malaysia has multiple policies and rules regarding women empowerment, such as establishing Technical Working Groups and Interagency Planning Groups that address gender inequality, legislations, and regulations and implementing improvements for women and girls.

Malaysia was one of 43 countries that presented a Voluntary National Review (VNR) of its SDG progress at the session of 2017 of the High-Level Political Forum (HLPF) on Sustainable Development Goals. During the VNR presentation, Malaysia highlighted its formulation of a National SDG Roadmap to guide SDG implementation. Malaysia has built a prominent development towards gender equality and empowerment of women. In 2001, under the Federal Constitution, the Malaysian supreme law, Article 8(2), was modified to end gender discrimination." The main objective of this law was to bring about higher consistent and objective-centered projects to coordinate each woman in development and additionally to promote their position in the society.

Source: UN Sustainable Development Goal-5: Gender Equality.

Figure 2: UN SDG5 Specific Targets and Indicators

Malaysia had established numerous international accords, which manifests the country's commitment to guaranteeing the protection of women and girls' rights. The government of Malaysia has taken multiple policies for women empowerment, and studies have shown that every four out of nine women have a need for these policies working in an organization or institution (Montiel, 2018). "The Sexual Offences Against Children Act 2017" had been sanctioned additionally to shield children, especially to protect female children from any harmful practice. Thus, it is necessary to involve young people, especially young students of a country, to achieve the gender equality-related goals faster because they are the future leaders who are responsible for a sustainable planet. As the government considers, education is the first step to demolish gender inequality. Therefore, the government ensures that girls and women could have equal access to education (Akinsemolu, 2018).

The government of Malaysia has planned to gather timely data on the development and on the implemented plans in action to reduce inequality in the society (Kusakabe, 2017). However, though the government has faced various challenges related to this, Malaysia has recognized the concept of sustainable development and applied the concept within the vision, mission, plans, and other policies (Musa & Husin, 2018). The world is trying to achieve gender equality and women empowerment for sustainable growth in society; women and children are still suffering from discrimination, ignorance, and violence. Psaki et al., (2018) expressed that women are part of a society where one side is trying to empower them; the other is torturing and demeaning them. The Malaysian government focuses on demolishing institutionalized discrimination against women in the country (Franco et al., 2019). Additionally, they invest in women's welfare and other supports for women, therefore, helps them to achieve gender equality. It also restricts subtle practices like portraying women and young girls in media in a stereotypical manner that indicates gender inequality (Shinbrot et al., 2019).

According to Ilham et al. (2019), university campuses can be imagined as small towns, and it is possible to convert such spaces as habitats for the experimental enactment of a new social and technological paradigm that can work as a center point in managing sustainability. One example is the study of "Perceptions and attitudes towards sustainable development among Malaysian undergraduates"

by Balakrishnan et al. (2020). The Universiti Kebangsaan Malaysia (UKM) has several courses in the field of Sustainable Development for both bachelors and masters programs. The Universiti Putra Malaysia (UPM) has sustainable development studies for different programs. Moreover, the University of Malaya (UM) offers various sustainable development courses i.e. Gender Development, Sustainable Development Education, Green Economy and Sustainable Development, and Development Economics at the graduate and post-graduate levels. These initiatives by higher education institutions in Malaysia clearly show that these institutions have put effort into addressing issues and emphasizing the importance of gender inequality issues to the students. These kinds of activities and approaches will involve university students in practicing gender equality, while at the same time making them aware of its consequences.

Therefore, it is rational to focus on students' knowledge, attitude, and action towards gender equality. Knowledge is the insights of people about certain topics, such as SDG5 and gender equality. Attitude is what they feel, and practice can result from the feelings and what they tend to do about it. (Kaliyaperumal, 2004). Numerous Knowledge, Attitude, and Practice (KAP) studies have been conducted to identify the awareness level of individuals on sustainability and development, for instance, sustainable consumption among university students (Ahamad & Arifin, 2018); environmental knowledge, attitude, and practices of students and teachers (Esa, 2010); environmental awareness among secondary school students. According to Sybille (2011), these kinds of studies show not only characteristics of knowledge, attitude, and behaviors but also the perceptions of each person on the content. This can be considered as an educational diagnosis of a community (Kaliyaperumal, 2004). Hence, KAP studies offer a way to measure the awareness levels of certain communities in an effective manner (Ahmad et al., 2015).

1.2 Problem Statement

Gender equality is fundamentally connected to Sustainable Development and is critical for the recognition of basic human rights for all. The inclusive objective of gender equality is to develop a society in which women and men can appreciate equal opportunities, rights, and obligations in all aspects of life. Both women and men should also have equal knowledge about gender equality. Higher Educational Institutions are an important place for young adults, both male and female. They start to gather knowledge of the outside world and prepare to walk outside the workplace during that time. Therefore, university students need to have the proper definitive knowledge about gender equality in achieving SDG5.

In Malaysia, to stimulate the actions on the SDG5 within the next few years, significant commitments and contributions from all segments of society, especially from higher learning institutions, are mandatory. Universities not only hold a strong influence on society but also on industries and private sectors. In Malaysia, there are about 20 public universities and a number of private universities and colleges, which can be the medium of supports for the implementation of SDG5 and gender equality related studies through the formation and dissemination of knowledge, attitude, and practices through the way of research, teaching and learning, innovation, governance, and leadership. However, the number of public and private universities and colleges that can support the implementation is very few, impacting university students' knowledge, attitude, and practice towards gender equality and SDG5.

Next, the issues of gender equality are very critical and sensitive among young adults i.e. university students, both male, and female. Nevertheless, very few studies and research were done regarding this issue. Some studies can be found on Sustainable Development; however, the studies regarding SDG5, which particularly stands for "achieving gender equality and empowerment for all women and girls," are scarce. University of Malaya (UM) is the oldest public research university located in Kuala Lumpur, Malaysia, and currently aspires to achieve sustainability agenda.

Moreover, in 2019, UM ranked 34th in the UI Green Metric World University rankings. However, no specific research has been found on the awareness level of SDG5-Gender Equality among students of the University of Malaya (University of Malaya [UM], 2019a). Thus, this study attempts to provide information about the current position of young university students of the University of Malaya on the aspect of awareness (Knowledge, Attitude and Practices) on SDG5 and gender equality and intends to enlighten them about the 2030 agenda, which demands an urgent call for actions to ensure gender equality and empower all women and girls. Gender equality is a fundamental human right and a necessary foundation for a peaceful, prosperous, and sustainable world.

1.3 Research Objectives

1. To evaluate the level of knowledge among students towards gender equality in achieving SDG5.
2. To examine the attitude level of university students regarding gender equality and SDG5.
3. To identify the university students' practice level of gender equality in performing their activities.

1.4 Significance of the Study

Equality between men and women exists when both sexes can share equally in the distribution of power, opportunity, and influence. It is important to acknowledge that women and girls possess half of the world's total population and half of its development. Gender equality is a basic human right. If women and girls do not face gender equality, the world does not advance to crucial aspects such as a healthy society, clean water, poverty reduction, quality education, and wellbeing. When the world is examined through gender equality perspectives, the world would swiftly advanced towards modern civilization and be assured that girls and women will have equal possibilities like boys and men in every aspects of society.

However, there are still many steps to be taken as many obstacles for girls and women still continue. The SDG5 studies seek to learn how women and girls are discriminated against within societies and how to put an end to these. From ending violence and exploitation to women empowerment or securing their mental, physical and sexual wellbeing, there are various aspects to target if gender equality and empowerment for all women and girls to be achieved by 2030. Thus, universities need to focus on the knowledge, attitude, and action of young students towards gender equality.

The main importance of this study is to take a micro-step towards young university students, by making them aware of the SDG5, which stands for 'achieving gender equality and empowerment for all women and girls. Knowledge is the insights of people about certain topics, such as SDG5-gender equality. Attitude is then what they feel about gender equality and practice can result from their feelings, what they tend to do about it (Kaliyaperumal, 2004). The Knowledge, Attitude, and Practice (KAP) studies are conducted to identify the awareness level of individuals or students on numerous serious issues such as Sustainable Development Goals and gender equality.

1.5 Scope of the Study

The scope of the study has numerous remarks required to be highlighted. First and foremost, the primary objective of this study is to assess the knowledge, attitude, and practice (KAP) level among university students towards gender equality in achieving Sustainable Development Goal-5. Secondly, some research has been done on students' knowledge, attitude, and practice level towards the Sustainable Development Goals (SDGs). However, no research has been particularly done on students' knowledge, attitude, and practices towards SDG5. Thus, by conducting this study, the readers will have an overall idea of how much university students know about gender equality and SDG5, their actions and practices regarding this agenda.

In this study, an online google survey was conducted on all University of Malaya's degree level students (Diploma, Bachelors, Masters, and Ph.D.). Due to the recent Covid-19 pandemic, all students at the University of Malaya had been attending their classes online until further notice. Thus, coping with the Covid-19 situation, this study was only conducted online through a google survey. At first, the total number of enrolled students at the University of Malaya was being identified. After that, a minimum sample size (180 respondents) was set for the study. Then, the online google survey form was distributed through UM's official email system (siswa.um.edu.my) of UM. Later, keeping track of the number of respondents, the online google survey form was distributed through official social media (WhatsApp) groups of UM students of different study sessions, years, and faculties. Approximately three to four weeks were allocated for the respondents to fill up the google survey form.

After collecting data from the respondents (123 respondents), an item validity and reliability test (Cronbach's Alpha internal consistency method) was conducted. Then, the data analysis was being done using SPSS (Statistical Package for Social Sciences) method. The results bear the percentages of students' knowledge, attitude, and practices on SDG5. Lastly, the correlation between students' knowledge and practice, attitude and practice, and cross-tabulation were conducted. This study was inferential, the distribution of the google survey form will be random, and the respondents' information was kept private. In the scope of this study, it is highly hoped to spread awareness among university students towards gender equality in achieving Sustainable Development Goal 5.

2. Methodology

2.1 Sample Size

In this study, an online-based google survey was conducted to all students at the University of Malaya (Undergraduate, Postgraduate, and Ph.D. students). Firstly, the total number of enrolled students at the University of Malaya (UM) was identified and set as a targeted population (University of Malaya [UM], 2019b). Next, based on a simple formula in the study of Yamane (Israel, 1992), the minimum sample size (180 respondents) was set. A convenient sampling method was used to distribute the targeted 180 respondents. However, later on, 123 respondents were gathered at a 95% confidence level at ± 5% margin of error. At first, this study was determined to be conducted by both online and paper-based survey, but due to the recent Covid-19 pandemic, only the online-based google form survey was used. The online-based google form survey was distributed through the official email application system circulated to all students at the University of Malaya called SISWA Mail (siswa.um.edu.my). Moreover, the survey forms were also distributed throughout all official social media (WhatsApp) platform groups used by the students at the University of Malaya (UM). The study was inferential, random distribution, and confidential.

2.2 Item Development

Based on the previous research papers done by Omisore (2017), Ahamad & Arifin (2018), and Borges (2019), a Knowledge, Attitude, and Practice (KAP) questionnaire (with a 5-point Likert scale) was designed. The questionnaire consisted of five categories. Category A was about the demographic background of the respondents. Category B, C, and D consisted of knowledge, attitude, and practice among University of Malaya (UM) students regarding gender equality in achieving SDG5. Moreover, Category E consisted of respondents' opinions. The number of items was adjusted following the validity and reliability tests conducted.

2.3 Item Validity and Reliability

Table 1: Reliability Test

Variable	Item No.	Cronbach's Alpha
Knowledge	10	.750
Attitude	10	.716
Practice	10	.890
Total	30	.842

Amidst several reliability test techniques, Cronbach's alpha (internal consistency) method was chosen for the analysis. From the performed reliability tests, the variables of UM students' knowledge, attitude, and practices towards gender equality in achieving SGD5 had a fine internal consistency, and the Cronbach's Alpha Coefficient was recorded at 0.842. Moreover, the Cronbach's Alpha values of all variables were also recorded to display the fair internal consistency under the satisfaction level of reliability tests, as illustrated in Table 1.

2.4 Data Analysis Technique

The awareness level among UM students' was analyzed by applying a descriptive test using the Statistical Package for Social Sciences (SPSS) software. Spearman's Rho Correlation Coefficient was used for the inferential test to determine the correlations between variables (knowledge and practices & attitude and practices). The data set within knowledge and practice levels was evaluated by applying rank biserial correlation.

According to Chua (2013), the data set was nominal (knowledge variables) & ordinal (practice variables); thus, Spearman's correlation coefficient was applied instead. Moreover, Spearman's

correlation coefficient was applied to evaluate the connection between UM students' attitudes and practice levels (both ordinal data) (Chua, 2013). The correlations were significant at $p < 0.01$. The depiction of the r-value of Spearman's Rho Correlation (Dancey & Reidy, 2004) is presented in Table 2 to demonstrate the level of strength of the relationships among the variables.

Table 2: Interpretation of r value of Spearman's Rho Correlation

Spearman's Rho	Correlation
0.01 - 0.19	None or very weak relationship
0.20 - 0.29	Weak relationship
0.30 - 0.39	Moderate relationship
0.40 - 0.69	Strong relationship
≥ 0.70	Very strong relationship

*The descriptor applies for both positive and negative relationships.

3. Results and Discussion

3.1 Descriptive Analysis

3.1.1 Students' Demographic Background

Table 3: Demographic Background of Students

Variables	Items	Percentage (%)
Gender	Male	39.8
	Female	60.2
Age	21 and under	30.1
	22 to 32	62.6
	33 to 43	5.7
	44 and above	1.6
Level of Education	Diploma	10.6
	Bachelors	74.8
	Masters	8.9
	PH.D	5.7
Faculty	Science	37.4
	Non-Science	62.6

Most of the respondents were female, with a high percentage of 60.2%, and the remaining 39.8% were male as shown in Table 3. The majority of the students were aged 22 to 32 (62.6%) and 21 and below (30.1%). Most of the students were bachelor students (74.8%). Students' educational background was divided according to science faculty at 37.4% and non-science faculty at 62.6%.

3.1.2 Students' Knowledge towards Gender Equality and SDG5

Table 4: Percentages of Students' Knowledge

No.	Items of Knowledge	Yes (%)	No (%)
K1	I am familiar with the term that "Gender Equality refers to the situation when men and women enjoy the same rights and opportunities across all sectors of society."	91.9	8.1
K2	I have heard about the term "SDG5 or Gender Equality" before.	72.4	27.6
K3	I am familiar with the fact that the main target of SDG5 is "to achieve gender equality and empower all women and girls" by 2030.	61.8	38.2
K4	I am aware that 'Gender Equality' is achieved when the different behaviours, aspirations and needs of men and women are equally favoured and valued.	90.2	9.8
K5	2/3 of all children deprived of schools are girls, and 75% of the world's illiterate adults are women.	69.1	30.9
K6	One in three women around the world are likely to be victims of gender-based violence in their lifetime.	78.0	22.0
K7	Gender-based violence is one of the extreme reasons of physical and mental trauma and deaths of women globally.	86.2	13.8
K8	Women possess only 21% of the world's parliamentary seats.	26.8	73.2
K9	Due to violence and abuse, there are 50 Million fewer women in South Asia today than there should have been.	59.3	40.7
K10	I am aware of the fact that "SDG5" calls for equal opportunities for women and men in leadership among all levels of decision-making.	65.0	35.0

The high level of knowledge of UM students is illustrated in Table 4. The majority of the students responded positively with a range of 59.3% to 91.9%, highlighted in blue color. Most of the students have heard about the issue of gender inequality, and most of them are well aware that there are issues on the gender gap. The highest proportion of positive response (Yes %) was for item K1 "I am familiar with the term that Gender Equality refers to the situation when men and women enjoy the same rights and opportunities across all sectors of society" at 91.9%. This suggests that UM students acquire a high level of knowledge about gender equality.

Additionally, about 90.2% of respondents positively responded to item K5 (Mölders, 2019) that "two-thirds of all the children in school are girls and 75% of the illiterate in the world are women." About 86.2% of them were well aware of item K7 (Thystrup, 2020) that "gender-based violence is one of the biggest causes of physical and mental trauma and death to women worldwide." On the other hand, when they were asked about a correct fact about gender equality in item K8 "women possess only 21% of the world's parliamentary seats", majority of the respondents wrongly answered "No" (73.2%), which is highlighted in grey color in Table 4. However, the majority of the UM students positively responded to all the other knowledge questions, which shows their high level of knowledge on gender equality and SDG5.

3.1.3 Students' Attitude towards Gender Equality and SDG5.

Table 5: Percentages of Students' Attitude

No.	Items of Attitude	SD(%)	D(%)	N(%)	A(%)	SA(%)
A1	I believe in our society, all men and women should be treated equally in all aspects of life.	2.4	4.9	9.8	13.8	69.1
A2	I acknowledge that in our society today, there are more advantages in being a man than being a woman.	2.4	9.8	26.0	24.4	37.4
A3	Achieving equality between men and women is important to me personally.	2.4	5.7	13.8	23.6	54.5
A4	I believe a man who stays home to look afterhis children is less of a man.	61.8	9.8	17.9	4.1	6.5
A5	I believe women will not achieve equality, unless men take actions to support women'srights too.	4.9	4.9	11.4	27.6	51.2
A6	In general, men are being expected to do toomuch to support women's equality.	19.5	17.9	30.9	18.7	13.0
A7	Sexual harassment is seen as the most important issue faced by women.	1.6	4.9	11.4	14.6	67.5
A8	I believe that ensuring primary education of girls' could decrease child mortality.	4.1	4.1	19.5	25.2	47.2
A9	To me, raising awareness on 'Sustainable Development Goal 5-Gender Equality' among the university students is necessary.	1.6	1.6	15.4	23.6	57.7
A10	I feel basic Gender and Development courses should be a part of a university's curriculum.	3.3	2.4	20.3	22.0	52.0

Note: *SD- Strongly Disagree *D- Disagree *N- Neutral *A- Agree *SA- Strongly Agree

Table 5 shows the level of students' attitude towards gender equality in achieving SDG5. All statements recorded well balanced between negative and positive responses accordingly. The majority of the students responded "Strongly Agree" or "Agree" to the attitude questions. However, few students responded "Strongly Disagree" or "Neutral." The shaded blue color ('Strongly Agree' and 'Agree') and grey color ('Neutral' and 'Strongly Disagree') shows the highest percentage for the attitude questions indicating the students' opinion. The highest proportion of "Strongly Agree" positive responses (69.1%) from students was for item A1 "I believe in our society, all men and women should be treated equally in all aspects of life." This illustrates that UM students are well aware of the importance of equal rights between all men and women.

Next, in Table 5, the majority of the students (61.8%) responded "Strongly Disagree" for the attitude question A4, "I believe a man who stays home to look after his children is less of a man." This represents that UM students strongly believe gender equality will be restored when men and women are

given equal household responsibilities. Moreover, the highest percentage (27.6%) of "Agree" positive responses from students was for item A5, "I believe women will not achieve equality unless men take actions to support women's rights too." This was followed by 30.9% of "Neutral" responses for item A6 "In general, men are being expected to do too much to support women's equality." Yet overall, the students presented a positive attitude towards gender equality and SDG5. Similar outcomes were also found in studies like those by Al-Naqbi and Alshannag (2018), Biasutti (2017), Borges (2019), Gündüz (2017), and Keles (2017).

3.1.4 Students' Practices towards Gender Equality and SDG5

For the practice level of students, a distinctive scenario is discovered, which is presented in Table 6. The highlighted blue color ('Always' and 'Often') and grey color ('Never') shows the highest percentages of the practice statements to show the opinions of the respondents. The majority of the students responded "Always" and "Often," and only a few of them responded "Never" to the practice questions. The highest proportion of students responded "Always" for the practice statement P5 "I give equal importance to all my classmates, friends, teachers, family members regardless their sex, sexual orientation, gender identity, or expression," with 64.2%. Followed by P6 "I do not make comments that ridicule, demean or humiliate regardless their sex, sexual orientation, gender identity, or expression" (58.5%); P4 "I treat people of all gender equally" (56.9) and P7 "I do not refuse to do a certain task that is 'specific gender based' task according to the society" (42.3%). Every student must make these critical commitments to achieve gender equality and SDG5.

Furthermore, when students were asked if they have taken courses related to SDG5 and gender equality (P8), a majority of students responded that they 'Always' (30.1%) and 'Never' (27.6%) do. Moreover, the majority of students responded 'Always' (25.2%) and 'Never' (27.6%) for item P9 "I participate in events (Such as seminars, talks, workshops that relate to SDG5 and gender equality". This is followed by item P10 "I talk about 'SDG5 and gender equality with my classmates, friends, teachers, and family" (Always= 22.8%, Never= 23.6%). Yet overall, Table 6 demonstrates that most of the UM students have a high level of practice towards gender equality in achieving SDG5.

Table 6: Percentages of Students' Practices

No.	Items of Practices	N(%)	R(%)	S(%)	O(%)	A(%)
P1	I stay alert for any gender based violence (i.e. sexual, physical, domestic harassment or abuse) happening around me.	0	14.9	18.7	35.8	40.7
P2	I raise my voice when someone is being treated differently just because of their sex, sexual orientation, gender identity, or expression.	0.8	7.3	26.0	32.5	33.3
P3	I report to authority if I am aware of any form of gender-based discrimination or abuse (i.e. sexual, physical, domestic harassment or abuse).	4.9	5.7	24.4	27.6	37.4
P4	I treat people of all gender equally.	0	4.9	13.0	25.2	56.9
P5	I give equal importance to all my classmates, friends, teachers, family members regardless their sex, sexual orientation, gender identity, or expression.	0.8	6.5	13.8	14.6	64.2
P6	I do not make comments that ridicule, demean or humiliate regardless their sex, sexual orientation, gender identity, or expression.	1.6	4.1	17.9	17.9	58.5

No.	Items of Practices	N(%)	R(%)	S(%)	O(%)	A(%)
P7	I do not refuse to do a certain task that is 'specific gender based' task according to the society.	0.8	4.1	26.0	26.8	42.3
P8	I have taken courses related to SDG5 and gender equality.	27.6	11.4	20.3	10.6	30.1
P9	I participate in events (Such as, seminars, talks, workshops that relate to Sustainable Development Goal 5 and gender equality.	27.6	23.6	15.4	8.1	25.2
P10	I talk about 'Sustainable Development Goal 5and gender equality with my classmates, friends, teachers and family.	22.8	18.7	17.9	17.1	23.6

Note: *N- Never *R- Rarely *S- Sometimes *O-Often *A- Always

3.2 Correlation Analysis

Table 7 illustrates a weak positive correlation (r= .275, N= 123, p= .00) between the levels of students' knowledge and practices towards gender equality in achieving SDG5. It also demonstrates that, despite having high knowledge regarding gender equality and SDG5, the practice level of UM students is low. Additionally, Jamilah et al., (2011) expressed that having higher knowledge regarding SDGs has failed to guarantee a higher level of practices amongst students. On the other hand, there is a very strong positive correlation (r= .789, N= 123, p= .00) between the levels of students' attitudes and practices towards gender equality in achieving SDG5. It implies that keeping a firm attitude towards gender equality and SDG5 will inspire the UM students to have a higher practice level.

Table 7: Correlation between Knowledge and Practice, and Attitude and Practice

Correlation Between	N	Spearman's Rho correlation coefficient	Inference
Knowledge and Practice	123	.275	Correlated
Attitude and Practice	123	.789	Correlated

Note: *Correlation is significant at the 0.01 level (2-tailed).

3.3 Cross Tabulation Analysis

For this study, cross-tabulation was executed to observe the knowledge, attitude, and practice level of UM students according to numerous variables explicitly. Cross-classification of average positive knowledge of students according to their gender demonstrated that the knowledge level of female students (60.82%) was much higher than the knowledge level of male students (39.18%). Moreover, female students (59.35%) had a higher affirmative attitude than male students (40.65%). Likewise, the tendency to practice gender equality and SDG5 was higher amongst female students (53.66%) than male students (46.34%). Moreover, UM students of non-science faculties had higher knowledge (science 41.02%, non-science 58.98%) and affirmative attitude (science 36.59%, non-science 63.41%) and a higher level of practice (science 37.40%, non-science 62.60%) towards gender equality and SDG5 than the UM students of science faculties.

The cross-tabulation was also conducted on the students' awareness level (knowledge, attitude, practice) according to their parents' (Father, Mother) educational level. Students who had higher knowledge towards SDG and gender equality (86 students), their parents' educational level was respectively- Fathers (79 Educated, 7 Unschooled) and Mothers (77 Educated, 9 Unschooled). Moreover, students who had affirmative attitude (80 students), their parents' educational level was respectively- Fathers (74 Educated, 6 Unschooled) and Mothers (72 Educated, 8 Unschooled). Furthermore, students who had affirmative attitude (77 students), their parents' educational level was respectively- Fathers (71

Educated, 6 Unschooled) and Mothers (69 Educated, 8 Unschooled). These variables indicated that students with educated parents (Father and Mother) generally tend to have a higher knowledge, attitude, and practices towards gender equality in achieving SDG5. According to Tatjana (2006), parents are mindful of the activity advancement of their children, but at the same time, they require development education to educate their children properly.

Next, UM students were approached to express their opinion on gender equality and SDG5 (open-ended questions). The majority of them stated they think providing equal rights, social value, freedom, respect, and responsibilities between all men and women is critical towards gender equality, which is the primary objective of SDG5. The outcomes of another two open-ended questions likewise showed that social media and online websites were the most favored platforms for the students to gain knowledge regarding gender equality and SDG5. In general, the majority of the students remarked that the execution of SDG5 initiatives in Malaysia would restore gender equality between all men and women.

3.4 Discussion

From the analysis and results obtained, the study indicated the importance of higher knowledge, attitude, and practice level towards gender equality in achieving SDG5 in Malaysia. There is worldwide awareness developing among young adults (i.e., university students) that gender equality in achieving SDG5 is the foundation of inclusive development. Having a high level of positive knowledge, attitude, and practices will lead students to achieve SDG5. Malaysia has been progressive on the way of women empowerment and gender equalities. Under the Federal Constitution, according to the Malaysian supreme law, Article 8(2) has been corrected to reduce gender discrimination and gender inequality at all stages.

The government of Malaysia has taken several steps through unequal primary education between boys and girls, unequal job description, stopping discrimination in the job sector, and many more towards SDG5. The sustainable development goals aim to ensure that the plans are properly implemented and in motion (Franco et al., 2020). Therefore, providing equal education access and financial freedom and possibilities to both male and female university students is crucial for the Malaysian government to achieve an advanced sustainable economy and improve national wellbeing. For this policy, the Malaysian government will require commitment, fair and successful mechanisms within and across government associations to interpret educational administrations, programs, services, and budgets into specific benefits for both male and female students.

Moreover, the results showed that all institutions and policy regions in Malaysia are counted for gender equality as they all affect young students, yet in a diverse way due to their distinctive situations in educational institutions. Thus, the government of Malaysia should make it compulsory for all students (both science and non-science) to have gender equality and SDG5 related courses in their respective curriculum. Mainstreaming sexual orientation throughout all social institutions should be a fundamental commitment of the Malaysian government. According to United Nations Educational, Scientific and Cultural Organization [UNESCO] (2012), “World Atlas of Gender Equality in Education is the clearest example of this international commitment to global gender equality across and including all levels of education, especially higher educational institutions.” According to the Department of Statistics of Malaysia, the country is on the right track to achieve its goals (Sustainable Development Goals, 2019). That is why It is very important to make the university students aware of SDG5 and Gender Equality issues. It is necessary to involve the country's university students to achieve SDG5 faster because they are the future leaders responsible for a sustainable planet.

Furthermore, the analysis of the results illustrated that a reasonable portrayal and participation of male and female students in public life in developing leadership and governance skills are significant towards achieving gender equality in Malaysia. The Ninth Malaysian Plan plays a predominant role in motivating serious sustainable development in Malaysia. Strategic approaches towards sustainable development and to achieve SDG5, which helped the country to ensure the 38th position among 146 nations (Arora-Jonsson et al., 2019). The government should encourage women to participate more in decision-making and be concerned about their participation in the growth and development of the country. Therefore, the analysis depicts that the composition of Malaysian government associations should reflect society to be seen as authentic, capable of conveying fair policies and maintaining gender equality in achieving SDG5 before the law because an effective gender-balanced and diverse policy-makers will have the good skill to handle the various requirements of the citizens of a nation.

Conclusions

Overall, the awareness level of UM students towards gender equality in achieving SDG5 is high, shown by a significant number of students who possess high knowledge with a positive attitude. Nonetheless, they showed lower performance in practicing gender equality and SDG5. There is a weak correlation between student knowledge and practice level, which indicates that although UM students possess high knowledge about SDGs, their practice level is slightly lower. This can be increased through strategic approaches and intervention programs by the university. However, a very strong positive correlation exists between students' attitudes and practice level. This showed that students would be more driven towards practicing actions aligned with SDG5 and gender equality by having a positive attitude. It should be noted that students' knowledge, attitude, and practice approaches may vary between institutions, and thus other university students in Malaysia may have different levels of awareness towards gender equality and SDG5. On a positive note, several leading universities in Malaysia have already started to include gender equality and SDG5 related courses in their academic structures for both science and non-science students. Therefore, future research could investigate deeper into the barriers of converting knowledge and attitude towards gender equality in achieving SDG5 into practices.

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Research Paper

The Effect of General and Vocational High School Quality on Labor Market Outcomes in Indonesia

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ABSTRACT

To improve the quality and competitiveness of human capital and correspond to the Sustainable Development Goals (SDGs) 4 especially target 4.3, to ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, Indonesia has been focusing on improving the quality of secondary education. However, empirical data and previous research showed that secondary school graduates in Indonesia face high unemployment and income differences, especially vocational school graduates. The quality of secondary high schools plays an important role in determining the years of schooling of the graduates and indirectly impacts labor market outcomes. Using longitudinal panel data at the individual level from the Indonesia Family Life Survey (IFLS) of 2000, 2007, and 2014; and applying education production function and Mincer earning equation, this study finds that the difference in wages between graduates of general and vocational high schools is not statistically significant despite the school quality. However, analyzing within the vocational high schools shows that better quality of vocational high schools increases years of schooling of its graduates as they can access tertiary education, and subsequently increases their performance in the labor market. This finding indicates that policies to improve school quality, especially vocational high schools, should be enhanced.

Keywords: school quality, vocational high schools, general high schools, education production function, mincer earning equation, return to education, SDG4.

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1. Introduction

The 4th Sustainable Development Goals (SDGs) focus on inclusive and quality education for all and reaffirm that education is a means to enhance the quality of human capital and increase economic growth. One of the targets in SDG 4 is to ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university, as in SDG 4 target 4.3 (Badan Perencanaan Pembangunan Nasional [Bappenas], 2021; Ministry of Education and Culture, 2017). Secondary education, both vocational and general education, is a prominent level of education in increasing human capital as the graduates of this level of education can either be working or entering tertiary education. Indonesia is committed to improving the quality and competitiveness of human capital, which is in line with the commitment to achieving SDG 4. One main strategic program to enhance human capital is with the improvement of technical and vocational and training (TVET) as stated in Presidential Regulation No. 18 of 2020 concerning the Medium-Term Development Plan of 2020-2024 (2020).

A number of cross-country studies showed supporting and disputing arguments on vocational high schools (SMK) in comparison to general high schools (SMA). For the case of Indonesia, studies such as by Newhouse and Suryadarma (2011), and Mahirda and Wahyuni (2016), showed that the education return of SMK graduates in the labor market is relatively lower compared to SMA's graduates. The portfolio of TVET in Indonesia comprises both formal and non-formal education. Formal education consists of vocational secondary and tertiary education, whereas non-formal education consists of vocational training centers. Formal secondary education consists of general and vocational high schools as a sub-system in Indonesia's national education system. In SMA, students are more focused on studying academic skills to continue to tertiary education. In contrast, in SMK, students learn more practical skills so that after graduating, they will be ready to work in industry, independent businesses, or other employment fields.

The number of secondary schools increased significantly from 2012 to 2019 by 19.9% and 13.8% for SMK and SMA, respectively (Jasmina, 2020). According to the government's policy stated in 2006, to increase the number of SMK (Newhouse and Suryadarma, 2011), the number of vocational high schools and their students has increased. To enhance the quality of SMK in Indonesia, the government issued Presidential Instruction Number 9 of 2016 concerning the revitalization of vocational high schools. However, the results of the instruction are not yet apparent. For the last five years, the unemployment rate in Indonesia has been dominated by workers who graduated from secondary education, reaching 11.29% in 2020. Specifically, from 2018 to 2020, a high proportion of unemployed workers are vocational high school graduates (Figure 1).

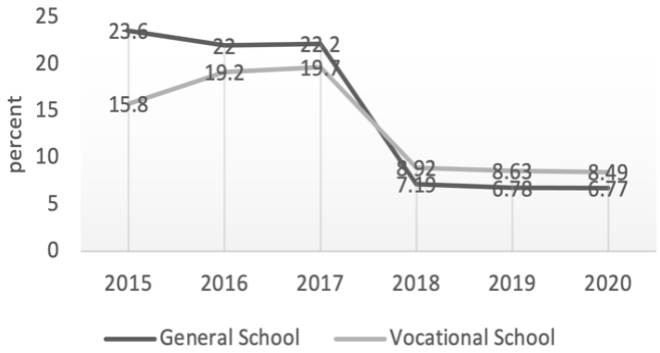

Figure 1. Unemployment Rate of Indonesia by Education, 2015-2020

Central Statistics Agency (2021a), edited

Moreover, Figure 2 shows that since 2016 the general high school graduates have higher average hourly wages than vocational graduates, but the difference is not significant. Despite extensive research into the subject, the debate regarding the returns of education between vocational and general high schools is not conclusive in Indonesia. Newhouse and Suryadarma (2011) found that males with general high school educations earned higher wages (premium wages) than individuals who attended vocational schools. In contrast, Mahirda and Wahyuni (2016) did not find a significant difference between the salaries of individuals who graduated from SMA and SMK.

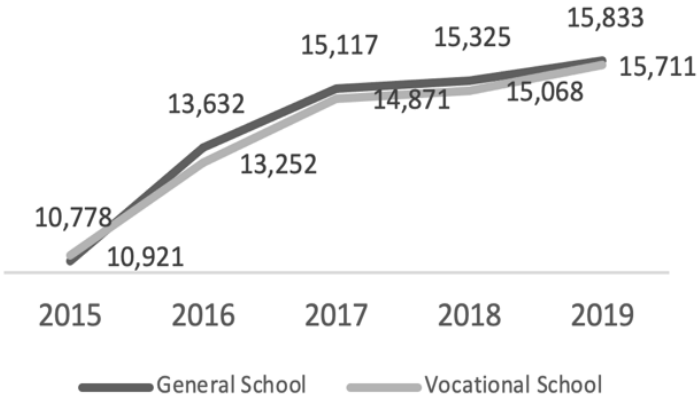

Figure 2. Average Hourly Wages of Workers in Rupiah

Central Statistics Agency (2021b), edited

Nevertheless, Quarina and Pasay (2007) and a recent study by Bhismananda (2020) found that attending vocational schools provides higher salaries/wages and higher employment rates than general high school graduates receive. The previous literature also reveals that years of education are a proxy for return to education as the labor market outcome. However, no literature in the context of Indonesia has discussed the role of school quality in graduates achieving high wages or salaries in the future. As Newhouse and Suryadarma (2011) explained, the wage-premium differences between graduates of general high schools and vocational high schools can be due to differences in quality between general high schools and vocational schools. By looking at educational returns, the school quality must be considered one factor that might affect the graduates' educational outcomes in the labor market (Card and Krueger, 1992; Behrman and Birdsall, 1983; Guo, 2018).

Currently, SMK in Indonesia still has problems in terms of quality. The schools have limited teachers, especially vocational teachers, who teach groups of vocational subjects. In 2015 only 22.3% of vocational teachers taught according to their field of competence (Ministry of Education and Culture, 2017). In addition, the recent data from the Ministry of Education and Culture (2016a) showed that public vocational schools experience a shortage of vocational teachers of 41,861, while private vocational schools lack 50,000 teachers (Ministry of Education and Culture, 2016b). SMK has limited vocational teachers even though SMK students are increasing every year. As result in Figure 3, the student-to-teacher ratio in vocational schools is higher than that in general high schools, and this seems to impact the learning competencies of vocational students.

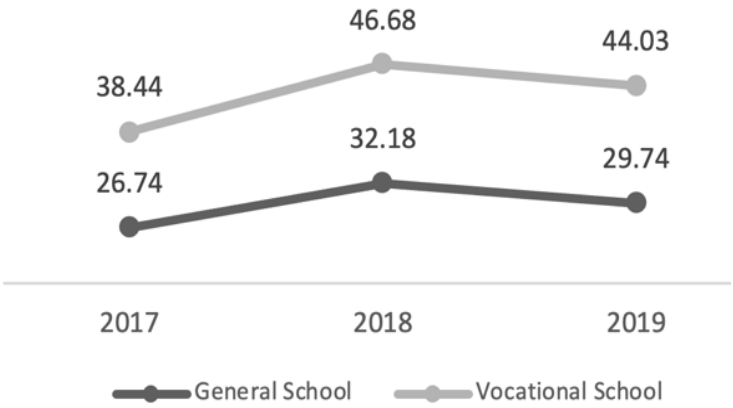

Figure 3. The ratio of Students to Public Teachers in 2017-2019
Ministry of Education and Culture, 2020

To improve the quality of human capital and achieve the quality of education, especially at general and vocational secondary as targeted in SGD 4.3, analyzing how the quality of respective schools affects education output and, hence, affects labor market income is important. Therefore, this study aims to determine how general and vocational high school quality affects labor market income or return to education by applying longitudinal data from the Indonesia Family Live Surveys (IFLS) of 2000, 2007, and 2014.

This study does not specifically discuss achieving SDG 4. However, this study argues that understanding the relationship between the quality of vocational and general high schools and the years of schooling; subsequently understanding the relationship between the years of schooling and labor market income, can contribute to policy recommendation to improve quality of education and enhance human capital, which is in line to SDG 4, specifically target 4.3. Better quality of SMA/SMK will indirectly lead the graduates to continue their education, and hence they are expected to earn higher incomes.

The study applies a two-step regression: (i) the theory of education production function of Hanushek (1979) with years of schooling as an output of education that might be affected by educational input factors such as school quality, individual performance, and family background; and (ii) the Mincer (1974) equation model with labor market income as a return on education that might be affected by years of schooling. Following previous studies, the school quality in this study is defined as the availability of school input factors with regards to the number of students, such as teachers, school facilities, and school expenditure (Card and Krueger, 1992; Case and Yogo, 1999; Dearden et al., 2002; Bedi and Edwards, 2002; Guo, 2018).

Literature Review

Supply and Demand of Education

Education from an economic perspective can be reviewed from the supply-side and the demand-side. Firstly, from the supply side, education is discussed from the point of view of educational producers such as educational institutions and other factors such as innate factors and family conditions. As pointed out by Hanushek (1979), the output of the educational process, namely student achievement such as academic grades, is influenced by inputs that are directly controlled by policymakers (characteristics of schools, teachers, and curriculum) and is also influenced by student academic performance factors, family background, and peer conditions. Educational outputs, apart from being shown in student test scores, can also be seen in

educational attainments, such as gross and net participation rates, or shown by the number of years of schooling attended by students (Garniss, 2006). However, the problem with the general measure of years of schooling is that it simply calculates time spent in school without assessing what is happening at school, so it does not provide a complete or accurate picture of the effect of school outcomes on income (Hanushek, 1979). The return on education assumes that one year of schooling results in the same number of achievements over time. Finally, this school outcome measure ignores the extensive policy debate about ways to improve school quality. Whereas school quality also influences the learning process and determines the academic performance of students while at school.

Secondly, from the demand side, education is considered a service that students consume. According to the human capital theory, education focuses on maximizing their expected lifetime earnings (Becker, 1975). The economic benefits that a person expects from investing in education in the form of salaries, wages, profits earned at work and are called educational returns. The measurement of the labor returns made by Mincer (1974) shows that employment earnings are a function of schooling and labor market experience. The Mincer equation estimates the average monetary returns of one additional year of education.

Previous Empirical Studies

Some previous studies that explained the supply-side impact of education discussed the quantity and quality of schools on educational output. Duflo (2001) focused more on the quantity of schools regarding the impact of the construction of primary education schools in Indonesia from 1974 to 1979. As a result, the construction of 61,000 primary schools during that period significantly increased the student enrollment rate from 69% to 83% and increased future income by 2.7% because of the increase in years of schooling. In addition, various literature also reveals that there is a relationship between school quality and wages. Studies such as Card and Krueger (1992) in the United States and Case and Yogo (1999) in South Africa showed a significant negative impact of school quality, indicated by the student-to-teacher ratio, on individuals' income. However, other studies such as Dearden et al. (2002) found that school quality was not a significant factor in determining income when family educational background and individual abilities were included as control variables.

Despite using on the student-to-teacher ratio to measure school quality, other studies have examined other factors such as the availability of school facilities and the average school expenditure per student. Bedi and Edwards (2002) used the percentage of teachers who graduated with bachelor's degrees, the length of time the teacher had studied, the percentage of schools with water and electricity facilities, and the student-to-class ratio as variables in measuring school quality. A recent study, Guo (2018), uses proxies of school expenditure per student and student-teacher ratio to reflect school quality. With significant results, school spending per student is positively correlated with individual income and indirectly affects educational outcomes.

The previous studies explain the influence of school quality only at the basic education level, namely elementary or junior high school. However, studies examining the effect of school quality on secondary education are limited. Strayer (2002) studied the effect of the quality of high school education on the income of individuals who choose to continue to college compared to those who do not attend college. Strayer (2002) first estimated the role of school quality on individual preferences for continuing tertiary education and incorporated these factors into the Mincer earning equation. The study found that the quality of secondary education schools, as measured by the student-to-teacher ratio and the percentage of teachers who graduated with a bachelor's degree, significantly affected students' chances of pursuing higher education and attending colleges and consistently increased their wages compared to individuals who did not attend

colleges. The schools' quality affects the length of education of individuals, which later will affect their respective wages.

Studies on the impact of secondary school quality in vocational or general schools are still limited, especially in Indonesia. Previous studies such as Newhouse and Suryadarma (2011), Bhismananda (2020), Quarina and Pasay (2007), and Mahirda and Wahyuni (2016) estimated education outcomes regardless of the characteristics of the schools. In Indonesia, individuals who graduate from general high school are intended to continue tertiary education after graduation. In contrast, vocational school graduates can choose to leave school because vocational education aims to produce graduates who can immediately enter the labor market. Results from those studies implied that society and companies have a better perception of workers who graduate from general high school than those who graduate from vocational high school.

Higher returns on education for general high school graduates than for vocational school graduates were reported by Newhouse and Suryadarma (2011). The study used IFLS panel data from 1993 to 2000 and calculated students' probabilities of attending school in four categories of secondary school: SMA and SMK for each school status, private or public. The result of this study is in contrast to Quarina and Pasay (2007), Mahirda and Wahyuni (2016), and Bhismananda (2020), all of which used the latest IFLS data, 2014/2007. Bhismananda (2020) and Quarina and Pasay (2007) found a high rate of return on individual education for individuals who graduate from vocational education than individuals who graduate from general high school. However, Mahirda and Wahyuni (2016) did not find any difference in educational outcomes between high school and vocational high school graduates. Moreover, Quarina and Pasay (2007), Mahirda and Wahyuni (2016), and Bhismananda (2020) have not been able to explain the educational track of individuals after graduating from high school to continuing their studies at the tertiary level and have not explained the effect of school quality which could be the cause of the difference in wages between the two groups of graduates.

2. Methodology

Research Framework

This study applies the econometrics method to estimate the relationship between the quality of SMK/SMA and years of schooling and further estimates the relationship between the years of schooling to future wages/income. This study first analyzes the effect of education inputs on education output and outcome. First, we explore the effect of educational inputs, such as school quality, on years of schooling following the educational production function theory by Hanushek (1979). The years of schooling as educational output is influenced by inputs, such as individual abilities, family background, and school quality factors. The relationship of input, output, and outcome of education is presented in Figure 4. The educational input factor, especially the quality of schools, is also distinguished based on the types of schools attended, SMA or SMK, considering that the individual and school characteristics are different in the respective schools. In contrast to previous studies, the individual preference factors for choosing the types of secondary schools (SMA/SMK) and tertiary institution are assumed to be constant. The conceptual framework of this study is shown in Figure 5.

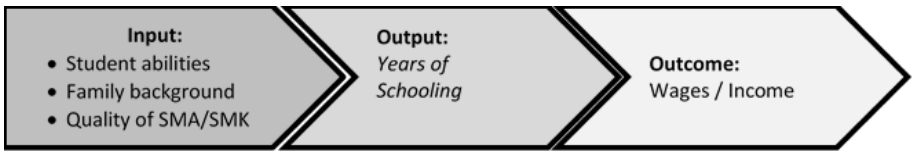

Figure 4. Relationship of School Quality Factors to Educational Output and Labor Outcomes

The adjustment in the years of schooling has affected wages as a return on education, according to Mincer (1974). Since we documented the educational track of individuals graduating from SMA/SMK, the current wage (2014) is indirectly influenced by educational input factors when the individual attended school in 2000, 2007, and 2014. In addition, school quality factors and other educational inputs are assumed not to directly influence income or salary (Card, 2001). However, as a research limitation, this study does not discuss school quality factors that may correlate with individual quality as measured by student test scores and assume that education is an investment.

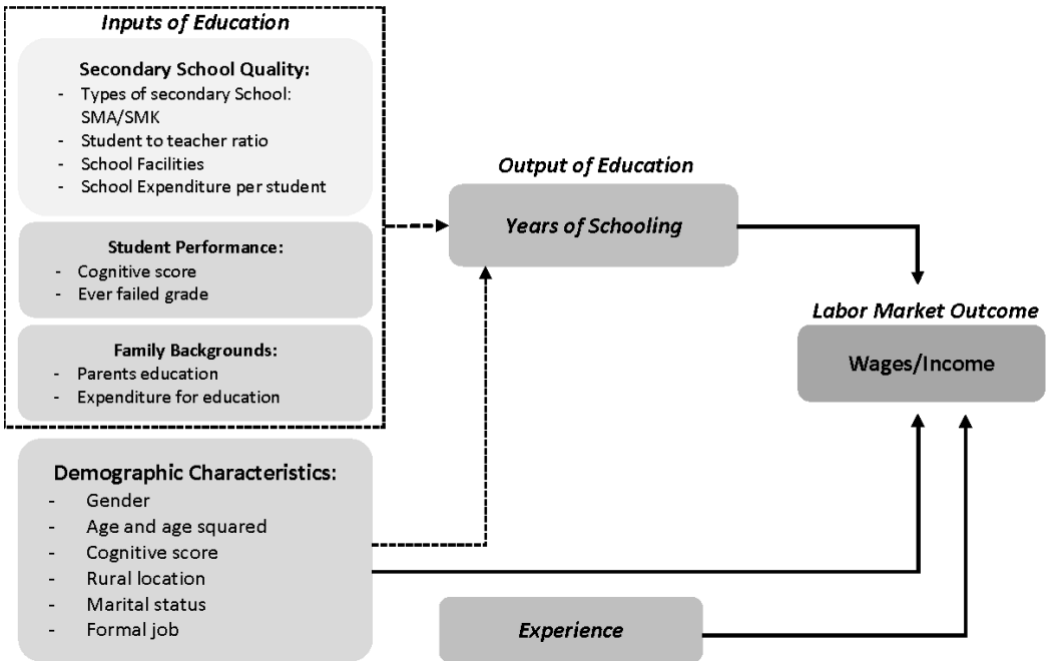

Figure 5. Conceptual Framework of the Study

Data and Sample

The empirical analysis draws on datasets from the Indonesian Family Life Survey (IFLS), a longitudinal household survey conducted by the Research and Development (RAND) Corporation. Three full follow-up waves were conducted in 2000, 2007, and 2014, and each wave contains two data sets (Strauss et al., 2004; Strauss et al., 2009; Strauss et al., 2016). The first dataset represents individual characteristics such as demographic characteristics, educational background as type and status of the school, academic performance, educational assistance, employment, and health characteristics. Second, the community dataset represents an educational facility book that explains school characteristics, such as school facilities and descriptions (status and types of schools, number of teachers and students), and characteristics of each school member, including the principal, teachers, and students.

This study used three waves of IFLS, combining both individual and community datasets. The individual dataset is categorized according to working population age and attendance at general high schools or vocational schools in 2000, 2007, and 2014 to capture demographic information, individual performance, and the family's educational and economic background when the individual attended school in the survey year. Subsequently, to capture the school quality, the data were merged with the community dataset in each survey year based on the location of the individuals when they attended

secondary schools. The data was then aggregated to the district or city level while considering the weight of facilities from each community. It is acknowledged that there might be a potential bias and overestimates of the aggregated data due to the heterogeneity of school characteristics within each region.

As a result, the characteristics of the first sample are those who have attended general high school or vocational school (currently in school and graduated in 2000, 2007, and 2014) and entered the workforce in 2014, as shown in Table 1.

Table 1 Number Samples

Characteristics:	SMK	SMA	Total
First step: ever schooled SMA/SMK	1142	1906	**3048**
Second step: having income and worked	585	969	**1554**

Source: IFLS 3, 4, and 5 (author calculation)

Table 2 shows a descriptive statistic of the sample for general high schools (SMA) and vocational high schools (SMK) across districts or cities in Indonesia. Comparing the indicators that reflect school quality in this study, the data show that, on average, SMA is of higher quality than SMK across districtscities in Indonesia.

Table 2 Descriptive Summary Statistics of School Quality between General and Vocational High School

Variable	Obs	Mean	Std. Dev.	Min	Max
General High School (SMA) graduates					
Student to teacher ratio	163	13.218	3.128	5.69	23.39
Number of school facilities	163	9.671	3.04	1	17
School expenditure per student*	163	128,825.25	1,076,810.8	14.939	13,435,793
Cognitive score	1906	52.08	27.12	0	100
Father years of schooling	1906	10.16	4.22	0	22
Mother years of schooling	1906	9.32	4.33	0	18
Education expenditure	1906	680.53	796.93	1.77	10138.02
Vocational High School (SMK) graduates					
Student to teacher ratio	125	14.841	5.593	3.845	38.805
Number of school facilities	125	8.341	3.265	1	14.924
School expenditure per student*	125	54,186.614	231,306.79	11.736	2,169,968
Cognitive score	1142	51.09	25.17	0	100
Father years of schooling	1142	8.94	4.03	0	18
Mother years of schooling	1142	8.02	4.09	0	18
Education expenditure	1142	557.08	657.89	3.65	10138.02

*In million IDR

Souces: IFLS 3, 4, and 5 (author's calculation)

First, general schools had a student-teacher ratio of 13, which is lower than vocational schools at 15, which indicates that vocational teachers teach more students. In addition, the standard deviation of the student-to-teacher ratio for vocational schools is higher than in general schools, which indicates that SMK teachers are not evenly distributed compared to SMA. Second, SMA schools have more physical facilities than SMK schools. Third, the average school expenditures per student for SMK are lower than SMA. The facilities and school funds for vocational schools should be more supportive and include laboratories, internet access, and practice facilities that can improve the skills of vocational students (Organisation for Economic Co-operation and Development [OECD], 2020a; OECD, 2020b).

Since this study observed the effect of educational inputs on years of student attendance in school, we also compared educational tracks for vocational and general graduates to the average salary earned. Table 3 shows that most individuals in the sample continued their studies until they graduated from

SMA/SMK. However, general school graduates continue to college more often than vocational school graduates. The average wage for general high school graduates is Rp1,503,507, higher than the average wage for vocational high school graduates. Meanwhile, if it is dissected at each educational level, the average wages of SMA and SMK graduates are not significantly different. Moreover, SMK graduates who continued their education to a diploma had a higher wage than those who had not finished or graduated from SMK. In other words, SMK graduates are better off continuing to higher education to get better compensation.

Table 3. Monthly Average Wages based on Educational Track

Education Track/Level	General High School Graduates		Vocational High School Graduates	
	N	Mean (Rp)	Mean (Rp)	N
Have not finished high school	54	1,006,509.6	454,619.21	52
High school graduates	552	1,435,608.3	1,404,305.3	446
Diploma I-III or still attend college	142	1,713,470.4	1,860,146.3	57
Bachelor degree or Diploma IV	213	1,642,439.6	1,787,045.2	30
Master degree or above	8	2,117,344.1	-	-
Total/Average	**969**	**1,503,507.2**	**1,383,931.7**	**585**
Minimum		**41,666**	**35,000**	
Maximum		**5,300,000**	**4,200,000**	

Sources: IFLS 3, 4, dan 5 (author's calculation)

Methods and Estimation Models

The quality of SMA/SMK is measured using several indicators based on previous studies and the availably of data in IFLS. First, the effectiveness of the learning process in the classroom is characterized by the student-to-teacher ratio. The higher student-to-teacher ratio means that the teachers must teach many students, which leads to lower learning effectiveness. However, a too low ratio also makes learning activities inefficient because one teacher only teaches a few students. Secondly, aspects of school facilities such as ownership of libraries, fields, canteens, halls, laboratories, internet connections, and other physical facilities also affect outcomes. Third, the financial aspect of schools as measured by school expenditures per student as a resource directly supports the effectiveness and efficiency of education management. Of course, a good quality school will have adequate school facilities and higher school expenditure to support learning activities.

Based on Figure 4, this study looks at the years of schooling as a proxy for return on education. Return on education is also influenced by individual performance and other factors such as family background and school quality, following the theory of the production function of education. Case and Yogo (1999) and Card (1999) reported the educational returns without considering education input factors. Their estimates might be too high and biased because they do not consider individual conditions and school characteristics. Therefore, the best inferential estimation method is a cross-sectional two-step linear regression. The first regression follows the education production function by Hanushek (1979) and proceeds to the second step following the income equation of Mincer (1974). In this context, the two-step regression method can explain the indirect effect of educational inputs, one of which is the quality of SMA/SMK, on the level of wages of individuals as it depends on the years of schooling. In addition, this study uses a second-step regression modified from the previous research by Guo (2018), Bedi and Edwards (2002), and Card and Krueger (2001). They estimate the coefficient of return on education for each district or province cohort. Next, each district's return on education value is used as the dependent variable, influenced by the school quality factor in the second stage of the regression. Guo (2018), Hanushek et al. (1996), and Johnson and Stafford (1973) explained that using two-stage regression and aggregating the educational outcomes and school quality factors at a certain regional level might cause potential bias. They also argued that two-stage regression is not controlled for family

background and individual performance variables and is insufficient to explain the heterogeneity of individuals in the intra-region.

Each regression is divided into two groups, full sample and separate samples, based on individuals with their respective types of high school, SMA, and SMK. The SMA and SMK graduates are separate samples because their objectives and learning competencies are different even though they are in the same line of secondary education. In addition, the separate samples can show the effect of schools with better quality compared to low-quality schools for each type of school. Meanwhile, the full sample represents the effect of educational inputs of SMK graduates compared to SMA graduates.

First step regression model:

$$Years\ of\ schooling_{isk} = \beta_0 + \beta_j \sum_{j=1}^{a} School\ Quality_{jiskt} + \beta_j \sum_{j=1}^{a} School\ Quality_{jiskt} \# TypeSchool_i + \beta_j \sum_{j=1}^{b} Ability_{jist} + \beta_j \sum_{j=1}^{c} FamilyBackground_{jist} + \beta_j \sum_{j=1}^{a} X_{jis} + u_{is} \quad (1)$$

where:

- $Years\ of\ schooling$ = current years of schooling attended by individual *i* who attended school *s*.
- $School\ quality$ = school quality vector variables (student-to-teacher ratio, school facilities, school expenses) of individual *i* who attended school *s* in district/city *k* in year of *t*.
- $Type\ school$ = type of secondary education attended by the individual, 1 for SMK and 0 for SMA (for full sample only).
- $Ability$ = a vector of individual performance, which consists of: cognitive score and whether the individual had failed in school during elementary (SD), junior (SMP), and senior high school (SMA/SMK) for individual *i* who attended school *s* in year *t*.
- $FamilyBackground$ = a vector of expenditure for education and educational family background variables for individual *i* who attended school *s* in year *t*.
- X = Mincer's control variables, i.e., cognitive score, gender, age, marital status, rural location, employment status of individual *i* who attended school *s* in 2014.

Subscript *t* is the year an individual attended school, in 2014, 2007, and 2000 and subscript *s* is sample collection by the types of high education attended, SMA, SMK, or secondary education (SMA/SMK).

Before the second stage regression, the study confirms that the error factor Mincer earnings equation must meet the assumption E (ε) = 0, meaning that the individual wage should be random. However, from the final sample in Table 1, several individuals from the first stage sample were employed but did not receive wages or did not participate in the labor force because they were in school or unemployed. This condition creates specification bias due to the selection of work participation samples or truncated samples (Heckman, 1979). Therefore, we also determine whether the observation does not result in a specification error by using the two-stage Heckman test before the second-stage regression. This two-stage Heckman test estimates the probability of working participation using the Probit model, in which a correction of sample selectivity or Inverse Mills Ratio (lambda or λ) is obtained. As mentioned in Case and Yogo (1999), the probability of work participation is influenced by the years of schooling, school quality variables, and control variables such as gender, age, and location. The Inverse Mills ratio variable is used as a control variable in the

two-step linear regression or in the Mincer equation (2) to avoid the problem of specification bias (Heckman, 1979).

After the first regression, we get the predicted number of years of schooling for each observation of general high school and vocational high school graduates from equation (1). Predicted years of schooling is used as an independent variable accompanied by years of experience and other control variables, such as lambda and demographic variables, in equation (2), which is Mincer (1974) income equation.

Second step regression model:

$$ln\ ln\ Wage_{is} = \beta_0 + \beta_{1a} Predicted\ Years\ of\ Schooling_{is} + \beta_{1b} Predicted\ Years\ of\ Schooling_{is} \# TypeSchool_{is} + \beta_2 Experience_{is} + \beta_3 Experience_{is}^2 + \beta_4 \lambda_{is} + \beta_j \sum_{j=1}^{a} X_{jis} + \varepsilon_{is} \quad (2)$$

where:

- $ln\ ln\ Wage_{is}$ = current income/wages of individuals *i* who had attended school *s*.
- $Predicted\ Years\ of\ schooling_{is}$= the estimated value of years of schooling from first step regression in each individual *i* who had attended school *s.*
- $Type\ school$ = type of secondary education attended by the individual, 1 for SMK and 0 for SMA (for full sample only).
- $Experience_{is}$= current years of work experience followed by individual *i* who had attended school *s* in 2014
- X_{jis}: Mincer's control variables, i.e., cognitive score, gender, age, age squared, marital status, rural location, and employment status of individual *i* who attends school *s* in 2014.

In equation (2), β_{1a} is the return for secondary education, representing the percentage of wages in 2014 obtained by SMA or SMK individuals who had attended school in the survey year. The education input factors have corrected the return on education, meaning that better high school quality and more support from other educational inputs can add years of education and indirectly increase individual wages in the future. The variable β_{1b} is the interaction variable between predicted years of schooling and type of schools and shows the percentage of wages obtained by vocational school graduates compared to general high school graduates for given education inputs.

3. Results and Discussion

To estimate the relationship between school quality and years of schooling, regression of equation (1) is applied, and the results are shown in Table 4. In column 1 of the table, the variables for the quality of schools: student-to-teacher ratio, school expenditures per student, and school facilities, have a significant influence on the years of schooling. In line with Strayer (2002) findings, higher-quality high schools, characterized by lower student-to-teacher ratios, can increase students' chances of studying for two or four years at college because school learning activities are more effective than those provided to students who attend lower-quality schools.

Table 4 First Stage Regression: The Effects of School Quality on Years of Completed Schooling

VARIABLES	(1) Full Sample		(2) General School		(3) Vocational School	
	Coef.	SE	Coef.	SE	Coef.	SE
School Quality						
student to teacher ratio	-0.037***	0.008	-0.035***	0.010	-0.012**	0.006
school expenditure (log)	0.102***	0.014	0.111***	0.020	0.062***	0.017
school facility	0.063***	0.011	0.046***	0.013	0.037**	0.016
School Quality#Vocational School						
student to teacher ratio#SMK	0.031***	0.010				
school expenditure#SMK	-0.027***	0.008				
school facility#SMK	-0.056***	0.008				
Student Performance						
cognitive score	0.011***	0.001	0.012***	0.002	0.009***	0.002
Fail grade SD, SMP, SMA	-0.406***	0.062	-0.623***	0.089	-0.111	0.077
Family Background						
Fatheryos	0.055***	0.008	0.065***	0.011	0.036***	0.009
Motheryos	0.031***	0.008	0.041***	0.011	0.009	0.010
educexp (log)	0.225***	0.028	0.278***	0.038	0.099***	0.036
Control Variable						
Gender	-0.298***	0.051	-0.312***	0.071	-0.240***	0.067
Age	0.446***	0.068	0.554***	0.085	0.286***	0.097
Agesqr	-0.006***	0.001	-0.007***	0.002	-0.003*	0.002
Married	-0.655***	0.076	-0.777***	0.104	-0.385***	0.097
Rural	0.194***	0.057	0.205***	0.075	0.155**	0.079
Formal	0.389***	0.059	0.432***	0.082	0.312***	0.075
Constant	-0.239	0.899	-2.728**	1.168	4.195***	1.218
Observations	3,048		1,906		1,142	
Fstat	119.29		86.13		44.53	
Prob > F	0.000		0.000		0.000	
R-squared	0.401		0.389		0.356	
Adj R-squared	0.398		0.385		0.348	

*** p<0.01, ** p<0.05, * p<0.1. Robust standard error (SE) in parentheses.
Source: IFLS 3, 4, 5 (author calculation)

However, the interaction variables of school quality and the type of high school (School Facility#Vocational Schools) show an opposite sign to school quality variables. SMK graduates from high-quality schools have lower years of schooling compared to SMA graduates with the same quality. For example, if the student-to-teacher ratio is reduced by one student, it reduces the time needed for SMK graduates to continue their education by 0.031 years compared to SMA graduates with similar school quality in the same district or city. Likewise, each additional one unit of school facility or an increase of 1% in school expenditure per student reduces years of schooling of SMK graduates compared to individuals graduating from SMA by 0.056 and 0.027 years, respectively. SMA graduates are expected to continue tertiary education, whereas SMK graduates can choose to work after graduation. This finding aligns with Chen (2009) that vocational school graduates in Indonesia are less likely to continue higher education than general high school graduates. However, Chen (2009) also found no significant difference in the probability of work between SMK and SMA graduates.

Table 4, column 2 compares the effects of general high school quality among districts or cities on years of schooling. The quality of SMA has a significant role in supporting graduates to continue their higher education. SMA graduates who attend high-quality schools in the districts or cities (schools with low student-to-teacher ratios, adequate school facilities, and high school expenditure per capita) have longer years of schooling. The results are similar if we compare the effects of vocational high school quality to years of

schooling among districts or cities, as presented in column 3 of Table 4. Students in high-quality SMK have higher years of schooling as they choose to continue their higher education after graduates.

The positive effect of high school quality is also supported by other educational input factors, such as individual cognitive ability, academic performance, and educational and financial family background. The high cognitive ability for SMK and SMA graduates increases years of schooling by 0.009 – 0.012 years. In addition, as indicated by having failed grades, academic performance in schools is significantly positive only in general high school graduates. In addition, general high school graduates have longer years of schooling, which means that they tend to continue their education, as the education level of both father and mother are higher. In contrast, vocational school graduates are driven by their father's education. The education expenses incurred by households are also significant in increasing the years of schooling.

The last discussion in this paper is the second regression according to equation (2), as shown in Table 5, which follows Mincer's income equation. The year of schooling variable is adjusting the predicted years of schooling from the first regression. In column 1 of Table 5, the return on education for senior high school graduates (SMA and SMK) is 0.259, which is significant at the 1% level. It means that an additional one year of schooling increases future wages by 25.9%. The results from the first regression show that the increase of high schools' quality will increase years of schooling; hence indirectly, the increase of school quality will increase future wages. However, the interaction variable of the predicted years of schooling and the type of education shows no significant effect on future wages. Differences in educational inputs between SMA and SMK, one of which is the quality of schools in certain districts or cities, have not been proven to affect differences in income between SMK graduates and SMA graduates. This finding supports Mahirda and Wahyuni (2016) and Chen (2009) empirical results that there is no difference in wages between the two graduates.

Table 5 Second Stage Regression: Estimating the Impact of School Quality on Returns to Education after Selectivity Bias Corrected

	(1)		(2)		(3)	
VARIABLES	**Full Sample**		**General School**		**Vocational School**	
	Coef.	SE	Coef.	SE	Coef.	SE.
Predict YoS	**0.259*** **	**0.070**	**0.302*** **	**0.092**	**0.300*** **	**0.109**
Predict Yos#SMK	**0.009**	**0.007**				
experience	0.164***	0.043	0.153***	0.054	0.225***	0.086
experiencesqr	-0.006***	0.002	-0.006**	0.003	-0.009**	0.004
lambda	-0.886***	0.328	-0.235	0.598	-1.356***	0.343
Control Mincer						
cognitive	-0.001	0.002	-0.002	0.002	-0.003	0.003
male	0.214*	0.113	0.423**	0.200	0.092	0.126
married	0.376***	0.104	0.325*	0.167	0.334**	0.141
age	-0.277**	0.133	-0.138	0.224	-0.446**	0.201
agesqr	0.005**	0.002	0.002	0.003	0.007**	0.003
rural	-0.294***	0.074	-0.289***	0.102	-0.193	0.119
formal	0.676***	0.070	0.618***	0.091	0.737***	0.111
Constant	13.675***	2.347	10.439**	4.258	16.017***	2.905
Observations	1,554		969		585	
Fstat	38.23		23.82		31.81	
Prob > F	0.000		0.000		0.000	
R-squared	0.233		0.191		0.321	
Adj-Rsquared	0.227		0.182		0.308	

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors (SE) in parentheses
Source: IFLS 3, 4, 5 (author calculation)

Moreover, columns 2 and 3 show the differences in educational outcomes for each type of secondary education (within-group). The return education for SMA graduates amounts to 30.2% ceteris paribus. This means that SMA graduates from high-quality schools supported by other educational inputs gain increases in future wages of 30.2% compared to SMA graduates from low-quality schools in other districts or cities. Similarly, in column 3, the return on education for SMK graduates is 30%, ceteris paribus. Individuals from high-quality SMK who continue their education in college earn 30% higher wages than those who graduated from lower quality SMK.

Under the Presidential Regulation No. 8 of 2012 (2012) concerning the Indonesian National Qualifications Framework (Kerangka Kualifikasi Nasional Indonesia-KKNI) , SMK graduates have the same level as SMA graduates, namely level 2 of 9 levels. Therefore, SMK graduates can continue their education up to 6 levels equal to graduating with a bachelor's degree, equivalent to the SMA path. Of course, those with a high KKNI level have better career development and can get higher wages than those who just graduated high school.

The results of the second step regression explain that school quality has an indirect effect on future income through the years of schooling and a direct influence on work participation. In line with Zimmermann (2021), the quality of SMK can directly affect the labor market because the curriculum provided at school may differ from the needs of the labor market. Meanwhile, school quality is indirectly manifested when vocational high schools provide more access to higher education pathways, such as vocational colleges, diplomas, expert competencies, or polytechnic education, which have more connections with the industrial and business sectors.

Moreover, Arum and Shavit (1995) explain that those who choose SMA tend to have higher ability and come from better family backgrounds than those who choose SMK, following the first regression result. Graduating from SMK might be a sign of lower capability; therefore, SMK graduates should continue their education to compete with general high school graduates. In addition to school quality in SMK, other educational inputs such as individual performance or family background also play an important role in continuing education.

Conclusions

This study observes the effect of general and vocational school quality on labor market outcomes. Using IFLS data, the estimation method follows a two-stage regression departing from the education production function of Hanushek (1979) and the income equation of Mincer (1974). We examine the labor market outcomes for general and vocational graduates, indirectly influenced by the educational input, one of which is school quality. This discussion of school quality might explain the differences in educational outcomes for both types of graduates because the years of schooling attended as a proxy for educational outcomes are affected by education inputs.

High school graduates attending high-quality schools, measured by the student-to-teacher ratio, better school facilities, and higher school expenditure per student, had significantly more years of schooling. However, the school quality reduced the years of schooling for vocational graduates compared to general graduates with the same school quality. Meanwhile, analyzing school quality within SMA or SMK shows different results. SMA graduates from better quality schools pursue more schooling than SMA graduates from relatively low-quality schools. Likewise, SMK graduates from high-quality schools pursue more years of schooling compared to individuals from low-quality SMK. Moreover, the school quality also affects the probability of working, and there is insufficient evidence that SMK quality increases the probability of work participation compared to the same SMA quality. Regardless of the quality of the school, all SMK in Indonesia is still facing limited access and match to the labor market.

Furthermore, the difference in school quality between vocational and general schools is not a significant cause of the difference in return on education between SMA graduates and SMK graduates. However, within SMK, graduates from higher quality SMK earn higher future incomes than those from relatively low-quality SMK. The same also applies to SMA graduates according to differences in school quality. In other words, students from higher quality SMK or SMA increase years of schooling and indirectly have better labor market outcomes than students from less qualified SMA or SMK. Due to the importance of the quality of schools in determining labor market outcomes, the government can implement a policy to improve the quality of schools as stated in Indonesia's Voluntary National Review 2021, including the following: improved quality and competence of educators/instructors, especially with increasing vocational educator/ instructor training according to competence; revitalization and improvement of the quality of learning facilities and infrastructure work practice education; and enhancement involvement of instructors/ practitioners from industry to teach in academic units and vocational training.

Of course, the present study also has some limitations which must be kept in mind. This study limits its coverage by indirectly estimating the effect of schools' quality, both vocational and general high schools, on the return of the graduates' education in the labor market through years of schooling of the graduates. The result of this study is expected to contribute to the achievement of SDG 4, especially target 4.3 related to vocational and general secondary education. However, further public policy analysis has to be conducted to specifically analyze the indicators related to SDG 4 target 4.3 for vocational and general secondary schools.

This study applies the definition of school quality based on previous studies and the availability of longitudinal data from IFLS 2000, 2007, and 2014. The indicators do not necessarily reflect the broad definition of school quality; hence, further studies are encouraged to capture a broader definition of school quality. Moreover, this study only focuses on the effect of educational inputs on years of schooling, the quantity of education. We have not explained the effect on students' academic performance, which reflects the quality of education.

This study does not address the heterogeneity of individuals in terms of the types of majors at vocational school, majors at the college/diploma level, and compatibility with occupational skills. These issues might be addressed in future research once different data sets become available. These analyses will remain highly relevant in the future, given the continuing educational expansion and the rising importance of school quality, especially for vocational high schools.

There are some technical shortcomings of this study that need to be acknowledged. First, the IFLS community data on school characteristics are reported in seven-year intervals and aggregates schools into districts or cities. These issues generate some potential bias because they exaggerate the effect of school quality due to the unobserved school characteristics for each individual or school year (Hanushek et al., 1996). The two-step method we used can directly correlate educational inputs and Mincer's error terms. Several previous studies, such as Bedi and Edwards (2002) and Guo (2018), explained the direct influence of school quality on individual wages as a proxy for effective schooling.

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Commentary

Discourse for Transition toward Sustainability Development in Industrial Ecology Context in Kutai Kartanegara

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1. Introduction

A rich ecological value area within East Kalimantan, Kutai Kartanegara, represents a specific-particular ecological system of an island in a tropical country. Covered by the evergreen forest in the past, it has a closed-loop system formed naturally due to its metabolism. This system maintains the high diversity of nature, which provides abundant resources, both renewable and non-renewable. Owing to its ecological system value, the earth has been numerous beneficial the economic sector both for country and region for decades. Coal, as one of the attractive resources for the energy sector, has contributed over 80% of the GDRP of Kutai Kartanegara in 2010.

Amongst the commitments of countries around the world returning to green resources, coal is still a mainstay to the day due to the low contribution from the other type of regional income such as taxes. The commodity and export value might depict the economic feature of the district from 2013 to 2018. Dinas Perindustrian dan Perdagangan [Disperindag] (2021) reported that coal consistently dominated the export value for Kutai Kartanegara for six years, followed by wood in chips. However, under the revenue sharing mechanism, this sole income has been insignificant for community welfare or reducing poverty in East Kalimantan's highest population region (Martati et al., 2020; Harefa, 2018).

Concerning the contribution of coal mining to the regional income, the proportion does not represent employment by sector. The proportion of GDRP and workforce for the mining sector from total sectors during 2005-2010 takes around 84.63% and 7.9%, respectively. In contrast, the agriculture sector,

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which merely contributes around 6.26% for GDRP, employed around 44.4% of the workforce in Kutai Kartanegara (Badan Perencanaan Pembangunan Daerah [Bappeda], 2014b). As the matter of fact, most of the local workforce occupies an inferior position, while the upper-middle position employed workers from outside (Badan Penelitian dan Pengembangan Daerah [Balitbangda], 2017). Apart from the insignificant income for the welfare of the community, I consider the industrial sector in Kutai Kartanegara to be less useful in absorbing local workers regardless of their quality.

The economic base on natural resources extraction implies the depletion rate of the natural resources and waste production. Its aftermath has already blown in the last decades as the accumulative impact as the result of the disturbance on the 'closed-loop system', not to mention the by-product of the industries. Amongst the poor management practice, the environment as the body of the system has been response to negative feedback in receiving the inputs (Kusnadi, 2021). This might result from attenuation in water regulation and service for ecological footprint assimilation toward the security for food, health, livelihood, and shelter (Bappeda, 2014a; Hansen et al., 2017; Susilowati & Leksono, 2013). The record for social conflicts for mining activity is the loss of land and livelihood of many of the people, including the depletion of buffer area for paddy rice. Even worse, the poor mining practice under weak environmental management aggravates the rate of degradation, and the frequency of disaster compound the conflicts (Pujiriani et al., 2015). The number of disasters for two years (2018-2020) is more frequent by years (Koran Kalimantan Timur, 2021), yet less spatial and temporal monitoring data to explain the phenomena.

The cost for the ecosystem damage presumably corresponds to a Ministry of Environmental and Forestry study in 2013. The natural capital of Kutai Kartanegara counted in Net Present Value (NPV), was lost around Rp. 581,43 trillion by mining activity (Suastha & Kandi, 2016). The economic motives coupled with the need for energy globally constitute the driver extraction and expansion to comply with the energy demand either for local or global. Over the decades, this ecosystem became a supply chain for the primary industry that relied on its natural resources (Indonesia-Investments, 2021; Statistical Review of World Energy, 2021). The awareness of these perils increased due to global concern for sustainability. Nevertheless, down-level governance did not fully understand the strategy and has a classical operational issue.

Kutai Kartanegara occupies the highest level of mining licensing on a national scale until 2009. Around 687 or two licenses per village from a total of 227 villages were noted (Kurnain. et al., 2012). The Mining Advocacy Network Data shows around 625 from 1,190 mining licenses in East Kalimantan are being in this district. Amongst those licenses, around 90 are in Samboja, one of two areas for the new capital city of Indonesia. Based on the Badan Pusat Statistik [BPS] (2017) survey, the survey classifies the big scale industry and middle scale industry on a scale of ≥ 100 labors and 20-99 laborers, respectively. Those represent around 11 oil palm processing plants (CPO and palm kernel) for the big scale industries, and around 8 big scales to middle scale industries for other sectors (comprise of energy, heavy equipment, transportation, wood, electricity, and service). In addition, Plantation Service data shows around 15 mills of oil palm processing for 50 oil palm plantation companies were in Kutai Kartanegara until 2016.

The booming of oil palm plantations that opened in rural areas and its striking growth undoubtedly have changed the rural ecology (Dharmawan et al., 2016). Known as the widest peat hydrological area in East Kalimantan, this middle stream of the Mahakam watershed has been recognized as the Mahakam cascade because of its ecological feature. It has appointed as a provincial strategic area as socialized by Dinas Lingkungan Hidup Kalimantan Timur [DLH] (2020) recently. However, the expansion area of oil palm plantations is presumably associated with the alteration of the lake and river in Kutai Kartanegara. The lakes near the oil palm farm have desiccated and the waters have been cloudy. It is compounded by aquatic biota reduction as recognized by the local community leader. They reported that the alteration of peat ecology showed water stress due to peatland drainage. The river is burdened by erosion mud, and the water is polluted due to becoming the route for coal transportation (Dharmawan et al., 2016). In contrast with the abundance of resources, many isolated villages lack electricity (Dinas Energi dan Sumber

Daya Mineral [ESDM], 2019) or clean water. Amidst the festive competition in depleting the natural resources, the inequality development in this energy barn region more justifies the paradox of the rich region.

Industrial activities are regarded as the major environmental impact contributor, so that the application of industrial ecology is critical to its sustainability. The mutual value exchange amongst the environment and its inherent aspects, such as natural resources, community, and industry, in a certain geographical space corresponds to the Industrial Ecology definition. Furthermore, the presence of industries among communities and policymakers is a potential for industrial ecology application. The application is not merely helpful to optimize the environmental performance for the company but also provides additional value both for companies and local people. I proposed IE to solve the electrification rate problem because of geographical limitations, reducing fossil fuel consumption for the energy sector, reducing waste generation and waste production, outright to creating wealthiness for local people and equality development. Therefore, the local government is a driving actor among the networking partner for IE applications. They are also determining the success of IE application by providing a transformation pathway through its function in establishing the platform, regulating, facilitating, and coordinating.

Concerning the existing situation of environmental issues which interconnected with society and the economy, I argued that the solution by sector could not solve the complexity of the issue chain. However, it is not too late for transformation to start from paradigm-shifting related to the sustainable development concept. The concept of development ensures the plan and manifestation of the current need without sacrificing the living of the next generation. The presence of industries amidst environmental, social, and economic concerns can be designed for Industrial Ecology implementation for sustainable development.

We based the reliability of the sustainable development paradigm on a scientific aspect that is measurable and empirically examined both for the development planning and policy. The challenge in sustainable development implementation is how to embed science in planning and policy. Thus a base-need approach is required, entailed with its analysis using an understandable scientific concept to produce a compatible tool or framework with planning and policy. The Industrial Ecology concept not merely offered measurable and empirical processes, but may ensure the integration of the sustainability pillars in planning and development.

2. Communicating Sustainability from Industrial Ecology Perspective

The fundamental definition of the IE concept is learning from and applying the concept of the natural system. Many countries in Asia (Berkel et al., 2009; Ban et al., 2015; Xiang & Yuan, 2019) and Europe (Lyakurwa, 2014; Domenech et al., 2019) have adopted it in various models to establish or promote a system (Xiang & Yuan, 2019; Raimbault et al., 2020) for sustainable development. However, using the metaphor both for understanding and communicating IE into more familiar domains is extremely needed (Johansson, 2001). Inspired by Wennersten and Gröndahl (2001), that Industrial Ecology is a metaphor of the natural system and its metabolism, thus it bases the system of thinking to develop the sustainable development plan. The dependence of all economic systems on the biosphere reinforces the role of the development model in considering the global biogeochemical cycles at a national or regional level. The global level evidence has shown that anthropogenic activities around the world interfere with the natural system and introduce many substances to the biosphere (Smill, 2001). Due to the continued global impact, many plausible technicals and socioeconomic adjustments may be taken for effective adaptation. Thus, "marrying" the industry and environment for exchanging the input and output is highly suggested rather than contradicting the two.

Climate Change will effects humans globally with floods and drought even though the activities hold locally. An unsustainable environmental theorem in industries practice will eventually threaten their business sustainability with the presence of environmental impact by its activities. The commitment of

industry sectors to reduce emission under 2°C (Paris Agreement, 2015) and emission target to achieve 1.5°C (Intergovernmental Pannel on Climate Change [IPCC], 2018) eventually urge the corporation to adjust their environmental performance. Owing to the commitment, the global industrial sectors have changed towards a sustainable business strategy through the determination of carbon performance to ensure the link of their supply chains corresponds to sustainable practices (Transition Pathway Initiative, 2021). The raw material derived from unrenewable resources or energy will eventually abandon and shift into a sustainable business model. The innovation and technology competition by the industrial sector has reached the stage of breaking away from unrenewable source dependence, both for high-carbon footprint and high-water footprint material origin. Thereby, the country that relied on natural resources extraction for economic will certainly have more serious concerns than those existing problems.

Sustainable Development Report 2021 recently ranked Indonesia at 97th out of 165 countries in sustainable development performance. The low expenses for research and development seem related to the paltry amount of scientific articles. This leads to industry, innovation, and infrastructure weakness, as shown in the 9th SDG (United Nations, 2021). Some indicators cannot be complemented because of the unavailability of data input. The lack of clean water and sanitation indicators, social discrepancy, irresponsibility of consumption and production, climate action, and partnership is the reason for the unavailability of solutions and innovations.

The perspectives of IE can be useful by emphasizing its critical need for specific environmental analysis and decision-making purposes (Lifset & Graedel, 2001). The connectedness among the existing issues ought to include the local sustainability problem and resources potential. Both of them intended to answer the fact of less electrification ratio in the area well-known as the energy barn for country and world globally. The connectedness concept in IE perspective offered a solution to promote environmental quality and additional values for society and industry. It precedes by the resources analysis among the entities in the myriad landscape of the area and promises the development model which able to create an independent and sustainable economic source.

We should clearly define the objectives of IE application and its focus, though it involves a multi-dimension approach. IE adoption means adopting its concept, processes, tools, and management as a comprehensive approach to achieve the goal. The ability of IE to integrate with the widespread applicable method is to support its comprehensiveness, including to assure the implementation corresponds to the system. I propose the core idea in IE to be associated with and optimize the existing development plan. An acknowledgment that the IE model ought to implement in one package and in a long-term period for continuous improvement. By means of these, the IE model's success is more promising than implementing a rhetorical-sophisticated solution.

The effectiveness of IE application has been observed the need for sustainability and suggested the applicability of IE for sustainable social, economic, political, and environmental performance for government both in developed and developing countries (Lyakurwa, 2014). The sharing processes both for resources and by-products among industries, power stations, and public facilities in Kalundborg are examples of IE utilization by government and industries. As for the successful implementation of IE ideology by government and industries, they mentioned it as the vital role of a country in providing policy and legal framework both for support and enforcing the environmental laws (Berkel et al., 2009). Having the local institutional structure together with regulation is necessary to support IE implementation. They have claimed that the largest barriers to the success of IE implementation on the grassroots level are caused by the poor community service and the lack of social legitimacy due to political integrity (Opoku, 2004). Both the former and the latter show that embedding the IE in politics should be considered seriously. Other findings convinced that a careful contextualized and a localized need-linked effort can shift the models of an industrial ecological system to become meaningful politically (Salmi & Toppinen, 2007). I am convinced that some respective research foregoing has redefined or translated the scientific community needs through scientific concepts and ideas into a more understandable definition.

Furthermore, the government needs to consider the incorporation of the concept into planning and policy as a significant political strategy to support sustainable development.

2.1. Framing Science into Policy

Framing the development goal based on the IE context is reliable and effective, including embedding IE into politics. Salmi & Toppinen (2007) probes the mechanism of embedding scientific ideas through a framework analysis for wide use. Even though it was a scientific idea and policy instrument at its initialization, yet they have used it for the natural resources management model. It has provided a breakthrough in problem-solving both ecologically and economically of where it was originated, the Kola Peninsula. There are several important aspect analogs of IE or what is so- called complex utilization. First, the metaphors and boundaries object of the natural resource ought to be set accordingly. Second, the proposed model should integrate a system and support connectedness in demand (input) and production (output) among the entities local and or regional scale (Salmi & Toppinen, 2007). The translation effort of the scientific context and IE should undergo issue framing and comprehension building into action. Appointing a particular aspect to communicate the issue is suggested prior to comprehending it to embody the guidelines. Addressing the environmental damage as the result of poor industrial practice based on facts is a framing example for a careful environmental design where the waste production should consider the existence of nature and its components (Salmi & Toppinen, 2007).

2.2. Redefining and Translating IE Through Understandable Definition

Introducing IE as a sustainability tool provides the holistic framework for guiding the transformation. The conceptual approach of closed-loop ecosystem characteristic is underlying the system of thinking in replicating and simulating the environmental design. Visualization of an engineering system is better to comprehend the processes, examine the design, and optimize the model rather than a mere rhetorical form of guideline. The transformation of qualitative information into an accountable manner (measurable) to result in the applicable tools is promising practical use as the plan and development tool.

2.3. The Connectedness of Sustainable Development Goals-Government Program

The connectedness between government programs with or aligned with SDGs might provide an opportunity to introduce and embed IE. Interpreting the national strategic plan, which aligns with SDGs seems not fully understood by local government and cannot communicate at the operational level. Even though this problem is still vague yet obviously, the implementation is not fruitful regarding its alignment with SDG. In addition, the breakdown of local government programs does not reflect the necessity of this alignment in managerial and operational level performance.

Since IE ought to implement in a full package to convince its success, embedding IE in local government programs provides a new discourse and might be helpful for government target achievement because it is aligned with SDGs. In addition, this package might provide a discourse for guidelines on performance standards of governance improvement at each stage, from managerial to operational.

3. Transformation Preparedness

3.1. Strategy, Policy, and Legal Framework

Based on the findings of the barriers to developing the connectedness (the Industrial Symbiosis), the combination of authority, public participation, and partnership might propose. They addressed the collaboration of these governance modes to support the sustainable development model in the IE context lately (Sodergen & Palm, 2021). The strategy and policy correspond to the aim is a precedent in transformation processes for further developing the respective legal framework. Pertaining to the IE implementation, these entities are subject to comprehensive analysis, such as the potential exchange value (trade-off), existing initiatives, and applicable regulation.

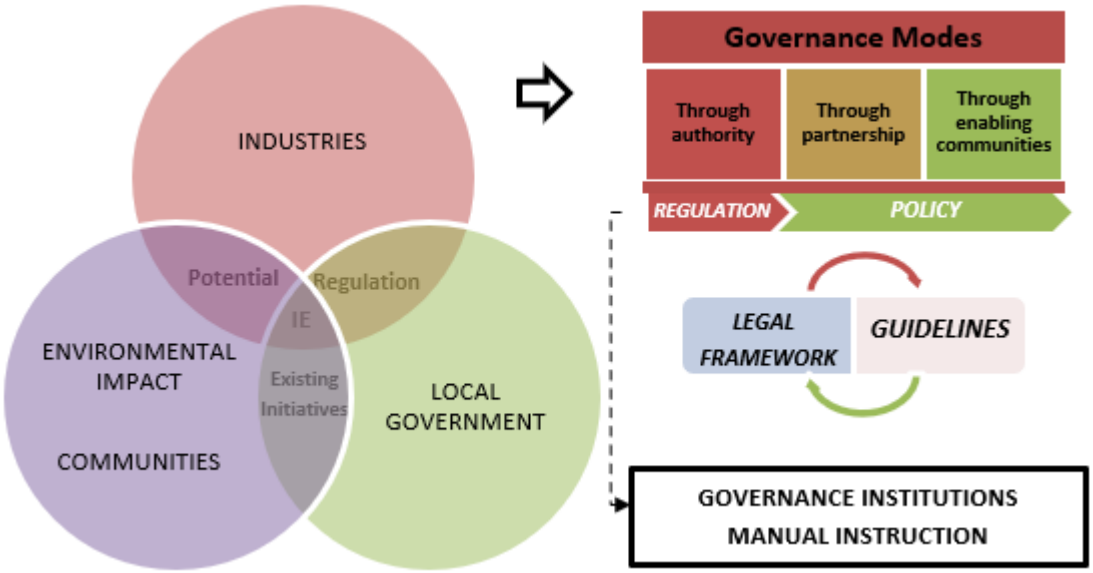

Figure 1. Strategy, Policy, and Legal Framework

The practical guidelines for public authorities and business development organizations on developing and implementing the Industrial Symbiosis of the ecosystem and good practice of IS in the Baltic Sea Region might be adapted to local conditions. Conditioning the pathway for transformation can achieve by developing a legal framework to regulate:

a. Mainstreaming the corporate social responsibility towards IE development.
b. Promoting the connectedness advantages among actors through education in a broad sense, simplification of the access for the public, and capacity building under their role.
c. Localizing Industries and research institute linkage to ensure the sustainability business of the private sector.
d. Integrating the development of the instrument package into the vision and strategic roadmap to ensure its continuity for future scenario plans.
e. Mapping the entities along with its material flow and shared information among respective actors.
f. Rewarding and promoting initiatives and talents contribution according to the alignment or best practice of the connectedness system among stakeholders.

g. Local and regional potential mapping regarding the connectedness strength, including local people for innovation and entrepreneur discovery.
h. Establishing solid networks and trusted systems to cultivate and maintain an active leadership role among respective actors.
i. Recognizing leading industrial role in coordinating the connectedness platform about the interest of their business sustainability.

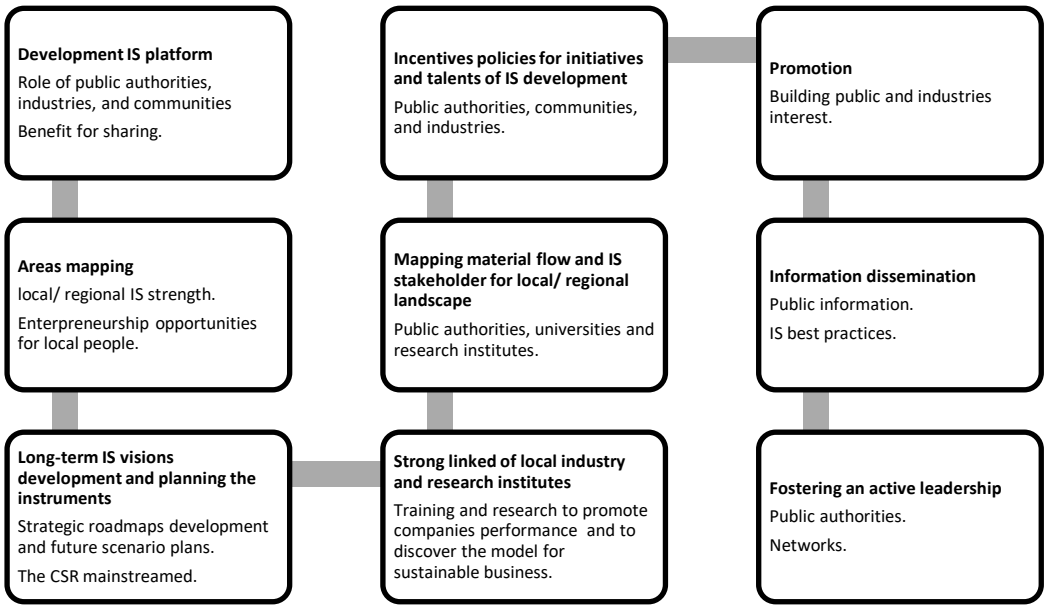

Figure 2. Adopting guidelines for transformation pathway

Amidst the global goals for sustainability, the industrial symbiosis financing models of the private sector are many to be adopted as the platform. We must understand the collectivity and connectivity regarding the global action in leading the sustainable development paradigm as an opportunity for affiliation and collaboration (Xiang & Yuan, 2019), notably for the third world countries amid a whirlpool of sustainability issues. The role of local government in promoting the initiatives and good practice of sustainability are critical to providing connection nodes for collaboration globally.

3.2. Document Planning

A spatial agent-based model is recommended for a complex system where the industry activities together with its waste are concomitantly exist in a geographical feature and space, including the inherent aspects that might affect. It has been used where the dynamic of a sustainable economy and its network is necessary to model. The presence of prescribed rules or boundaries among the interactions enables the observation of system behavior. This spatial arrangement-based model offers the ability to include the empirical data based on the boundary and the flexibility to use in various objectives, entailed with the analysis (Raimbault et al., 2020). An incentives policy might be proposed concerning the lack of data and information as a classical problem in local government. This could encourage the performance of empirical data achievement, including information sharing. The diagrams below visualize the self- governance of local government for planning.

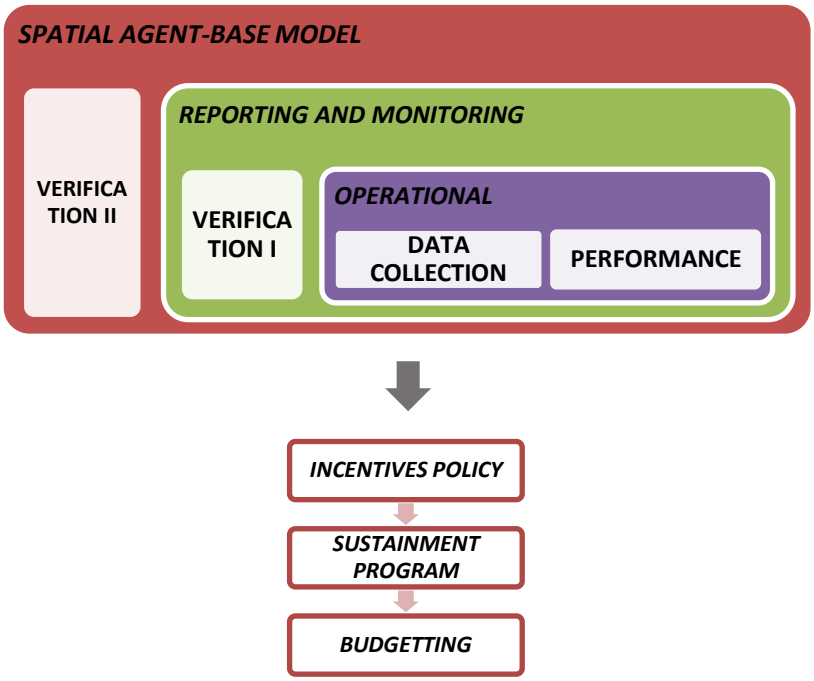

Figure 3. Self-governance for planning

3.3. Enabling Community Engagement.

According to recent research, linking government through enabling shows the strongest correlationbetween local government and IS network (Sodergen & Palm, 2021). I mainly addressed it to overcome the barriers for local government as economic, regulatory, social, and information through integrating and coordinating the actors within the network. Lack of willingness to collaborate and social isolation between organizations depend on how local government effort to convince the public through their function in promoting, facilitating, building the network for industrial symbiosis. The local government also can play a role as a knowledge broker and provide a platform for joint data and information sharing to overcome the lack of community awareness and technical knowledge.

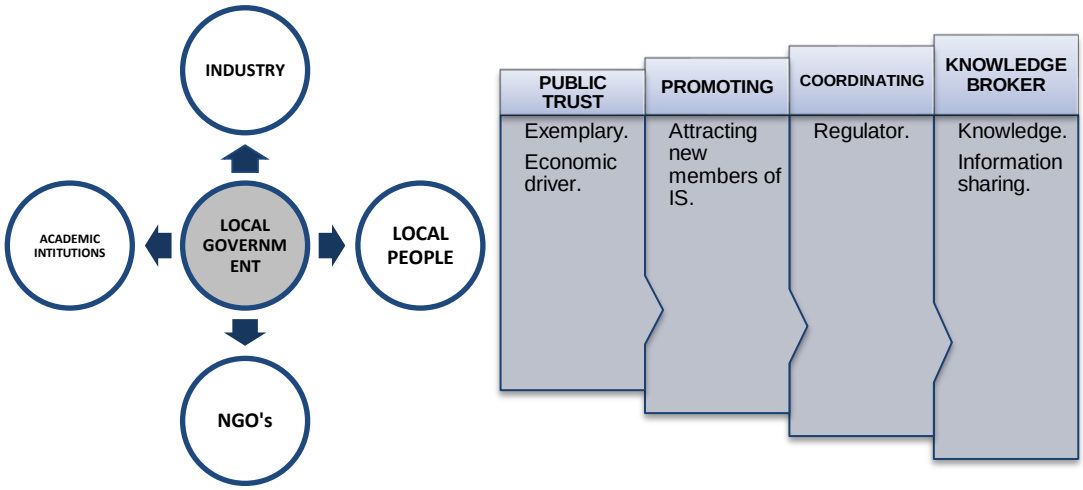

Figure 4. Governance Mode by Enabling IS Network

4. Proposing a Framework for IE Implementation

The local government might start from the existing initiative to develop program alignment with IE to linked. Here is the district government program linked Industrial Ecology concept.

Table 1. The connectedness of existing programs and initiatives with the IE concept.

Philosophy of Current Development (2021-2026)	Mision	Environmental and Forestry Program	Program Description	Ongoing initiatives and/or service	Proposing Framework
Innovative	Establish a clean, effective, and efficient bureaucracy and serving.	Environmental-Friendly Village	Incentives for environmentally friendly management	Not available	Innovation, promotion, and information disseminati on.
		Environmental Awareness	Monitoring waste management, including its facilities and infrastructures.	Environmental Protection and Conservation	Monitoring through industrial ecology design.
		Environmentally friendly business practice	Strengthen Environmental Impact Assessment and facilitate one million trees at reforestation and reclamation area.	Environmental Impact Assessment and environmental law enforcement	Industrial ecology design based on geographical featuresand environme ntal impact assessment.
Competitiveness	Improving human resources development within noble, prominent, and ethical.	Environmental Awareness	Incentives for environmentally friendly management	Forest management and conservation	Incentives policies for initiatives and talents of IS developme nt and fostering active leadership.
Autonomous	Improving environmentally friendly management of the natural resources.	Environmental-Friendly Village	Bio village	Land carrying capacity inventory	Symbiosis environme ntal design based on geographical features.
		Environmental Awareness	Waste Dump Facilities at respective district priority.	Land carrying capacity inventory and environmental protection and conservation.	Industrial symbiosis design based on geographical features and risk assessment.
	Strengthening economy-based agriculture development and creative economy.	Environmentally friendly business practice	Monitoring waste management, including its facilities and infrastructures.	Environmental Impact Assessment	Industrial ecology design based on geographical features and environme ntal impact assessment.

Philosophy of Current Development (2021-2026)	Mision	Environmental and Forestry Program	Program Description	Ongoing initiatives and/or service	Proposing Framework
	Improving the quality of basic infrastructure and connectivity among regions.	Environmentally friendly business practice	Monitoring waste management, including its facilities and infrastructures.	Environmental Impact Assessment	Symbiosis design based on geographical features.

Source: Vision and Mision of KUKAR IDAMAN (2021-2026) and Program of Dinas Lingkungan Hidup dan Kehutanan (2021).

Meanwhile, Regional Spatial Planning Service and Environmental and Forestry Service have an ongoing program that could be considered the ongoing initiatives with potential for IE framework implementation. Further outlook is needed to evaluate to what extent those initiatives and/or services on its achievement to support the requirement for the framework.

Ongoing Initiatives and or/ service	Requirement for framework
•Regional spatial change	•Mapping the entities •Licensing issuance •Defineing the boundary
•Land carrying capacity inventory	•Material flow
•Environmental Protection and Conservation	•Material flow
•Environmental Impact Assessment	•Company environmental management •Corporate social responsilbility
•Environmental Law Enforcement	•Public trust
•Forest management and conservation	•Connectedness of government institution, local people, NGO's,and academic institutions.

Figure 5. Potential support for framework requirement

This linkage merely connects the current development program with two institution programs. The connectedness among other institutional programs is strongly suggested to enhance the effectiveness and efficiency both for budgeting and controlling and to increase the potential of value exchange. Even though a wider pattern connectedness will provide more potential exchange value within the system, further analysis of the technical potential and limitations should be considered.

Conclusions

Sustainable development requires a transformation that collectively encompasses governance, the industrial sector, and society to synergize and adapt with sustainability instrumentation. Even though this transformation process requires a long-term period in its goal, it is not too late to begin. The lack of infrastructure in a developing country could be regarded as an opportunity for infrastructure development through environmental planning and design, which aligned the development model. As a result, infrastructure development costs might be efficient and can optimize according to achievement level and sustainable development target.

The initiatives aligned with sustainable development are essential to entail and adjust with sustainable development model framework to speed up the transformation processes. The transformative policies are mandatory as sustainability instrument packages that ensure the implementation until the operation level. Last but not least, it should apply the instrument thoroughly for sustainability and completion to ensure the success of the sustainable development model. The transformation requires full support from the whole stakeholder and society and a political sacrifice. This is because the transformative policies in practice often faced the political interest and business as usual. Nevertheless, the transformation will determine development sustainability and secure the current and future livelihood.

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Book Review

The Foundation of Social Analysis: Interest Approach

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Introduction

The book entitled 'Interest' is a theoretical elaboration in social sciences written by Richard Swedberg and published by Open University Press in 2005. The book cover is simple, designed with light blue as the cover base, the purple-colored title. Under the title is an illustration of a puzzle that is not yet perfectly formed. The illustration basically hints at an effort of the book in accomplishing the theory of interest. Indeed, throughout the book, Swedberg generally works hard to compile and consolidate the progress of interest as a fundamental concept in social sciences. The book is not directly elaborating or studying about sustainable development studies. However, the theory of interest is obviously helpful in providing a solid perspective in analyzing development issues such as conflict, corruption, policy, and participation.

Interest Theory in Sociology

The Richard Swedberg's book has five chapters. Chapters 1 and 2 mostly trace the history of interest concept from the nineteenth century or during the industrial revolution in Western Society. Those chapters show the early approach on interest concept, interest as a driving force and a major force. Interest as a driving force means that all humans intrinsically have an interest in their bodies. While as a major force, interest is the result of social dynamic, in which the influence of social structure and interaction contributes to constructing interest. Chapter 3 is the foundation of the approach to the concept of interest from the perspective of the social sciences by elaborating the philosophy of interest among leading scholars from Gustav Ratzenhover, Max Weber, George Simmel, to Pierre Bourdieu. Chapters 1 to 3 are keys to understanding the theoretical approach to interest that Swedberg offers in Chapter 4. Chapter 4 is the original thought of Swedberg that offers a new concept of interest to conduct a social analysis. Chapter 5 is a case of interest analysis as a tool analysis.

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The interesting part of Swedberg's book is his effort in chapter 4 at formulating a new approach of interest as a theory, interest as activity, and interest analogy. However, before discussing the core concepts in Chapter 4, it is necessary to understand the development of the theory of interest in the historical phases of its development from Chapters 1 to Chapter 3. Briefly, those chapters explain the concepts of interest developed in European society since the industrial revolution era in the 19th century. The philosophical elaboration from Rochefoucauld, David Hume, Adam Smith, Alexis de Tocqueville, Karl Marx, and many others will lead readers to an interesting preliminary analysis of interest. However, at the beginning of its development, the concept of interest was viewed more as material goals or self-interest. In Chapter 3, Swedberg begins elaborating the development of interest from the social sciences perspective, where interest is no longer seen as a material goal and an intrinsic desire. Chapter 3 consists of two perspectives of interest concept led by Gustav Ratzenhover with the concept of interest as a driving force and Max Weber as a major force.

In Chapter 4, Swedberg further clarifies, following the previous chapter, the distinction between the concept of interest in economics and social sciences, including political sciences and sociology. Economics defines interest only as an economic interest or economic self-interest (Swedberg, 2005: 79). Meanwhile, social sciences conceptualize interest with more dimensions rather than only economic interest. However, there is an important intersection between the concepts of interest in economics and social sciences. The interest of an actor is not only generated from an intrinsic want or private interest but social environment such as public pressure.

What is new in Swedberg's thought, among other theories on interest, is to catch the meaning of interest through the analogy of 'following signpost' as the part of 'activity' or 'form of life' (Swedberg, 2005: 96). A signpost is something with a meaning provided by rules, norms, and social values. The analogy of the following signpost indicates that the meaning of interest can be reached in a certain type of activity. There are two conditions of the analogy. First, the actors' decision to choose the direction of a signpost is seen as activities and a physical comprehension of body movement. Therefore, if actors pursue an interest, they will mobilize their bodies at stake. The body movement gives a force and existential dimension to the process of interest realization. Second, the actors of interest have a distinct and special level of consciousness. Each actor has a different way and level of consciousness. In this part of the analogy, that interest is signed by the actors' body movement, not only the mind but also have a special mindset for their activity to result in interest.

The analogy has "three components the actors, the signpost, and the activity of following the direction of signpost" (Swedberg, 2005: 96). Actors can be influenced by other factors such as tradition, habit, and affection, which means that the actors only follow those factors. However, it primarily happens at an early stage of society. When the actors are more aware of their own interests, they try to realize interest intentionally. Therefore, the actors follow the signpost when they know their distinct interest and want to get it. Actors must intentionally orient their behavior to the signpost in which the actors are required to have a decision capacity to follow the signpost or not. At the same time, many signposts exist due to many interests in society such as religion, economic, and love.

Actors are possible to go in many directions by following the signpost. However, private interest will be more difficult to realize than publicly known and acknowledged interest (Swedberg, 2005: 97). An example of this is corruption or anti-corruption action. In an environment dominated by the meaning of interest about bribery as something acknowledged, the interest of anti-corruption will be considered a private interest. Therefore, the actors with the interest of anti-corruption will find it difficult to realize their interests. Another example can be seen in the wasting behavior of a community. When the meaning of interest in wasting behavior or signpost, 'throw trash in the right place' is publicly acknowledged, the actors with private interest that 'throw trash in the wrong place' will have a hard time realizing their interests. The realization of interest, between private interest and public interest, is influenced by the notion that the signpost has a physicality or resistance. Physicality and resistance of signpost, according to Swedberg, signify a force that is out of individual immediate control. Sociologically, the concept of physicality and resistance can be understood as a social structure in the tradition of positivism. A social structure of positivism tradition, such as the theory of structural functionalism of Talcott Parsons, provides what is known as an objective reality that can change the actors' actions.

Signs are not always clear and definite and sometimes can be vague. The vague signpost does not define detailed direction. As an illustration in a daily experience, a driver knows the signpost that instructs to turn left to get an alternative way. However, the signpost does not provide more detail about the map of the road. This is the situation that an actor or driver needs to handle. Inspired by Max Weber

theory, Swedberg offers a mental disposition composed of distinct awareness and lack of bound feeling. Mental disposition is the capacity to make a decision. A capacity means a readiness to think and act intentionally. Do all actors have a mental disposition? At this concept, generally, researchers in social sciences, including sustainable development studies, can conduct research about related issues. For example, research on women's participation in a village development plan. Do women have mental disposition in the village development plan in the context of patriarchy institution as a signpost? This research can examine whether women's interest has a capacity to follow or even redefine a patriarchal institution during their participation in the village development plan. Participation in this topic is part of women's interest in influencing village development plans.

Last but not least is explaining and understanding how the actors form or create an action to pursue an interest. Since there are many signposts in life, Swedberg does not agree to see interest realization with a single or narrow concept of self-interest. Actions are not merely about the calculation of actors rationally or instrumentally. Actions as an instrumental occur when actors rationally calculate an action as a means to achieve a goal, as in economics called 'cost and benefit analysis.' The reality of a large number of actors in society also illustrates the existence of many signposts. This means that there are many ways in which actions can achieve interests. An interest has its own purpose that is different from other interests. Therefore, the means of action to achieve material and immaterial goals can be different. In addition, each actor has a different mental disposition from one another. Fundamentally, Swedberg implies the need for contextual research from every action related to efforts to realize interests.

The approach of 'activity and analogy' on interest by Richard Swedberg will be a useful perspective for researchers in sustainable development studies. Many issues can be analyzed with this approach to practically recommend a strategic policy, especially in government. The theory of interest by Richard Swedberg also provides a case of interest analysis as a policy tool in Chapter 5 that will help use the theory of interest in many research issues in sustainable development studies.

Conclusions

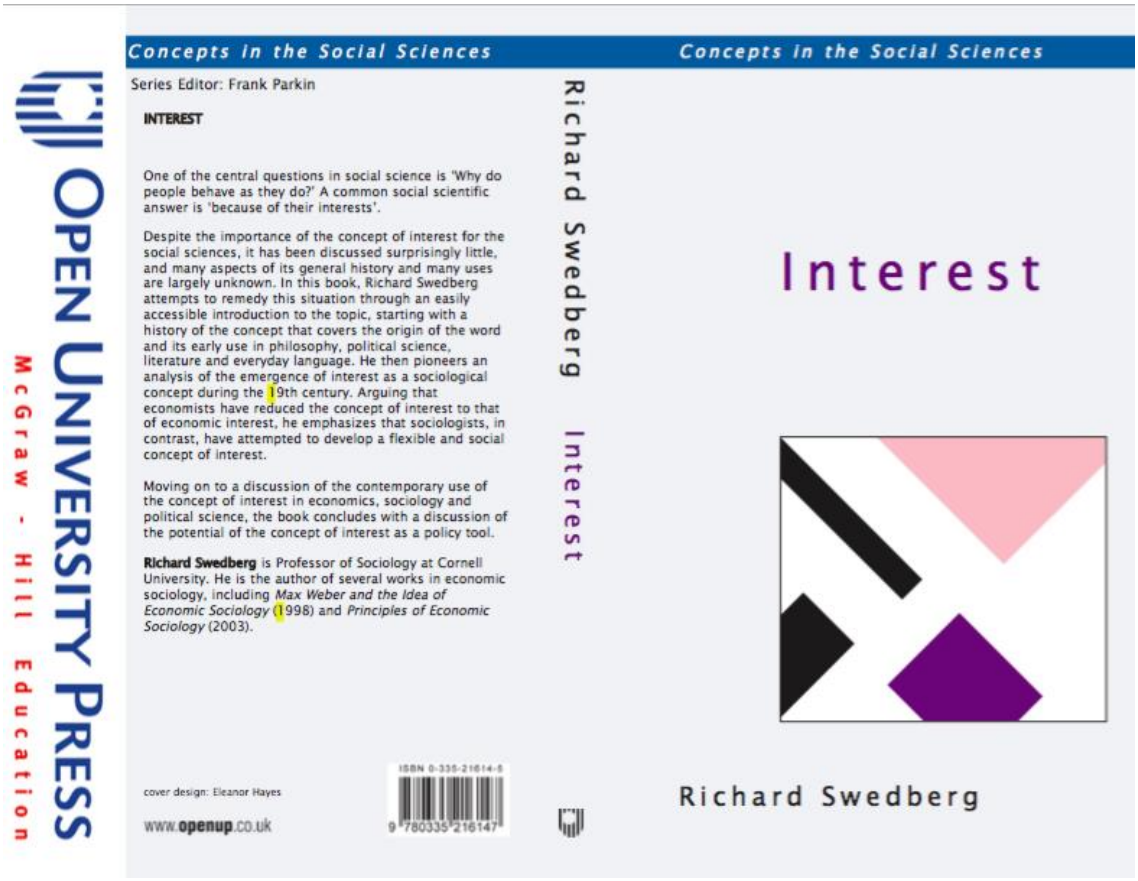
The book entitled 'Interest' by Richard Swedberg aims to examine the development of interest theory from the 19th century or the Industrial Revolution era. This book has succeeded in clearly mapping out the theories of interest that have developed. First, interests are analyzed as a 'driving force' and a 'major force'. Second, interest is seen through the concept of self-interest, which is supported by instrumental actions (economics) and non-material actions (socially). Third, a new approach in interest analysis called 'activity and analogy' elaborates the concept of actors, signposts, and activity following signposts.

Why should one read Richard Swedberg's interest analysis approach? The interest analysis approach in the book 'Interest' is a theoretical foundation that is useful for academics and researchers in social science and sustainable development studies. Through the analysis of this approach, academics and researchers are able to understand the underlying problem of why and how actors create an action in certain cases. The results of the interest analysis of cases in sustainable development issues such as environmental issues, governance, participation, and others will provide a policy guide for dealing with issues or formulating new policies.

The Book Rating

As a foundation of theoretical thought in social sciences, the book 'Interest' is compulsory reading in which many scholars in social sciences can easily comprehend. This book gets five of five stars rating in the author's view.

The Cover book



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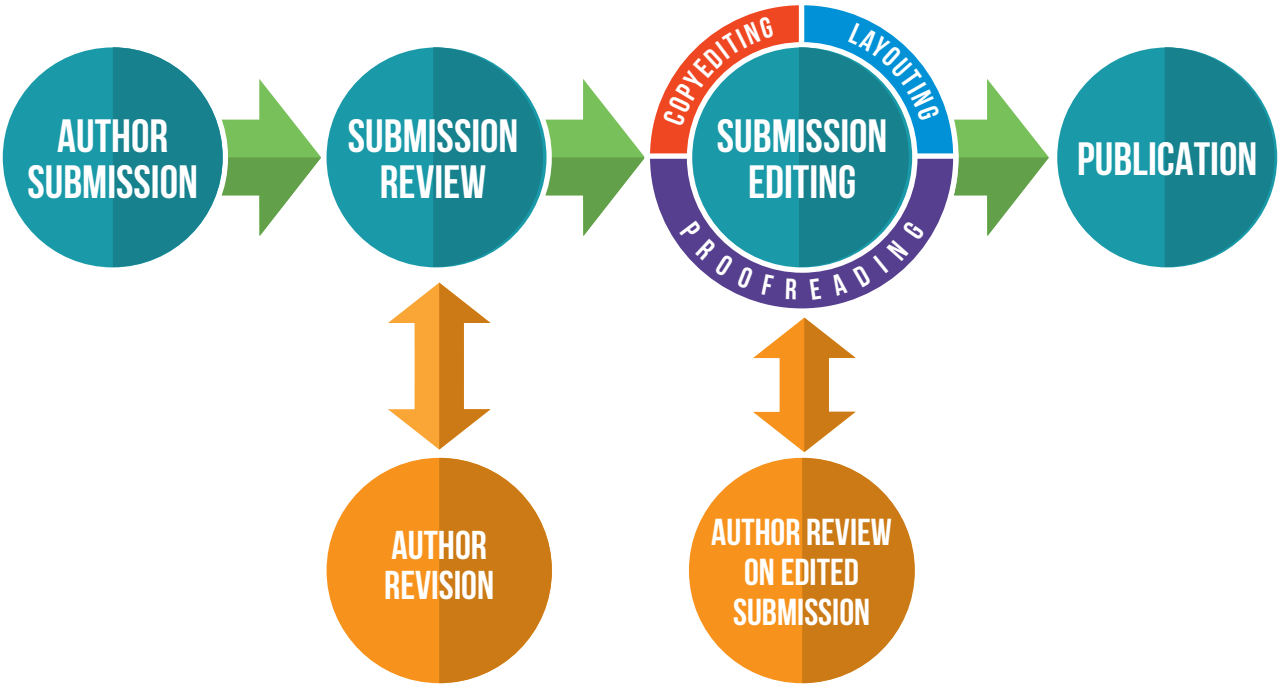

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- The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
- The submission file is in OpenOffice, Microsoft Word, or RTF document file format.
- Where available, URLs for the references have been provided.
- The text is single-spaced; uses a 10-point Calibri font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
- The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.
- If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Blind Review have been followed.

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