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Contents

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Editorial Notes

Post-Pandemic Development: Sluggish or Rapid Recovery?

Dharendra Wardhana

Editorial Team

The year 2020 will be recorded in world history as one of the most challenging periods. With the benefit of hindsight from previous crises, humanity will eventually (and this time hopefully) prevail. Covid-19 pandemic which has been around for a full calendar year sets a reminder and a call for us to adapt with new mindset to embrace new normal in our life. Not many countries can strike a delicate balance between saving lives and protecting livelihoods during this difficult time. Obviously, most developing countries have been struggling to control this seemingly intractable calamity from the first day of the outbreak.

Covid-19 pandemic has sent the world one strong message, it is that we are only as safe as the most vulnerable among us. This vindicates the central place of solidarity in our life. While we are predicting the emergency-authorized vaccine as the "game-changer", estimating the outcome in the following years leads us to numerous possibilities and scenarios. Questions surrounding vaccine distribution, efficacy rate, and unintended consequences will still linger. Narrowing down the probabilities will lead us to two contrasting scenarios either growth will be propelled immediately or growth will not be accelerated due to various factors.

Echoing previous editorial note, the impact of Covid-19 pandemic to SDGs targets (also to other global and national development plans) can be mixed. The quintessential question is on how we maintain positive outcomes when the pandemic is over and how to get back on the right track. Apparently, many development targets need to be revised and some if not most of them might not be easy to catch up. This situation arguably sets a backdrop for "the great reset" where all development strategies need to be restarted, policies have to be scrutinized, and targets must be re-calibrated.

Undoubtedly, making prediction these days is not an easy job indeed. Too many variables and events need to be taken into account so as to reflect the complex world we live in. Sophisticated statistical methods and state-of-the-art computation technology do not really guarantee the accuracy. It only needs a shock which makes our prediction becomes irrelevant. Many these days acknowledge VUCA (volatility, uncertainty, complexity and ambiguity) as inherent characteristics of modern development. This poses serious challenges for those who work as planners in various contexts. Revising our projection might increase credibility but nobody knows for how long the revised targets will remain in a dynamic setting like nowadays.

The year 2020 gives a lesson that we seemingly learn the hard way. One important lesson is on finding the correct perspective in viewing government spending. For many years we have seen the dominant role of government spending in development and it becomes more prominent when economy stagnates. However, we have also been constantly looking for the better way to increase quality of

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spending and more importantly: the way we measure it. Apparently, it seems, current measurement is inextricably linked with rigid public accounting standard which does not allow much flexibility and largely fulfils an administrative purpose. Sadly, it tends to normalize the "gold standard" of government spending: "the more we spend, the better" which unfortunately reveals the downside of such spending pattern. That explains the acceleration of absorption rate at the end of fiscal year, anecdotes on spending frenzy, and whimsical disbursement for the sake of spending.

Alternative measurement like efficiency score needs to be introduced immediately as a replacement of current performance indicators which is merely based on the monetary-based absorption rate of annual budget. A simplistic method of budget absorption rate might still be relevant with tangible projects like infrastructure but it might be barely sensible within the context of intangible activities such as research, studies, advisory, and other knowledge sector-related projects.

In order to reduce the Covid-19 contagion, governments opt to mobility restriction which consequently causes almost entirely business activities into hold. Travelling and MICE industries—which arguably predominates government spending on knowledge-sector as well as one of the most prioritised sector in economy—have been hit the hardest during the pandemic. The inefficiency problem has been rising into the surface and this time should attract more attention to the policymakers and scholars. This sends an urgent call for those who are competent to develop a correct alternative to measure one's performance.

Indeed, government spending is considered as the prime mover during difficult time and plays pivotal role to accelerate economic recovery. However, the quality of spending will determine the policy effectiveness. Mobility restriction brings a corollary that practices like working from home, digital economy, and assistive technology become a new normal. Numerous companies in developed countries pledged to resume this highly efficient and environment-friendly practice even after the pandemic. Yet, we have to ponder upon this shift into the context of developing countries where informal economy is still rampant with labor force population entering its peak. Probably unbeknownst to many, this "inefficiency" and negative externality (air pollution, road congestion, disposed waste) somehow correlates with employment creation and significantly acts as economic multiplier. Finding the balance between "multiplier" and "efficiency" on government spending is therefore another issue should be on the problem-solving bucket list. With quality spending, the policy effectiveness will lead to better outcomes which hopefully will bring rapid recovery.

Not only have the Covid-19 crisis taken a heavy toll on people's lives, it also made a dent in global economy. Its adverse impact on jobs, livelihoods, poverty and inequality has been reversing some of the gains that countries had made over the past few decades. To contain the damage, countries the world over have been adopting and adapting various policies to protect their populations and stabilize the economy. Problems and challenges that remain unsolved before the pandemic have been looking for solution. Therefore, in this issue we invite authors from diverse academic backgrounds to present their works not exclusively revolving around topics on Covid-19 pandemic but also to other important themes such as poverty (Nuryitmawan), urban planning (Sari et al), public finance (Putri), disaster mitigation (Erlinna), environment (Yazawa and Shimizu), electricity-saving behaviors (Aufan), middle class (Pratomo et al), and tourism (Warganegara). We invite the readership to give us feedback on these articles and we surely welcome submissions on other topics from all fields of science in the upcoming issue.

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Research Paper

Can Credit Recipient Household Escape from Poverty?

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Abstract

This study aims to answer whether or not financial distribution can play a role in development and poverty alleviation in Indonesia. Households who receive credit are treated as the analysis level and research object. Credit is an instrument to help households escaping from poverty. Some opinions believe that by being given credit, households will be able to boost their economic capacity both in terms of purchasing power or business development capacity. However, to prove this opinion as well as to answer the question, using panel data from the Indonesian Family Live Survey (IFLS) in 2007 and 2014 will attempt to estimate the effect of the probability of households receiving credit on their poverty status. The probability of a credit recipient household will be calculated using Propensity Score Matching so that a similarity score of household characteristics will be obtained between those who get credit and those who do not. Using Double Differences, this study will address the description of changes in household poverty status after receiving credit from financial institutions. The PSM calculations results show that there are four variables as credit recipient household's characteristics, namely collateral ownership, the status of property ownership, history of natural disasters, and gender. Meanwhile, the estimation results on poverty status indicate that credit recipient households have a greater probability of escaping poverty than those who do not receive credit. Therefore, the anti-poverty policy through the transmission of financial institutions is relevant to be prepared. The anti-poverty policy is related to low credit interest rates through government subsidies, public fund placement with low cost of fund, increasing financial literacy and knowledge of the society, and adjusting credit approval based on regional economic conditions.

Keywords: Household Poverty, Credit Approval, Impact Evaluation

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1. Introduction

Research on poverty shows that there is a significant relationship between financial inclusion and poverty alleviation. The United Nations (UN) has explicitly advocated the development of an inclusive financial system since 2005. The history of financial institutions such as Grameen Bank in Bangladesh, Banco Solidario in Bolivia, Latin America's Village Bank, and Bank Rakyat Indonesia in Indonesia show that financial inclusion is an effective tool for achieving poverty alleviation and sustainable development (Morduch, 1999)

The relationship between the development of financial institutions and poverty alleviation is believed by many to be a good policy. Jaililian and Krikpatrik (2005) studied the impact of financial development on poverty in developing countries. Jaililian and Kirkpatrick (2005) provided empirical evidence about the causal relationship in the scheme of poor households' access to credit at low prices. Odhiambo (2009) looked at the causal relationship between the development of financial institutions and poverty alleviation in Kenya and Uddhin (2014) in Bangladesh where their findings are if the financial system develops well, the multiplier effect arises is reduced poverty.

A good financial system is a massive and comprehensive one. Comprehensive means easily accessible and beneficial for the whole social strata. It is by the definition of the Financial Inclusion concept. Bank Indonesia (2014) defined financial inclusion as an effort to remove barriers in accessing financial services both price and non-price. Financial inclusion is also referred to as an additional solution and a powerful way to alleviate poverty (Chibba, 2009; Kiendrebeogo & Minea, 2016).

Looking at the role of financial inclusion in poverty, the financial stakeholders strive to establish the role of financial institutions in a more tangible economic development. A visible role in economic development and community welfare realization is through credit distribution. Data from Otoritas Jasa Keuangan or Financial Services Authority (2017), until 2016, banking stakeholders have distributed loans up to 4,709.5 trillion rupiahs while the finance companies have channeled 387.5 trillion rupiahs. On the other hand, pension funds have increased to 228.8 trillion rupiahs higher than in 2015. Each stakeholder of the financial institution, in addition to profit-seeking, also seeks to realize the community welfare through its service products. For more details, see Table 1 below:

In addition to the finance distribution, in terms of funding as well as the nominal of saving account numbers also happens to grow. OJK (2016) mentioned that within eight years, the total savings of commercial banks increased by 82.7 million (141%). To achieve the goal of being easily accessible to the whole social strata, the LAKU PANDAI program is aimed at people who live in remote or rural areas. These various efforts increased Indonesia's financial inclusion index to 67.8 percent in 2016.

Table 1: The role of the Financial Service Industry in Indonesia.

	2013	2016
Banking Credit Distribution	Rp. 3.585,8 Trillion	Rp. 4.709,5 Trillion
Stock Market Capitalization	Rp. 4.219,0 Trillion	Rp. 5.753,6 Trillion
Gross Insurance Premium	Rp. 193,1 Trillion	Rp. 212,9 Trillion
Accounts Receivable of Funding	Rp. 348,0 Trillion	Rp. 387,5Trillionn
Investment of Pension Fund	Rp. 157,6Trillionn	Rp. 228,8Trillionn

Source: Otoritas Jasa Keuangan and Bank Indonesia, (2017)

Despite the Financial Inclusion Index increment, what should be underlined is if the high Financial Inclusion Index has an impact on the number of poor people and an increment in living standards of the community. To find out these impacts, a poverty portrait is needed before and after the inclusion index exists. Referring to the Indonesian poverty data (Figure 1), there was indeed a poverty trend continued to decline from 1970 to 2014. In 1970, 60 percent of the Indonesian population was poor. In 1990 there was an improvement where the poor fell by 15 percent. The achievement in the 90s exceeded the proportion of the world's population living below the absolute poverty line. However, in 1997 Indonesia was heavily affected by the Asian currency crisis which caused the poor to rise 10.7 percent above the world average even though after the crisis period it gradually improved (Yusuf & Sunmer, 2017). So, it can be concluded that poverty always has a sensitive conjuncture to change. This sensitivity is because poverty is a multidimensional phenomenon. There are many reasons why people might become poor thus the formulated anti-poverty policies are also multidimensional (Dawood et al., 2019; McCulloch & Calandrino, 2003; Todaro, 2000; Weber & Jensen, 2004).

This study will examine the impact of household access to credit on poverty alleviation efforts in Indonesia. The idea is based on an explanation of the financial inclusion concept which is considered as an alternative way to reduce poverty from a unique channel namely financial institution. The reinforcing point for this idea is the success of Asian and African countries implementing credit as a powerful policy since it reaches the target of financial inclusion as well as anti-poverty. Also, some studies on dynamic poverty include aspects related to financial inclusion as the main variables releasing a person from poverty (Alisjahbana & Yusuf, 2003; Dartanto & Nurkholis, 2013; Dartanto & Otsubo, 2016; Fields et al., 2003; Khandker, 1998b; Kim et al., 2009; Lanjouw & Ravallion, 1995; Latifa et al., 2018; Wkh et al., n.d.; Xue & Zhong, 2006).

2. Research Background

2.1. What is Poverty

In this study, we analyze the impact of access to credit at the household level on poverty status. Before performing the econometric estimation of such an impact, it would be better to understand poverty itself. According to the World Bank (2000), "Poverty is pronounced as depreciation in well-being". This then raises the question of what is meant by well-being and what is the basis for the deprivation measurement (Khandker & Haughton, 2009). The most widely used approach in defining well-being is expressed by Sen (1988) in Khandker and Hougthon (2009) that welfare comes from the ability to function properly in a society. Therefore, poverty, in this case, arises when: “people lack key capabilities, and so have inadequate income or education, or poor health, or insecurity, or low self-confidence, or sense of powerlessness, or the absence of rigwht such as freedom of speech”.

According to this view, poverty is a multidimensional phenomenon causing uneasy solutions to poverty. Mujumdar (2001) formulated three prominent features of poverty in Indonesia, one of which is multidimensional. Many people who are "not poor" in terms of income can be categorized as "poor" based on the lack of access to basic services as well as the low indicators of human development. The existence of these characteristics causes the measurement of poverty to be even more difficult. Poverty is often associated with inequality even though both are different things. Inequality is more visible in the income or expenditure distribution among the whole community (Khandker & Haughton, 2009). Poverty emphasizes the inability to fulfill basic needs (Swastika et al., 2008).

Sukirno (1985) discussed poverty thoroughly in terms of the definition, causes, and consequences of poverty within the poverty circle concept. The poverty circle is a series of forces that influencing each other in such a way hence creating a situation where a country will remain poor (including at the household level) and will experience a lot of difficulties to achieve higher levels of development. According to Nurkse (1953), poverty is not only caused by the absence of development in the past but also creating obstacles to future development. According to him, the most important cycle of poverty is the conditions that cause obstacles to create high levels of capital formation. In this case, the financial institutions play a big role in capital, both on a small scale to MSMEs which are closely related to poverty, or even a bigger scale where many people are involved in the production process and new jobs are available. The capital establishment is caused by savings and another factor which is policy to attract foreign investors’ interest to invest their capital. However, these factors are difficult to be realized in developing countries. Therefore, according to Nurkse's. the view there are two types of poverty preventing developing countries to achieve rapid development rates: in terms of supply and demand for capital.

Poverty is also closely related to factors of household characteristics. To understand poverty, it is necessary to review the demographic, geographic, and economic factors. Demographic factors are closely related to the population on the macroeconomic scale, and household size on the microeconomic scale. Latifa (2008) in her study showed several demographic factors were highly correlated in poor households such as the education level calculated from the length of education, the number of children, and the number of children under five years who passed away. Other findings from Zhang and Wei (1999); Alisjahbana and Yusuf (2003) confirmed that people might become poor due to low education, large household size, and other demographic variables.

Another factor closely related to poverty is the unemployment rate. Poverty is a phenomenon that can be identified in terms of the inability to actualize oneself so that cash programs should be provided, or even the inability to enter the labor market thus unemployment arises where the source of income is limited. Being unemployed will usually reduce one's living standards due to a lack of income.

On the other hand, there is a phenomenon where someone has a job and is still extremely poor as the wage obtained is unable to meet the threshold that needs to be categorized as not poor (Abdullah & Suhaib, 2011). Research by Egunjobi and Adenike (2014) explained that unemployment and poverty is an interrelated international phenomenon. The poor labor market somewhere makes many workers decided to leave their workplace. In certain cases, the low level of wage and the high level of inflation on basic goods make workers seeking another alternative income which is most likely illegal so that it causes other socio-economic problems such as crime rates increment, migration, and living standards drop (Akwara et al., 2013)

2.2. The Role of Microfinance on Poverty Alleviation

Poverty is closely related to limited access to resources, both economic and social. Therefore, the government established an entity to increase these resources and can be easily accessed by the whole social strata. Microfinance institutions are aimed to create financial inclusion for the poor, to improve household welfare, and to alleviate the poverty rate (Littlefield et al., 2003). OJK (2017) illustrated that microfinance has advantages in the flexibility aspect which can be easily adjusted to the needs and characteristics of the community, especially poor households. According to Addae-Korankye (2012), microfinance provides financial services to poor households with different conditions from financial services in general. Microfinance also covers all products in the form of savings, credit loans, and insurance. There are several types of microfinance throughout the world which can be seen in Table 2 below:

Table 2: Types of Microfinance Institutions.

No	Type	Ownership	Funding Source	Example
1	*Project-Based*	Private investor	Donor	Informalized institution usually for a development project, e.g. Morocco and Russian microfinance development projects from World Bank
2	*Non-profit Organization/ foundation*	Separate institution	Donation, grant	The Sanduk in Comoros and Opportunity International in Australia
3	Cooperation	Member	Capital, Deposit, and Commercial Fund	Face cam in Benin; KSP in Indonesia
4	Private company	Private and public capital	Capital, deposit, and commercial	RDS Islamic Bank Bangladesh Limited (IBBL) and Grameen Bank in Bangladesh
5	Public entity	The central and regional government, a public limited company	Government and public	Cajas in Municipales Peru and Bank Rakyat Indonesia (BRI) in Indonesia

Source: Fianto, B.E, et al. (2018)

The concept of microfinance arises when there is a phenomenon of the need to provide credit to low-income groups and cannot be accessed by formal financial institutions with large credit. Conroy (2002) stated that microfinance is a provider of various financial services such as deposits, loans, payment services, money transfers, insurance, and training for poor and low-income households. This term has evolved from the concept of microcredit and microenterprise to provide an understanding which is equally important between savings and loans. In general, microfinance represents the field as a whole, whereas microcredit is more about providing credit (Vasanth et al., 2015)

Providing microcredit in microfinance by Khandker (1998a) is a counter-attack in response to the cause of one to be poor. According to him, the reason why one becomes poor can be categorized into two, first because of unemployment, and second because of limitations in physical and human capital. By providing microcredit, there will be new entrepreneurs who can earn additional income for their

consumption needs. Since microfinance allows credit facilities without collateral, the program is considered to be effective and suitable for the poor who do not have physical collateral.

2.3. Research Area

We use the survey data from the Indonesia Family Life Survey (IFLS) 4 in 2007 and (IFLS) 5 in 2014 which covered nearly 80 percent of the entire Indonesian population and the data is longitudinal thus we can track respondents and follow their progress from period one to another period. This research does not divide the territory of Indonesia into east and west as we try to cover all regions. This level of research is households in Indonesia. The selection of households is based on household characteristics, namely receiving credit. Credit recipient households are a treatment variable to see changes in household poverty status after receiving the credit from financial institutions.

This research uses two quantitative approaches with Propensity Score Matching (PSM) and Double Differences (DD) methods. The collaboration of the two methods is carried out to find out the effect of an intervention (treatment) on the investigated outcomes by showing similarities in the characteristics of the two sample groups being compared (Khandker et al., 2010). The strengths of both methods are that they can answer the research hypothesis, which is access to credit influences poverty status changes.

PSM is applied to get a sample group that will be used in DD estimation based on the probability of a household receiving credit with some observable household characteristics. The adoption of PSM will set aside households that do not have similar characteristics. Combining PSM and DD can include observable and non-observable characteristics with constant assumptions over time (Khandker et al., 2010). DD is used to estimate the effect of financial inclusion on household poverty status

3. Methodology and Data

In this study, we use two methods to analyze the research objectives. The first method is Propensity Score Matching to look for common characteristics of credit recipient households. Propensity Score Matching can generate two groups of households that are accessed by financial institutions and households that are not accessed by financial institutions but have similar characteristics. It can be written in an equation P (X) = Pr (T = 1 | X) which means the group of households accessed by financial institutions (P) is the same as households who are not accessed by financial institutions (T = 1) in terms of program participation based on characteristics X. Propensity Score Matching graphically illustrates the similarity of the two groups in the common support area. The wider the common support area, the better the PSM matching results. Common support areas should meet the assumptions: $0 < P (T = 1 \mid X) < 1$. Heckman (1999) stated that the assumptions ensure that the treated groups must have a close score or nearly the same as the control group. This assumption is important since it is only in the common support area that can be used as the basis for concluding the relationship between the treatment group and the control group.

PSM testing in this study was carried out by dividing households into two groups, namely credit recipient households and non-credit recipient households. The next step is to estimate these groups' probability of participating in a program based on certain characteristics where in this context is the probability of the household having access to financial institutions. The estimation is carried out using the Probit model and generates a probability of program membership or propensity score. The probability of program participation forms a common support area and households outside the common support area are set aside in the next PSM testing process, namely the balance test. A balance test (Balancing test) is carried out to ensure that the average of each characteristic and the average propensity score on each quantile of propensity scores are the same: (P * (X / T = 1) = P (C / T = 0). followed by comparing households accessed by financial services institutions and households who are not accessed by financial service institutions with Double Differences techniques.

The second method is Double Differences, where a large estimate of changes will occur before and after the program with a parallel-trend assumption. The parallel trend means characteristics that can influence program participation and there is no observation that the value is always constant or does not change over time (Khandker & Haughton, 2009). This unobservable heterogeneity can cause selection bias problems. The combination of Double Differences and PSM can answer the problem of selection bias by keeping the sample used in the common support area.

DD estimation in this study was carried out by using panel data. It requires data availability in the baseline period which in this study is the 2007 data. Estimation is done by measuring the outcomes and covariates for groups of households accessed by financial institutions and households who are not accessed by financial institutions before and after the financial inclusion policy. The fixed effects panel regression model is used to maintain the time-invariant heterogeneity that cannot be observed and the heterogeneity of observable characteristics over many periods. Khandker and Houghton (2009) explained DD estimation with the fixed efficiency panel regression model in an equation as follows:

$$Y_{it} = \phi Y_{it} + \delta X_{it} + \eta_{it} + \varepsilon_{it} \quad (1a)$$

$$(Y_{it} - Y_{it-1}) = \phi(Y_{it} - Y_{it-1}) + \delta(X_{it} - X_{it-1}) + (\eta_i - \eta_i) + (\varepsilon_{it} - \varepsilon_{it}) \quad (1b)$$

$$\Delta Y_{it} = \phi \Delta T_{it} + \delta \Delta X_{it} + \Delta \varepsilon_{it} \quad (1c)$$

The equation above explains that the Yit outcome can be estimated in Tit treatment with Xit covariates and time-invariant heterogeneity that cannot be observed by ηi which is well-correlated with treatment or other characteristics that cannot be observed by εit. Decreasing equation 1a is done considering the change in time and generate equation 1b. Keep in mind that heterogeneity of ηi is time-invariant, so the variable is excluded from the equation. The treatment impact is φ with ordinary least square (OLS).

3.1. Data

The data used in this study were obtained from the Indonesian Family Life Survey (IFLS) in 2007 and 2014. The IFLS data is a longitudinal survey data or micro survey data that includes individual, household, and community data in Indonesia. IFLS data is collected and compiled by the RAND Corporation based on a household survey conducted in 13 out of 27 provinces in Indonesia. The 13 provinces are DKI Jakarta, West Java, East Java, South Kalimantan, South Sulawesi, South Sumatra, West Nusa Tenggara, Central Java, D.I Yogyakarta, Bali, North Sumatra, West Sumatra, and Lampung. The survey results generated a sample representing approximately 83% of the Indonesian population and contained more than 30,000 people living in 13 of the 27 provinces.

This research uses two quantitative approaches, so a comprehensive operational explanation of variables is needed. The PSM and DD methods require the use of two types of variables. The variables have been selected based on relevant theories and previous researches therefore it is sufficient to present the research needs to find out the effect of access to credit on poverty status change at the household level in Indonesia. The two types of variables are the dependent variable and the independent variable. In the Propensity Score Matching model based on the probability of a household receiving credit, the dependent variable is access to credit dummy, whereas the independent variable is collateral ownership dummy, the status of property ownership dummy, natural disaster dummy, and gender dummy. In the Double Differences model, the dependent variable is the household poverty status dummy meanwhile the independent variable consists of 3 dimensions, namely the economic dimension, demographic dimension, and social dimension.

3.2. Econometric Specification

The margin of the treatment variables change is obtained after calculating the impact of household access on credit. The impact calculation will be close to reality since the characteristics of credit recipient households have been matched before. Characteristics of credit recipient households are explained through the following probability models:

$$\text{Ƥ}_i = \alpha + \beta_1 Col + \beta_2 Kota + \beta_3 BA + \beta_4 PHK + \epsilon_i$$

Where, Є_i is an error term and assumed to be normally distributed, β is the coefficient of each credit recipient household characteristic determinant, and Ƥ_i illustrates the probability of a household in receiving credit. The credit recipient household model is a preliminary way to filter populations hence a dataset will be constructed containing households with the same characteristics.

$$Y_{it}^{*} = \alpha + \beta T_{it} + \rho t + \Upsilon(T_{it}\, x\, t) + \sum_{j=1}^{n} \beta COV_{jit} + \epsilon_{it}$$

Y_it^* is the outcome of household poverty status, where (*) shows each poverty status either to be poor or not. α shows intercept, while Tit a dummy variable of receiving credit treatment. t is a dummy variable showing the period of before and after receiving credit, β shows treatment coefficient which is household characteristics supporting one to fall into poverty or escape it. The effect of credit on poverty status calculation will be seen when the average value of credit influence is multiplied by the probability of household poverty status change.

3.3. Operational Definition

In this section, we first estimate the Propensity Score Matching against the probability of a household receiving credit. The score results from matching the credit recipient household characteristics which then will be used to estimate the status change of poor households in Indonesia as the core of this study. In the first model, we take 5 variables with four independent variables and one dependent variable. Here is how we construct these variables:

Table 3: The list of operational variables definition using Propensity Score Matching Model.

Dependent Variables	Description	Level of Measurement and Data Management
Credit Dummy (the debtor)	This variable explains the credit recipient household who got the credit application approved.	Nominal 1= credit approved 0= credit rejected
Collateral Dummy (col)	Collateral required by the creditor. Value 1 for a collateral possession, and value 0 for no possession of the collateral.	Nominal 1= have collateral 0= do not have collateral
Status of Property Ownership Dummy (house)	Status of Property Ownership is a socio-economic assessment indicator determined by the creditor. Assessment is aimed to consider the credit approval.	Nominal 1= owned 0= rent
Natural Disaster (Natdis)	It refers to the geographic situation where the household lives. A region with intense natural disasters will also be considered in credit approval.	Nominal 1= natural disaster has ever happened 0= natural disaster has never happened
Gender Dummy (sex)	Sex representing gender aspect is taken into account in credit approval	Nominal 1= Male 0= female

The second model of this study is Double Differences which consists of one dependent variable namely household poverty status and treatment variable namely access to credit as well as seven control variables describing the demographic, economic, and social dimensions. Following these variables are as follows:

Table 4: The list of operational variables definition using Double Differences Model.

Dependent Variables	Description	Level of Measurement and Data Management
Time Dummy (year)	This variable explains the credit recipient household who got the credit application approved.	Nominal 1= credit approved 0= credit rejected
Treatment Dummy (debit)	Collateral required by the creditor. Value 1 for a collateral possession, and value 0 for no possession of the collateral.	Nominal 1= have collateral 0= do not have collateral
Interaction (debtor x year | dinner)	Status of Property Ownership is a socio-economic assessment indicator determined by the creditor. Assessment is aimed to consider the credit approval.	Nominal 1= owned 0= rent
Demographic characteristic		
Gender Dummy (sex)	Sex representing the gender aspect is taken into account in credit approval.	Nominal 1= Male

		0= female
Household Size (size)	It explains how many people or family members live under the same roof or have moved out but still financially dependant on the household head.	Ratio
Economic characteristic		
Collateral Dummy (col)	Collateral required by the creditor. Value 1 for a collateral possession, and value 0 for no possession of the collateral.	Nominal 1= have collateral 0= do not have collateral
Access to Funding/Lending (access)	This variable illustrates household status in a financial institution.	Ordinal 1= only know, not customer 2= funding or lending customer 3= funding and lending customer
Status of Property Ownership Dummy (house)	It illustrates the economic dimension related to the status of property ownership where they live.	Nominal 1= owned 0= rent
Social characteristic		
Length of Education (Educ)	This variable refers to the highest education done by the respondent and counted based on the average time to complete the study by the respondent. In Indonesia, primary education takes nine years (graduate from junior high school or equivalent).	Ratio
Housing Location Dummy (doc)	It explains the difference between living in a city and a rural area. In some literature, it represents a social condition.	Nominal 1= city 0= rural

4. Results and Discussions

4.1. Propensity Score Matching Estimation Result on Credit Recipient Household

The Propensity Score Matching (PSM) estimation is done by combining IFLS 4 data in 2007 and IFLS 5 in 2014. In 2007 (IFLS 4) there were 506,470 households and combined with 664,669 households in 2014 (IFLS 5) and resulting in 1,171,139 households in total. After being combined, an estimated PSM matching was carried out in 2007 and made the base year of a matching analysis with the breakdown of the household numbers including credit recipients as many as 102,965 households and 403,505 non-credit recipient households (Table). Initially, 506,470 households in 2007 (IFLS4) were excluded by the estimated PSM and the remaining 495,087 households where credit recipient households became 101,912 households due to the unequal characteristics of credit recipients.

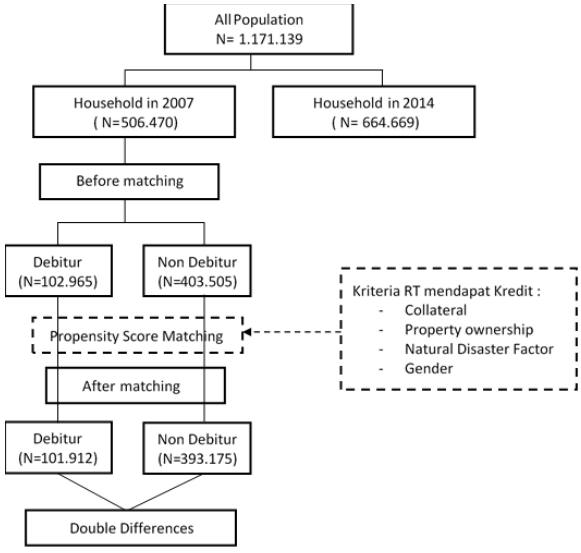

Figure 1. Flow chart of credit recipient household construction.

Propensity Score Matching estimation is done to look for the characteristics of household credit recipient households. Table (6) addresses the characteristics of credit recipient households, namely collateral ownership, the status of property ownership (rent or owned), gender (male and female), and natural disaster factors. These four characteristics are obtained after attempting to select some of the similarities to get the best balancing test. Khandker (2010) mentioned that in finding the best characteristics that represent a data match, it must be performed until the balancing test value is satisfactory.

Table 5: Balancing Test Propensity Score.

Inferior of a block of propensity score	Household		Total
	Credit Recipient	Non-credit Recipient	
0.15	64.018	13.751	77.769
0.175	75.805	15.591	91.396
0.1875	84.116	20.449	104.565
0.2	95.254	25.230	120.484
0.2125	53.424	15.003	68.427
0.3	18.750	10.611	29.361
0.4	1.808	1.277	3.085
Total	393.175	101.912	495.087

Picture (3) shows the results of a good balancing test because visually there are many overlap areas between groups of credit recipient households and non-credit recipient households (Caliendo & Kopeinig, 2008; Khandker et al., 2010). Table (6) shows the control variables that explain the characteristics of credit recipient households. All control variables show significant values in statistics.

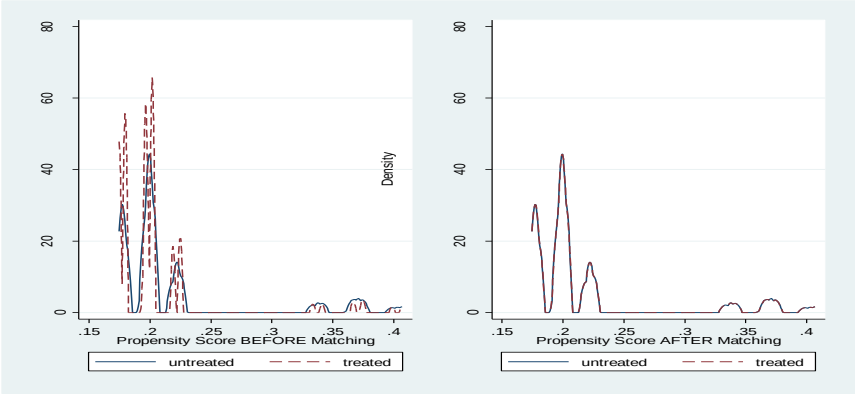

Figure 2. Regions of Common Support (Propensity Score) of Credit Recipient and Non-credit Recipient Households.

Table 6: Propensity Score Matching estimation result of credit recipient household.

Variable Test	Number of Observation	Mean Propensity	Collateral	Housing	Natural Disaster	Sex
Credit recipient	495.087	0.21	0.861***	0.146***	0.135***	-0.0342***
			(0.0121)	(0.00717)	(0.00809)	(0.00710)

Numbers within parenthesis are standart errors
Notation: *** p<0.01, **p<0.05, *p<0.1

In the credit application process, financial institutions will conduct the evaluation and selection of potential customers based on the company's internal eligibility criterion. These criteria usually consist of several indicators illustrating the risk of potential customers. If the potential customer has an acceptable level of risk, the financial institution can provide credit, but if the perceived risk is too large and related to the ability to pay obligations, the application will be rejected. The regulation also explains that the availability of financial institutions does not guarantee a large number of credit recipient households.

Based on PSM estimation, collateral ownership is the first factor in determining whether or not a household receives the credit. Households whose collateral has a greater probability of receiving credit than those who do not have collateral. Elsas and Krahnen (2000) stated that collateral has a large role in providing credit in all types of financial institutions. Stiglitz and Weiss (1981), considered collateral as a reason for banks to tolerate adverse selection and asymmetric information between creditors and debtors. Low-risk debtors usually have loans with high collateral value whereas high-risk debtors choose loans without collateral. This collateral is then used by financial institutions as a guideline in case of default in the future. Bester (1994) in his model explained that the existence of collateral gives power to financial institutions in negotiation when the default happens, whereas on the other side it makes the debtors more responsible.

The next factor is the status of property ownership, either rent or own. The status of property ownership by financial institutions is used as one of the qualitative indicators and is related to collateral. Those who live in their own house are more likely to get credit than those who rent. However, it does not mean that those who live in the rented house do not have collateral, because collateral can be in the form of movable objects (fiduciary) or immovable (mortgage rights). However, financial institutions and banks generally will be more likely to approve households whose collateral in the form of a housing property as it is more binding and personal.

Another interesting factor is unexpected factors such as natural disasters. When estimating the PSM and balancing test, it was found that natural disasters have a connection to the decision to give credit. Limited studies are discussing the relationship between natural disasters, but some studies can explain the relationship on this topic. Ninno et al (2003) revealed that after the flood disaster in Bangladesh in 1998, the demand for credit increased but financial stakeholders became more stringent in providing loans except for households whose already portfolios and previous exposures. Berg and Schrader (2012) also found similarities related to credit restrictions after the eruption of a volcano in Ecuador. The reason for the limitation is that after the natural disaster, asymmetric information has become greater because financial institutions such as banks have become unable to properly assess the quality of potential debtors.

The last factor is the reason for gender bias. Female household heads have a lower probability of receiving credit than males. A banking study conducted by the SME Assistence (2008) For Eastern Indonesia Program found that banks do not consider women as the main target of their products although the creditworthiness level of women is not much different than male debtors, and even better in some cases. Coleman (2000) argued that discrimination against women could be in the form of a few approved loans. This is because banks view that women entrepreneurs would have a lower tendency for success than men since they have lower education levels and also less experience in doing business. According to Barro & Sala-i-Martin (1992), women entrepreneurs usually have a smaller business scale compared to men. Therefore, assets and sales are also lower so when applying for credit, it is difficult as it is not feasible enough. Also, the characteristics of households in Indonesia where men play a role as an income earner, makes creditors reluctant to provide credit if those who apply for credit are women, considering payment sources (first way out) and collateral (second way out) that are usually owned by men.

4.2. The Result of Double Differences

Double Difference (DD) estimation is conducted to obtain counterfactual value on outcomes. Two groups of households whose similar characteristics namely credit recipient households will be compared with their respective outcomes before and after receiving credit. Control variables are also included in DD testing to get the net effect of credit on household poverty status (outcomes). The use of fixed fixe defections is done to control the characteristics of unobservable households and time variants that can affect the outcome values (Khandker et al., 2010).

Table 7: Double Differences estimation result on household poverty status.

VARIABLE	Poor	Odd ratio	Marginal Effect
Year (dyear)	-0.00251	0.997	-0.002
1=2014, 0=2007	(0.0393)	(0.0392)	(0.26)
Debtor (debitur)	-0.0893	0.915	-0.016
1= credit approved	(0.0554)	(0.0507)	(1.69)
0= credit rejected			
Debtor x Year (dinter)	-0.167**	0.846**	-0.032

	(0.0758)	(0.0641)	(2.49)*
Demographic characteristic			
Gender (dsex)	-0.174***	0.841***	-0.031
1= male	(0.0323)	(0.0272)	(5.64)**
0= female			
Household Size (HHsize)	-0.233***	0.792***	-0.038
	(0.0110)	(0.00874)	(21.21)**
Economic Characteristic			
Collateral (col)	-0.164***	0.832***	-0.027
1= have collateral	(0.0436)	(0.0360)	(3.77)**
0= do not have collateral			
Access to Financial Service Institution (access)	-0.0840**	0.919**	-0.011
1= know only, not customer	(0.0397)	(0.0365)	(1.62)
2= funding or lending customer			
3= funding dan lending customer			
Status of Property Ownership (house)	-0.131***	0.877***	-0.008
1= owned	(0.0403)	(0.0353)	(1.14)
0= rent			
Social Characteristics			
Mean Years Schooling (Educ)	-0.130***	0.878***	-0.020
	(0.00437)	(0.00383)	(31.02)**
Housing Location (dloc)	-0.280***	0.756***	-0.047
1= city	(0.0363)	(0.0275)	(7.63)**
0= rural			
Constanta	2.212***	9.130***	
Observations	30,719	30,719	30,719
Number of PID code	23,830	23,830	23,830

DD testing with PSM will be applied to 495,087 households whose a similar propensity score. The amount was obtained from the estimated PSM by setting aside 11,383 households. The results of DD estimation through PSM estimation in advance in table (7) show that the majority of dependent variables are affected by the existence of credit received by households. The majority of variables negatively impact poverty status in the poverty model. The impact is shown by the negative probability margin on the line "Debtor x Year" in the table (7) or Tit x t in the research model. This means an increase in the probability of people escaping poverty because it approaches the number one for each increase in the probability of a household receiving credit (Figure 4).

The results of the PSM and DD analysis also found that credit, gender, collateral ownership, location of residence, access to financial services institutions, length of education, simultaneously influence poverty status. Partially, it is proved that credit, gender, collateral ownership, location of residence, length of education of the household's head, and the size of the household have a significant effect on poverty status, meanwhile, access to financial institution services has an insignificant effect on poverty status.

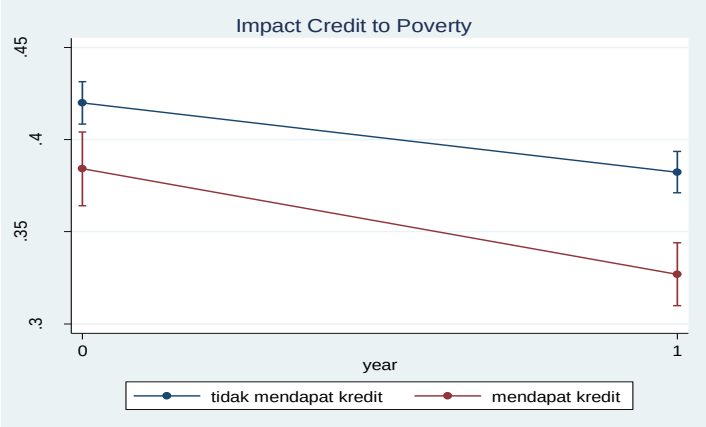

Figure 3. Effect of receiving credit on household status poverty. Source: IFLS year 2007 and 2014.

The dependent variable is significantly affected by credit recipient households (Figure 4.7). The poverty status has a probability margin of 0.032 points and a coefficient of 0.19 points with a significance level of 5 percent which means that if a household receives credit, then the probability of the household becoming one poor decreases by 3.2 percent compared to households that do not receive credit.

4.3. Research and Discussion Results

The conducted PSM and DD analysis proved to be able to support the hypothesis of this study, that credit hurts household poverty status. It means households who have accessed and received a credit will have a lower chance of falling into poverty. By receiving credit, households become more productive and their household purchasing power or consumption will increase. Pitt and Khandker (1998) stated that credit recipient households have higher per capita income than those who do not receive so that per capita expenditure and household welfare also point to higher outcomes than those who do not receive and conclude that poverty rates in the recipient group are lower than with groups that do not receive. The urgency of the credit is the reason why the government genuinely strive to build financial inclusion as massive as possible (Otoritas Jasa Keuangan, 2017).

The government also attempts to alleviate poverty through credit, one of which is through the household-scale entrepreneurial transmission. According to Bah et al (2015), household-scale entrepreneurship in the form of Micro, Small, and Medium Enterprises (MSMEs) contributed 58.1 percent to GDP, 97.2 percent to new employment opportunities, and 14.1 percent to export revenues in 2012. According to Firdausy (2005), MSMEs play an important role in accelerating poverty alleviation. Providing credit to household-owned MSMEs will increase their capital and business capacity to create new jobs. Therefore, the role of credit is extremely important to encourage the household business's capacity thus a more optimal impact will be obtained. Figure (4.8) shows that the lower the proportion of MSME credit, the higher the poverty rate and vice versa.

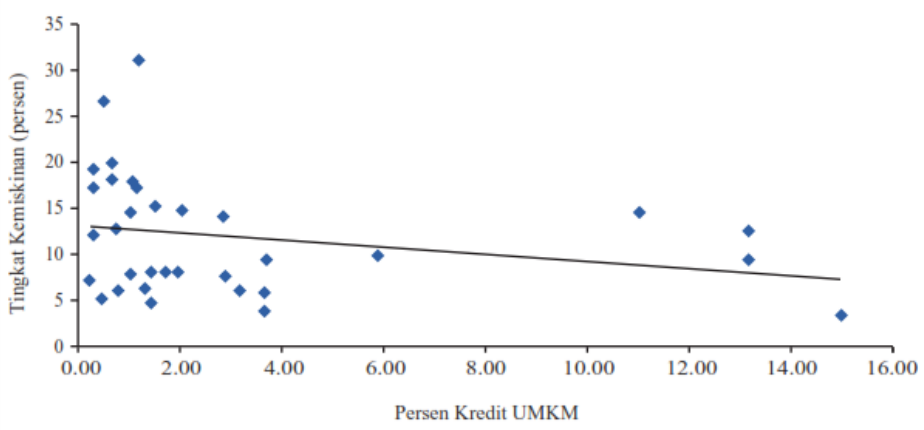

Figure 4. The relationship between poverty and credit proportion. Source: P2E-LIPI (2012).

This finding has implications for anti-poverty policies with credit instruments at the household level. The government has additional options for poverty alleviation with specific targets and policies. These specific targets and policies are intended to reduce poverty from financial institution channels. An example of the poverty policies implementation through financial institutions is subsidized loan interest, current account loans, and loan tenor allowances. Current account loans specifically will be best applicable for debtor households whose a business previously. Long-term interest and loan subsidies provide flexibility for household consumption. Consequently, their consumption quality will improve by itself. Households will be able to allocate their sources of income to better consumption utilities, for instance, secondary and tertiary goods and even investments that generate future benefits.

The role of financial services institutions as a way to empower the community and alleviate has been widely studied, one of which is research conducted by Damayanti and Adam (2015), mentioning productive loans such as KUR was able to make debtors more confident in developing businesses, creating assets, and broaden employment opportunities, while consumptive-designed loans are intended to guard the people's purchasing power, even credit is often used as a source of payment for health and education matters. However, credit benefits will not be maximized if household access to financial institutions, and vice versa experience obstacles. In this study, household access to financial institutions has no significant

effect on poverty status and household consumption levels. The easiest explanation is due to the perception of the financial institution itself. Financial institutions such as banks maintain a net performing loan (NPL) as a business health indicator thus they prefer feasible and bankable households. Feasible means that households can pay all of their credit obligations, while bankable is related to the ability to meet credit requirements of financial institutions, where one of them is collateral ownership (Yushita, 2017). On the other hand, there there's a set of moral hazards and adverse selection found when households access financial institutions particularly for credit (Damayanti & Adam, 2015)da. In poor households, even though financial infrastructure has spread almost throughout Indonesia Otoritas Jasa Keuangan (2017), they access financial institutions only to withdraw social assistance funds from the government or private sector so that the financial Institutions presence does not significantly change their poverty status (Coulibaly et al., 2016).

5. Conclusions

Based on the results that have been through the process of analysis and discussion, then conclusions can be formulated from this research as follows:

1. There is a 6.54 percent increment in the number of households receiving credit and have access to finance. 20.52 percent of the total number of credit recipient households are poor. Meanwhile, the number of poor households who did not receive credit was 79.48 percent. Most of the total poor households live in rural areas.
2. Based on Propensity Score Matching analysis, there are 1,171,139 households and marginalized by category into 495 087 households comprising as many as 101 912 credit recipient households and 393 175 households who do not receive the credit. The characteristics of credit recipient households are considered marginalizing these households, i.e the collateral ownership, status of property ownership, history of natural disaster, and gender.
3. Based on the entire Double Differences analysis both with PSM or not, it was found that household credit hurts poverty status, and has a positive effect on household consumption. It was found that credit recipient households had a greater probability of escaping poverty than those who did not receive credit. The probability of having a much greater consumption can also be obtained by receiving credit compared to households who do not receive credit.ani
4. The control variables that significantly affect household poverty status are the head of the family gender, collateral ownership, location of residence, access to financial institutions, length of education, and household size. Status of residential property variable is proven insignificant on household poverty status while those that have a significant effect on household consumption are the head of the family gender, collateral ownership, location of residence, the status of residence, length of education, and size of the household. The variable access to financial institutions does not significantly influence household consumption.

5.1. Recommendation

Based on the conclusion above, an anti-poverty policy through credit transmission seems to be an alternative solution for the poverty problem. Picture 4.7 shows that credit is proven to be able in encouraging household consumption directly through consumptive activities or productive activities in form of venture capital. However, some preconditions are needed to enable credit to be an effective policy. Some of them are:

1. Subsidized Interest of Consumptive and Productive Credit

The government loan interest subsidy program is the main precondition. Interest is the price that the customer has to pay for the credit taken. Households will be greatly helped by a low interest in both consumptive and productive financing products low-interest consumptive loans enable households to add their assets and access basic services such as health care and education. On the other hand, low-interest productive loans will make it easier for them to develop their businesses due to new capital injection, thus production capacity increases and have an impact on new employment opportunities.

2. Placing Public Fund with Low Cost of Fund

Placing government funds on a product with a low cost of funds is the second precondition. The government can place several bags of funds with low returns on financial institutions that provide low credit as the covenant. Financial institutions still have to pay a high share of interest to the

government with a moderate risk profile due to the threat of capital adequacy ratio (CAR) if funds are withdrawn during this time. With a lower cost of funds, financial institutions will have the ability to reduce lend rate tool to be more accessible to the whole social strata.

3. Improving Financial Literacy and Knowledge of the Society

Finance is an important aspect of most people's life. Financial knowledge possession determines one's decisions in choosing financial products. Financial decisions have a direct impact on living standards and even well-being. Knowledge about finance is important for individuals so that they are not making wrong financial decisions later. However, financial product services for the poor should include savings, money transfers, insurance services, and leasing options that are good in financial literacy. Lack of financial literacy will result in losses for individuals both as a result of inflation and a decline in economic conditions. A misunderstanding causes financial losses, as a result of wasteful spending and unwise consumption. Lack of financial literacy makes it difficult for individuals to invest or access financial markets even at a higher level.

4. Credit Approval Adjustment based on Average Regional Economic Ability

In general, banks or other formal financial institutions registered in the Financial Services Authority have internal guidelines regarding granting financing to the prospective debtor. The guidelines have been prepared based on risk management that prioritizes prudence which has been regulated by OJK through Financial Services Authority Regulation (POJK) No. 18 / POJK.03 / 2016 concerning Application of Risk Management for Commercial Banks. The rule applies nationally, thus 'one price' is for all regions in Indonesia. This concept is good for simplifying business processes but there are unconsidered factors related to differences in communities' ability between one region and another. It would be better if the credit provided is adjusted to regional macroeconomic indicators such as regional minimum wage (UMR), purchasing power, or regional inflation, therefore it will be more attractive and also be by the natural ability of prospective debtor in certain regions.

References

Abdullah, M., & Suhaib, A. (2011). The impact of Zakat on the social life of Muslim society. *Pakistan Journal of Islamic Research*.

Addae-Korankye, A. (2012). Microfinance: a tool for poverty reduction in developing countries. *Journal of Business and Retail Management Research*, *7*(1), 138–157.

Awkward, A. F., Akwara,;, Ngozi F, Enwuchola,;, John, Adekunle,;, Udaw,;, & Joseph E. (2013). Unemployment and Poverty: Implications for National Security and Good Governance in Nigeria. *International Journal of Public Administration and Management Research*, *2*(1), 1–11.

Alisjahbana, A., & Yusuf, A. A. (2003). Poverty dynamics in Indonesia: panel data evidence. *Department of Economics, Padjadjaran University*.

Bah, A., Nazara, S., & Satriawan, E. (2015). Indonesia's Single Registry for Social Protection Programmes. *Research Brief*, *49*.

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *The Journal of Political Economy*, *100*(2), 223–251.

Berg, G., & Schrader, J. (2012). Access to credit, natural disasters, and relationship lending. *Journal of Financial Intermediation*, *21*(4), 549–568. https://doi.org/10.1016/j.jfi.2012.05.003

Bester, H. (1994). The role of collateral in a model of debt renegotiation. *Journal of Money, Credit and Banking*, *26*(1), 72–86.

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1), 31–72.

Chibba, M. (2009). Financial inclusion, poverty reduction, and the millennium development goals. *The European Journal of Development Research*, *21*(2), 213–230.

Coleman, S. (2000). Access to capital and terms of credit: A comparison of men- and women-owned small businesses. *Journal of Small Business Management*, *38*(3), 37–52.

Coulibaly, A., Yogo, U. T., Coulibaly, A., Thierry, U., Access, Y., & Devel-, W. P. (2016). *Access to Financial Services and Working Poverty in Developing Countries To cite this version : HAL Id : hash-01403001 Access to Financial Services and Working Poverty in Developing Countries*.

Damayanti, M., & Adam, L. (2015). *TNP2K*.

Dartanto, T., & Nurkholis. (2013). The determinants of poverty dynamics in Indonesia: evidence from panel data. *Bulletin of Indonesian Economic Studies*, *49*(1), 61–84. https://doi.org/10.1080/00074918.2013.772939

Dartanto, T., & Otsubo, S. (2016). Intrageneration Poverty Dynamics in Indonesia: Households' Welfare

Mobility Before, During, and After the Asian Financial Crisis. *JICA-RI Working Paper*, *117*, 1–42. https://www.jica.go.jp/jica-ri/publication/workingpaper/jrft3q00000027bc-att/rJICA-RI_WP_No.117.pdf

Dawood, T. C., Pratama, H., Masbar, R., & Effendi, R. (2019). Does financial inclusion alleviate household poverty? Empirical evidence from Indonesia. *Economics & Sociology*, *12*(2), 235–252.

Del Ninno, C., Dorosh, P. A., & Smith, L. C. (2003). Public policy, markets, and household coping strategies in Bangladesh: Avoiding a food security crisis following the 1998 floods. *World Development*, *31*(7), 1221–1238.

Egunjobi, T. A. (2014). Poverty and Unemployment Paradox in Nigeria. *IOSR Journal of Humanities and Social Science*, *19*(5), 106–116. https://doi.org/10.9790/0837-1954106116

Elsas, R., & Krahnen, J. P. (2000). *Collateral, default risk, and relationship lending: An empirical study on financial contracting*. CFS Working Paper.

Fianto, B. A., Gan, C., Hu, B., & Roudaki, J. (2018). Equity financing and debt-based financing: Evidence from Islamic microfinance institutions in Indonesia. *Pacific-Basin Finance Journal*, *52*, 163–172.

Fields, G. S., Cichello, P. L., Freije, S., Menéndez, M., & Newhouse, D. (2003). Household income dynamics: A four-country story. *Journal of Development Studies*, *40*(2), 30–54. https://doi.org/10.1080/00220380412331293757

Firdausy, C. M. (2005). Trends, issues, and policies towards international labor migration: An Indonesian case study. *United Nations Expert Group Meeting on International Migration and Development, New York, USA*, *68*.

Haughton, J., & Khandker, S. R. (2009). *Handbook on Poverty+Inequality*. The World Bank.

Jalilian, H., & Kirkpatrick, C. (2005). Does financial development contribute to poverty reduction? *Journal of Development Studies*, *41*(4), 636–656. https://doi.org/10.1080/00220380500092754

Khandker, S. R. (1998a). Fighting poverty with microcredit: experience in Bangladesh. In *Fighting poverty with microcredit: experience in Bangladesh* (p. 228). Oxford University Press.

Khandker, S. R. (1998b). *Poverty*. Oxford University Press.

Khandker, S. R., & Haughton, J. (2009). *Handbook on poverty and inequality*. World Bank.

Khandker, S. R., Koolwal, F. G. B., & Samad, H. A. (2010). *Handbook on Impact Evaluation: Quantitative Methods and Practices*. World Bank.

Kiendrebeogo, Y., & Minea, A. (2016). Financial development and poverty: evidence from the CFA Franc Zone. *Applied Economics*, *48*(56), 5421–5436.

Kim, J., Engelhardt, H., Prskawetz, A., & Aassve, A. (2009). Does fertility decrease household consumption? An analysis of poverty dynamics and fertility in Indonesia. *Demographic Research*, *20*(June 2009), 623–656. https://doi.org/10.4054/DemRes.2009.20.26

Lanjouw, P., & Ravallion, M. (1995). Poverty and household size. *Economic Journal*, *105*(433), 1415–1434. https://doi.org/10.2307/2235108

Latifa, A., Aswatini, A., & Romdiati, H. (2018). Population and Social Demographics Poverty: a Case Study in the Border Areas of East Kalimantan and North Sulawesi. *Journal of Indonesian Social Sciences and Humanities*, *1*(1), 175–191. https://doi.org/10.14203/jissh.v1i1.13

Littlefield, E., Morduch, J., & Hashemi, S. (2003). Is microfinance an effective strategy to reach the millennium development goals? *Focus Note*, *24*(2003), 1–11.

McCulloch, N., & Calandrino, M. (2003). Vulnerability and chronic poverty in rural Sichuan. *World Development*, *31*(3), 611–628.

Morduch, J. (1999). The microfinance promise. *Journal of Economic Literature*, *37*(4), 1569–1614. https://doi.org/10.1257/jel.37.4.1569

Mujumdar, N. A. (2001). World development report, 2000/2001: attacking poverty. *Indian Journal of Agricultural Economics*, *56*(1), 146.

Nurkse, R. (1953). *Problem of Capital Formation in Underdeveloped Countries*. Oxford University Press.

Otoritas Jasa Keuangan. (2017). *Strategi Nasional Literasi Keuangan Indonesia (Revisit)*. Otoritas Jasa Keuangan.

P2E LIPI. (2012). *KUR di Era Otoonomi Daerah: Membangung Sinergi antara Kelembagaan Pasar, Pemerintah Daerah dan Komunitas dalam Pengeloalan Kredit Program untuk Pemberdayaan UMKM*.

Pitt, M. M., & Khandker, S. R. (1998). The impact of group-based credit programs on poor households in Bangladesh: Does the gender of participants matter? *Journal of Political Economy*, *106*(5), 958–996.

Program for Eastern Indonesia SME Assisten. (2008). *Akses ke pendanaan bagi perempuan pengusaha di*

Indonesia. Ringkasan Eksekutif.

Sen, A. (1988). Freedom of choice. Concept and content. *European Economic Review*, *32*(2–3), 269–294. https://doi.org/10.1016/0014-2921(88)90173-0

Stiglitz, J. E., & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *The American Economic Review*, *71*(3), 393–410.

Sukirno, S. (1985). *Ekonomi Pembangunan (Development Economics)*. LPEF-UI Bima Grafika.

Swastika, D., Hardono, G., Supriatna, Y., & Bastuti, T. (2008). Poverty in the era of decentralization in Indonesia. *CAPSA Working Paper*, *102*, 73–130.

Todaro, M. P. (2000). Pembangunan Ekonomi di Dunia Ketiga Edisi Ketujuh. *Jakarta: Erlangga*.

Uddin, G. S., Shahbaz, M., Arouri, M., & Teulon, F. (2014). Financial development and poverty reduction nexus: A cointegration and causality analysis in Bangladesh. *Economic Modelling*, *36*, 405–412. https://doi.org/10.1016/j.econmod.2013.09.049

Vasanth, V., Selvam, M., Lingaraja, K., Miencha, I. O., & Raja, M. (2015). Testing the Environmental Kuznets Curve Hypothesis at Firm Level in India. *Journal of Sustainable Development*, *8*(8), 201–212. https://doi.org/10.5539/jsd.v8n8p201

Weber, B. A., & Jensen, L. (2004). *Poverty and place: A critical review of rural poverty literature*.

Wkh, S. I., Zlwk, Q., Iurp, V., & Wkh, D. Q. G. (n.d.). *6Kruw Whup 3Ryhuw \ '\ Qdplfv (Ylghqfh Iurp*. *60*.

Xue, J., & Zhong, W. (2006). Unemployment, poverty, and income disparity in urban China. *Unemployment Inequality and Poverty in Urban China*, *1999*, 43–64. https://doi.org/10.4324/9780203446515

Yushita, A. N. (2017). Pentingnya literasi keuangan bagi pengelolaan keuangan pribadi. *Nominal: Barometer Riset Akuntansi Dan Manajemen*, *6*(1), 11–26.

Yusuf, A. A., & Sunmer, A. (2017). *Poverty, Inequality, and Structural Change in Indonesia*.

Zhang, W. . dan Z. W. (1999). Poverty Problem in Urban China, in Zhongguo Jumin SHorufenpei Yanjiu. *China Finance and Economics Publisher*.

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Research Paper

The Implementation of Urban Drainage Maintenance to Reduce Inundation Risk

Case Study in Tegal, Indonesia

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Abstract

Coastal cities with low elevation and mild slopes tend to be more vulnerable to the threat of floods and inundations. Expansion of impermeable areas caused by land conversion greatly diminishes a city's ability to cope with the threat. Urban drainage systems play a crucial role in controlling excess surface water and reducing the threat of flood and inundation. To maintain an urban drainage system within an optimum condition and to reduce inundation risk, various types of drainage maintenance activities have been implemented in Tegal. This research was conducted in five inundation prone areas in Tegal to analyze the impact of those maintenance activities to urban drainage conditions and in reducing inundation. GIS and statistical analysis revealed that from the numerous urban drainage maintenance activities that have been performed, drainage sediment cleanup has the most obvious impact on drainage conditions and in reducing inundation.

Keywords: Urban Drainage, Drainage Maintenance, Inundation Risk

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1. Introduction

Indonesia is the largest archipelagic state in the world with the second-longest coastline, wherein 60% of the population lives within a 50 km radius of the coastline (Kementerian Kelautan dan Perikanan, 2019; Suryadiputra, 2012). Annual flooding is very common in many cities in Indonesia, especially in coastal areas, which have a relatively flat land and low elevation. The dynamics of natural events, such as global warming, high-intensity rainfall, and river sedimentation, as well as human activities, such as land conversion, housing construction on the riverbank, and the lack of flood control infrastructure are increasing the risk of flooding (Authority, 2015). The National Disaster Management Authority categorizes floods into the following: coastal flooding, river flooding, and flash flooding. Coastal flooding occurs because of high tides submerging the land, while river flooding occurs because of the overcapacity of rivers; and flash flooding (inundation) occurs because of inadequate drainage capacity or poor drainage conditions (Government, 2019).

Flood and inundation risks faced by each catchment area are affected by many factors, such as the individual characteristics of the actual storm events, drainage and pumping capacity, system failure, levee height, water surface elevation, and other factors. Each individual or combination of these aspects may have different effects based on the characteristics and sensitivities of the catchment areas. High-intensity rainfall and climate change in rapid growth areas increase the frequency of urban drainage failure (Ngamalieu-Nengoue, Iglesias-Rey, Martínez-Solano, Mora-Meliá, & Valderrama, 2019; Yongchao Zhou, 2019).

Poor urban drainage physical conditions greatly affect the performance of the entire drainage system. Poor drainage system conditions could interfere with water flow and cause flooding. Flood inundation in urban areas may lead to direct losses to the residents and their properties and indirect losses in the form of interruption to their daily activities. Inundations also leave behind a dirty and muddy environment, ruin the local aesthetics, and can be a breeding ground for various diseases (Suripin, 2004; Yazdi, 2017). Urban drainage system maintenance is crucial in ensuring that the drainage system is in good physical condition and to guarantee that the drainage system works properly. The dynamics of socio-economic activities and development in the city significantly fortify or degrade urban drainage condition (Jonatan Zischg, 2018).

Various types of flood and inundation risk reduction activities involving multiple stakeholders have been performed on a massive scale in several regions. One activity that is generally applied in high-risk inundation areas is drainage maintenance that is carried out through various programs. To obtain clear results, this research focuses on all drainage maintenance activities performed in areas categorized as inundation prone.

The study site was in Tegal, a small coastal city located in the northern part of Java with a 7.5 km coastline. The city of Tegal was chosen as the research location because flooding and inundation occur annually in this area. Massive drainage treatment and maintenance programs have been implemented by the local government in the last five years; consequently, cases of flooding in the area are gradually decreasing, but they still persist every year. Government efforts to develop a good drainage system are not significant enough to completely overcome flood and inundation problems. The objective of this research is to observe the implementation of drainage maintenance and its impact on inundation in the research area. This research also analyzes the role of each activity on inundation reduction.

2. Methodology

The primary objective of this research is to analyze the general characteristics and the impact of drainage maintenance activity in inundation areas and to consider future inundation treatment.

2.1. Data Collection

Tegal (Figure 1) is a small coastal city located in the northern part of Java, Indonesia, covering an area of 39.68 km^2 with a total population of 276,734 in 2018. Three large rivers (Kali Gangsa, Kali Ketiwon, and Kali Gung) and two smalls rivers (Kali Kemiri and Kali Sibelius) flow through the Tegal area (Government, 2019). The city is located at a low elevation of 0-3 m above sea level and experiences high-intensity rainfall; thus, more than half of the area is categorized as having a moderate to high flood risk (Authority, 2015).

Moreover, based on the 2015 vulnerability index data released by the Ministry of Environment and Forestry, two villages in the area are categorized as high disaster risk with low levels of adaptation to climate change; therefore, direct action is needed to improve climate change adaptation in the region. Thirteen villages are categorized as moderate disaster risk, and the rest are categorized as low disaster risk. However, based on the Tegal hazard map published by the Planning Agency, 18 of 27 villages in Tegal are categorized as having a moderate to high risk of flooding.

Figure 1. Location of Study Area (Government, 2019).

Interviews and field surveys regarding drainage conditions, inundation areas, and the treatments applied to the drainage channel were conducted in August 2019 and March 2020. These interviews were conducted to the local government's officials and communities who reside near the inundation areas. Secondary data were collected from various sources, namely the Public Works Agency, Planning Agency, Village Government, and the Ministry of Public Works and Housing.

2.2. Research Method

To analyze drainage maintenance activities and the impacts of drainage conditions and inundation reduction, the analyses were divided into two parts, i.e., technical and social analyses.

Table 1: Analysis Method.

Technical Analysis	Social Analysis
- **Water Runoff in Urban Catchment Area**	- Dissemination of Drainage Maintenance Activity
- **Drainage Capacity**	- Drainage Cleaning Frequency
- **Drainage Condition**	- Community Participation
- **Normalization, Rehabilitation, and New Channel Development**	
- **Inundation reduction**	

The catchment area in each inundation location is divided into sub-catchment areas, which follows the water runoff pattern in the system and analyzed using GIS program. The Rational Method was used to adjust the flow rate according to the following formula (Davies, 2000):

$$\boldsymbol{Q = 2.78CiA}$$

$\boldsymbol{Q}$ maximum flow rate (l/s)
$\boldsymbol{i}$ rainfall intensity (mm/h)
A catchment area (ha)

The water runoff calculation was compared to the drainage capacity calculation. The comparison result was analyzed using a GIS map to produce a high probability prediction of inundation in a location as a result of water overflow. Because urban drainage channels in Tegal are mostly open channels, the following equation was employed to calculate drainage capacity (Davies, 2000):

$$Q = \frac{1}{n} R^{\frac{2}{3}} S_o^{\frac{1}{2}} . A$$

n Manning's Roughness coefficient ($m^{-\frac{1}{3}} s$)
S_o bed slope
A wet cross-sectional area

Considering that no specific regulation or standard of assessment on drainage channel and network condition exists, the evaluation of drainage channel conditions shall refer to the Ministry of Public Works and Housing Regulation No. 32 of 2007 on Irrigation Channel and the Ministry of Public Works and Housing Circular Letter No. 02 of 2011 on Swamp Reclamation.

Table 2: Risk Scale Index Determination Based on drainage Physical Condition and Sedimentation Level.

Index	Physical Condition	Damage Level (%)	Sedimentation Level (%)	Function (%)	Condition State	Risk Scale
1	Good structural condition, no significant damage	< 10	0	76 – 100	Good	1 – 2 (Very low)
2	Medium structural condition with some damages but fully functional	10 - 20	1 - 25	51 – 75	Fair	3 – 4 (Low)
3	Severe damage with interrupted channel function	21 - 40	26 - 50	26 – 50	Lightly damaged	5 – 6 (Medium)
4	Heavy damage that reduces channel capacity	> 40	51 - 75	1 – 25	Heavily damaged	7 – 8 (High)
5	Total damage and total channel malfunction	> 70	76 - 100	0	Broken	9 – 10 (Very high)

Source: (Faiz Isma, 2018) and Channel Condition Criteria in Ministry of Public Works and Housing Regulation Number 32 of 2007 on Irrigation Channel

Each drainage condition requires a specific treatment depending on the damage and channel function.

Table 3: Recommendation Treatment.

Index	Inundation Depth	Function (%)	Treatment Recommendation
1	< 0.3 m	76 – 100	Routine Maintenance
2	0.3 – 0.5 m	51 – 75	Periodic Maintenance
3	0.5 – 1 m	26 – 50	Rehabilitation (Channel Repair)
4	1 – 3 m	1 – 25	Rehabilitation (Channel Replacement)
5	> 3 m	0	Channel New Development

Source: (Faiz Isma, 2018).

The inundation risk map is determined by overlaying the drainage sufficiency, elevation, and slope maps. The spatial analysis involves a series of geographical modeling processes that use maps and imagery, computational analysis, and geographical patterns to produce advanced predictive modeling. The two methods commonly used in spatial analysis are the feature overlay (overlaying points, lines, or polygons) and raster overlay (Esri Press Team, 2018). Geographic Information System (GIS) overlay analysis operation focuses on map layers that can express the global relationship among those layers, while raster overlay references map layers with the same geographic location, making it well suited to compile the characteristics of numerous layers into a single layer (Tiede, 2014). By comparing the inundation risk map before and after the drainage maintenance which is carried out with the maintenance activity overlay, the effectiveness of maintenance activity could be examined. The social analysis determines the effect of community behaviors on drainage conditions.

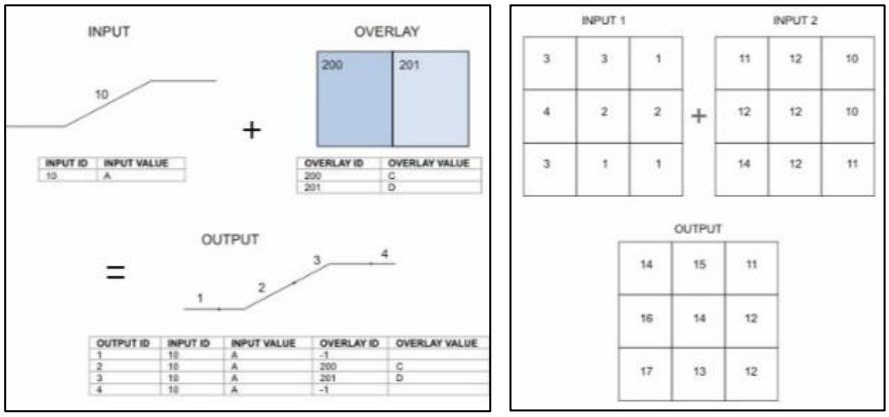

Figure 2. Feature Overlay (Left) and Raster Overlay (Right). Source: (Esri Press Team, 2018).

3. Results and Discussions

3.1. Inundation Risk Area

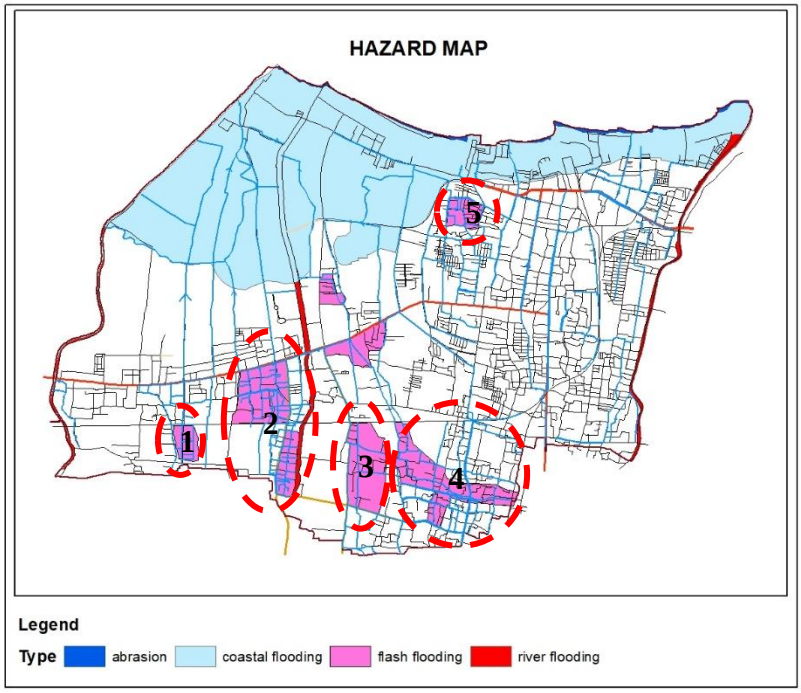

Figure 3. Hazard Map and Inundation-Prone Locations in Tegal.

Eight locations in Tegal are categorized as flash flood-prone areas affected by stormwater (Figure 3). Based on the elevation and inundation map analysis, three out of the eight inundation areas are located at sites that are lower than their surroundings. Rainwater cannot move out of the low-elevation areas; therefore, it increases the vulnerability and the scale of inundation. Moreover, Tegal is categorized as a highly flood-prone area because of the additional volume of water flowing in from Tegal Regency. At the end of 2018, the area of Tegal affected by coastal and flash flooding reached 100.39 Ha (2.53%). Reduced water catchment areas, the high sediment levels, and the lack of existing channel integration that connects Tegal are the additional detrimental factors. In the first quarter of 2019, moderate-intensity rainfall inundated an approximately 50.59 hectares of land (12.84%) (Government, 2019).

To reduce the risk, the local government has already implemented several programs, including drainage channel maintenance, retention pond construction, and water pump procurement. The result of the flood management efforts has been positive, as seen in several locations, while others have experienced no significant changes. A detailed maintenance and inundation area analysis was performed in six of the eight locations. Because the main program was not actively implemented in the other two locations, no significant reduction in the level of inundation was apparent in these two areas. The first

analysis was performed for Cabawan village, in the western part of the city. The second analysis consisted of two flood-prone areas that share a watershed. The third and fourth inundation areas are located in the eastern side of the second analysis area. The fifth is located in the northern side of the city near the sea.

3.2. Drainage Maintenance Activity

From 2016-2019, frequent types of drainage maintenance activities were carried out in Tegal under numerous programs by governments at the central, provincial, city, and local levels. Other stakeholders, including corporations implementing their corporate social responsibility (CSR) programs and the village community also actively participated in the process. A detailed illustration of the urban drainage channel maintenance activity is presented in Table 13. The black font color denotes the maintenance programs that were used in inundation area analysis, and the red color indicates inadequate maintenance programs that did not have a significant influence on drainage conditions and inundation reduction in the chosen areas.

Table 4: Drainage Maintenance Activity.

Stakeholders	Routine Maintenance	Periodic Maintenance	Rehabilitation	Special Maintenance
Central Government			- Kotaku (Housing Area Upgrading) - NUSP BDI Program	Coastal Drainage Development
Province Government		River Normalization		
City Government	Bio pore program to reduce drainage load (DLH)	- Irrigation channel maintenance - Inundation reduction	- Irrigation channel maintenance - Inundation reduction - Collector Channel Rehabilitation (DPU Cipta Karya)	Retention Pond, Water pump and Sluice Gate
Village			APIK program	
Community	Clean the channel			

Source: Interview with Public Works Agency, Planning Agency, and Housing Agency of Tegal

3.2.1. Routine Maintenance

Periodic urban drainage channel maintenance is carried out by the city government through the bio-pore maintenance and monitoring programs, and by the village community through an urban drainage cleaning activity. Coordinated by the environmental agency of Tegal, a bio-pore maintenance program is intended to increase the quantity of water catchment areas to reduce water runoff. The water load in the drainage channel decreases in line with a drop in the volume of the runoff. Unfortunately, this program is still in its early stages and does not show significant results, because the number of bio pores remains low. The results of the questionnaire pertaining to the program reveal that the basic bio-pore data is also unavailable. Thus, this program was not included in the analysis.

Figure 4. Routine Maintenance by the Community (left), by Local Government (middle) and by Drainage Repair Worker.

Tertiary and neighborhood drainage cleaning programs were initiated by the local and village governments and performed by the village community. Dissemination of public information regarding the importance of urban drainage channel maintenance is regularly provided by the local governments, especially before the rainy season. The local government constantly urges the community to actively participate in the periodic drainage cleaning activities to reduce flooding. However, depending on the community characteristics, each village responds differently regarding this request.

3.2.2. Periodic Maintenance

Periodic maintenance is conducted by the provincial government to bring about normalization of the riverbank and by the local government under an irrigation channel maintenance program and inundation reduction program. In 2016-2019, no riverbank normalization activities were conducted by the provincial government because Tegal was considered to have a lower risk than the other 32 regions. The fact of the matter is that the provincial government prioritizes actions in cities with a higher risk of inundation, landslides, and earthquakes. However, because river sediment cleaning is not the responsibility of the local government, they cannot, on their own, act on riverbank treatment.

The local government, through the Water Division of the Public Works Agency, directed a periodic maintenance in irrigation, primary and secondary channels for urban drainage cleaning, channel rehabilitation, and other treatments i.e., sluice gate maintenance and demolition of illegal buildings that obstruct the function of urban drainage. The detailed periodic maintenance activities conducted by the water division of the Tegal local government are presented in Table 5.

Table 5: Periodic and Special Maintenance Activities Conducted by Local Government from 2017 to 2019.

Program	Year	Drainage Cleaning (m)	Drainage Repair (m)	Sluice Gate Repair (unit)	Pump Establishment
Inundation Reduction Program	2017	11722	401	2	0
	2018	16712	7156	0	0
	2019	9495	137	9	4
Irrigation Channel maintenance Program	2017	15017	625	0	0
	2018	0	514	3	0
	2019	4444	555	0	0

3.2.3. Rehabilitation

Rehabilitation of an urban drainage channel is performed by two methods: drainage channel repair and drainage channel replacement. In addition to the channel rehabilitation implemented by the local government (mentioned in Table 3), other rehabilitation activities are conducted by the central and village governments. Most of the drainage channel replacement is carried out under the *Kotaku* (housing area upgrade) program by the central government in dense neighborhoods to reduce slums. Because no channel replacement was identified in the chosen area of analysis, further discussion will only focus on drainage channel repair.

One of the special programs initiated by some local governments in Central Java Province is the *Akselerasi Pembangunan Infrastruktur Kelurahan* (Accelerated Urban Village Infrastructure Development (APIK)) program. Tegal Regulation No. 4 of 2016 (regarding the APIK Program Implementation Instructions) defines APIK as a community empowerment program to accelerate the development of basic infrastructure facilities for the area to achieve a clean and healthy residential environment. The program is carried out by the village government under the auspices of the local government through a housing upgrading program.

3.2.4. Special Maintenance

Special urban drainage maintenance activities were implemented by the central government under the Coastal Settlement Development Program to reduce slums in coastal settlement neighborhoods and by the local governments through various tailor made programs, i.e., installing sluice gates, water pumps, and retention ponds treatments that follows the unique character of each watershed. Special maintenance programs that have been applied are discussed in detail in the following inundation area analysis.

3.2.5. Urban Drainage System Problems

According to the result of the interviews conducted with the local government, urban drainage maintenance activity problems in Tegal are classified as social and technical problems. Technical problems are issues correlated with the ability of the urban drainage network to perform its function of discharging rainwater from the mainland; meanwhile, social problems are related to administrative issues and the behavior of the population towards urban drainage.

Social Problems:

- Community Behavior
  Community behavior toward an urban drainage system has a significant influence on drainage network optimization, especially regarding waste and sediment accumulation. Littering in the drainage channel eventually clogs the channel with garbage and disrupts drainage channel performance. Negative community behavior in urban drainage channel has to change, because how the community behaves ultimately will affect drainage conditions, and the community plays a critical role in performing tertiary urban drainage cleaning.
- Law Enforcement
  There are some regulations related to building development from the join central and local government's regulations that prohibit construction over urban drainage channels. Furthermore, the city spatial planning (RTRW) and city development planning (RPJMD) documents provide building development guidelines that determine where buildings can be constructed. However, because of the lack of stringent punitive measures for people who break the rules, noncompliance is considered as somewhat normal. People commonly set up shops or trades over the top of the drainage channel on the side road. Moreover, the main drainage channel located far from the main road, which usually has bigger dimensions, is used as a makeshift kitchen and washroom. To improve the effectiveness of drainage maintenance, strict law enforcement is urgently needed. A scheme of reward and punishment may also be implemented to increase community awareness in law enforcement attempt regarding drainage maintenance activity.
- Institution Synchronization
  Institutional problems grow into classical problems in many spaces and aspects. The urban drainage problem grows more complex, as the system collects water from upstream through several districts before finally reaching downstream. The division of authority and responsibilities without a solid coordination between the relevant institutions will exacerbate an already ineffective drainage maintenance and drainage control, especially in the river and primary channels.
- Urban Channel Data Sufficiency
  One social obstacle in the drainage maintenance effort is the unavailability of detailed data on the overall urban drainage network. Insufficient urban drainage system data will lead to problems in identifying channel conditions and maintenance planning arrangements. The local government has already taken several measures to solve the data sufficiency problem by collecting urban drainage data since 2019. Because the urban drainage system is rather complex, the data collection process is still ongoing in 2020.

Technical Problems

- Channel Dimension
  Most of the primary and secondary channels in Tegal are old channels built before most of the settlement areas were developed. Land conversion from rice fields and mixed plantations into settlement areas increases the volume of water runoff. Without channel-dimension enhancement, inundation reduction is difficult to achieve.
- Elevation
  Some areas near the sea and the river tend to have a lower elevation with a mild slope, which slows the velocity of water flow. Water elevation in some areas is also higher than in the mainland. Ordinary urban drainage treatment is not sufficient to eliminate the recurring inundation and special treatments such as water pumps installation and sluice gates construction should be implemented to ensure that the drainage network functions properly.
- Combined Drainage System
  Sediment creation in a combined drainage system is relatively faster than in a separate drainage system and can easily overwhelms drainage cleaning performance. Therefore, sediment measurements in combined drainage channels are consistently high. Drainage cleaning action needs to be accelerated to offset the sediment.
- Vegetation Growth Close to Rice Fields, Farms, and Mixed Plantations
  In addition to carrying stormwater and wastewater, urban drainage transports excess irrigation from fields that usually contain seeds. Vegetation usually flourishes near rice fields,

farms, and mixed plantations and it eventually interferes with drainage channel performance. Therefore, periodic cleaning should be conducted in those channels.

- Urban Drainage Location
  In the dense settlement area, the drainage channel is usually located between two houses or buildings, and some even located under buildings; thus, the drainage is relatively untouched and difficult to observe and maintain.

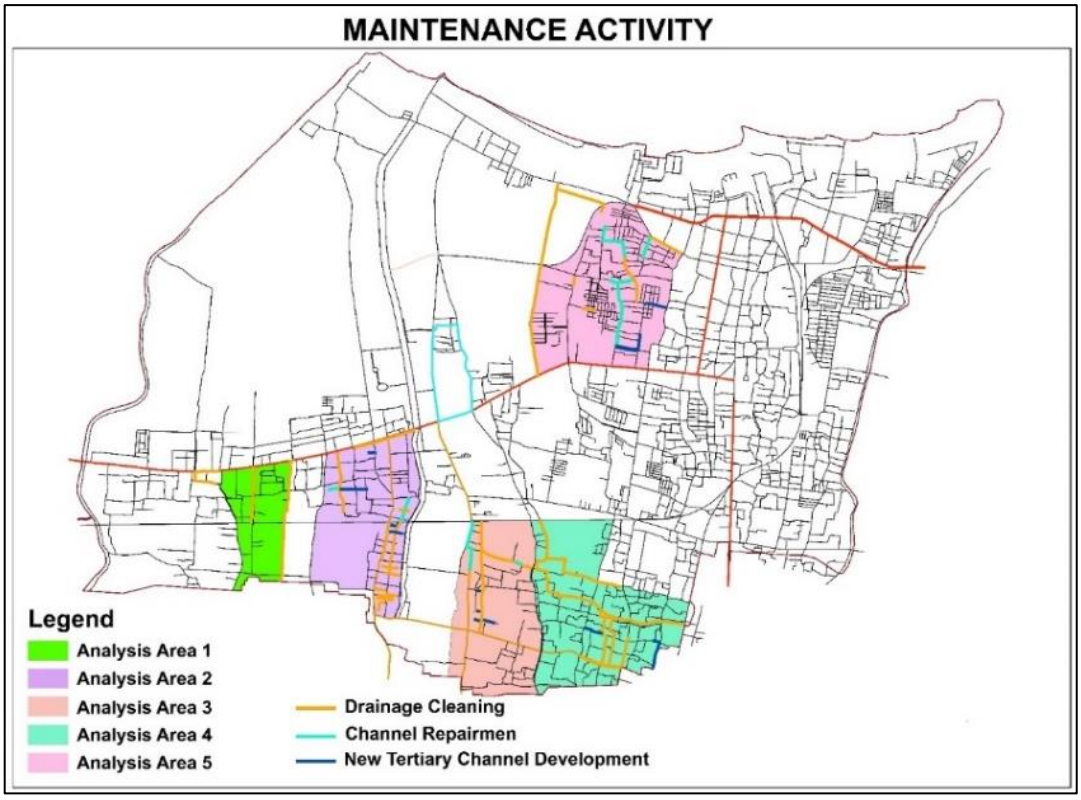

Figure 5. Drainage Maintenance Activities in Tegal.

3.3. Technical Analysis

Technical analysis was conducted by comparing water runoff and drainage capacity in each chosen inundation area followed by drainage maintenance and inundation reduction analysis.

3.3.1. Water Runoff and Drainage Capacity Comparison

a. Cabawan Village Analysis Area (Analysis Area 1)

Table 6: Cabawan Drainage Capacity Calculation Result.

Catchment Area	Water Runoff			Drainage Capacity		
	2-years Return Period (L/s)	5-years Return Period (L/s)	10-ears Return Period (L/s)	Current Drainage Capacity (L/s)	Drainage Capacity Without Sediment (L/s)	Planned Drainage Capacity (L/s)
Subsystem 1	0.296	0.405	0.499	23.348	40.442	31.577
Subsystem 2	1.471	2.011	2.476	2.809	4.992	12.133
Subsystem 3	0.445	0.608	0.749	1.081	1.836	3.266
Subsystem 4	1.497	2.048	2.521	5.548	9.911	17.523
	3.709	5.072	6.246	26.881	46.777	31.577
Subsystem 5	1.285	1.757	2.163	6.184	10.038	16.160
Subsystem 6	1.763	2.410	2.968	1.324	2.169	1.876
Subsystem 7	1.208	1.652	2.034	1.324	2.169	1.876
Subsystem 8	1.370	1.873	2.306	7.185	12.542	15.061
Subsystem 9	2.121	2.900	3.570	1.324	2.144	1.876
	11.456	15.664	19.288	34.656	66.565	31.577

The result of the channel capacity calculation shows that the current channel capacity in subsystems 6 and 9 is smaller than the required capacity for the 6-hours rainfall analysis of the 2-year return period. This condition makes the possibility of inundation high in both areas. When the channel is clear without sediment, the increase of the channel capacity becomes more prominent than the required capacity. The inundation risk determined by the urban drainage network before treatment is shown in Table 6.

Before drainage maintenance treatment was conducted, almost all the areas were categorized as high-risk inundation with the 4th level risk index displayed in orange on the map (Figure 80). Because this location has a high elevation (9 m) with steep slopes, drainage capacity has a greater impact on the formation of inundation. The maintenance activities in the inundated area were focused on normalizing the secondary and irrigation channels. No rehabilitation or new channel construction programs were applied in this area. In 2017 and 2018, around 1,228 m of irrigation channel was normalized through the inundation reduction program carried out by the Water Division of Public Works Agency. However, although maintenance activities were focused on the secondary channel, the average condition of the secondary channel (54.87 %) was slightly smaller than the average condition of the tertiary channel (up to 58.91%).

b. Margadana, Sumurpanggang and Kalinyamat Kulon Village Analysis Area (Analysis Area 2)

On the Tegal hazard map, the subsystem 1, 2, and 3 are designated as risky areas, except for the subsystem 4, which is not categorized as a risk area. Although the drainage capacity in the subsystem 1 and 3 is categorized as a risk area, their drainage capacities are larger than the water runoff. In the subsystem 4, the drainage capacity is not sufficient to accommodate the overflow. As a result, annual inundations continue to occur in this area. The maximum drainage capacity in subsystem 2 is larger than the runoff capacity from the 10-year return period calculation. However, because of sedimentation, the current capacity of the secondary channel is lower than the required capacity. In 2020, inundation only occurred in the subsystem 4.

Table 7: Margadana, Sumurpanggang and Kalinyamat Kulon Drainage Capacity Calculation Result.

Catchment Area	Capacity Requirement			Drainage Capacity		
	2-years Return Period (L/s)	5 -years Return Period (L/s)	10-years Return Period (L/s)	Current Drainage Capacity (L/s)	Drainage Capacity Without Sediment (L/s)	Planned Drainage Capacity (L/s)
Subsystem 1	4.237	5.794	7.134	34.727	49.417	34.264
Subsystem 2	2.296	3.140	3.866	1.414	8.446	0.801
Subsystem 3	2.402	3.284	4.044	28.993	43.072	46.493
Subsystem 4	2.257	3.086	3.800	0.115	0.212	0.261
	11.193	15.304	18.845	34.727	49.417	34.264
Subsystem 5	2.429	3.321	4.090	3.957	5.118	5.118
Subsystem 6	2.910	3.978	4.899	9.425	19.046	34.583
Subsystem 7	2.388	3.265	4.021	2.702	3.301	29.892
				Water Pump 1 x 250 L/s (0.25 m3/s)		
	13.6217	18.6256	22.9345	12.15109252	26.93315841	26.93316

In the southern side, the catchment area is divided into subsystems 5, 6 and 7. Most of the water runoff collected in the subsystem 6 and 7 empties into the river through a secondary channel located alongside the railroad tracks to the north. The drainage capacity in subsystem 6 is higher than the capacity required, whereas the maximum capacity in subsystem 7 is only capable of accommodating the intensity of 6-hours rainfall in a five-year return period. However, the principal problem is the low elevation. The sluice gate prevents water flows from the river to the residential area. The gate is supposed to close, and the water pump should engage as the water level rises. The problem occurs in the rainy season as the river water and discharged water from the land reach their highest levels at the same time. To discharge rainwater from the settlement area to the river, a water pump with a capacity of 250 L/s is used. Compared to the overflow calculation, this pump capacity is simply too small to accommodate all the rainwater in the catchment areas 6 and 7. The drainage maintenance activities applied in Kalinyamat Kulon, Sumurpanggang, and Margadana village are shown in Table 8.

Table 8: Summary of Maintenance Activities in Margadana, Sumurpanggang and Kalinyamat Kulon Village Analysis Area

Channel	Normalization (m)	Rehabilitation (m)	New Development (m)	Drainage Average Condition	
				Without Maintenance (m)	With Maintenance (m)
Primary	0	0	0	55.36	no maintenance activity
Secondary	2905	226	0	68.63	70.55
Tertiary	1880	139	644	62.16	64.85

None of the drainage channels in this location is categorized as the primary channel, and the water from the secondary channel flows directly into the river. The average condition of the secondary drainage channel after maintenance is 70.55%, which is only 2% higher than the drainage condition without maintenance. This number also appears in the tertiary drainage channel, where the capacity increases slightly from 62.16% to 64.85%. In general, maintenance activities do not have a significant impact on the conditions of secondary and tertiary drainage. However, in the location where a new drainage channel was constructed, connectivity between tertiary drainage is established, thereby reducing the extent and duration of the inundation.

Although the installation of water pump is able to reduce the inundation area from 54-10 ha and 24-10 ha in the northern and southern sides of the railroad tracks respectively, the pump capacity needs to be increased to solve the inundation problem in this area once and for all.

c. Tunon, Keturen, Bandung, Kalinyamat Wetan and Kalinyamat Kulon Village Analysis Area (Analysis Area 3)

The results of drainage capacity calculation of the analysis area show that the volume of water runoff is larger than the maximum drainage capacity in all catchment areas, which lead to inundation in all of the analyzed areas. The absence of tertiary channels in the subsystems 4 and 5 causes rainwater to flow into the same channel. The small capacity of the channel generates water overflow that becomes an inundation with the onset of rain.

Table 9. Tunon, Keturen Bandung, Kalinyamat Wetan and Kalinyamat Kulon Village Drainage Capacity Calculation Result

Catchment Area	Capacity Requirement			Drainage Capacity		
	2 Years Return Period (L/s)	5 Years Return Period (L/s)	10 Years Return Period (L/s)	Maximum Drainage Capacity (L/s)	Drainage Capacity Without Sediment (L/s)	Planned Drainage Capacity (L/s)
Subsystem 1	2.724	3.725	4.586	0.976	1.287	1.287
				0.374	0.559	0.489
				2.020	3.050	3.050
Subsystem 2	2.501	3.420	4.211	1.444	1.970	3.410
Subsystem 3	1.723	2.355	2.900	1.276	1.591	2.2326209
Subsystem 4	0.981	1.342	1.652			
Subsystem 5	1.904	2.603	3.205			
	2.885	3.944	4.857	1.843	2.154	2.154
	9.832	13.444	16.554	37.452	63.876	136.488

Table 10 illustrates that normalization activities focused on the primary channels and were applied to 2050 m of the primary channels and, therefore, to all the primary channels in the analysis area. Drainage clean-up was applied to 577 m of secondary channel and 100 m of irrigation channel. Channel repairs are concentrated on the irrigation channels and new developments are dedicated to the tertiary channels.

Table 10. Summary of Maintenance Activities in of Tunon, Keturen, Bandung, Kalinyamat Wetan and Kalinyamat Kulon Village Analysis Area.

Channel	Normalization (m)	Rehabilitation (m)	New Development (m)	Drainage Average Condition	
				Without Maintenance (m)	With Maintenance (m)
Irrigation	100	555	0	-	76.48
Primary	2050	0	0	-	63.97
Secondary	577	70	0	66.68	85.56
Tertiary	0	0	345	67.99	71.77

As illustrated in Table 10, normalization activities are focused on the primary channel and have been applied to 2050 m of the primary channels, which means that they were applied to all primary channels in this analysis area. Around 577 m of secondary channel was cleaned as well as 100 m of irrigation channel. Channel repairs are concentrated on the irrigation channels and new developments are dedicated to the tertiary channel.

Because the drainage system in this area is insufficient to accommodate rainwater, drainage capacity received the same score in all catchment areas. This condition raises the chance of inundation across the study area. However, because of the high elevation and slope conditions, some areas have low inundation risk scores. The high-risk inundation area is in the northern part of the analysis area that has a lower elevation. Inundations occur annually in locations with a high inundation risk score. Inundations do not occur in the southern part of the analysis area with higher elevation, confirming the significantly high contribution of elevation and slope to inundation propensity.

d. Tunon, Keturen, Bandung, Debong Kidul and Debong Tengah Village Analysis Area (Analysis Area 4)

The water runoff and drainage capacity comparison in Table 11 shows that the inundation problem is not caused by drainage capacity, because the total secondary channel capacity is higher than the required capacity for a 10-year return period analysis. The risk only occurs in subsystem 5, where the current capacity is not sufficient for 5 and 10-years of rainfall intensities. However, without sedimentation build up, the drainage maximum capacity is higher than the runoff.

Table 11. Tunon, Keturen, Bandung, Debong Kidul and Debong Tengah village Drainage Capacity Calculation Result.

Catchment Area	Capacity Requirement			Drainage Capacity		
	2-years Return Period (L/s)	5-years Return Period (L/s)	10-years Return Period (L/s)	Maximum Drainage Capacity (L/s)	Drainage Capacity Without Sediment (L/s)	Planned Drainage Capacity (L/s)
Subsystem 1	3.126	4.275	5.264	18.738	12.963	0.510
Subsystem 2	2.551	3.488	4.295	10.665	13.563	5.440
Subsystem 3	1.045	1.429	1.760	2.531	4.145	5.046
Subsystem 4	2.763	3.778	4.652	5.131	10.098	27.956
Subsystem 5	2.280	3.118	3.839	2.531	4.145	5.046
Subsystem 6	0.934	1.276	1.572	7.069	12.372	12.371

Numerous urban drainage maintenance treatments have been carried out in this inundation area, resulting in distinct effects on each channel. A sporadic tertiary drainage cleaning and a low level of community participation in the five villages lead to the degradation of tertiary drainage channel conditions over time. Secondary drainage also indicates a deficiency in performance, although massive cleaning has been done on this channel. Improvement on drainage channel only appears in the primary channel, in which the stream is collected from a secondary channel with a 10% increase. However, the network of drainage channel in this area is categorized as good compared to other areas. More massive drainage cleanup is required to overcome the accelerated rate of sediment accumulation.

Table 1. Summary of Maintenance Activities in of Tunon, Keturen, Bandung, Kalinyamat Wetan and Kalinyamat Kulon Village Analysis Area.

Channel	Normalization (m)	Rehabilitation (m)	New Development (m)	Drainage Average Condition	
				Without Maintenance (%)	With Maintenance (%)
Irrigation	0	0	0	49.81	no activity
Primary	2072	0	0	57.27	67.72
Secondary	6450	129	0	78.13	73.48
Tertiary	185	0	388	61.00	48.21

The Tunon, Keturen, Bandung, Debong Kidul, and Debong Tengah villages, inundation analysis areas are located at a relatively high elevation with good drainage capacity. However, the land and drainage slope in many parts of the area are relatively mild. Regular road infrastructure construction and repair that place material without dredging increase the road elevation over time, and in some old houses,

the floor elevation is now lower than the road. To reduce inundation, the drainage water level needs to be maintained so that water flowing in the drainage channel continues to flow without obstacles.

e. Tegalsari, Keraton, Pekauman and Pesurungan Kidul Village Analysis Area (Analysis Area 5)

Table 2. Tegalsari, Keraton, Pekauman, and Pesurungan Kidul Village Drainage Capacity Calculation Result.

Catchment Area	Capacity Requirement			Drainage Capacity		
	2 Years Return Period (L/s)	5 Years Return Period (L/s)	10 Years Return Period (L/s)	Maximum Drainage Capacity (L/s)	Drainage Capacity Without Sediment (L/s)	Planned Drainage Capacity (L/s)
Subsystem 1	3.083	4.215	5.190	**1.220**	1.714	1.457
Subsystem 3	3.521	4.815	5.929	1.724	3.016	3.049
Subsystem 2	4.768	4.107	5.057	0.244	0.320	0.320
Subsystem 5	2.763	3.778	4.652	3.107	6.523	0.324
Subsystem 4	0.596	0.815	1.004	7.578	15.755	74.218
	14.731	17.730	21.832	11.823	25.419	72.774
Subsystem 6	0.616	0.842	1.037	1.019	1.019	1.681
Subsystem 7	2.865	3.918	4.824	0.089	0.089	0.350
	3.481	4.760	5.861	1.540	1.540	33.894
	18.212	22.490	27.693	20.693	**61.671**	88.945

Bordered by a secondary channel in the north, a main road in the east and south, and a river in the west, the analysis area measures approximately 65.2 ha—twice as large as the inundation area. The analysis location is divided into seven subsystems, each of which has a different area determined by a watershed and secondary channel. Water runoff capacity is calculated using a 6-hour rainfall intensity for 2, 5, and 10-years return periods. The calculation results are compared with the maximum capacity of the secondary drainage function as the collector channel in each subsystem.

The results of the secondary ditch capacity calculation and analysis show that most of the secondary channel capacity is lower than the volume of water runoff, even in the 2-years return period of rainfall. The current condition of the secondary channel can only accommodate rainfall in the catchment area in the subsystems 4, 5, and 6. Without sedimentation build up, all the primary channels are in optimum condition to accommodate rainwater; however, in the current high-sediment condition, they simply do not have the capacity.

Table 3. Summary of Maintenance Activities in of Tegalsari, Keraton, Pekauman and Pesurungan Kidul Village Analysis Area.

Channel	Normalization (m)	Rehabilitation (m)	New Development (m)	Drainage Average Condition	
				Without Maintenance (%)	With Maintenance (%)
Primary	2728	0	0	50.00	63.31
Secondary	990	361.15	0	51.24	62.53
Tertiary	500	1630.85	815.6	67.59	74.14

3.3.2. Inundation Risk Map

The inundation risk map was created by overlaying the elevation, slope, and drainage sufficiency maps based on previous calculations. Because drainage sufficiency was only available in the chosen inundation area, inundation map analysis will be focused on those inundation sites.

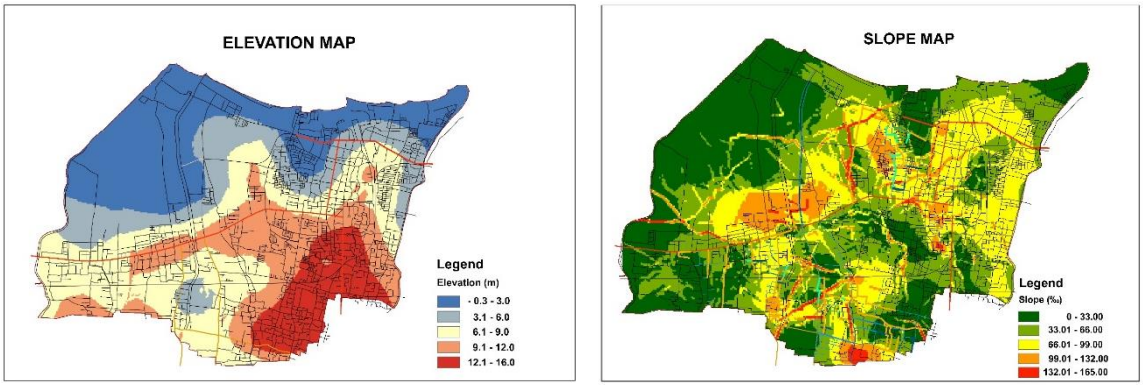

Figure 1. Tegal Elevation Map (left) and Slope Map (right).

Based on the drainage overlay map, we can see that most of the chosen inundation analysis areas have various levels of inundation risk from moderate (6) to high (10). Each maintenance activity in a specific area has a different impact on drainage conditions and inundation reduction. The details of inundation location and reduction in each of the analysis areas are illustrated in Table 15.

The implementation of drainage maintenance provides a major contribution in reducing the level of inundation in four locations. However, the proportion is different for each area, which is in line with the unique location characteristics, because the inundation in each area is caused by various factors, including performance of the drainage system and its lengths. Secondary drainage cleaning and repair significantly improve its effectiveness in reducing stormwater. Secondary drainage cleaning also contributes more significantly in maintaining the efficiency of secondary channels than secondary drainage repair. More actions need to be regularly implemented to eliminate the inundation area.

The implementation of urban drainage maintenance reduces the inundation risk by 1-3 levels, depending on location's characteristics. In the analysis areas 1 and 4, which are located at higher elevations, the inundation risk level decreased to levels 5 and 6; although inundation did not occur in 2020, the risk and the possibility of inundation are still high. Compared to the analysis areas 1 and 4, the inundation risk at sites 2, 3, and 5 (at a lower elevation) is relatively higher because drainage maintenance activity only affects drainage condition and does not affect the elevation and drainage slope.

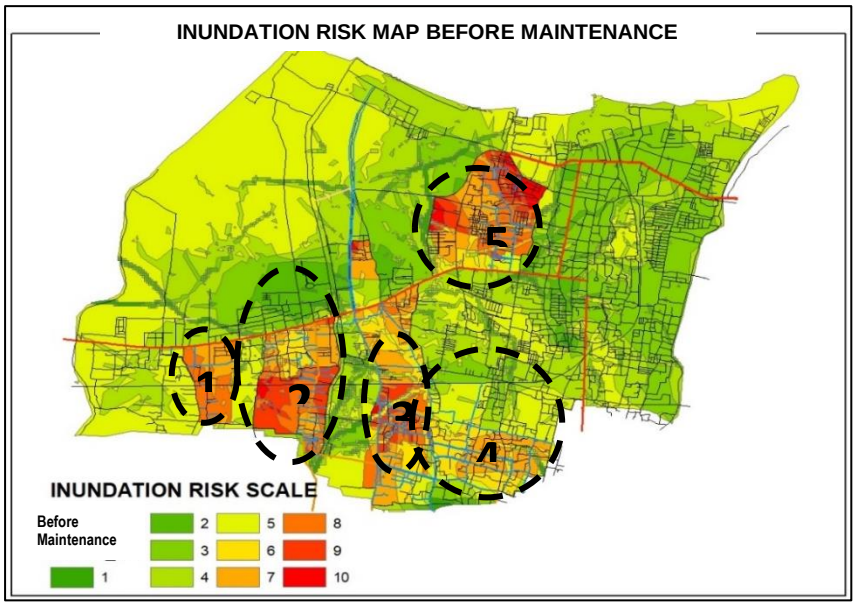

Figure 2. Inundation Risk Map Before Drainage Maintenance.

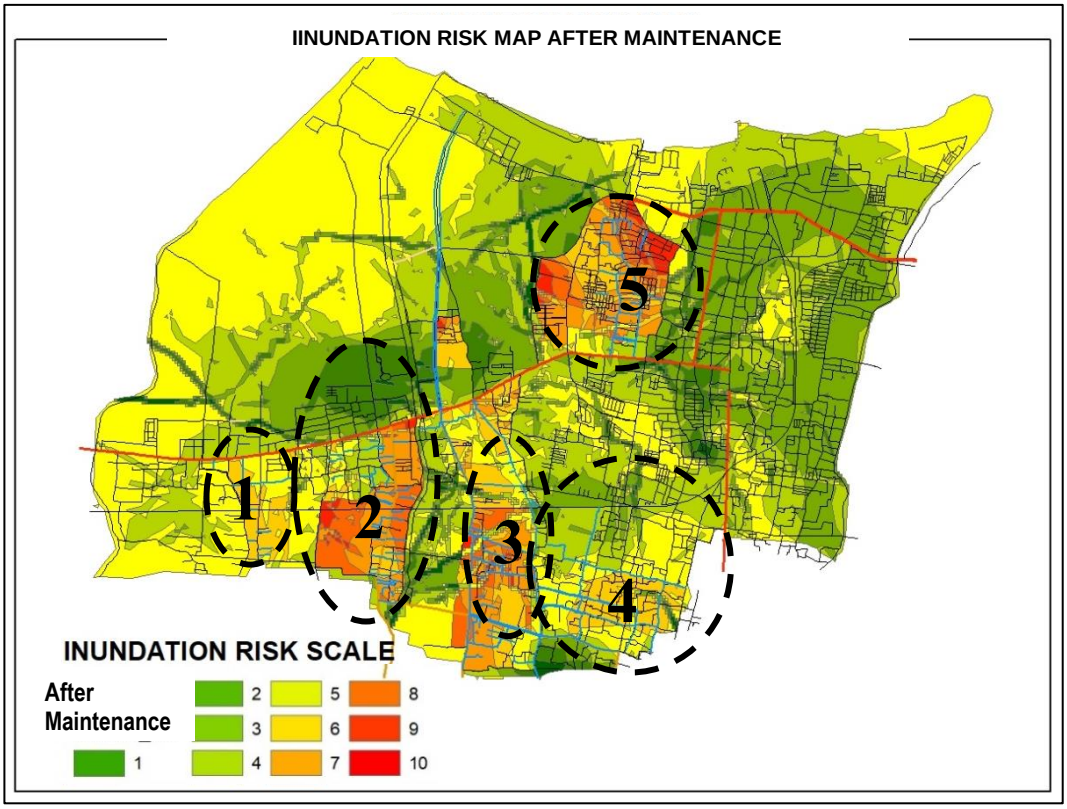

Figure 3. Inundation Risk Map After Drainage Maintenance.

Table 4. Inundation Area, Maintenance Activity and Current Average Drainage Condition in Each Inundation Area.

Inundation Area	Inundation Area (ha)			Secondary Channel		Tertiary Channel			Average Drainage Condition
	2011 (Hazard Map)	2020 (February Survey)	Reduction	Normalization (m)	Rehabilitation (m)	Normalization (m)	Rehabilitation (m)	New Channel (m)	
Cabawan	13.95	0	13.95	1189.0	0.0	0.0	0.0	0.0	56.89
Kalinyamat Kulon, Margadana, and Sumurpanggang	75.40	17.57	57.83	2625.0	726.0	1880.0	139.0	644.0	67.00
Tunon, Bandung, Kalinyamat Kulon, and Keturen	56.80	65.70	- 8.90	2727.0	625.0	0.0	0.0	345.0	67.24
Bandung, Tunon, Keturen, and Debong Tengah	63.17	0	63.17	7100.0	129.0	0.0	0.0	787.0	69.93
Tegalsari and Keraton	52.61	20.06	32.55	3718.0	361.2	500.0	1269.7	815.6	70.72

3.4. Social Analysis

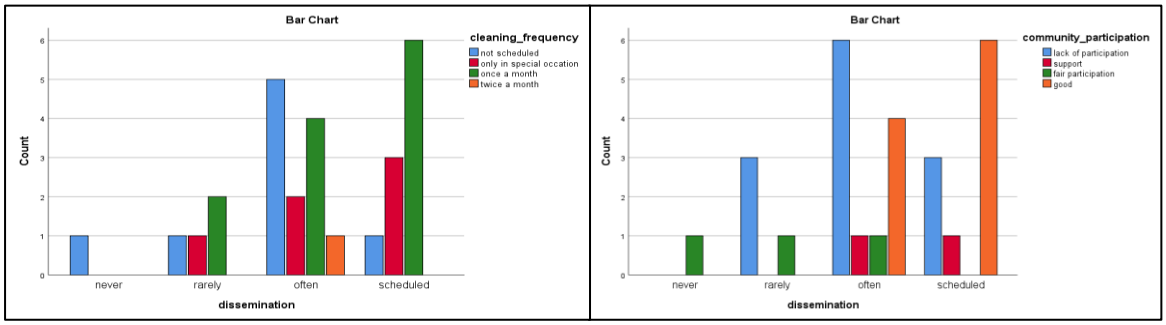

Figure 4. Dissemination of Drainage Maintenance Influence in Drainage Cleaning Frequency (left) and Community Participation in Drainage Maintenance (right).

Crosstab analysis was conducted to determine the effect of information dissemination frequency on urban drainage cleaning by the community and community participation. According to the cross-tabulation results, activities related to dissemination of public information in the 12 villages are carried out 3 or 4 times a year and have been scheduled for more than 5 times in the other 10 villages. The cleaning frequency in villages that never or rarely received the relevant information from the local government is relatively low and no urban drainage cleaning is scheduled and community participation simply does not exist. Villages that receive information regularly are more likely to carry out drainage channel sediment cleanup once a month and, in most cases, show active community participation. However, villages that engage in frequent socialization show a relatively less community participation with no scheduled drainage maintenance activity. This result indicates that to increase the frequency and community participation in urban drainage cleaning, the dissemination activity should be scheduled periodically at least 5 times per year. In addition to the city government, the village chief and government should also assume the responsibilities and participate in this activity to increase the social effect of urban drainage maintenance.

4. Conclusions

Below are the multi-layered processes associated with the implementation of urban drainage maintenance to reduce the risk of inundation in the city of Tegal:

- The implementation of combined drainage networks quickly creates ditch sediment; thus, countless maintenance activities have been performed but they are insufficient in some places and even lead to poor drainage conditions.
- Two types of problems generally exist in the activities associated with urban drainage maintenance: i.e., social problems, which are caused by human behaviors and technical problems, which are caused by water stream process. Social problems include community behavior, law enforcement, institutional coordination, and data sufficiency. Technical problems include insufficient channel dimension, low elevation, the implementation of combined drainage networks, vegetation, and poorly placed drainage locations under buildings.
- The impacts of urban drainage maintenance differ by area because different locations have their own unique characteristics and problems and must be individually treated.
- Ditch sediment cleaning has a larger impact on urban drainage improvement than other maintenance activities in almost all analysis areas. However, the sedimentation level at some sites remains high due to rapid sediment accumulation. In lower elevation areas, sediment cleaning must be followed by further water runoff controls, such as sluice gates operations, and water pumps installation. Drainage treatment must be adjusted to site characteristics and cannot be generalized.
- Local government, as the principal driver in drainage maintenance activity, plays a fundamental role in increasing the frequency of drainage maintenance, because all drainage maintenance activates are closely associated and organized by the local governments. Furthermore, the regional government has the obligation to increase community involvement in drainage maintenance activities.

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Reference

Authority, N. D. (2015). *Risiko Bencana Indonesia*. Jakarta: BNPB.

Davies, D. B. (2000). *Urban Drainage*. New York: E & FN Spon.

Esri Press Team. (2018). How to Perform Spatial Analysis.

Faiz Isma, I. Y. (2018). Sistem Informasi Geografis (Sig) Sebagai Evaluasi Jaringan Drainase di Gampong Sungai Pauh Kota Langsa. *Jurutera*, *12*.

Government, T. L. (2019). *Rancangan Peraturan Daerah (RAPERDA) RPJMD Kota Tegal 2019-2024*. Tegal:

Bappeda Kota Tegal.

Jonatan Zischg, B. R. (2018). Future trajectories of urban drainage systems: A simple exploratory modeling approach for assessing socio-technical transitions. *Elsevier B.V*, *11*.

Kementerian Kelautan dan Perikanan. (2019). Laut Masa Depan Bangsa, Mari Jaga Bersama.

Ngamalieu-Nengoue, U. A., Iglesias-Rey, P. L., Martínez-Solano, F. J., Mora-Meliá, D., & Valderrama, J. G. S. (2019). Urban Drainage Network Rehabilitation Considering Storm Tank Installation and Pipe Substitution. *Multidisciplinary Digital Publishing Institute Journal*, *11*(3).

Suripin. (2004). *Sistem Drainase Perkotaan yang Berkelanjutan*. Yogyakarta: ANDI OFFSET.

Suryadiputra, N. (2012). Mangrove Mengamankan Pesisir yang Rentan Bencana.

Tiede, D. (2014). A new geospatial overlay method for the analysis and visualization of spatial change patterns using object-oriented data modeling concepts. *Cartography and Geographic Information Science*, *41*.

Yazdi, J. (2017). Rehabilitation of Urban Drainage Systems Using a resilience-based Approach. *Water Resources Management*, *32*.

Yongchao Zhou, D. S. (2019). Urban Flood Risk Assessment Using Storm Characteristic Parameters Sensitive to Catchment-specific Drainage System. *Science of The Total Environment*, *659*.

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Research Paper

Interconnecting Issue of Government's Regional Budget Allocation and Open Burning Behavior: Study from Indonesia

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Abstract

This research aims to analyze whether people's perception, living area such as rural/urban, and regional budget proportion for the environment at province level influence open burning behavior of a household in Indonesia. Using household-level data in 2017 from the National Socioeconomic Survey of Indonesia and adding control factors such as socio-demographic characteristics, a logit regression method is conducted. The result reveals that burning behavior perception has an important role in open burning thrash decisions and people living in rural areas tend to do open burning trash compared to those who are living in urban areas. Furthermore, provinces with higher proportion budgets for environmental facilities tend to have fewer open burning cases done by households compared to provinces with lower proportion budgets for environment. The findings suggest that government should improve waste policies at regional and municipal level to reduce open burning trash behavior of households.

Keyword: open burning trash behavior, people's perception, regional budget, urban/rural.

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1. Introduction

In developed countries, doing open burning trash on purpose is regulated strictly and has been considered as an old-fashioned technology. However, in developing countries, the application of these technologies is still preferable. Open burning remains to be the cheapest and easiest way to reduce volume and burnable materials disposal (UNIDO, 2008 as cited in Estrellan & Iino, 2010, p. 194). Although environmentally intolerable, practice of doing open burning is still done by most people in developing countries especially those in the groups which arranged waste treatment has not been familiar and people are set aside with their ways for waste dumping; thus, threatening them to the health risks of toxic emissions, for instance, irritation of smoke and unpleasant smell that are related with open burning actions (Estrellan & Iino, 2010). Consequently, a better understanding of internal and external factors' effect on households' open burning behavior would help to map people's preferences. This paper seeks to address open burning trash behavior among households and provide inputs valuable in municipal planning for policymakers.

Waste generation and waste disposal hurt the environment and people's health; therefore, some actions need to be done. Waste handling is coherent with the Sustainable Development Goals (SDGs) target 12.5, that by 2030 each country will significantly reduce the production of waste through prevention, reduction, recycling, and reuse to certify a sustainable way of production and consumption. Municipal solid waste in Indonesia mostly is discarded in landfill locations without any treatment compared to other developing countries (Aye & Widjaya, 2006). The prohibition on open burning is also regulated in Article 29 of Law Number 18 the Year 2008 concerning Waste Management, one of which states that everyone is prohibited from burning waste that is not by the technical requirements of waste management. The regulation also states that the perpetrators of waste burning are threatened with imprisonment or fines. However, the extent of law prosecution varies by region, especially in rural areas where the waste management is still insufficient (Meidiana & Gamse, 2011) From the questionnaire, the results show only 1.2 percent of households doing recycling. The main concern is the number of households that burn garbage reaches 66.8 percent, even though it has been known that burning garbage is a source of pollution that can cause respiratory illnesses (Badan Pusat Statistik, 2018).

The implication is that the Indonesian Government's effort to handle solid waste problems may not be recognized if there is no change at the household level conditions. To improve household solid waste management in the country, knowing the determining factor behind a household's solid waste disposal behavior is necessary (Alhassan et al., 2020). Professionals agreed that solid waste management integration not only about technical and environmental aspects but also they found that a variety of environmental issues are affected by people's behavior and could be relieved by changing the behavior (Steg & Vlek, 2009).

A study that examined the underlying factors of open burning behavior in Indonesia is still few. However, research to break down the drivers of such behavior in the country is limited. Even though open burning is part of waste disposal behavior, the current study mostly models the drivers of households' solid waste sorting and dumping behavior, not specifically observe open burning behavior. Moreover, a paper that uses data obtained from a huge number of respondents on a national scale has not been conducted regarding open burning behavior decisions. Therefore, hypotheses could be taken to prove that internal and external factors matter on open burning behavior. To analyze the hypotheses and to fill the gap from the previous study, logit regression is conducted using 297,276 household data from the National Socioeconomic Survey of Indonesia in 2017. The objective of this study is to identify the influence of people's perception, rural/urban category of living area, and regional budget proportion for the environment at province level on open burning behaviors of household's level in Indonesia.

2. Methodology

To investigate the impact of urban/rural category, burning trash perception, and regional budget proportion for the environment on open burning trash behavior of households, this study using binary logistic regression (LOGIT). The following basic specification is used:

$$Logit(R) = \frac{1}{1+e^{-z}} \quad ; z = \beta_0 + \beta_1 urb_{rural_i} + \beta_2 burn_{percept_i} + \beta_3 reg_{budget_{prop_i}} + \beta_4 x_i' + \varepsilon_i$$

Where z is latent measures of household open burning habit, β is the vector of parameters to be estimated, urb_{rural_i} is a dummy variable for urban/rural category, $burn_{percept_i}$ is a dummy variable for

open burning perception at household, $reg_{budget_{prop}_i}$ is variable of regional budget proportion at the province level, $x_i^{'}$ refers to socio-demographic variables as control variables for household *i* and ε is the error term. Then, the marginal effect of a change in the explanatory variable on the expected value of the dependent variable is calculated. Logit regression method is conducted since the dependent variable is the binary type, where "1" equals doing burning trash behavior, and "0" equals never burning trash. Moreover, logit is relevant to be utilized in maximizing utility cases to answer the research question.

This study utilized the data from the National Socioeconomic Survey of Indonesia (SUSENAS) year of 2017 that conducted by BPS, with the total number of respondents, were approximately 297,276 households. The data widely used by researchers to examine various topics, particularly health, welfare, demographic issues, and pro-environmental behavior. Especially in Indonesia, the study about open burning trash behavior which uses national scale data is very limited. Therefore, the variables and arguments used by previous studies related to waste disposal behavior can be utilized and applied in this study of open burning behavior. By using the binary logit regression method, household-level data were used in this study to identify the relationship between open burning behavior with internal factors such as people's perception and socio-demographic, as well as external factors. Given the previous studies, this research includes the dependent and independent variables as can be seen in table 1.

The independent variables of this study are socio-demographic factors, people's perception of burning trash perception, the regional budget proportion for the environment, and air quality index factors. Socio-demographic factors consist of age group, gender, family size, marital status, monthly expenses, education level, and poor/non-poor category. According to previous studies regarding waste disposal behavior, socio-demographic variables have a significant outcome on household behavior (Abebaw, 2008; Tadesse et al., 2008; Binyaruka, 2015; Chu et al., 2013; Mamady,2016). For open burning case, education level variables treated as categorical data because in Indonesia curriculum for chemistry subjects only begin to be taught when students are at the high school level. It is assumed, people can understand the impact of chemical reactions resulting from the open burning and the types of pollutants produced by it after going through high school education. Therefore, the education variable in this study uses categorical rather than ordinal types.

For urban/rural category classification, this study is based on The Head of the Central Bureau of Statistics Regulation Number 37 of 2010 concerning about Classification of Urban and Rural Areas in Indonesia (Badan Pusat Statistik, 2010). Besides, there is an important impact of district area characteristics from the previous study such as ease of the access area (Awah Manga, 2012), inadequate planning on the spatial aspect (Mamady, 2016), or the density of population (Ojewale, 2014). Moreover, many cities in developing countries are struggling to deal with their municipal solid waste. The waste collection rates estimation range is usually still low. For instance in Africa, Sotamenou (2019) found that these low collection rates can be justified by the inadequate service of municipal solid waste collection vehicles, lack of assets and technical skill, continued urbanization, deficient aspect of infrastructure, poor waste management systems, the behavior of household and geo-environmental restrictions which including challenging topography.

For burning trash perception, some people who have the perception to burn garbage might implement them as a real habit or vice versa. The result could be significant or insignificant. The reasoned action theory is based on the hypothesis that people usually act practically; that they take into account information availability and indirectly or consider the consequences of their actions (Ajzen, 1985). In other words, a person's perception could affect whether someone would do (or not to do) a behavior. Therefore, household characteristics, disposal options available as well as people opinions, and social norms are likely to be the main contributing factor to household waste disposal (Sotamenou et al., 2019). Van Liere (1978) found that there is a significant interaction between responsibility acknowledgment, consequences awareness, and burning behavior. To measure the relationship between people's perception and acts, household heads were being asked for their opinion about open burning trash behavior whether they agree that not burning trash will reduce air pollution or not.

Cities authority have the responsibility for waste management, providing an effective and efficient system to the residents. However, they often face problems away from the capability of the municipal authority to handle (Sujauddin et al., 2008) generally due to lack of arrangement, fiscal resources, and systematic variation due to the waste management system. The proportion of the regional budget for the environment is seen as an independent variable in describing the government's efforts to improve the quality of the environment. Environmental protection as one of the national priorities continues to get attention from the government both in terms of budget and implementation. The proportion of budget

allocation at the regional level is used as a policy variable because the government fiscal capacity is closely related to the availability of public goods (Guerrero et al., 2013). Also, compared to other policies, complete data related to the allocation of government budget are only available at the regional level in Indonesia.

Then, the last independent variable, air quality index, is calculated from each province in Indonesia after the annual average concentration of air pollutant parameters in the form of SO and NO is obtained from the results of ambient air quality measurements in districts/cities. Previous studies have largely discussed air pollutant emissions resulting from burning waste in several countries such as Mexico (Gullett et al., 2010), China (Wang et al., 2017), India (Kumari et al., 2017), Thailand (Junpen et al., 2018) and Indonesia (Bastian et al., 2013; Permadi & Kim Oanh, 2013). Improper handling of waste will also have an impact which becomes a global concern, such as greenhouse gases (World Bank, 2018). Measurement of ambient air quality at the regional level is carried out at 4 (four) locations representing industrial, residential, transportation, and office areas using the manual passive sampler method with established requirements and criteria. The formula is used assuming that the measured air quality data are pollutant concentration data (Ministry of Environment and Forestry, 2018). Consequently, it must be converted into air quality concentrations, with a reduction of 100 percent. Therefore, the air quality index results from the calculation are categorized as good results if it gets closer to 100 and vice versa.

Table 1: Variables included in the analysis.

	Code Name	Definition	Type
DEPENDENT VARIABLE	op_burn	0= Never burning trash 1=Doing burning trash	Categorical
INDEPENDENT VARIABLE	urb_rural	Location Type (Urban=1 Rural=0)	Categorical
	fam_mmbr	Household size with a total family member	Numeric
	marit_stat	Marital Status (1=married; 0=Not married)	Categorical
	gender	Gender (1=male; 0=female)	Categorical
	age	Age of Household's head	Numeric
	educ	Education of Age of Household's head (0=below Senior High School 1=Above Senior High School)	Categorical
	poor	Whether If the household received social security or not (Poor =1 Otherwise=0)	Categorical
	Expend	Total family expenditure (Rp)	Numeric
	dburn_percept	Doesn't burn trash could reduce air pollution (0=not agree 1= agree)	Categorical
	reg_budget_prop	Percentage of Provincial Budget for Environment by Province	Numeric
	air_index	Air quality index, using EU directives. The closer to 100% is better, the further away from 100% is worse.	Numeric

3. Results and Discussion

Conducting logistic regression and calculating the marginal effect of each variable could be used to analyze the more reflective relationship between variables and open burning behavior. Three models are established to build up the analysis. In the first model, only the variables of burning perception and urban/rural category are included in the specification to observe the result without controlling sociodemographic and external factors at the province level. It could be seen in Table 2, the relationship between perception, rural/urban category, and burning habit are significant in model 1. Besides, the perception to burn and urban/rural category show a meaningful and negative association on open burning behaviors of households. In other words, the more people agree to not burn trash, they tend to not burn trash, and people who live in rural areas tend to burn trash compared to people who live in urban areas. Since this model could deteriorate from omitted variable bias, it could not directly conclude before including control variables.

This analysis then includes socio-demographic characteristics and external factors such as budget proportion for environment and air quality index at province level in models 2 and 3. From table 2, we can see that socio-demographic factors and external factors could have a relationship with open burning behaviors. This result is in line with previous studies that find that socio-demographic characteristics

matter on open burning behavior (Abebaw, 2008; Tadesse et al., 2008; Binyaruka, 2015; Chu et al., 2013; Mamady,2016). The three models show that marital status, age of household head, poor status, and household size have a positive correlation with open burning behavior. In contrast, the rest characteristics such as gender of household head, education level, and monthly expense of household show a negative correlation with open burning habits.

Table 2: Marginal effects of estimated parameters.

Variables	Model 1	Model 2	Model 3
Open Burning Behavior			
Urban/rural category	-0.277***	-0.255***	-0.224***
	(0.00)	(0.00)	(0.00)
Burning perception	-0.198***	-0.190***	-0.180***
	(0.00)	(0.00)	(0.00)
Regional budget proportion		-0.028***	-0.022***
		(0.00)	(0.00)
Air quality index		0.007***	0.007***
		(0.00)	(0.00)
Household size (Family member)			0.013***
			(0.00)
Marital status			0.062***
			(0.00)
Gender			-0.013***
			(0.00)
Age			0.001***
			(0.00)
Education			-0.042***
			(0.00)
Poor			0.013***
			(0.00)
Monthly Expense			-0.000***
			(0.00)

**significant at the 10%; **significant at the 5% level; ***significant at the 1% level*

After controlling socio-demographic variables, the marginal effect of the urban/rural variable becomes lower from 28% in model 1 to 25% in model 2 and 22% in model 3. The results reveal that people who live in urban areas have a lower probability of burning trash by around 22% compared to those who live in rural areas. It can be concluded that the people who live in rural areas tend to do open burning behaviors more than urban people. This is consistent with the hypothesis that people in rural areas have an incentive to do open burning. Mamady (2016) stated that waste disposal behavior with disrespect for environmental concerns is probably influenced by geographical risk factors (suburban area and residents' distance to municipal legal dumpsite). This finding matches with Awah Manga (2012) which shows that demographic features, geographic topographies, and waste facility aspects seem to affect disposal behavior among farming households in lowland areas of Yaoundé.

For household perception, this study involves the variable of burning perceptions. The marginal effect of the burning perception variable becomes lower from 20% in model 1 to 19% in model 2 and 18% in model 3. The results reveal that people who have good perceptions have a lower probability of burning trash by around 18% compared to those who have bad perceptions. The regression result shows that with higher positive perceptions people tend to not burn trash. This result is matched with the previous study, such as (Van Liere & Dunlap, 1978) who found that there is a significant interaction between responsibility acknowledgment, consequences awareness, and burning behavior. However, Taylor (1995) exposed a comparable vibe with this result were given adequate knowledge, people might be willing to overcome

personal inconvenience to realize the more global benefits of doing appropriate waste disposal. While for some cases they will attempt to not do that when they face a serious obstacle. As a result, household characteristics, disposal options availability, people's opinions, and social norms are likely to be the main contributing factor to household waste disposal (Sotamenou et al., 2019).

In line with the results of the two previous variables, the external factors such as the budget proportion for the environment at province variables shows a negative relationship with open burning behaviors. The marginal effect of the burning perception variable becomes lower from 2.8% in model 2 to 2.2% in model 3. Provinces with a higher budget proportion are more likely to have fewer open burning cases, while provinces with a lower budget proportion are less likely to do so. As can be seen in model 3, increasing the value of budget proportion by 1 level leads to decreasing the probability of doing open burning by 2.2%. In other words, provinces that have more environmental budgets tend to have less open burning behaviors compared to those that have a lower budget. Guerrero (2013) supports this result by explaining that resources are required to have qualified personnel, proper equipment, adequate infrastructure, good maintenance, and operation. The financial support from the government, the interest of the municipal authority in waste handling issues, the participation of the service users, and the accurate funding administration are crucial for a restructured sustainable system.

On the other hand, air quality index factors show a positive relationship with open burning behaviors. The marginal effect of the air quality index variable still has the same level at 0.7% in models 2 and 3. Provinces with higher air quality index are more likely to have higher open burning cases, while provinces with lower air quality index are less likely to do so. As can be seen in model 3, increasing the value of the air quality index by 1 level leads to an increased probability of doing open burning by 0.7%. In conclusion, people who live in provinces with good air quality index, tend to do open burning or the other way around. It could make sense because, in the more developed regional area, the need for transportation and energy increases in line with the increasing population so the causes of low air quality index are not only influenced by open burning (Ministry of Environment and Forestry, 2018). Increased use of transportation and energy consumption will increase air pollution which will have an impact on human health and the environment. Nonetheless, Kumari (2017) discovered that in the case of open burning, 20% of uncollected municipal solid waste, the level of dioxins, furan and its congeners intend to be greater than the limit of its daily intake which can affect in changing various immune and increasing risk for cancer diseases. Therefore, air pollution interventions are required for better air quality and health benefits.

Although it has an intuitive result like the previous study, this study shows that socio-demographic factors, mainly urban/rural category and people perception, as well as a regional budget proportion from the government, have the most significant correlation on open burning behavior using larger observation data in Indonesia. Indonesia is an archipelago country with various regional topology. The decentralization effect makes laws, regulations, and government budget arrangements regulated by each regional authority. This causes the progress of regional development to vary. Included in the case of waste disposal treatment, urban areas tend to have better facilities than rural areas because of the adequate infrastructure and easy access. In Indonesia, farther from the center of government, rule enforcement is usually not well monitored. Because of that, people do the behavior that they think makes it easier for them in the effectiveness of time and lower costs such as open burning. Also, in rural areas, more people have a low educational background and poor economic conditions. This further reinforces the reasons why open burning behavior occurs more in rural areas than in urban areas. Furthermore, assuming that local governments, especially in rural areas, are still lacking in resources to implement ideal waste management, it could be seen from the many cases of open burning behavior mostly in rural areas. The results of this study reinforce these assumptions by showing a significant correlation between urban/rural areas and regional budget by the government on open burning behavior. Therefore, further policy measures could be implemented with the factors examined above to take into account.

As a final point, a connection to possible improvements in waste policies in Indonesia could be generated. From the collected works on household waste disposal practices in Indonesia, three recommendations emerge. Firstly, decision-makers should improve the waste disposal options availability (Aye & Widjaya, 2006; Damanhuri et al., 2009) and invest in infrastructure and improve waste collection services in remote areas (MacRae & Rodic, 2015). It could be done by expanding regional budget allocation for the environment and waste service. Secondly, adjusting waste policies through setting optimal waste retribution tariff and disposal fees, as well as preventing undesirable waste dumping through increasing monitoring and enforcement (Meidiana & Gamse, 2011). Lastly, increasing the engagement of public or private sectors and improved education to encourage households' awareness

(Sekito et al., 2013; Ulhasanah & Goto, 2018) and knowledge of the environmental (Bastian et al., 2013; Permadi & Kim Oanh, 2013) as well as health concerns are also crucial in accelerating changes in the solid waste management system in general.

4. Conclusions

The relationship between people's perception, rural/urban category of living area, and regional budget proportion for the environment at province level on open burning behaviors of household's level in Indonesia are the main focus of this research. It is assumed that perception to burn has an important role in open burning decisions and people living in rural areas tend to do open burning trash compared to those who are living in urban areas. Also, provinces with higher proportion budgets for environmental facilities tend to have fewer open burning cases done by households compared to provinces with lower proportion budgets for the environment. Previous studies reveal that perception and socio-demographic factors as well as government policies affect household waste disposal behavior. Then, to analyze the hypotheses, logit regression is conducted by using Indonesian household-level data.

This study noted that the urban/rural category is the primary driver to encourage households for doing open burning. After controlling socio-demographic characteristics, the result is that the people who live in rural areas tend to do open burning behaviors more than urban people. This result is consistent with the hypothesis that people in rural areas have an incentive to do open burning. Also, the higher positive perceptions people tend to not burn trash. From the external factors, provinces with higher budget proportion are more likely to have fewer open burning cases, while provinces with lower budget proportion are less likely to do so. In other words, provinces that have more environmental budgets tend to have less open burning behaviors compared to those that have lower budgets. However, waste policy implementation in Indonesia, especially in regional areas still needs many improvements. For that reason, the government should convey national benchmarks, rules, or technical support about various waste treatment methods, collection services, and final waste dumping sites and distribute them to the municipal authority.

This research outcome provides a step forward for the national data mapping about household open burning behavior for Indonesia which might be used for the regional government but more specifically for decision-making purposes. However, there are some limitations to this study. Since it is a questionnaire data type, there is a possibility that it could suffer from selection data biases. Consequently, to overcome that problem some field experiments could be possibly done in the future for analyzing open burning behaviors. Moreover, this study has a limitation in describing open burning behavior distribution in smaller areas in Indonesia since solid waste management is a local government responsibility. This study should be improved further including more significant characteristic data like ethnics, social-custom, policy variables, and certain occupations (e.g. farmers) at the district level and updated regularly to reveal the up-to-date changes in the household behavior. Therefore, district level and more microdata characteristics should be included in the future analysis.

Reference

Abebaw, D. (2008). Determinants of Solid Waste Disposal Practices in Urban Areas of Ethiopia: A Household-Level Analysis. *Eastern Africa Social Science Research Review*, *24*(1), 1–14. https://doi.org/10.1353/eas.2008.0000

Ajzen, Icek. (1985). From intentions to actions: A theory of planned behavior. *Action Control*, 11–39.

Alhassan, H., Kwakwa, P. A., & Owusu-Sekyere, E. (2020). Households' source separation behaviour and solid waste disposal options in Ghana's Millennium City. *Journal of Environmental Management*, *259*(December 2019), 110055. https://doi.org/10.1016/j.jenvman.2019.110055

Awah Manga, L. A., & Manga, A. (2012). *Solid Waste Disposal Among Urban Agricultural Households* in Third International Scientific Symposium "Agrosym 2012", Jahorina, Bosnia and Herzegovina, 15-17 November 2012. Book of Proceedings. Faculty of Agriculture, University of East Sarajevo, pp. 363–367.

Aye, L., & Widjaya, E. R. (2006). Environmental and economic analyses of waste disposal options for traditional markets in Indonesia. *Waste Management*, *26*(10), 1180–1191. https://doi.org/10.1016/j.wasman.2005.09.010

Badan Pusat Statistik. (2010). Peraturan Kepala Badan Pusat Statistik Nomor 37 Tahun 2010 tentang Klasifikasi Perkotaan dan Perdesaan di Indonesia. In *Badan Pusat Statisistik Republik Indonesia*

[Regulation of the Head of the Central Bureau Statistics Number 37 of 2010 concerning Classification of Urban and Rural Areas in Indonesia]. https://sirusa.bps.go.id/webadmin/doc/MFD_2010_Buku_1.pdf

Badan Pusat Statistik. (2018). Statistik Lingkungan Hidup Indonesia (SLHI) 2018 [Indonesian Environmental Statistics 2018]. In *Badan Pusat Statistik*., 37-45 https://doi.org/3305001

Bastian, L., Yano, J., Hirai, Y., & Sakai, S. (2013). Behavior of PCDD/Fs during open burning of municipal solid waste in open dumping sites. *Journal of Material Cycles and Waste Management*, *15*(2), 229–241. https://doi.org/10.1007/s10163-012-0114-5

Binyaruka, P. J. (2015). Patterns and correlates of solid waste disposal practices in Dar es Salaam city, Tanzania. *African Journal of Environmental Science and Technology*, *9*(6), 545–556. https://doi.org/10.5897/ajest2014.1831

Chu, Z., Xi, B., Song, Y., & Crampton, E. (2013). Taking out the trash: Household preferences over municipal solid waste collection in Harbin, China. *Habitat International*, *40*(145), 194–200. https://doi.org/10.1016/j.habitatint.2013.05.001

Damanhuri, E., Wahyu, I. M., & Ramang, R. (2009). *Evaluation of municipal solid waste fl ow in the Bandung metropolitan area , Indonesia BANDUNG CITY*. 270–276. https://doi.org/10.1007/s10163-009-0241-9

Estrellan, C. R., & Iino, F. (2010). Toxic emissions from open burning. *Chemosphere*, *80*(3), 193–207. https://doi.org/10.1016/j.chemosphere.2010.03.057

Government of Indonesia. (2008). *Law Number 18 of 2008 Concerning The Waste Management*.

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management*, *33*(1), 220–232. https://doi.org/10.1016/j.wasman.2012.09.008

Gullett, B. K., Wyrzykowska, B., Grandesso, E., Touati, A., Tabor, D. G., & Ochoa, G. S. (2010). PCDD/F, PBDD/F, and PBDE emissions from open burning of a residential waste dump. *Environmental Science and Technology*, *44*(1), 394–399. https://doi.org/10.1021/es902676w

Junpen, A., Pansuk, J., Kamnoet, O., Cheewaphongphan, P., & Garivait, S. (2018). Emission of air pollutants from rice residue open burning in Thailand, 2018. *Atmosphere*, *9*(11), 449. https://doi.org/10.3390/atmos9110449

Kumari, K., Kumar, S., Rajagopal, V., Khare, A., & Kumar, R. (2017). Emission from open burning of municipal solid waste in India. *Environmental Technology (United Kingdom)*, *40*(17), 2201–2214. https://doi.org/10.1080/09593330.2017.1351489

MacRae, G., & Rodic, L. (2015). The weak link in waste management in tropical Asia? Solid waste collection in Bali. *Habitat International*, *50*, 310–316. https://doi.org/10.1016/j.habitatint.2015.09.002

Mamady, K. (2016). Factors influencing attitude, safety behavior, and knowledge regarding household waste management in Guinea: A cross-sectional study. *Journal of Environmental and Public Health*, *2016*. https://doi.org/10.1155/2016/9305768

Meidiana, C., & Gamse, T. (2011). The new Waste Law: Challenging opportunity for future landfill operation in Indonesia. *Waste Management and Research*, *29*(1), 20–29. https://doi.org/10.1177/0734242X10384013

Ministry of Environment and Forestry. (2018). *IKLH 2017 Indeks Kualitas Lingkungan Hidup Indonesia 2017* [Indonesian Environmental Quality Index 2017]. *11*, 1–108.

Ojewale, O. S. (2014). Intraurban Analysis of Domestic Solid Waste Disposal Methods in a Sub-Sahara African City. *Journal of Waste Management*, *2014*, 1–7. https://doi.org/10.1155/2014/193469

Permadi, D. A., & Kim Oanh, N. T. (2013). Assessment of biomass open burning emissions in Indonesia and potential climate forcing impact. *Atmospheric Environment*, *78*, 250–258. https://doi.org/10.1016/j.atmosenv.2012.10.016

Sekito, T., Prayogo, T. B., Dote, Y., Yoshitake, T., & Bagus, I. (2013). Influence of a community-based waste management system on people's behavior and waste reduction. *Resources, Conservation and Recycling*, *72*, 84–90. https://doi.org/10.1016/j.resconrec.2013.01.001

Sotamenou, J., De Jaeger, S., & Rousseau, S. (2019). Drivers of legal and illegal solid waste disposal in the Global South - The case of households in Yaoundé (Cameroon). *Journal of Environmental Management*, *240*(March), 321–330. https://doi.org/10.1016/j.jenvman.2019.03.098

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Sujauddin, M., Huda, S. M. S., & Hoque, A. T. M. R. (2008). Household solid waste characteristics and

management in Chittagong, Bangladesh. *Waste Management*, *28*(9), 1688–1695. https://doi.org/10.1016/j.wasman.2007.06.013

Tadesse, T., Ruijs, A., & Hagos, F. (2008). Household waste disposal in Mekelle city, Northern Ethiopia. *Waste Management*, *28*(10), 2003–2012. https://doi.org/10.1016/j.wasman.2007.08.015

Ulhasanah, N., & Goto, N. (2018). Assessment of citizens' environmental behavior toward municipal solid waste management for a better and appropriate system in Indonesia: a case study of Padang City. *Journal of Material Cycles and Waste Management*, *20*(2), 1257–1272. https://doi.org/10.1007/s10163-017-0691-4

Van Liere, K. D., & Dunlap, R. E. (1978). Moral Norms and Environmental Behavior: An Application of Schwartz's Norm-Activation Model to Yard Burning. *Journal of Applied Social Psychology*, *8*(2), 174–188. https://doi.org/10.1111/j.1559-1816.1978.tb00775.x

Wang, Y., Cheng, K., Wu, W., Tian, H., Yi, P., Zhi, G., Fan, J., & Liu, S. (2017). Atmospheric emissions of typical toxic heavy metals from open burning of municipal solid waste in China. *Atmospheric Environment*, *152*, 6–15. https://doi.org/10.1016/j.atmosenv.2016.12.017

World Bank. (2018). *What A Waste 2.0: A Global Snapshot of Solid Waste Managementto 2050*. The World Bank.

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Research Paper

Implementation of Build Back Better (BBB) Framework in Achieving Sustainable Development Goals

Case Study: Housing Reconstruction at Duyu Urban Village, Palu City, Central Sulawesi Province

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Abstract

The occurrence of 7.5M earthquake and tsunami in Central Sulawesi in September 2018 resulted in 2,045 fatalities and 67,310 damaged houses. In line with RIPB and SDGSs 11, the government has established a masterplan for rehabilitation and reconstruction of Central Sulawesi by adopting the build back better concept. This research tries to analyze the implementation of BBB framework which focuses on reducing the risk of housing reconstruction in Duyu urban village, using the scale and index method. The result shows that the implementation of risk reduction falls into a moderate level although some indicators are still in the poor category. In accordance with SDGs, at least four key factors related to disaster mitigation, specifically SDGs 11 – making cities and human settlements inclusive, safe, resilient and sustainable - have been successfully achieved, which are: 11.5; 11.b1; 11.b2; and 11.c1. This result indicates that the Duyu housing reconstruction has gone through analysis and consideration of risk reduction practices involving five variables by adopting the BBB framework in creating community resilience while achieving SDGs in Indonesia.

Keywords: Build Back Better, Disaster Risk Reduction, Housing Reconstruction

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1. Introduction

The realization of the emergence of the resilient recovery concept has given rise to a concept now commonly referred to as "Build Back Better" (BBB). The phrase of BBB actually became popular during the large-scale reconstruction effort following the Indian Ocean Tsunami disaster in 2004 (Clinton, 2006). Since then, this phrase has become more officially embraced with the creation of sets of BBB Guidelines by Clinton in 2006 to steer recovery activities towards achieving resilient goals. This concept is proposed as a complete recovery framework that integrates numerous elements to create a resilient community in the future (Kennedy, Ashmore, Babister, & Kelman, 2008).

Several attempts to adapt this framework into disaster risk management have been made in many countries, such as in 2011 by the Victorian Bushfire Reconstruction and Recovery Authority, Australia that created a Recovery and Reconstruction Framework that focused on the safety and well-being of communities. However, the adaptation of this framework had shortfalls due to complications of the post disaster environment (Mannakkara & Wilkinson, 2013b, 2013a). After being created, improvements to the BBB framework were carried out to complete this concept so that it can be effectively implemented. One previous study conducted by Mannakara using two case studies of Sri Lanka and the case in Australia produced a framework solution to allow the BBB concept to be adopted (Mannakkara, 2014).

Indonesia, as a member of the Sendai Framework Risk Reduction is obliged to implement and develop the BBB framework as post Disaster Risk Management (United Nations, 2016). In accordance with the Indonesia Sustainable Development Goals roadmap 2030, specifically Goal 11, creating Sustainable Cities and Communities, the government of Indonesia is integrating this concept into the Disaster Prevention Masterplan (Rencana Induk Penanggulangan Bencana 2015-2045) with the following mission: Indonesia is Resilient to Disaster to Support the Sustainable Development Goals (BNPB, 2018). As a result, the National Disaster Management Agency (BNPB) adapted the BBB framework by creating the concept of Build Back Better, Safer and more Resilient to be implemented in disaster areas (BNPB, 2015).

As previously explained, the challenge in implementing this framework is the absence of detailed guidelines for applying and measuring this framework into action, thus making it difficult for Indonesia to apply and evaluate the performance of the BBB framework (Mannakkara & Wilkinson, 2014). Another problem related to risk reduction as part of this framework is that many countries including Indonesia still do not have multi-hazard assessment for disaster risk reduction (DRR) as reconstruction is susceptible to other hazards (GFDRR, 2010). Meanwhile, DRR is an essential aspect in implementing the BBB framework because through integrated DRR it can minimize the number of casualties and extensive damage of infrastructure so as to create a city that is resilient to disasters as one of the key factors addressed in the SDGs. Based on the existing problems, this study has an objective to determine the implementation of the BBB framework by the government in achieving the SDGs, with a case study of housing reconstruction process in the Palu disaster area.

2. Methodology

2.1 Theoretical Framework

This research departs from the concept of Disaster Risk Management (DRM) as a global standard effort to address the four phases of the disaster approach , namely mitigation, preparedness, response, and recovery activities (Carter, 2008). Since the recovery phase is highly crucial for victims after a disaster, this has led to the realization of the emergence of a resilient recovery concept. One concept adapted by the global world is called "Build Back Better" which is defined as rebuilding community, the environment and infrastructures better than before in order to reduce existing vulnerabilities (GFDRR, 2018).

One of the current discoveries was made by Sandeeka Mannakara in 2014 using two environmental case studies 1) Sri Lanka (2004 Indian Ocean Tsunami disaster recovery); and 2) Australia (2009 Victorian Bushfire recovery) producing a framework solution that allows the BBB to be adopted in post-disaster situations efficiently and effectively (Mannakkara, 2014). This framework consists of three main categories, namely: 1) Risk Reduction; 2) Community Recovery; and 3) Implementation, each of which has two principles (Mannakkara & Wilkinson, 2014). Specifically on the aspect of Risk Reduction, it is stated that risk reduction is primarily achieved through the implementation of two principles, which are: Principle 1) Improvement of Structural Design, depicting improving structural designs and enforcing them through revised building codes; and Principle 2) Land-use Planning, representing the use of hazard and risk-based land-use plans to minimize risks (Mannakkara, 2014).

Based on previous studies related to the BBB framework conducted by Manakkara, this framework depicts a holistic recovery effort including key multivariate actors, such as state and local governments, private sectors, communities, NGOs, and others. Nevertheless, the government has a big role in the first category, risk reduction, because this category has implications for policies and regulations in its implementation. Following that reason, my research points out a risk reduction category which involves six variables 1) DRM Capacity; 2) Building Codes and Regulations; 3) Cost and Time; 4) Quality; 5) Risk-based Zones; and 6) Resettlement.

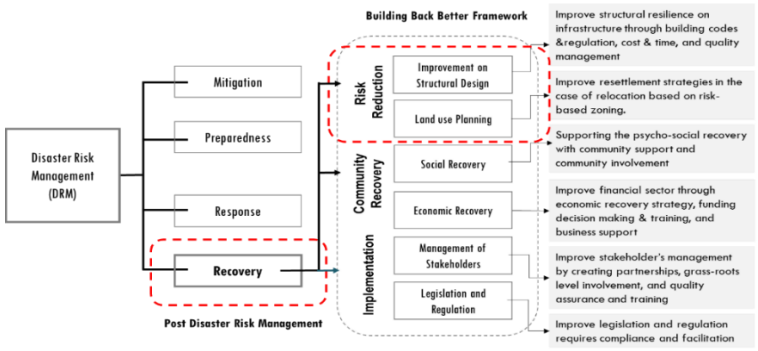


Figure 1. Theoretical Framework of the Study
Source: (Author Analysis, 2019)

2.2 Data Collection

This research uses two types of data which are primary data and secondary data. The primary data were collected using questionnaires to the survey target (purposive sampling) while secondary data were obtained from government institutions. Respondents were categorized into three domain targets, namely the central government, regional governments, and an expert team comprised of 19 respondents from 10 institutions. Meanwhile the questionnaires consisted of three sections 1) capacity of disaster risk management; 2) housing reconstruction process; and 3) constraints and challenges in the reconstruction process with a total of 45 questions to be answered. It was conducted by using face to face interviews with respondents in February 2020. The field survey was carried out in several locations of Palu post-disaster areas: 1) The liquefaction areas in Petobo, Jono Oge, and Sidera; 2) The tsunami area near the beach; 3) The housing reconstruction area in Tondo-Talise; and 4) various points of temporary housing.

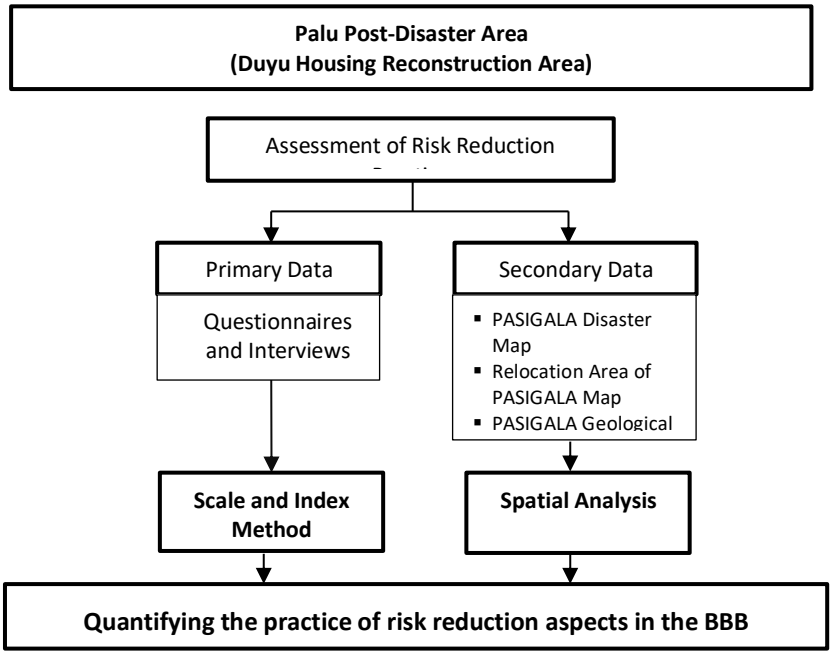


Figure 2. Methodology Diagram of the Study
Source: (Author Analysis, 2020)

2.3 Analytical Method

2.3.1. Scale and Index Method

Measurement is a crucial part of the research and so are the evaluation efforts in quantifying the results. This study uses a scale and index method in order to capture the degree of indicators executed through ordinal level measurements. To be more specific, it uses the Likert scale, a scale that measures underlying phenomenon by aggregating an individual's rating of his/her perception using ordinal-level categories that are ranked along a continu.

Table 1: Suggested Data Analysis Procedures for Likert-Type and Likert Scale Data

	Likert-Type Data	Likert Scale Data
Central Tendency	Median or mode	Mean
Variability	Frequencies	Standard deviation
Associations	Kendall tau B or C	Pearson's r
Other Statistics	Chi-square	ANOVA, t-test, regression

2.3.2. Spatial Analysis

Spatial analysis is a diverse and comprehensive process that includes simple visual analysis of maps and imagery, computational analysis and geographic patterns, and other advanced predictive modeling (ESRI, 2013). One method generally used is overlay analysis through Geographic Information System (GIS) where the operation is merely a stack of map layers that is able to express causal relationships where temporal sequences also an integral part (Ahlqvist, 2019). ESRI describes that in general there are two methods for performing analysis; the first is a feature overlay (overlaying points, lines, or polygons) and the other is a raster overlay. This research uses a raster overlay in which each layer references the same geographic location then combines the characteristics of numerous layers into a single layer.

3. Study Area Overview

3.1 Chronology of the Latest Disaster Event in Palu

Friday, 28 September 2018 was a nightmare for Palu; a 7.5 magnitude shallow strike-slip earthquake occurred in Central Sulawesi with an epicenter of 0.18°S; 119.85 that generated a significant tsunami from Palu bay around fifteen minutes after the quake (Paulik & Gusman, 2019). Seven major earthquakes with a magnitude of between 7.5 and 5.7 hit the island of Sulawesi within 7 hours and within 100 km resulting in the three worst-hit areas of Donggala, Palu, and Sigi (European Commission, 2018). This catastrophic disaster scenario when a large earthquake triggered tsunamis, liquefaction, and landslides causing direct damage which was reported by BNPB had 2,045 fatalities, 20,679 injuries, and 67,310 houses damaged where Palu was the most affected area among other cities/regencies as listed in Table 2 (AHA Centre, 2018). Table 2 shows that more than 65,000 houses in Palu city were damaged, while in contrast in Donggala only 680 houses and in Sigi 897 houses were damaged.

Table 2: Human Casualties and Damage by City/ Regency

Human Casualties and Damage	Palu city	Donggala regency	Sigi regency	Parigi Moutong regency
Fatalities	**1,636**	171	222	15
Injuries		Severe: 2,549; Light: 8,130		
IDPs	**38,621**	20,223	15,600	t.b.a
Damaged houses	**65,733**	680	897	t.b.a

3.2 Alternative Areas for Housing Reconstruction

Palu, as the most affected city in Central Sulawesi, adopted the build back better concept to restore its damaged areas which cover five main sectors: housing, infrastructure, social, economy, and cross sectoral. Focusing on housing reconstruction, the government gives options for victims to live, either relocating to a new settlement area (ex situ) or repairing their damaged houses in the initial area (in situ) as long as they are not located in a restricted area (ZRB 4). For the ex situ concept, four villages were proposed as alternative areas for new settlements for victims of 1) Duyu; 2) Tondo Talise; 3) Pombewe; and 4) Petobo (Bappeda Kota Palu, 2019).

Currently, housing reconstruction projects have been conducted in three areas, Duyu, Tondo Talise, and Pombewe with various sources of budget (ministries, local governments, private sector, and organizations). The Ministry of Public Works and Public Housing, which is responsible for housing provision, is at the present time actively participating in the construction of 450 houses in Duyu and 500 units in Pombewe. However, when we were conducting this research, Pombewe village was still in the auction phase. Therefore, based on this reason, this research will focus on the housing reconstruction process carried out in Duyu urban village by the Ministry of MPWH. Duyu as an alternative area for relocation covering an area of 79.3 Ha has a building right certificate from the government. Referring to Palu Spatial Plan year 2010-2030, Duyu is designated as a low-density residential area, disaster evacuation area and low activity region. However, based on research by the Geology Agency, Duyu, which is located in ZRB 3,implies that the development in this area should take into consideration the Palu-Koro Fault near this area (Bappeda Kota Palu, 2019).

4. Results and Discussions

This part will discuss the measurement of risk reduction implementation through designated indicators which represent each variable using the scale and index method. The aim is to quantify the implementation of risk reduction practices in the housing reconstruction process. There are 40 indicators in total that cover six variables, and the data analysis used SPSS version 18.0 statistical software as the main tool. The first step taken in analyzing the Likert scale data is measuring the reliability or internal consistency to determine whether the survey is reliable. The Cronbach's Alpha score for all variables is 0.943 indicating the survey test has good internal consistency and questions are correlated with each other, so that further analysis shall carry out.

In the original version, Likert uses five options that include neutral options; however, the response format has been expanded including removing the neutral category. Therefore, this research carried out a rating scale of 1 to 4 in order to prevent respondents from standing in the middle or giving neutral answers with item expressions that may be different from one to another. Then the results ranged from bad to good categories based on the index score with the categorization distribution listed in Table 3. A score of 1.00 – 1.75 is in the Bad category, 1.76 – 2.50 is in the Poor category, 2.51 – 3.25 is in Moderate category, and 3.26 – 4.00 is in Good category.

Table 3: Category Distribution based on Index Score

Index Score	Category
1.00 – 1.75	Bad
1.76 – 2.50	Poor
2.51 – 3.25	Moderate
3.26 – 4.00	Good

Source: (Author Analysis, 2020)

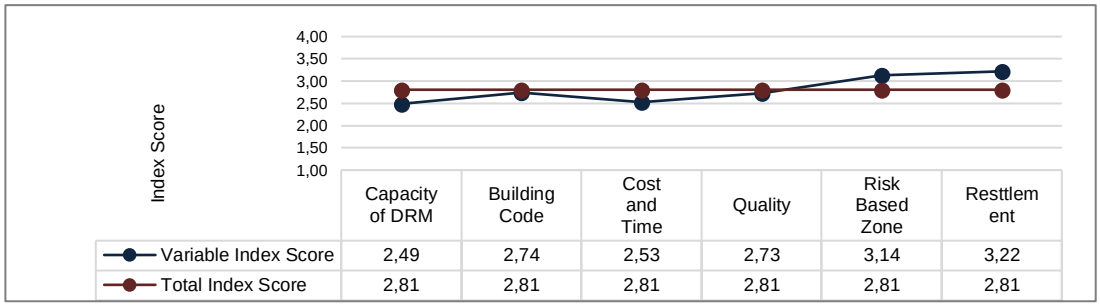


Figure 3. Index Score for Each Variable in Risk Reduction Aspect
Source: (Author Analysis, 2020)

The survey found that the housing reconstruction strategy based on disaster risk mitigation proposed by the government (Governor Law No. 10 of 2019 regarding Post Disaster Rehabilitation and Reconstruction Plan) did not reach the maximum score, merely the "moderate" category with a total index score of 2.81 as shown in figure 4 while sequence Resettlement had the highest mean score of 3.22 followed by Risk Based Zone with 3.14, and the rest which are Building Code, Quality, Cost and Time, and DRM Capacity stood at 2.74, 2.73, 2.53, and 2.49, respectively. The detailed results are illustrated in Table 4 by indicating performance score and categories of each variable used in the research.

Table 4: Indicators of Performance Score of Risk Reduction Practices in Duyu Urban Village Housing Reconstruction

Code	Indicator	Score	Category			
			Bad	Poor	Moderate	Good
(1) DRM Capacity		**2.49**				
I.1	Availability of DRM policy/guidelines	2.63			■	
I.2	Effectiveness of guidelines	2.79			■	
I.3	Availability of a tsunami warning system	2.11		■		
I.4	Effectiveness of the tsunami warning system	2.16		■		
I.5	Availability of disaster evacuation signs	2.32		■		
I.6	Availability of evacuation drills	2.37		■		
I.7	Availability of DRM related institutions	3.05			■	
(2) Building Codes and Regulation		**2.74**				
I.8	Availability of housing reconstruction guidelines	2.63			■	
I.9	Compliance of building permit	2.84			■	
I.10	Compliance of multi hazard assessment for structure design	2.95			■	
I.11	Consideration of innovative technologies	2.68			■	
I.12	Compliance of building technical requirements	2.21		■		
I.13	Consideration of standard requirements for materials	3.05			■	
I.14	Consideration of bearing capacity	2.95			■	
I.15	Education of community and stakeholders for risk reduction	2.58			■	
(3) Cost and Time		**2.53**				
I.16	Availability of pre-planned strategies	2.53			■	
I.17	Consideration of manageable & realistic cost	3.26				■
I.18	Utilization of local materials	2.58			■	
I.19	Utilization of recycled materials	1.79		■		
I.20	Involvement of community skills and knowledge	2.47		■		
I.21	Provision of an assistance system in quality control	2.84			■	
I.22	Promotion of building codes adoption	2.16		■		
I.23	Preparation of long-term funding	2.58			■	
(4) Quality		**2.73**				
I.24	Consideration of environmental and health aspects	3.32				■
I.25	Consideration of the number of majority households	2.37		■		
I.26	Consideration of an expandable housing design	2.68			■	
I.27	Companion of professional supervision	3.16			■	
I.28	Availability of regular workshops and training	2.47		■		
I.29	Application of traditional materials and techniques	2.37		■		
(5) Risk Based Zone		**3.14**				
I.30	Adoption of integrated hazard assessment for disaster-prone maps	3.00			■	
I.31	Adoption of multi-hazard assessment to establish a master plan	3.37				■
I.32	Consideration of coastal buffer zone	3.05			■	

I.33	Conformity with national and regional spatial plans	3.16				
I.34	Implementation of long-term continuity of risk reduction practices	3.11				
(6) Resettlement		**3.22**				
I.35	Implementation of land swap schemes	3.47				
I.36	Availability of adequate infrastructure and livelihood opportunities	3.16				
I.37	Consideration of new land risk level	2.89				
I.38	Consideration of community preferences	3.21				
I.39	Consideration of land tenure security	3.05				
I.40	Provision of legal ownership or long-term occupancy evidence	3.53				

Source: Author analysis, 2020

4.1 Disaster Risk Management Capacity

In Indonesia, BNPB is the primary agency at the national level responsible for disaster risk management from mitigation, preparedness, response, and recovery efforts. Under the umbrella of BNPB, they have the right to lead coordinating body in disaster response and also to mobilize the equipment in disaster response. BNPB has a vertical institution at the provincial and local levels, the Regional Disaster Management Agency (BPBD), which has a role as the executor of DRM in provinces/regions with guidance from the headquarters. Central Sulawesi and Palu have regional level BPBDs which are responsible for handling disaster mitigation and recovery after the PASIGALA earthquake. Besides BNPB, another essential institution in Indonesia to support DRM is the Agency for Meteorology, Climatology and Geophysics (BMKG) which disseminates the Indonesia Tsunami Early Warning System (InaTEWS) established in 2005 and started officially in 2008 (Center for Excellence in Disaster Management & Humanitarian Assistance, 2018).

This variable addresses the current situation (pre disaster event) of DRM in Palu city, Central Sulawesi province which consists of seven indicators concerning the policy, institution, and disaster infrastructure aspect at the location. Figure 4 illustrates the performance of each indicator in comparison to the overall index score of this variable of 2.49, which falls into “poor” category. This current situation implies that the readiness of the government for disaster resilience needs to be improved to reduce future vulnerability.

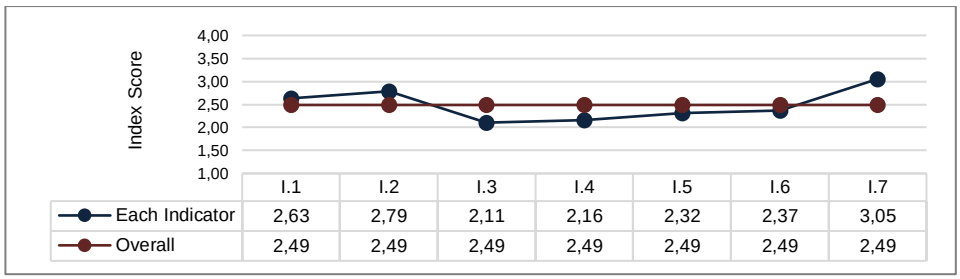


Figure 4. Index Score Performance for DRM Capacity Variable
Source: (Author Analysis, 2020)

As described in Figure 4, there are four indicators that have “poor” performance scores, namely I.3, I.4, I.5 and I.6. These four indicators are related to the tsunami warning system and disaster evacuation. As for disaster infrastructure in Palu, the government has provided a tsunami early warning system (InaTEWS) developed by BMKG. However, this system is not only damaged and in poor condition but there have also been reports of vandalism of supporting equipment with several buoys being damaged, missing or stolen, and dead due to lack of maintenance. Therefore, the system is not functioning properly in notifying the public regarding the latest tsunami event. As a result, the performance indicators I.3 and I.4 regarding the availability and effectiveness of tsunami early system have the lowest index scores namely only 2.11 and 2.16.

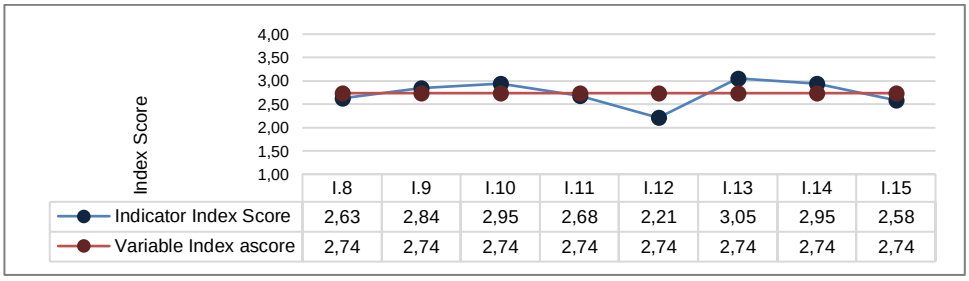
Slightly higher than the tsunami early warning system, the availability of adequate signs or information regarding disaster evacuation routes and assembly points has a performance score of 2.32 while the availability of an evacuation drill only has a score of 2.37. The signs are visible in certain areas near the seashore, but in residential areas the signs are not noticeable. The limited number of signs causes confusion in the community when a disaster occurs and it can lead to the loss of life because they do not understand where to go to reach a safer area. This condition prompted local governments to be

more aware of the availability of disaster warning signs for the community, and after the Palu tsunami they repaired and improved these signs.

In addition to the availability of disaster warning signs, the presence of evacuation drills or simulation exercise for the community regarding how to deal with disasters are also crucial to do to increase public awareness and knowledge about how to respond to emergency situations. Since the earthquake and tsunami in September 2018, the government of Palu has committed to strengthening public resilience through workshops and evacuation drills as part of the disaster-resilient city program. This policy is in accordance with the achievement of SDGs goal 11, specifically in clause 11.b.1, the implementation of mitigation and adaptation plans and policies and 11.b.2 countries with existing local disaster reduction strategy.

4.2 Building Codes and Regulations

In general, the housing reconstruction process in Palu post disaster area refers to Law of Republic of Indonesia No. 28 of 2002 regarding Buildings while the detailed guidelines refer to the Regulation of the Ministry of Public Works and Housing No. 5 of 2016 regarding Building Construction Permits, especially Appendix II on the specifications of earthquake resilient and prototype design for one-story building. In principle, the main concept in housing reconstruction is to use the knock down method (RISHA) which is proposed as a practical and safe house for post-disaster recovery (Ministry of Public Works and Housing, 2015). There are eight indicators involved in this variable to determine the performance of building codes and regulations in the post-disaster area of Palu. The overall achievement of a performance index of 2.74 that represents the execution of this variable reaches the moderate category. The majority of indicators are categorized into moderate level, even though there is one indicator that falls under poor performance, compliance with building codes.



	I.8	I.9	I.10	I.11	I.12	I.13	I.14	I.15
Indicator Index Score	2,63	2,84	2,95	2,68	2,21	3,05	2,95	2,58
Variable Index ascore	2,74	2,74	2,74	2,74	2,74	2,74	2,74	2,74

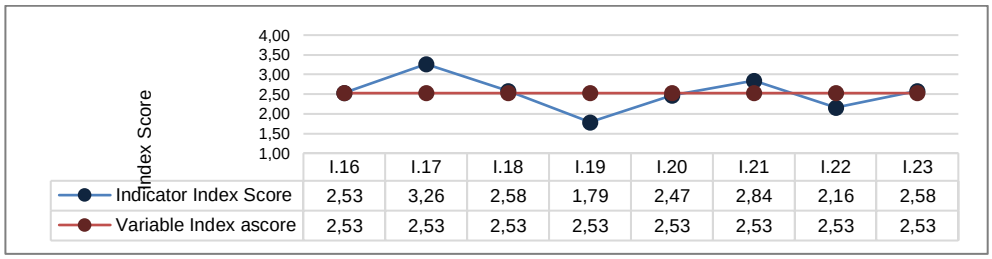
Figure 5. Index Score for Building Performance Codes & Regulations Variables
Source: (Author Analysis, 2020)

Referring to Figure 6, the performance index for building codes and regulations, it can be seen that the government has integrated the majority of variables from this aspect with BBB practice. This situation implies a strategy and policy for the reconstruction process considering the design parameters to determine whether to just require restoration for damaged houses or to rebuild new ones by considering the compliance of the multi hazard assessment to risk reduction for the structural design. Besides, the government should also adopt innovative technologies and local wisdom for housing design using RISHA as the prototype design for permanent housing in the post-disaster area of Palu with SDGs key factor number 11.c.1, sustainable and resilient buildings. This concept was developed by the MPWH in order to accommodate the needs of low-middle income housing as well as emergency housing by adopting knockdown technology which is appropriate for local conditions and saves time.

On the other hand, there is one indicator in this variable (I.12) which has “poor” performance with a score of 2.21, which is compliance with building technical requirements (fire hydrants, disabled facilities, earthquake alarms, evacuation routes, and assembly points) in new housing areas. Unfortunately, the public facilities as listed in the technical design for housing reconstruction in Palu do not include disaster mitigation appliances as a preparation for future hazard. This situation portrays that the disaster mitigation aspect is still not a priority in development planning although it could be a good start to raise the awareness of public by creating a supportive environment.

4.3 Cost and Time

According to the estimation of BNPB, the costs for the rehabilitation and reconstruction project by adopting Build Back Better and Safer are up to Rp. 22.8 trillion including the needs for reconstruction of victims' housing. Palu as the city with the worst damage has the highest budget for rehabilitation and reconstruction compared to Sigi and Donggala with Rp. 18.931 trillion. The budget needed for each sector in Palu includes settlement, infrastructure, social, economic, and cross sectoral and housing reconstruction of Rp. 4.776 trillion equals to one quarter of the overall rehabilitation budget. The high budget needed for housing reconstruction does not only refer to the application of new housing methods but also refers to the establishment of a map of disaster-prone areas with a multi hazard assessment to determine a proper and safe location. The extra costs are incurred by adopting technologies and materials to improve structural resilience and also enforcing compliances with building codes and spatial plans. Time pressure in the recovery process with expectations for fast results contribute to ignorance towards building codes and hazard assessments which lead to future vulnerabilities for inhabitants. The implementation period of the rehabilitation and reconstruction process in Palu took two years from 2019 to 2020 with an evaluation after reconstruction in 2021. An explanation regarding the performance of the cost and time variables is illustrated in Figure 6, where overall indicators have a score of 2.53 with a "moderate" level, even though 3 indicators have poor scores, which are I.19, I.20, and I. 22.



	I.16	I.17	I.18	I.19	I.20	I.21	I.22	I.23
Indicator Index Score	2,53	3,26	2,58	1,79	2,47	2,84	2,16	2,58
Variable Index ascore	2,53	2,53	2,53	2,53	2,53	2,53	2,53	2,53

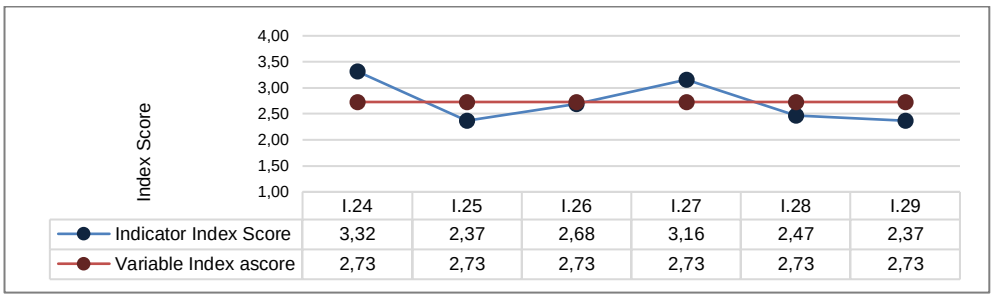
Figure 6. Index Score of Performance for Cost and Time Variables
Source: (Author Analysis, 2020)

Basically, the strategy for rehabilitation and reconstruction was planned after the occurrence of the disaster (Master plan of rehabilitation and reconstruction for Central Sulawesi province). This document includes the current condition of Palu and the measures to handle the unpredicted impact (liquefaction case) after the disaster. However, the primary substances in this document had been prepared by the government before the calamity occurred, referring to the RPJMD of Palu. One challenge in conducting housing reconstruction at Duyu is the limitation of local materials in terms of both quantity and quality. Utilization of recycled materials from the damaged houses could be a way to fulfill the needs of local materials and to save some budget from materials. However, because the majority of victim's houses were severely damaged or lost due to liquefaction, then almost none of the wreckage can be used as recycled materials. In addition, the quality of building remains does not meet the standard specifications from the government. This reason explains why I.19 has the lowest score.

Undergoing housing reconstruction in a limited time was not an easy task, as the minimum number of skilled workers to construct RISHA exacerbated the situation. The public and communities volunteered to be involved in the reconstruction process by learning how to build RISHA houses. However, the government still has not maximized the potential of the community, and various workshops and trainings only focus on workers, while the community has no obligation to help. Regarding the promotion of building code practices for housing provision, the government of Palu does not currently have any specific program to support the adoption of building codes and this leads to minimum enforcement of risk reduction practice. Nevertheless, in the future, the World Bank will help in the compliance with building codes for infrastructure under the IDRIP program by investing in disaster-resilient development planning initiatives. This indicates that the government is very serious in achieving the SDGs goal 11, specifically in clause 11.b.1 on the implementation of mitigation and adaptation plans and policies.

4.4 Quality

The quality of design and construction influences the safety aspects of buildings that are determined by good comprehensive planning and the skill level of the workers. Referring to the Palu Action Plan for Rehabilitation and Reconstruction, the recovery strategy is based on a mitigation and risk reduction approach in order to minimize the deprivation for future hazards through the concept of build back better. In the housing reconstruction sector, the government is responsible for providing safe areas for relocation as well as designing new settlement areas that support the social and economic aspects of the victims. Figure 7 provides an overview of the performance indicators on this variable that is categorized into "moderate" performance with an index score of 2.73, although the three indicators I.25, I.28, and I.29 still have "poor" performance.



	I.24	I.25	I.26	I.27	I.28	I.29
Indicator Index Score	3,32	2,37	2,68	3,16	2,47	2,37
Variable Index ascore	2,73	2,73	2,73	2,73	2,73	2,73

Figure 7. Index Score of Performance for Quality Variable
Source: (Author Analysis, 2020)

The RISHA concept proposed for the prototype of housing design meets the PUPR qualifications in the health and safety aspects. The site plan provides green open space and reservoir infrastructure to support the lives of future inhabitants. From Figure 8, regarding the housing reconstruction condition in Palu, it is noticeable that the housing component has recognized the essential standards of housing provision. The buildings have ventilation, clean water channels, drainage systems, distance between houses to reduce the risk of fire, and wide roads that can be accessed by ambulances as well as fire trucks. Meanwhile, the typical unit of one house in this project is 36m^2 with two bed rooms, a dining room, a kitchen as well as a separate toilet/bathroom with the assumption that one household has four family members with a space requirement standard of 9m^2/person. This design was determined by following the budget availability from the government, so that it does not cover households with more than four family members. Due to this reason, indicator I.25 still has a poor performance.

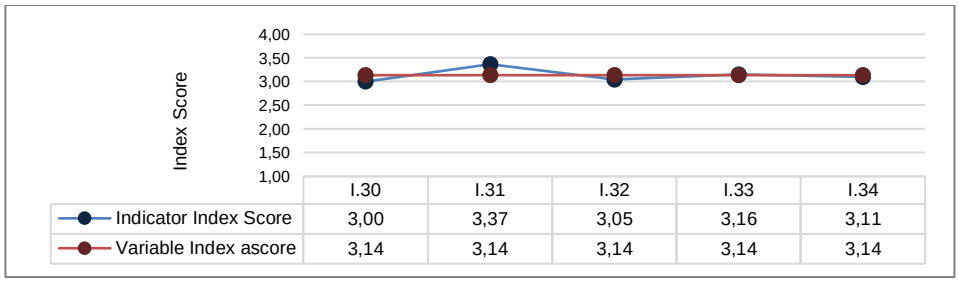
As explained before, at the present time, the regular workshop and training programs only target housing construction parties to upgrade their skills and are not open for public, so I.28 is categorized into a poor level. For long-term planning, the government prepares a program to increase the risk reduction implementation from the community. On the other hand,, materials as an important aspect of housing should pay attention to local climate and conditions to provide comfort for the occupants. RISHA designs are mainly made of concrete that is durable and suitable for the local climate in Palu. While for the architecture design adopting the typical design of RISHA, no specific traditional techniques are applied in the construction. This explains why I.29 also has poor performance. Nevertheless, several indicators on this variable need to be improved in order to ensure the quality of houses, and the government has tried to achieve the SDGs goal key factor 11.c.1, namely sustainable and resilient buildings.


Figure 8. Housing Construction Condition in Palu
Source: (Field survey, 2020)

4.5 Risk-Based Zone

According to the master plan of the rehabilitation and reconstruction document for Central Sulawesi, the strategy for the structure and spatial plan of the Palu post disaster area is to restore the function or to establish it as a protected area if the location cannot be used anymore. The scope of the new spatial plan covers disaster risk assessment to reduce the hazard vulnerability of future disaster occurrences through the classification of disaster-prone zones (ZRB). ZRB consists of four areas: restricted zone, limited zone, conditional zone, and development zone. For the housing reconstruction process in particular, the government established the LARAP document that contains the principles of resettlement such as relocation facilities, livelihood restoration action plan, institutions, and settlements. The drafting phase of this document involved the community or victims as the permanent occupants to give ideas and recommendations for action plans.

Overall, the alternative areas, including Duyu urban village, have passed the parameter analysis to ensure the safety and legality aspects of the land. Figure 9 illustrates the index score performance of risk-based zone variable and indicators in the Duyu housing reconstruction area. Compared with the previous variables, DRM capacity; building codes and regulations; cost and time; and quality, this variable has a higher score with 3.14 classified as “moderate” achievement. Moreover, the overall indicators in this variable have a score of more than 3.00 that implies that the government took seriously the safety aspect of the new settlement area for victims. This result is in line with the SDGs 11.5 achievement, namely protection of the poor and the vulnerable.



	I.30	I.31	I.32	I.33	I.34
Indicator Index Score	3,00	3,37	3,05	3,16	3,11
Variable Index ascore	3,14	3,14	3,14	3,14	3,14

Figure 9. Index Score of Performance for Risk Based Zone Variable
Source: (Author Analysis, 2020)

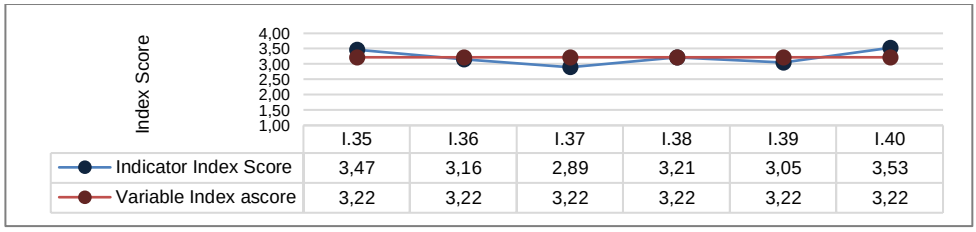
The government through ATR/BPN and other related institutions classifies disaster prone zones into four categories that estimate the potential hazards of a variety of types of disasters (tsunami, earthquake, liquefaction, landslide, and flood). Then in a further step, the data are utilized as the basis for creating a master plan for the rehabilitation and reconstruction of Central Sulawesi. The relocation area in the master plan avoids the red zone in the selection which considers the spatial use for new settlement areas recommended by the government. Moreover, the creation of the master plan for the rehabilitation and reconstruction collaborates with related ministries and institutions and involves the local authority in order to harmonize policies and regulations on spatial planning in Palu city, so that there is compatibility between national and regional planning.

After the completion of the reconstruction process, the challenge faced in Indonesia is how to practice disaster risk reduction in land use in a sustainable manner in the long-term. The government took the initiative that besides giving instructions and restrictions on building development in red zones, they put up warning signs in every red zone in order to make the public stay away from that location and

prevent them from building houses near the area. However, inadequate law enforcement has caused some residents to disobey the rules and continue to use the space that should not have been built.

4.6 Resettlement

Referring to the master plan for the rehabilitation and reconstruction of Central Sulawesi, the resettlement area needs to follow the land compatibility criteria, namely: 1) safe from disasters (active faults, volcanoes, landslides, tsunamis, and floods); 2) located in the cultivation area spatial plan on RTRW (with good carrying capacity); 3) slope < 15%; 4) the existing land condition has not been constructed; 5) adequate accessibility of water sources and public facilities; and 6) relatively close to the initial area of the victims. The resettlement strategy is aimed for victims whose houses were heavily damaged or lost due to liquefaction by conducting prior public consultation. In general, the resettlement implementation variable for the housing reconstruction process has achieved "moderate" performance as illustrated in Figure 10 with a score of 3.22, which is the highest score among other variables. Based on the figure, the overall indicator of this variable is categorized as "moderate" or "good" performance. This achievement depicts how the government is highly thorough in determining the appropriate strategy and location for victims so they can protect their lives better. Similar to the previous variable, resettlement also contributes to achieving the SDGs key factor 11.5 on protection for the poor and people in vulnerable situations.



	I.35	I.36	I.37	I.38	I.39	I.40
Indicator Index Score	3,47	3,16	2,89	3,21	3,05	3,53
Variable Index ascore	3,22	3,22	3,22	3,22	3,22	3,22

Figure 10. Index Score of Performance for Resettlement Variable
Source: (Author Analysis, 2020)

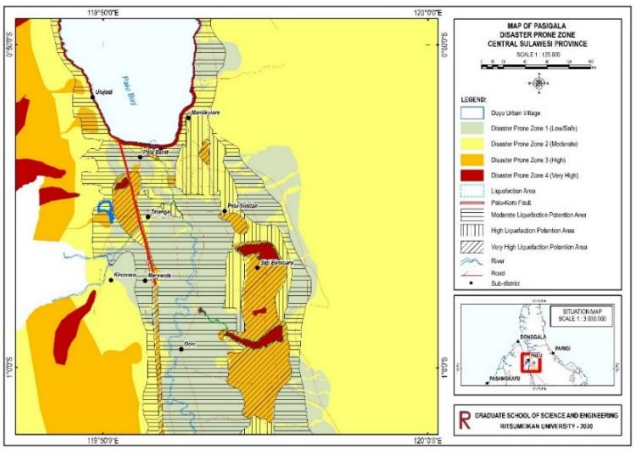


Figure 11. Map of Palu Disaster-Prone Zone

The determination of the relocation area refers to the disaster-prone zone with a multi-hazard assessment by ATR/ BPN and analysis of soil geological condition using the micro zonation method by the Geological Agency. As illustrated in Figure 11, there are four categories of risk levels in the area considering four types of hazards (tsunami, earthquake, landslide, and flood), which are: 1) ZRB 1: Low/Safe level; 2) ZRB 2: Moderate level; 3) ZRB 3: High level; 4) ZRB 4: Very high level with the area scope. It can be seen, that Palu city is mostly located in a safe area in ZRB 1 with the potential for moderate liquefaction and so is Duyu urban village. Even though in RTRW this location is stated to function as a low-density settlement, it is geologically located near the Palu-Koro fault, which means this area has a potential hazard to the people who live there.

Duyu urban village is located 1,361 m from the nearest river, so that a commercial area (traditional market, culinary zone) will be built in this relocation area to support the victim's livelihood. Fortunately, as stated in the LARAP document, not only the victims affected by the earthquake and liquefaction, but also residents who live in the red zone (ZRB 4) have the right to own a new house in the relocation area or they can apply for subsidies from the government to build new houses on their land as long as the new location is not in the red zone. However, the government prioritizes victims first before local residents and one household can only have one house because this is not a house replacement program.

For the legality aspect of the land in the relocation area, the local government cooperates with ATR/BPN in ensuring land tenure security, so that it is freed from a dispute status. As a consequence, in Duyu urban village the area used for housing reconstruction was reduced from the initial 41.65 Ha (based on the Mayor's decree) to 38.6 Ha (based on the certificate of ATR/ BPN). Meanwhile, regarding the provision of legal ownership for habitants, the government guarantees land ownership for the new house for the victims. However, the land rights for the new house cannot be transferred to other parties within a certain time (in this case 10 years after the certificate is given) and this clause will be written in the certificate. The reason is to prevent the victims from selling off their houses and coming back to the previous area or even using their money for harmful things.

5. Conclusions

Based on the findings of the study as previously explained, the implementation of risk reduction as part of the build back better framework for housing reconstruction in Duyu, Palu's post disaster area falls into a moderate level even though some indicators have not properly been implemented. This indicates that the Duyu housing reconstruction process has gone through the analysis and consideration for risk reduction practices that involve five variables (building codes and regulations; cost and time; quality; risk-based zone; and resettlement) by adopting the build back better framework in order to create a resilient community.

To begin with, the current DRM capacity of local authority regarding mitigation and preparedness for disaster is in the poor category with an index score of 2.49. This condition triggered the high level of community vulnerability in facing the earthquake and tsunami in Central Sulawesi in September 2018 as proven by the high mortality rate and damaged buildings after the incident. The current disaster infrastructure and disaster knowledge have failed in preparing the community to encounter emerging situations. Consequently, the government is expected to be able to restore this condition through better measures and practices in order to improve community resilience to face hazards in the future.

Referring to the National Disaster Management plan of 2015-2019, rehabilitation and recovery practices in Central Sulawesi adopt the build back better framework. Specifically, in housing reconstruction, the risk reduction aspect plays a crucial role in ensuring the safety of victims/communities to live their new lives. Based on the results, unfortunately 7 out of 22 indicators of improvement on the structural design aspect have low performance. Nevertheless, at least the four key factors of SDGs 11 - making cities and human settlements inclusive, safe, resilient and sustainable - have been achieved by the government. The first key factor 11.5 is Protection of the poor and people in vulnerable situation; the second key factor 11.b.1 is Implementation of mitigation and adaption plans and policies; the third key factor 11.b.2: is Countries with existing local disaster reduction strategy; and the last key factor 11.c.1 is Sustainable and resilient buildings.

This condition concludes that the government of Indonesia has recognized the need for long-term efforts in order to build a community's resilience in facing future hazards towards the recovery process through the implementation of multi hazard assessments in risk reduction practices. Nevertheless, the integration of disaster risk reduction into technical measures is quite weak if it only considers the perspectives of several actors. The active role and awareness of disaster mitigation of various important actors, including ministries, communities, local authorities, professional and scientific institutions could be strengthened both in policies and practices of risk reduction in rehabilitation and reconstruction process.

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References

AHA Centre. (2018). *SITUATION UPDATE NO. 10 M 7.4 EARTHQUAKE & TSUNAMI Sulawesi, Indonesia.*

Ahlqvist, O. (2019). 'Overlay (in GIS).' In *International Encyclopedia of Human Geography*.

Bappeda Kota Palu. (2019). *Rencana Aksi Daerah Rehabilitasi dan Rekonstruksi Pascabencana Gempabumi, Tsunami dan Likuifaksi Tahun 2019-2020 Kota Palu*.

BNPB. (2015). *Kerangka Kerja Sendai untuk Pengurangan Risiko Bencana 2015 - 2030*.

BNPB. (2018). *Rancangan Rencana Induk Penanggulangan Bencana (RIPB) tahun 2015-2045*.

Boone, H. N., Boone, D. A., & Virginia, W. (2012). *Analyzing Likert Data Likert-Type Versus Likert Scales*. *50*(2).

Carter, W. N. (2008). *Disaster Management: A Disaster Manager's Handbook*. Manila: Asian Development Bank.

Center for Excellence in Disaster Management & Humanitarian Assistance. (2018). *Indonesia Disaster Management Reference Handbook*.

Clinton, W. J. (2006). *Lessons learned from tsunami recovery: key propositions for building back better*. New York: Office of the UN Secretary-General's Special Envoy for Tsunami Recovery.

ESRI. (2013). *The Language of Spatial Analysis*. California: ESRI Press.

European Commission. (2018). *Mw 7.5 Earthquake in Indonesia, 28 September 2018*.

GFDRR. (2010). *Building Back Better in Post-Disaster Recovery*.

GFDRR. (2018). *Building Back Better, Achieving Resilience Through Stronger, Faster, and More Inclusive Post-Disaster Reconstruction. Washington, DC.*

Harpe, S. E. (2015). How to analyze Likert and other rating scale data. *Currents in Pharmacy Teaching and Learning*, *7*(6), 836–850. https://doi.org/10.1016/j.cptl.2015.08.001

Kennedy, J., Ashmore, J., Babister, E., & Kelman, I. (2008). The Meaning of 'Build Back Better': Evidence From Post-Tsunami Aceh and Sri Lanka. *Journal of Contingencies and Crisis Management*, *16*(1).

Mannakkara, S. (2014). *A Framework for Building Back Better During Post-Disaster Reconstruction and Recovery*. The University of Auckland.

Mannakkara, S., & Wilkinson, S. (2013a). 'Build back better' principles for land-use planning. *Urban Design and Planning*. ICE Virtual Library.

Mannakkara, S., & Wilkinson, S. (2013b). Build Back Better principles for post-disaster structural improvements. *Structural Survey*, *31*(4).

Mannakkara, S., & Wilkinson, S. (2014). 'Re-conceptualising "Building Back Better" to improve post-disaster recovery.' *International Journal of Managing Projects in Business*, *7*(3).

Ministry of Public Works and Housing. (2015). *(RISHA) Rumah Instan Sederhana Sehat*. Bandung: Ministry of Public Works and Housing.

Neuman, W. L. (2014). *Social Research Method: Qualitative and Quantitative Approaches* (Seventh). Edinburgh: Pearson Education Limited.

Paulik, R., & Gusman, A. R. (2019). Tsunami Hazard and Built Environment Damage Observations from Palu City after the September 28 2018 Sulawesi Earthquake and Tsunami. *Pure and Applied Geophysics*, *176*(3).

United Nations. (2016). *Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*.

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Research Paper

The Socio-hydrological Impacts of Oil Palm Plantations on Integrated Watershed Management:

Insights from Malaysia and Ways Forward

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Abstract

This paper aims to investigate the feasibility of flood management based on the concept of Integrated Watershed Management (IWM) via a literature review and field surveys. The investigation focused on the primary industry of oil palm plantations in Malaysia. Although the country is promoting the palm oil industry, the impact of oil palm plantations on the local environment has been relatively disregarded because of the benefits and opportunities, such as subsidies, jobs, and amenities, which the local companies/people can obtain. Effective flood management in oil palm plantations entails the local peoples' understanding and participation in the management activities, such as removing fallen leaves and weeding an area. The flood management strategies suggested in this research provide new insights into local flood management, which usually focuses on the hydrologic aspects, by promoting the integration of the actual-local environment and local people's actions for their environment within the framework of IWM.

Keywords: Integrated Watershed Management, Oil Palm Plantation, Flood Management, Malaysia

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1. Introduction

Flooding is one of the most common and serious problems in Southeast Asian countries, particularly during the monsoon season. Malaysia is one of the most sensitive and vulnerable areas to climate change in Southeast Asia because of its monsoonal climatic characteristics (T., Kim, Sato, & Shimizu, 2019b). Malaysian watersheds have historically suffered from severely damaging floods that are common in monsoon climates. Rapid land-use changes, such as urbanization and deforestation, affect watershed hydrology. Poor river management and ineffective flood control regulations exacerbate the flooding in Malaysia (Chan, 1997). Although the Department of Irrigation and Drainage (DID), which manages water resources in Malaysia across the board, is the acknowledged authority in flood control, its legislative power is weak when it comes to making decisions regarding the development of rivers or the land adjacent to the rivers because the local governments or authorities are the ones usually in charge (Yazawa, 2017). In response to these circumstances, Integrated Watershed Management (IWM) has recently been garnering more attention in the Malaysian local environmental management bodies so that environmental issues can be managed at a watershed scale under the concept of IWM.

IWM is the basic concept of river basin management, and it is a comprehensive countermeasure for water-related problems on account of its effectiveness in handling flood-related problems, its efficiency in controlling water resources, and its ability to ensure high-quality water (Mohamadab et al., 2015). Malaysian IWM principles for flood management have already been established under the history and situation of severe flood disasters (MSMA, 2000). Under the principles of, for example, sustainable flood management, the Sustainable Urban Drainage System (SUDS) has been introduced as one of the Best Management Practices. Some SUDS approaches, such as rainwater harvesting and vegetated infiltration system, have been applied to some pilot areas to reduce runoff rates, runoff volumes, and pollutant loads during storm events (MSMA, 2012; Zakaria, Ghani, Abdullah, Sidek, & Ainan, 2003, 2004). Since the quantity and quality of water in rivers depend on the climatic situations, natural conditions, and human activities in a watershed, the IWM concept for the integrated management of rivers and their watersheds is vital for the implementation of rational countermeasures (Yazawa, 2017). Successful IWM entails gradual, continuous, and holistic improvement of watershed governance including sustained efforts to integrate institutional responsibilities, policy directions, stakeholder participation, scientific and traditional knowledge, technological possibilities, and funding prospects and constraints (Nakamura & W., 2014). IWM is a sustainable approach to achieving watershed management that involves relationships between upstream and downstream, lentic and lotic waters, people at large, and the people specifically operating in a watershed (Kondo, 2016).

In that respect, the management of a plantation with a focus on oil palm is one of the most important factors in considering IWM in Malaysia from both the environmental and industrial perspectives. On one hand, this is because Malaysia is one of the largest producers of palm oil (Koh & Wilcove, 2007). The development of the industry is a vital issue for the country since the palm oil industry provides not only job opportunities for over half a million people in Malaysia and the neighboring countries but also other opportunities, such as housing and basic amenities (Koh & Wilcove, 2007) as well as subsidies (Bronkhorst et al., 2017). On the other hand, environmental issues, e.g., biodiversity loss, air pollution (i.e., haze), and soil degradation, have occurred because of oil palm plantations. In particular, the impact of the expansion of oil palm plantations on watershed hydrology is not yet clear as will be discussed in subsection 3.2.2. This paper, thus, focuses on one of the serious environmental problems in Malaysia, flooding, and it aims to investigate the feasibility of flood management particularly in oil palm plantations from both social and hydrological aspects. This was done by reviewing the flood situations and their causes in Malaysia, and investigating the actual environment and associated problems in oil palm plantations based on literature reviews and field surveys. The discussion opens opportunities for the local people to participate in the management activities based on the IWM concept by suggesting several feasible flood management strategies reflecting the condition of the local environment. The findings of this research provide new insights into local flood management, which usually focuses on hydrological aspects, by promoting the integration of the actual-local environment and the local people's actions against their environment within the framework of IWM. Achieving the Sustainable Development Goals (SDGs) has also become one of the important factors in the sustainable development of Malaysia (Afroz & Ilham, 2020). This research also contributes to the achievement of the SDGs related to environmental issues, such as climate change (Goal 13), land degradation (Goal 15), and management with stakeholder's participation (Goal 17) in Malaysia.

2. Methodology

A comprehensive literature review was conducted in this research to reveal the underlying issues related to floods and their causes in Malaysia and the flood management in the Malaysian oil palm plantations and to propose feasible flood management. To review the issues and trends in the management approaches, journal articles, official documents, and online news articles were collected by a means of web search using Google and Google Scholar.

2.1 Locations of the Field Surveys

Two field surveys were conducted, with the first in the region near Routes 91 and 93 in the Johor River Watershed in December 2012 [Figure 1 (a)] and the second in the town of Tanjung Karang near the Selangor River Watershed in August 2016 [Figure 1 (b)]. These sites were selected because of the existence of several ownerships of oil palm plantations, such as company-ownership and individual ownership. Farmlands destined for oil palm and rubber plantations occupy 60 - 70% of the area of the Johor River Watershed (T., Kim, Sato, & Shimizu, 2019a) and 40 - 50% of the area of the Selangor River Watershed (Kondo, 2016).

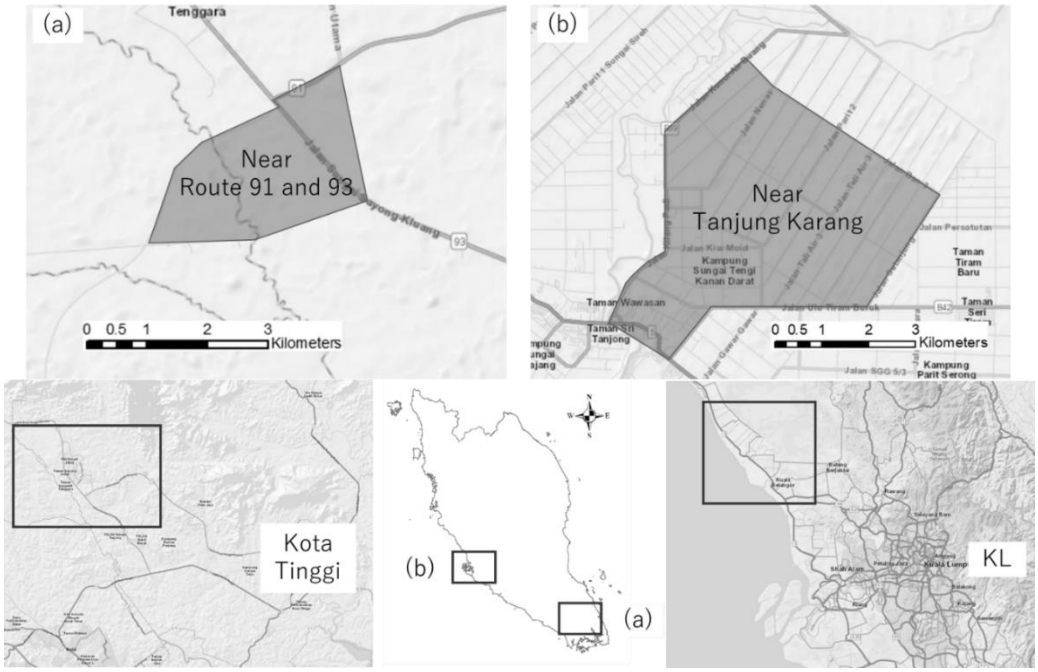

Figure 1. Field survey areas: (a) Near Routes 91 and 93 in the Johor River Watershed and (b) Tanjung Karang near the Selangor River Watershed in Malaysia (Map Source: The ESRI World Street Map)

3. Methodology

3.1 Floods and their Management in Malaysia

The regions on the Maritime Continent including some Southeast Asian countries, such as Indonesia, the Philippines, Singapore, and Malaysia, and are located in the Tropical Warm Pool. Malaysia frequently suffers from floods and droughts during the El Niño years and the La Niña years respectively since deep cumulus convection and heavy precipitation systems play a major role in the climatic and weather conditions on the Maritime Continent (Chang, Harr, & Chen, 2005). According to a report published by DID (2009), there are 189 river systems (89 in Peninsular Malaysia, 78 in Sabah, and 22 in Sarawak) flowing directly to the sea. Also, 85 of these are prone to floods, which are caused by a combination of natural and human factors. Natural factors such as heavy monsoon rainfall and intense convection rainstorms have become common features in Malaysia. In particular, heavy rains tend to occur in the two major monsoon seasons, the Southwest (SW) monsoon (from May to September) and the

Northeast (NE) monsoon (from November to March), and they have a critical influence on floods (Chan, 1995).

According to (Chan, 1997), floods in Malaysia can be categorized as either "normal" or "major" flood events. Normal Floods are regarded as seasonal floods that occur almost every year in the NE monsoon season, particularly on the east coast. The people living in the region have adapted well to the regular floods by constructing houses on stilts so that the water does not exceed the level of the floor. However, the monsoon rains also cause "major" floods which are regarded unusual or extreme events that are difficult to deal with. The northeasterly winds during the NE monsoon season sometimes bring heavy rains and cause prolonged devastating floods, particularly on the east coast of Peninsular Malaysia. On the other hand, the southwesterly winds during the SW monsoon season bring short-lived squalls called "Sumatra," which sometimes cause flash floods on the west coast including the capital area of Kuala Lumpur. However, the floods do not last long. This significant weather condition is caused by the Sumatra squall line which brings in heavy rain not only to Malaysia but also to Singapore (Yi & Koh., 2007). Meanwhile, rapid land-use changes such as urbanization and deforestation in the region are regarded as human factors that intensify floods (Billa, Mansor, & Mahmud, 2004). In addition, most of the Malaysian watersheds are mainly occupied by forests in the upper stream, while the lower part of the basin is occupied mainly by farmlands for oil palm and rubber plantations. Although these plantations play a crucial role in the industries in Malaysia, the farmlands have hurt the watershed hydrology with decreased runoff time that can trigger severe floods downstream to where the cities are located (Adnan & Atkinson, 2011; Yusop, Chan, & Katimon, 2007).

Recent significant disasters have revealed some of the issues in flood management in Malaysia, such as the incident that occurred in the Johor River Watershed from December 2006 to January 2007 during the NE monsoon season. Two devastating floods with heavy rain hit Peninsular Malaysia, and the Johor River Watershed was one of the most severely damaged areas during the flooding period. When the two devastating floods occurred, Kota Tinggi, an area of the city located downstream of the Johor River, was severely damaged. This is shown in the report of the DID (Department of Irrigation and Drainage Malaysia (2009). DID Manual 1, 2009). During these incidents, the observed maximum water levels in Kota Tinggi were reportedly up to 5.0 m in December 2006 and 5.5 m in January 2007. In this area, the dangerous, alert, and normal water levels are 2.8, 2.5, and 2.1 m respectively (Abdullah, 2013). Most of the city was flooded and many of the residents had to be evacuated. The amount of rainfall during these two events was greater than 400 mm. This exceeds the monthly average value of 200 mm (Department of Irrigation and Drainage Malaysia (2009). DID Manual 1, 2009; Razi, Ariffin, Tahir, & Arish, 2010). The reported cost of repairing roads and bridges was about 147 million RM (43.6 million USD). Also, the estimated cost of replacing the hydraulic structures was about 260 million RM (77 million USD) in Johor district alone (Shafie, 2009). The two flood events in the Johor River Watershed between December 2006 and January 2007 are representatives of flooding in Peninsular Malaysia. One of the defining characteristics of Malaysian watersheds is the continuous rainy days during the monsoon season (Muhammad & Julien, 2015; Muhammad, Julien, & Salas, 2015; Suhaila & Jemain, 2007) in addition to short-term heavy rainfall that causes flash flooding. Multiday rainfall events are very common during the monsoon season in the Johor River Watershed. It is well known that flooding is an unavoidable natural phenomenon given the characteristic of such rainfall (Chan, 1995).

Unfortunately, a concrete design flood system that flexibly considers the various watershed's characteristics, depending on the region of focus in Malaysia, has not yet been established. With the changes brought about by global warming, rainfall events, in specific rainfall patterns and frequency of heavy rain, will become even more consequential. It is necessary to accurately predict the river conditions and to effectively mitigate flood damage by implementing efficient flood management measures under the concrete design flood system. In addition to the hydrologic design value, when it comes to conducting the structural measures, reasonable and acceptable countermeasures reflecting the actual watershed condition should be considered to prevent flooding based on the IWM.

3.2. Flood Management of Oil Palm Plantations

3.2.1. Situation of the Palm Oil Industry in Malaysia

As of 2016, Malaysia was the second-largest producer and exporter of palm oil in the world, only after Indonesia (Nguyen et al., 2014). Although the oil palm plantations play a crucial role in the Malaysian industries, some researchers have warned that they negatively affect watershed hydrology as elaborated

in the following subsection. These unfavorable situations are caused by the construction of plantations since the processes involved entail soil compression by trucks and tractors. On the other hand, the economic opportunity presented by oil palm plantations cannot be disregarded. Thus, it is obvious that these complex situations regarding oil palm plantations require an IWM approach in Malaysian watersheds to consider the balance of environmental management and the Malaysian economy.

3.2.2. The General Processes of Palm Oil Production and the Triggered Environmental Problems

In general, oil palm plantations focus on three cultivation stages: nursery, immature, and mature. The cultivation practices and places differ depending on the stage of the tree's development (Indonesia, n.d.-b, n.d.-a, 1999). The nursery stage is the first stage in the production of seedlings that are sent to the oil palm plantations. Oil palm trees at the nursery are cultivated using polybags. Only at this stage must the oil palm trees be watered and fertilized. From this stage, it takes two or three years to reach maturity that is the last stage, a process described in this subsection. The immature stage is the second part of cultivation, covering one- to two-year-old trees. This is essentially a two-step stage: planting and maintenance. At the planting step, the land is cleared, and roads and drains are constructed to transport the seeds and to prevent root rot. After the roads are built, drains are constructed in the interconnecting series. There are two types of roads: harvest and main roads. The seeds that are produced by the oil palm trees are harvested along the harvest road, collected along the main road, and transported to the palm oil mill. As for the drains, there are three types: field, collection, and main drains. The drain type is determined by size, capacity, and location. All drains are designed to reduce water retention time in the oil palm plantations. The field and collection drains are connected to the main drain, which eventually connects to a neighboring river. Maintenance follows the planting step. Maintenance operations, such as weeding and fertilizer application, are implemented during this step. The mature stage covers oil palm trees that are three years old and older, and oil palm trees that continue fruiting for approximately 25 years. After that, the trees are cut, burned, and fertilized. New oil palm trees are then prepared, and the oil palm plantation reverts to the nursery stage.

As the industry is developing, some of the environmental issues caused by oil palm plantations, such as biodiversity loss and air pollution, have been discussed by researchers. Palm oil is primarily used in snacks and cosmetics. Oil palm trees usually grow in areas that were once peatlands or wet areas where dead organic material is plentiful. These days, peatlands are dried for agricultural purposes as quickly as possible (Dohong, Aziz, & Dargusch, 2017). Swidden cultivation, or slash-and-burn cultivation, which only degrades the area and surrounding environment, sometimes entails illegal draining and burning of the land (Dohong et al., 2017). Recently, air pollution (i.e., haze) has become a serious problem in Malaysia. This haze spreads and causes hazy weather both in Malaysia and in neighboring countries. Extensive swathes of natural forest and tropical rainforest have been lost due to logging for the construction of oil palm plantations (Dohong et al., 2017; Yazawa, 2017). Also, the effluent from the oil palm plantations finding its way into the rivers degrades the water quality, which is another problem stemming from oil palm plantations (Yazawa, 2017). The conversion of forests and the expansion of oil palm plantations also affect the biodiversity in the region because oil palm plantations can support fewer species than natural forests (Fitzherbert et al., 2008; Koh & Wilcove, 2008). Furthermore, the watershed hydrology is also affected by the conversion from forest to oil palm/rubber plantations. Merten et al. (2016) mentioned that the conversion causes soil degradation and thus the soil permeability in oil palm plantations is low. Compressed soil reduces the amount of water infiltrating into the ground (Merten et al., 2016; Yusop et al., 2007; Ziegler, Fox, & Xu, 2009). This situation causes higher surface runoff, peak flows, and eventually flooding of the oil palm plantations during rainfall events. However, the impact caused by the existence of plantations on watershed-scale hydrology, particularly flooding, is still under debate. Majizat (Majizat, Ahmad, & Noordin, 2009) and Rahaman (Rahaman, Noordin, Sahat, Muhamad, & Majizat, 2010) explain that cutting rubber and oil palm trees may cause an increase in surface runoff and flooding. Thus, it is necessary to clarify the impact of the life cycle of oil palm plantations on watershed hydrology using hydrological techniques, such as modeling, since the expansion of oil palm plantations is expected to continue in the future. Although more scientific and hydrological investigations are needed to reveal the causes of flooding, Malaysia is still susceptible to flooding because the plantation areas continue to expand for economic benefit.

3.3. Insights from Field Surveys on Oil Palm Plantations

3.3.1. Condition of the Oil Palm Plantations in the Field Survey Areas

Ramasamy (Ramasamy, Ong, & Yeung, 2005) stated that ownership is one of the important factors in considering the profitability of the Malaysian palm oil sector. There are four categories of industrial ownership: privately owned (mainly company-owned), government-owned, state-owned, and smallholders (individually owned). The oil palm plantations in the field survey sites of this research are either individually owned or company-owned. There are significant differences in the management strategies employed by these two types of ownerships because land use is already destined by the land categories which have been established by the government. The land categories determine the types of activities that can be carried out on said land, including residential, agricultural, industrial, commercial, or other purposes. People or companies in Malaysia can start oil palm plantations and paddy fields when the land they possess is categorized as agricultural.

For the most part, mature oil palm trees do not require maintenance, and they continue fruiting for approximately 25 years without being attended. Thus, oil palm trees are easy to maintain and offer significant income opportunities, which explains the high number of individually-owned oil palm plantations in Malaysia. Since the people who individually own oil palm plantations usually do not carry out any maintenance, owning an oil palm plantation is still popular with individuals. Figure 2 shows the (a) individually-owned and (b) company-owned oil palm plantations observed in the field survey areas. The differences in maintenance conditions between these two types of oil palm plantations are on full display in Figure 2. The ground of the company-owned oil palm plantations is kept clean, whereas the ground of individually-owned oil palm plantations is left as it is.

Company-owned oil palm plantations account for a much greater share of land than individually-owned ones. The companies hire many workers, including local and foreign workers, to efficiently maintain and systematically manage the land (Koh & Wilcove, 2007). As shown in Figure 2 (b), the companies have workers remove fallen leaves from the ground, weed the area, and then fertilize the soil using chemical or organic fertilizers to accelerate tree growth/fruit production. Over the past few decades, company-owned oil palm plantations have used chemical fertilizers that have degraded the quality of river water, particularly when heavy rains and subsequent surface runoff occur. Accordingly, some companies have recently shifted to using organic fertilizers (Ismail, Zulkifli, & Azmi, 2010).

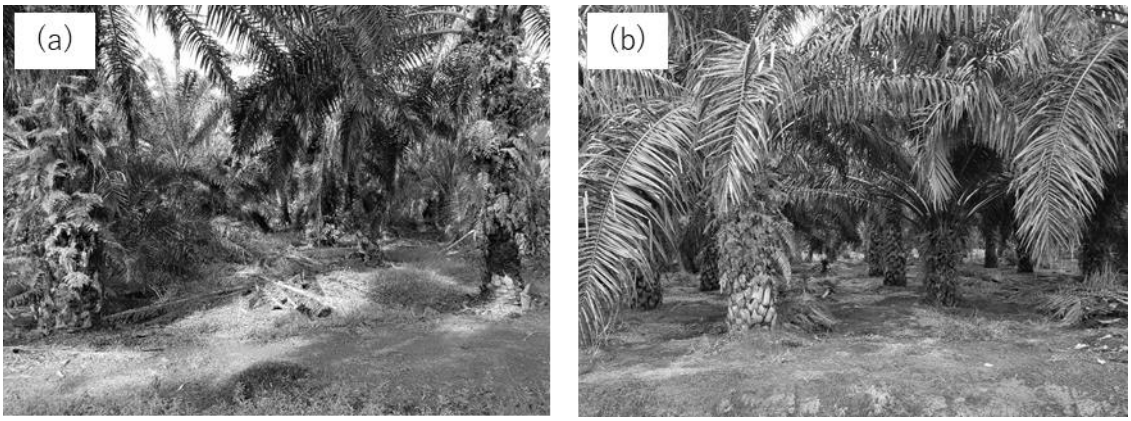

Figure 2. (a) Individually-owned and (b) Company-owned oil palm plantations in the field survey areas

3.3.2. Flooding in Oil Palm Plantations

In oil palm plantations, rainwater can be the only water source, i.e., there is no need to prepare an artificial water supply system. This facilitates the locals in starting their oil palm plantation business by reducing the initial cost. The fallen leaves are left because they play an important role in maintaining the soil moisture of oil palm plantations owned by individuals that do not usually have workers/employees to maintain vast areas. Oil palm trees grow sufficiently with no more than soil moisture. This makes it easier for the locals to keep their oil palm plantation business by reducing the maintenance cost and manpower needed. If oil palm trees are overwatered, the fruits produced are of lower quality and they may even be

rotten. This means that flooding is far from desirable, particularly for private owners. This is because flooding brings in too much water, and surface runoff washes fallen leaves away. Moreover, floods carry soil away, and this causes sedimentation in rivers and clogging in drainage canals.

During the December 2012 field survey in the Johor River Watershed, flooding was observed on an individually-owned oil palm plantation (Figure 3). Given that December is in the Northeast (NE) monsoon season, rainy days continued during the period of the field survey. Such weather situations can easily trigger flooding, and individually-owned oil palm plantations are particularly vulnerable to flooding because they are not maintained and because fallen leaves clog drainage canals. Both individually- and company-owned oil palm plantations usually have small drains (i.e., field and collection drains) between the trees; these small drains connect to the main drain, and the main drain connects to an artificial drain or river. The water in the artificial drains eventually flows into the neighboring bodies of water, whether they are rivers or the sea. For company-owned oil palm plantations, drains are usually constructed in accordance with established rules, and they are maintained by workers to effectively discharge stagnant water. In the case of individually-owned oil palm plantations, artificial drains connect to a neighboring river. However, these drains are designed based on the locals' experiences, and they do not follow a systematic design. Additionally, these drains are rarely managed, and thus overflowing often occurs due to clogging caused by accumulated leaves, garbage, sediment, and weeds, etc., all of which reduce drainage capacity. Therefore, the drainage system and its maintenance should be addressed by oil palm plantation owners with appropriate fallen leaf management to make sure enough soil moisture and to keep adequate drain capacity to handle rainfall in the rainy season.

Figure 3. Flooding on an oil palm plantation in the Johor River Watershed, Malaysia (December 2012)

3.3.3. Co-existence and Harmonization with Paddy Fields

In the town of Tanjung Karang, there is an excellent example of an oil palm plantation with an adjacent paddy field. This ensures that the water is balanced by a give-and-take relationship. Most drains in the paddy field are also connected to the same main drains in the oil palm plantation. The DID controls the water by using water gates that are adjusted to the paddy field's water level, thereby ensuring that the water level of the paddy field remains constant. As mentioned above, an excessive water supply is detrimental to oil palm plantations. Paddy fields, on the other hand, require water. Thus, connecting an oil palm plantation and a paddy field with a drainage canal means that almost any irrigation system can take advantage from flooding. The local people in Tanjung Karang told us that they had never experienced flooding on their oil palm plantations. Thus, the co-existence of oil palm plantations and paddy fields has proven to be advantageous. In general, as shown in Figure 4, paddy field drains are highly managed and maintained compared to those of oil palm plantations. This gap in drain maintenance indicates the importance of controlling the amount of water/water level in the paddy fields, which is in contrast to the relative unimportance of water management in oil palm plantations. In the dry season, paddy fields must have their water levels adjusted. Therefore, the water gates dam up in the paddy fields during the dry season resulting in limited rainfall. Occasionally, this limits the downstream flow of the connected river.

During the field survey conducted near the Selangor River Watershed in August 2016, the days without rains were prolonged on account of the El Niño phenomenon, which limited the observed downstream flow of the paddy fields. Also, just outside the paddy fields, there was a significant amount of garbage at the mouth of the drain as shown in Figure 5. Trash returned to the top and it often clogged the water gate which, in turn, hindered the effective water management in the paddy fields as well as that of the oil palm plantations. Given that the co-existence of oil palm plantations with paddy fields produces a harmonious effect in terms of floodwater management in both fields during periods of heavy rain, resolving these issues would be substantially beneficial to the owners.

Figure 4. Drain in a paddy field in Tanjung Karang, Malaysia (August 2016)

Figure 5. Garbage in the drain near the water gate connected to a paddy field (August 2016)

3.3.4. Retention and Detention Ponds in the Field Survey Areas

Retention (wet) and/or detention (dry) ponds are known as multifunctional basins that temporarily store water during heavy rains and mitigate flooding in addition to for recreational and aesthetical uses (Loc, 2013). If an oil palm plantation has retention and/or detention ponds, flooding may be prevented or mitigated. These plantations are especially benefitted from the excessive water storage in the ponds during periods of heavy rain. During the field survey of the Johor River Watershed in December 2012, the rain events lasted several days because December is part of the NE monsoon season; flooding was observed as shown in Figure 3. The field survey left no doubt that there were no satisfactory retention and detention ponds or drainage capacity in the study area.

In contrast, during the field survey in Tanjung Karang in March 2016, three retention ponds were confirmed within the region. Based on interviews with the locals, the retention ponds were identified as being used for "commercial use", namely fishing. They are not considered to be retention ponds for water storage, and thus they are not maintained. One of the three retention ponds is artificial and is used by the DID to check the water quality of neighboring drains. However, the pond is not controlled for water storage and the local people can use it for fishing even though the water quality is monitored by a local governmental institute. The other two (natural) retention ponds are not managed either. However, they are directly linked to oil palm plantations.

Even though the local people of Tanjung Karang have not yet experienced flooding, that does not mean that they are free from flooding in the future caused by climate change. To mitigate and prevent damage from flooding in the oil palm plantations, retention ponds should be used and maintained. Such ponds have been used commercially and individually up until now, with the hope that more ponds to avoid flooding will be constructed on bare land that is generally neglected by the locals.

3.4. Feasible Flood Management in Oil Palm Plantations

3.4.1. Factors to Ponder for the Effectiveness of Management

Certain flooding countermeasures have not yet been well recognized at the local level of the plantation area, as observed from the findings of the field surveys, even though the oil palm plantations in some regions in Malaysia (e.g., the Johor River Watershed) have been flooded almost every year (T. et al., 2019a). Additionally, the management approach and the owners' awareness are different between individually-owned and company-owned oil palm plantations. In particular, individually-owned oil palm plantations significantly affect the local environment, e.g., watershed environment. In Tanjung Karang, there have been almost no problems regarding flooding until recently, as some existing drains have sufficient capacity and the co-existence of plantations and paddy fields manages the floodwater during heavy rain. However, the increased frequency of rainfall and flooding events is predicted to occur because of the future climate change in Malaysia that has been discussed by many researchers (Hassan, 2012; Juneng & Tangang, 2008; Kwan, Tangang, & Juneng, 2013; Shaaban, Amin, Chen, & Ohara, 2011; T. et al., 2019b; Tan, Ficklin, Ibrahim, & Yusop, 2014; Tukimat & Harun, 2011). The capacity of the existing drains is unlikely to be able to handle the extreme events predicted. Certain flood management strategies, therefore, must be implemented for both existing and potential oil palm plantations with the proper understanding and participation of the local people. According to Dumanski and Peiretti (Dumanski & Peiretti, 2013), when planning land management, the following factors must be taken into account: how to maintain and enhance production (productivity), how to reduce production risk (stability), how to enhance soil capacity (resilience), how to protect the natural resources/prevent the degradation of soil and water quality (protection), how to ensure economic viability (viability), and how to garner social acceptance (acceptability). Based on these criteria in conjunction with the findings from the field surveys and the literature review, several feasible flood management strategies for use in oil palm plantations are suggested below along with several case studies.

3.4.2. Effective Use of Retention and/or Detention Ponds

Retention and detention ponds are general and conventional methods for managing floodwater. These ponds collect flood water and slowly release it at a controlled rate. Hence, they also prevent flooding in downstream areas. The main difference between retention and detention ponds is that the former is wet, i.e., it has permanent water, and the latter is dry, i.e., occasionally wet. The ponds themselves are effective and important for storing and attenuating surface runoff (Sustainable Stormwater Management, 2009). Therefore, the effective use of existing retention ponds, e.g., the ponds currently used only for fishing in Tanjung Karang, means that they will be able to play a crucial role in preventing and mitigating flooding in oil palm plantations with minimal improvements needed.

Retention ponds are multifunctional basins that function as an important source of irrigation water supply, as retarding basins for local residents, and as a temporary water storage basin during a flood (Loc, 2013). Retention ponds play an important role in cutting peak flow, delaying surface runoff time, and reducing sediment and pollutants attached to sediments (Robinson, Scholz, Bastien, & Carfrae, 2010). Retention ponds are an online storage facility that permanently retains water, thus keeping the water out of the groundwater table. They have an orifice at a higher point to retain a permanent pool of

water (Sustainable Stormwater Management, 2009). Detention ponds are also multifunctional basins with the primary function as a temporary water storage basin during flooding. However, it is an offline form of storage that only detains water during heavy rainfall. Detention ponds drain all of the water after the end of a rainfall event. Their orifice is located at the bottom of the basin so that all water eventually drains out, which means that they remain dry between rainy events (Sustainable Stormwater Management, 2009). Given that they are dry between rainy events, land use control brings in additional benefits. For example, detention ponds designed for flood control may also serve as sports facilities for the community (Tucci, 2001). Parkinson and Mark (Parkinson & Mark, 2005) designed a detention pond as a soccer field in Brazil. Thus, detention ponds can not only help in flood control but also offer recreational value. In Malaysia, there is a successful example of Putrajaya Lake and Wetland. Putrajaya Lake has a water catchment area of 51 km2, and the wetland is the first man-made wetland in Malaysia. The quality of the lake water is maintained at a certain level which allows people to use the lake for sports and recreational activities (Majizat et al., 2009; Rahaman et al., 2010). When Putrajaya Lake and Wetland were constructed, their hydrological roles in flood mitigation, storm and flood storage, peak flow reduction, and groundwater recharge were also taken into consideration. They both prevent flooding in Putrajaya where the government center is located. From the perspectives of efficiency, sustainability, and acceptability, these ponds will prove valuable in the fight to mitigate flooding, and they will also offer recreational value as recreational sites for locals even in urban areas.

Although retention and detention ponds have various functions, maintenance is one of the most important elements to ensure their utility. The retention pond's orifices are sometimes clogged by pollutants and garbage. Similarly, the detention pond's orifices are often clogged by pollutants and garbage due to the orifices' location, i.e., at the bottom of the pond. Therefore, maintenance activities, including erosion repair, sediment removal, and vegetation management, are necessary for proper functioning. This requires understanding and participation of the locals.

3.4.3. Improvement of the Drainage System

The three types of drains (field, collection, and main) in the oil palm plantations and their concomitant construction rules have been discussed. Although the drains in the company-owned oil palm plantations are well-maintained to effectively discharge water, those in individually-owned oil palm plantations are sometimes not. Flooding often occurs because of clogging caused by accumulated garbage, sediment, weeds, etc. In other words, there is a lack of maintenance. This leads to an inadequate drainage capacity in the rainy season. For that reason, individually-owned oil palm plantations are vulnerable to flooding, which highlights the importance of drainage systems and their maintenance. In this case, the owners' awareness is highly relevant. When the locals construct their oil palm plantations, they should not only actively count on their experiences but also follow certain guidelines or criteria. The wisdom, knowledge, perception, and experiences of the locals should primarily be respected as "bits of wisdom" for future generations, incorporated into practical management, and integrated in line with IWM. Technical guidelines or criteria will also be effective when it comes to preventing flooding in oil palm plantations. Also, given the impact of climate change on the frequency and intensity of flooding, the current construction rules and guidelines for drainage design systems in oil palm plantations might not be satisfactory. They must be revised to improve the drain capacity to cope with future flooding. Moreover, the participation of the locals in maintenance activities such as garbage collection and removal of weeds from the drains is crucial because stakeholder participation is one of the pillars of IWM. Thus, it is vital to reflect on the ways in which local people participate and to facilitate their understanding of the underlying issues discussed herein. It should be noted, however, that the downstream peak flow rate might increase because of the management activities at the upper stream. In that sense, a discussion of the people between upstream and downstream would become more important in the IWM concept.

3.4.4. Management of Fallen Leaves

According to Tarigan (Tarigan et al., 2016), the expansion of oil palm plantations reduces the regulatory function of watershed's waters because of increased surface runoff. Their research thus proposed two flood mitigation options: frond pile management and a combination of frond pile management and silt pit treatment. Both options represent simple ways to enhance the locals' adoption and sustainable application. They can reduce surface runoff by approximately 10 - 30%. These options are considered to be ecologically effective and economically viable because the implementation costs are

low. They also satisfy the land management criteria suggested by Dumanski and Peiretti (Dumanski & Peiretti, 2013). Based on the pilot study conducted by Tarigan (Tarigan et al., 2016) in the Merangin Tembesi Watershed in Indonesia, fallen leaf management is also effective. Its implementation requires understanding and cooperation from local people, and above all those who have individually-owned oil palm plantations because these owners generally leave leaves on the ground. The difficulty of enacting this strategy is compounded by the belief of the local community that fallen leaves provide the advantage of keeping moisture in the soil so that the trees bear more and better fruits. However, fallen leaves cause flooding and clogged drains. Managing fallen leaves can reduce the clogging of drains during heavy rain. This is better for the locals insofar as it allows them to understand the pros and cons of their lack of maintenance. By being armed with that understanding, the locals can implement appropriate fallen leaf management. More scenario simulations using hydrologic models would be helpful to evaluate the effects of fallen leaf management and its effectiveness in facilitating the understanding of the locals in light of engineering.

3.4.5. Non-structural Flood Management Approach

People living in the regions vulnerable to flooding usually construct houses on stilts so that water does not exceed the floor height (Chan, 1997). This is a clear example of the locals' adaptation to flooding conditions based on their experience and this demonstrates how they respect their ancestors' experiences. However, when we consider the future impacts of climate change, there is a lingering doubt as to how people will adapt to more severe floods in the future. In this case, non-structural flood management will become a key factor in the preparation for future floods. Non-structural measures reduce flood damage through non-constructive solutions (i.e., solutions that do not involve construction) as well as flood management plans. Wing (Chia, 2004) suggested non-structural measures to effectively avoid a flood. For example, flood forecasting and an early warning system are important, practical, and low-cost measures to minimize flood damage. These are currently the most acceptable and applicable ways for local people to handle floods in the era of ubiquitous smart devices with internet connections.

Population relocation/resettlement is another non-structural measure traditionally implemented in Malaysia to reduce the potential damage and loss of life in areas that are prone to flooding. In particular, this method is effective for areas where floods cannot be significantly reduced by structural measures. The Malaysian government has already prepared many relocation/resettlement schemes as a part of flood management (Chan, 1995). For example, 1,672 and 2,715 families from the states of Kelantan and Pahang respectively have been resettled since 1971 because these areas are known as the most flood-prone areas in the country (Chia, 2004). However, there have been only a few cases of relocation/resettlement because of its unpopularity and high cost. It is considered to be the worst and last option by the locals who, naturally, do not want to incur the hardship of relocation/resettlement, i.e., preparing alternative locations and houses, losing contact with their relatives, friends, and places of work or schools, and getting acclimated to their new environment (Chan, 1995). Having said that, the locals have already recognized that moving to other places with a higher elevation is effective in mitigating the damage of floods (Iya, Gasim, Toriman, & Abdullahi, 2014). Iya (Iya et al., 2014) proposed an alternative, suggesting a flood-fighting drill for the locals and encouraging them to participate in the drill. This is in addition to the development of housing that is designed to mitigate floods (flood-proofing).

4. Conclusions

Malaysian watersheds have historically suffered from severely damaging floods because of the monsoonal climatic characteristics. To achieve successful IWM in Malaysia, the real situations of the target watershed should be comprehensively considered before any practical strategies are applied. The conditions and underlying issues of flood management in the Malaysian main industry, oil palm plantations, have been reviewed and summarized in this research. As a result, feasible flood management strategies have been proposed based on the findings of both the field surveys and the literature review of the concept of IWM.

The Malaysian palm oil industry is one of the important factors when we consider IWM because it is the most dominant land use in most of Malaysian watersheds. It was revealed that local people's awareness and ownership strongly affect the management of oil palm plantations and sometimes lead to environmental problems such as flooding. The unattended oil palm plantations triggers flooding during heavy rain because fallen leaves, garbage, sediment, and weeds clog drainage canals, leading to

inadequate drain capacity. Thus, this research has presented feasible flood management strategies for oil palm plantations including effective use of the retention and detention ponds, improvement of the drainage systems, management of fallen leaves, and a design of a non-structural approach.

In balance, effective IWM requires consideration of structural and/or non-structural measures that rely on preventive and adaptive countermeasures in addition to fostering understanding and participation in planning among the locals to comply with IWM principles. Even though this research discusses differences in the management strategies of company-owned and individually-owned plantations, it should be emphasized that this research does not aim to determine which strategy is better because the local people's interests, knowledge, and experiences must be respected based on the concept of IWM. Thus, what we have to consider is enhancing the locals' understanding and promoting their participation. It is incumbent upon further flood management research to evaluate suggested countermeasures using engineering techniques, such as hydrological modeling. Therefore, the effectiveness of feasible flood management strategies including the ones discussed in this article should be assessed so that evidence-based management plans to convince stakeholders could be proposed.

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References

Abdullah, J. (2013). *Distributed Runoff Simulation of Extreme Monsoon Rainstorms in Malaysia using TREX*. Colorado State University.

Adnan, N. A., & Atkinson, P. M. (2011). Exploring the impact of climate and land use changes on streamflow trends in a monsoon catchment. *International Journal of Climatology*, *31*(6).

Afroz, N., & Ilham, Z. (2020). Assessment of Knowledge, Attitude, and Practice of University Students towards Sustainable Development Goals (SDGs). *The Journal of Indonesia Sustainable Development Planning*, *1*(1).

Billa, L., Mansor, S., & Mahmud, A. R. (2004). Spatial information technology in flood early warning systems: An overview of theory, application, and latest developments in Malaysia. *Disaster Prevention and Management: An International Journal*, *13*(5).

Bronkhorst, E., Cavallo, E., Medler, M.-M. van D. tot, Klinghammer, S., Smit, H. H., Gijsenbergh, A., & Laan, C. van der. (2017). *Current practices and innovations in smallholder palm oil finance in Indonesia and Malaysia: Long-term financing solutions to promote sustainable supply chains*. Bogor: CIFOR.

Chan, N. W. (1995). Flood disaster management in Malaysia: An evaluation of the effectiveness of government resettlement schemes. *Disaster Prevention and Management: An International Journal*, *4*(4).

Chan, N. W. (1997). Increasing Flood Risk in Malaysia: Causes and Solutions. *Disaster Prevention and Management: An International Journal*, *6*(2).

Chang, C. P., Harr, P. A., & Chen, H. J. (2005). Synoptic Disturbances over the Equatorial South China Sea and Western Maritime Continent during Boreal Winter. *Monthly Weather Review*, *133*(3).

Chia, C. W. (2004). Managing flood problems in Malaysia. *Bulletin Ingenieur*.

Department of Irrigation and Drainage Malaysia (2009). DID Manual 1, P. 5.-1. (2009). *DID Manual 1, p.5A-1.*

Dohong, A., Aziz, A. A., & Dargusch, P. (2017). A Review of the Drivers of Tropical Peatland Degradation in South-East Asia. *Land Use Policy*, *69*.

Dumanski, J., & Peiretti, R. (2013). Modern concepts of soil conservation. *International Soil and Water Conservation Research*, *1*(1).

Fitzherbert, E. B., Struebig, M. J., Morel, A., Danielsen, F., Brühl, C. A., Donald, P. F., & Phalan, B. (2008). How will oil palm expansion affect biodiversity? *Trends in Ecology and Evolution*, *23*(10).

Hassan, Z. (2012). Application of Statistical Downscaling Model for Long Lead Rainfall Prediction in Kurau River Catchment of Malaysia. *Malaysian Journal of Civil Engineering*, *24*(1).

Indonesia, I. P. N. I. and P. A. S. (n.d.-a). *Oil Palm Series -Mature-, Field Handbook 3*.

Indonesia, I. P. N. I. and P. A. S. (n.d.-b). *Oil Palm Series -Nursery-, Field Handbook 1*.

Indonesia, I. P. N. I. and P. A. S. (1999). *Oil Palm Series -Immature-, Field Handbook 2*.

Ismail, S., Zulkifli, R., & Azmi, K. (2010). Crops and Livestock Integration with Oil Palm. In *Further Advances in Oil Palm Research, 2000-2010 1* (pp. 543–568).

Iya, S. G. D., Gasim, M. B., Toriman, M. E., & Abdullahi, M. G. (2014). Floods in Malaysia: Historical Reviews, Causes, Effects and Mitigations Approach. *International Journal of Interdisciplinary Research and Innovations*, *2*(4).

Juneng, L., & Tangang, F. T. (2008). Level and Source of Predictability of Seasonal Rainfall Anomalies in Malaysia using Canonical Correlation Analysis. *International Journal of Climatology*, *28*.

Koh, L. P., & Wilcove, D. S. (2007). Cashing in palm oil for conservation. *Nature*, *448*(7157).

Koh, L. P., & Wilcove, D. S. (2008). Is oil palm agriculture destroying tropical biodiversity? *Conservation Letters*, *1*(2).

Kondo, T. (2016). *Prediction of Water Resource in the Future in Selangor River Watershed, Malaysia using a Distributed Watershed Model*. Kyoto University.

Kwan, M. S., Tangang, F. T., & Juneng, L. (2013). Projected changes in future climate extremes in Malaysia. *Sains Malaysiana*, *42*(8).

Loc, H. H. (2013). *Integrated Assessment of Sustainable Urban Drainage Systems in Ho Chi Minh City, Viet Nam*. Asian Institute of Technology, Bangkok.

Majizat, A., Ahmad, B., & Noordin, N. (2009). *Integrated Catchment Management of Urban Man-made Lake and Wetlands–Putrajaya Experience*. Putrajaya, Malaysia: Putrajaya Corporation.

Merten, J., Röll, A., Guillaume, T., Meijide, A., Tarigan, S., Agusta, H., … Hölscher, D. (2016). Water scarcity and oil palm expansion: Social views and environmental processes. *Ecology and Society*, *21*(2).

Mohamadab, Z. F., Nasaruddin, A., Kadir, S. N. A., Musa, M. N., Ong, B., & Sakai, N. (2015). Community-based Shared Values as a 'Heart-ware' Driver for Integrated Watershed Management: Japan-Malaysia Policy Learning Perspective. *Journal of Hydrology*, *530*.

MSMA. (2000). *Urban Stormwater Management Manual for Malaysia* (Volume 4/C). Department of Irrigation and Drainage.

MSMA. (2012). *Urban Stormwater Management Manual for Malaysia*. Department of Irrigation and Drainage.

Muhammad, N. S., & Julien, P. Y. (2015). Multiday Rainfall Simulations for Malaysian Monsoons. *ISFRAM 2014*. Springer, Singapore.

Muhammad, N. S., Julien, P. Y., & Salas, J. D. (2015). Probability structure and return period of multiday monsoon rainfall. *Journal of Hydrologic Engineering*, *21*(1).

Nakamura, M., & W., R. (2014). *Development of ILBM Platform Process Evolving Guidelines through Participatory Improvement, 2nd ed.* Otsushigyo Photo Printing Co. Ltd., Otsu.

Nguyen, M. T., Walle, D. Van de, Petit, C., Beheydt, B., Depypere, F., & Dewettinck, K. (2014). Mapping the Chemical Variability of Vegetable Lecithins. *Journal of the American Oil Chemists' Society*, *91*(7).

Parkinson, J., & Mark, O. (2005). *Urban Stormwater Management in Developing Countries*. London: IWA publishing.

Rahaman, N. A., Noordin, N., Sahat, R., Muhamad, Y., & Majizat, A. H. (2010). Putrajaya Lake and Wetlands—Current Status and Lesson Learned. *National Seminar on Lake and Its Basin*. Putrajaya.

Ramasamy, B., Ong, D., & Yeung, M. C. H. (2005). Firm Size, Ownership, and Performance in the Malaysian Palm Oil Industry. *Asian Academy of Management Journal of Accounting and Finance*, *1*(1).

Razi, M. A. M., Ariffin, J., Tahir, W., & Arish, N. A. M. (2010). Flood Estimation Studies using Hydrologic Modeling System (HEC-HMS) for Johor River, Malaysia. *Journal of Applied Sciences*, *10*(11).

Robinson, M., Scholz, M., Bastien, N., & Carfrae, J. (2010). Classification of different sustainable flood retention basin types. *Journal of Environmental Sciences*, *22*(6).

Shaaban, A. J., Amin, M. Z. M., Chen, Z. Q., & Ohara, N. (2011). Regional Modeling of Climate Change Impact on Peninsular Malaysia Water Resources. *Journal of Hydrologic Engineering*, *16*(12).

Shafie, A. (2009). *Extreme Flood Event: A Case Study on Floods of 2006 and 2007 in Johor Malaysia*. Colorado State University, Colorado.

Suhaila, J., & Jemain, A. A. (2007). Fitting daily rainfall amount in Malaysia using the normal transform distribution. *JApSc*, *7*(14).

Sustainable Stormwater Management. (2009). Stormwater 101: Detention and Retention Basins. Retrieved July 1, 2020, from https://sustainablestormwater.org website: https://sustainablestormwater.org/2009/05/28/stormwater-101-detention-and-retention-basins/

T., Y., Kim, S., Sato, K., & Shimizu, Y. (2019a). Estimation of Design Flood Criteria toward Integrated Watershed Management in the Johor River Watershed, Malaysia. *Journal of EICA*, *24*.

T., Y., Kim, S., Sato, K., & Shimizu, Y. (2019b). Future Changes in Watershed-scale Rainfall Characteristics: Application of AGCM20 to the Johor River Watershed. *Journal of EICA*, *23*(4).

Tan, M. L., Ficklin, D. L., Ibrahim, A. L., & Yusop, Z. (2014). Impacts and uncertainties of climate change on streamflow of the Johor River Basin, Malaysia using a cmip5 general circulation model ensemble. *Journal of Water and Climate Change*, *5*(4).

Tarigan, S. D., Sunarti, Wiegand, K., Dislich, C., Slamet, B., Heinonen, J., & Meyerc, K. (2016). Mitigation options for improving the ecosystem function of water flow regulation in a watershed with the rapid expansion of oil palm plantations. *Sustainability of Water Quality and Ecology*, *4*.

Tucci, C. 'E. M. (2001). *Urban Drainage in the Humid Tropics*. Paris: UNESCO International Hydrology Program.

Tukimat, N. N. A., & Harun, S. (2011). The Projection of Future Rainfall Change over Kedah, Malaysia with the Statistical Downscaling Model. *Malaysian Journal of Civil Engineering*, *23*(2).

Yazawa, T. (2017). *Design Flood Criteria toward Integrated Watershed Management in the Johor River Watershed, Malaysia*. Kyoto University.

Yi, L., & Koh., T. H. (2007). Analysis and prediction of Sumatra squall lines. *22nd Conference on Weather Analysis and Forecasting/18th Conference on Numerical Weather Prediction*.

Yusop, Z., Chan, C. H., & Katimon, A. (2007). Runoff characteristics and application of HEC-HMS for modeling stormflow hydrograph in an oil palm catchment. *Water Science & Technology*, *56*(8).

Zakaria, N. A., Ghani, A. A., Abdullah, R., Sidek, L. M., & Ainan, A. (2003). Bio-ecological Drainage System (BIOECODS) for Water Quantity and Quality Control. *International Journal of River Basin Management*, *1*(3).

Zakaria, N. A., Ghani, A. A., Abdullah, R., Sidek, L. M., & Ainan, A. (2004). Bio-ecological Drainage System (BIOECODS): Concept, Design, and Construction. *Advances in Hydroscience and Engineering*, *1*(3).

Ziegler, A. D., Fox, J. M., & Xu, J. (2009). The rubber juggernaut. *Science*, *324*(5930).

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Research Paper

The Influence of Government Subsidy and Pro-environmental Gaps on Electricity-saving Behaviors of Households in Indonesia

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Abstract

This research analyzes whether electricity subsidy as an external factor and pro-environmental intention and acts as internal factors have any relationship on households' electricity-saving behaviors in Indonesia. To this end, Indonesia's household data from the National Socioeconomic Survey of Indonesia (SUSENAS) in 2017 is empirically analyzed. Using logit regression with control factors such as dwellings and sociodemographic characteristics, the statistical analysis reveals that subsidized households are less likely to save electricity in their daily lives. Furthermore, families with higher pro-environmental intentions are not necessarily likely to save electricity, while households who are accustomed to pro-environmental routines are likely to do so. These demonstrate the existence of internal gaps between their pro-environmental intention and the acts, suggesting that electricity subsidies reform and program should be considered along with the way how intention-act gaps can be mitigated at household levels for energy saving.

Keywords: electricity-saving behaviors, pro-environmental, subsidies.

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1. Introduction

Inefficient use of electricity and over-dependence on non-renewable electricity sources such as coal are the reasons why climate change and limited stock of non-renewable resources become crucial issues. These issues are closely related to Sustainable Development Goals (SDGs) especially goal no. 7: affordable and clean energy, and goal no. 13: climate action. Along with an increase in population and economic growth, the electricity demand also increases. Figure 1 depicts average annual growth in per-capita electricity consumption in South East Asia in which Indonesia's per-capita electricity consumption is almost similar to the average of overall ASEAN's.

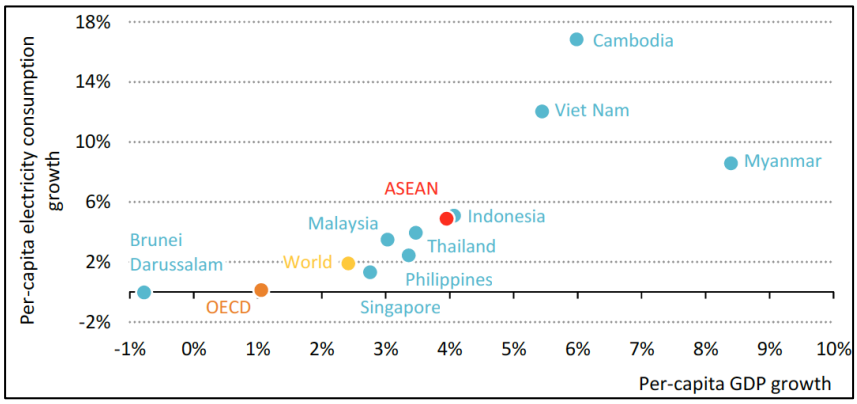

Figure 1. Average annual growth in per-capita electricity consumption in South East Asia, 2000-2015 (IEA, 2017)

In Indonesia's context, the need for an additional power plant with 4.1 gigawatts (GW) of capacity per year until 2030 is projected, in which 50% of the capacity is produced by the coal power plant (International Energy Agency, 2017). This projection indicates that consumption will still rise with the increase in population. Also, the household sector stands in the first position as the final energy consumer in Indonesia, with 42.33% comes from electricity consumption as can be seen in figure 2 (Ministry of Energy and Mineral Resources Republic of Indonesia, 2018). In terms of electricity consumption per capita, Indonesia is relatively low at approximately 1,048 kWh/capita in 2018 or equal to a quarter of the world average (International Energy Agency, 2017). Besides, Indonesia's electricity is predominantly fossil-fuel-based, with 50% from coal, 29% from natural gas and 7% come from oil. Accumulation of renewable sources such as hydro, geothermal, and so on shared 14%, as shown in figure 3. Coal-based power plants, which are the majority in Indonesia, are one of the largest contributors to CO_2 emissions. Institute for Essential Services Reform (IESR) states that Indonesia experiences significant growth of CO_2 emissions for approximately 18% throughout 2012-2017 (IESR, 2019). This becomes a challenge for Indonesia in achieving SDGs.

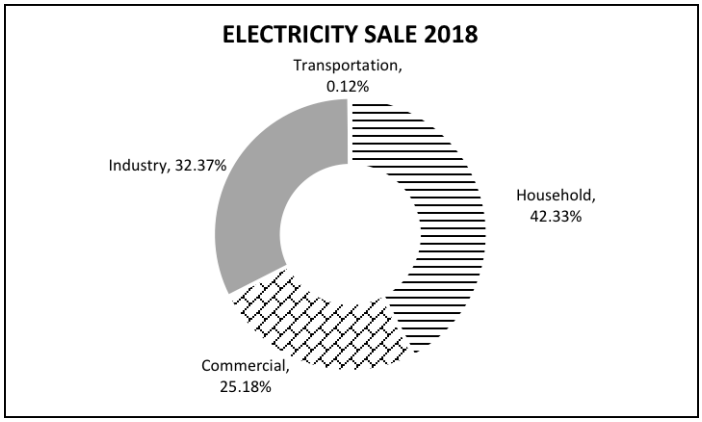

Figure 2. Electricity Sale 2018 (HEESI, 2018)

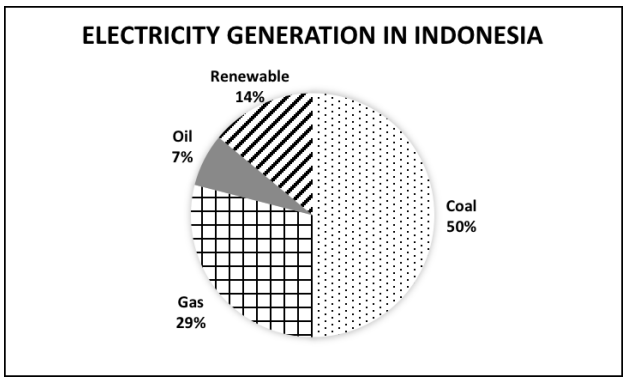

Figure 3. Electricity Generation in Indonesia 2018 (HEESI, 2018)

The government set the electricity prices and delegate *Perusahaan Listrik Negara* (PLN) as a government-owned corporation to distribute electricity throughout Indonesia. For the households sector, the costs are divided into several consumer groups based on the capacity installed in their house. Especially for residences with connections of 450 VA and 900 VA, they will face an increasing block tariff structure. The electricity tariff subsidies for households are given by setting the price below the cost of supplying electricity. The difference will be covered by tax and will be given to PLN. Assisting the poor, increasing industrial competitiveness, and stabilizing prices become the main objectives of the subsidies (Burke & Kurniawati, 2018). However, this policy brings a heavy burden on the financial side of the government. In 2012, the annual electricity subsidies boomed to approximately 103.3 trillion IDR, as shown in figure 4. Moreover, the biggest problem of these electricity subsidies is in the distribution, which is not on the right target. From 2015 to 2017, for instance, the government gives subsidies to households with an electricity capacity installed of 450 VA and 900 VA without considering their level of income. As a result, many non-poor homes receive subsidies. PLN states that in 2016, 18.7 million out of 22.7 million consumers with connections of 900 VA come from wealthy families.

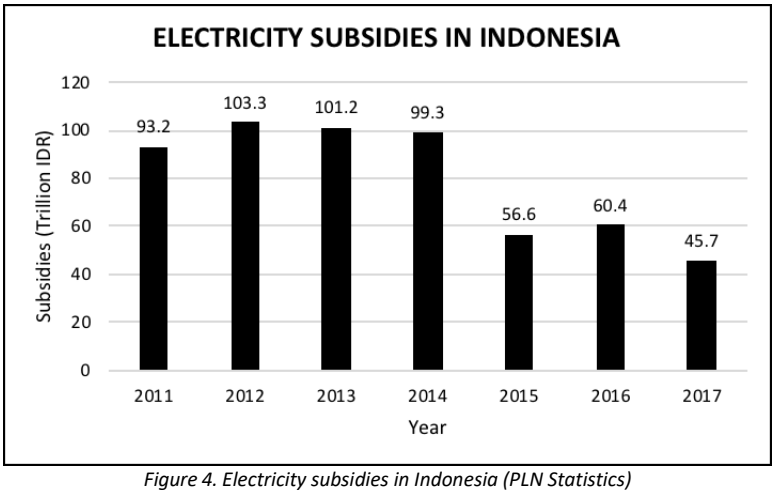

Figure 4. Electricity subsidies in Indonesia (PLN Statistics)

Along with the subsidies reform policies, the government also promotes a campaign called “cut 10%” to encourage people to cut their electricity consumption by 10% by implementing electricity-saving behaviors such as turning off lights when unused and using a timer when using air-con. 10% is reasonable since this percentage is the amount that can be saved without having to spend more investment like purchasing energy-saving appliances. The government simulates that the savings of 10% for the next three years are equal to the development of a new electric steam power plant. Additionally, it can also electrify about 2.5 million families in all villages in 6 provinces in Eastern Indonesia, which is equivalent to 10 million people. This campaign is expected to make people aware that not only financial benefits will be obtained, but also a positive impact on the environment. It contributes to reducing CO_2 emission resulting from fossil-fuel based power plant (SDGs no. 7 and 13).

Consequently, the implementation of energy efficiency and energy saving, especially in terms of electricity consumption in households, are essential to face the SDGs issues since resident behaviors play an indispensable role. Households can lower their energy consumption by adopting energy-saving behaviors. Energy-saving is more about a change in consumer behaviors that leads to energy savings without investing in new technologies (Oikonomou, Becchis, Steg, and Russolillo, 2009). Studies show that energy-saving routines are affected by internal factors such as environmental concern, and external factors such as government policies.

In Indonesia, the government gives electricity subsidies to particular households. It means that a subsidized household experiences lower price and have a disincentive to save electricity. Furthermore, there is also a gap between their environmental consciousness and environmental acts that can also affect the behaviors. Nusrat Afroz & Zul Ilham (2020), for instance, perform a study to investigate the awareness level of University of Malaya students towards SDGs and find that there is a negative correlation between student's knowledge and practice level. Jamaludin et al. (2020) show that there is also a gap in interpretation that indicates the need for more intellectual activities that covers information on the development, technologies, and benefit of renewable energy. Therefore, it is crucial to understand the right policy and factors that can influence the responses of the household. Then, hypotheses could be taken that government subsidies policy lower electricity-saving habits and pro-environmental gap also matter.

This research tries to complete the previous study by using 187.000 household data from the National Socioeconomic Survey of Indonesia 2017. Furthermore, most of the studies have a similar objective, which is to examine the determinants that influence energy-saving behaviors in general. Therefore, to fill the gap between previous studies, this study only focuses on the impact of electricity subsidies and the pro-environmental gap on the behaviors of the household. The other variables or factors such as socio-demographic and dwelling characteristics will be treated as control variables. Moreover, this study only concentrates on daily electricity-saving behavior, not on the transformation to renewable energy. This paper will utilize logistic regression (LOGIT) to analyze the relationships among variables which will be explained in more detail in the methodology section.

2. Literature Review

Previous studies examine the relationship of sociodemographic characteristics on energy-saving behaviors. A study conducted by Schleich, Mills, and Dütschke (2014) in Germany shows that younger people tend to save energy more for environmental reasons while older people tend to do so for financial reasons. Yang, Zhang, and Zhao (2016), who researched Hefei, China, found that the energy-saving level of married people is significantly higher than that of unmarried people. Besides, women's daily energy-saving behaviors level and their intention to invest in energy efficiency are considerably higher than those of males. Trotta (2018), using British household data, also shows that low-income households tend to implement energy-saving behaviors more through daily activities compared to the medium and high-income, while the level of education is not a significant factor that influences energy-saving actions. It contradicts Yue, Long, and Chen (2013) which find that educational background is an essential factor affecting energy-saving behaviors in Jiangsu Province, China. In general, studies show that sociodemographic aspects have a significant association with energy-saving practices.

Some researchers take into account environmental aspects to investigate their significance in terms of energy-saving behaviors. Hori, Kondo, Nogata, and Ben (2013), in their comparison of five major cities in Asia, shows that global warming consciousness, environmental behaviors, and social interaction significantly influence energy-saving practices. Sardianou (2007) estimates determinants influencing energy-saving behaviors in Greece and founds those energy-saver consumers have keen environmental consciousness of energy problems. Another study by Ding, Wang, Liu, and Long (2017) in Jiangsu, China, reveals that a sense of responsibility for the environment becomes the main factor that supports daily energy-saving. However, Ohler and Billger (2014), who compare the influence of self and social interest on electricity consumption, show different findings where self-interests have a higher impact on energy-saving behaviors and electricity use regardless of an individual's environmental concern.

Dwelling factors have to be taken into account since there is a lot of research that wants to measure their significance in terms of energy-saving behavior. These features include the kind of homeownership, size of the house, number of rooms, the source of lighting, the capacity of electricity installed, and electrical appliances owned by households. J. Walsh (1989) through his survey, found that conservation engagements are less likely to be implemented by those who rent a house since their

expectations are relatively low due to a shorter contract in their dwellings. Another significant result that is obtained by Barr et al. (2005) showed that based on a database of 1265 household in Devon, those who own the house tend to have more awareness in terms of energy-saving behavior compared to the renters. More recently, Trotta (2018) explained that the type of house that a household lives in becomes a significant determinant of energy-saving measures and the investment in energy-efficient retrofits. Those who live in a flat seem to be more possible to implement energy-saving behavior through daily activities. Moreover, previous studies also show that home specification matters in influencing energy-saving behavior. Households who live in large dwellings, as approached by the number of rooms and floors, consume more energy than those who live in a smaller house (Ritchie, Mcdougall, Claxton, Mcdougall, & Claxton, 1981). Walsh (1989) supported this argument and found that the older and larger the dwelling is, a household has a higher probability to implement energy conservation actions. Uidhir, Rogan, Collins, Curtis, & Gallachóir (2020) show that alternative retrofit choices have a positive impact on energy efficiency.

External factors such as government policy also become one of the variables of interest. Hong, She, Wang, and Dora (2019) observe the impact of subsidies incentive policy for energy-saving products on the energy-saving behaviors of residents in China and shows that the policy has a positive effect on the actions. Zhao, Cheng, Zhao, Jiang, and Xue (2019) finds that the price of energy-saving products is a matter for farmers. Still, in China, Liu and Lin (2020) reveal that the implementation of increasing-block electricity pricing encourages household electricity-saving at a particular level. Nakano et al. (2018) try to explore factors influencing willingness to purchase LED lighting in Indonesia. They expose that information about the national energy efficiency labeling program shows a positive impact on the purchasing decision. This research describes that government intervention could influence the behaviors of households.

Even though a lot of studies have been done, the findings are varied. This diversity probably happens because of the different characteristics between locations, and sample-sized used might not be enough to represent the region. Some researchers explicitly state that they have limitations in terms of sample size that are too small and not enough to describe the region, and they realize that a larger sample size will give better results (S. Wang et al., 2018; Ru, Wang, & Yan, 2018; Zhang, Yu, Wang, & Wei, 2018; Erell, Portnov, & Assif, 2018; Mizobuchi & Takeuchi, 2013). Moreover, many studies use primary data from hundreds number of respondents (Ohler & Billger, 2014; Vogiatzi et al., 2018; Sardianou, 2007; Webb, Soutar, Mazzarol, & Saldaris, 2013; Z. Wang, Zhang, Yin, & Zhang, 2011; S. Wang, Lin, & Li, 2018).

3. Data and Methodology

To investigate the impact of electricity subsidies and the environmental gap on the electricity-saving behaviors of households, this study employs binary logistic regression (LOGIT). The following basic specification is used:

$$Logit(R) = \frac{1}{1+e^{-z}}; z = \beta_0 + \sum_{i=1}^{n} \beta_1 subsidy_i + \beta_2 env\ gap_i + \beta_3 x_i' + \varepsilon_i \quad (1)$$

Where z is latent measures of household commitment in electricity-saving, β is the vector of parameters to be estimated, $subsidy_i$ is a dummy variable for subsidized household, $env\ gap_i$ is variable of household's environmental gap, x_i' refers to sociodemographic and dwelling characteristics, which are introduced as control variables for household *i* and ε is the error term. Then, the marginal effect of a change in the explanatory variable on the expected value of the dependent variable is calculated. The marginal effect will be interpreted as a percentage, not as a percentage point.

Logit regression is employed since the dependent variable is the binary type, where "1" equals 100% implement electricity-saving behaviors, and "0" equals not 100% implement electricity-saving behaviors. Besides, logit is relevant to be utilized in maximizing utility case. Wang et al. (2011) explain that people's commitment to electricity-saving principally depends on the expected utility from their saving habit. Previous studies such as Fiorillo & Sapio (2019), Wang et al. (2011), Nakano et al. (2018), and Umit, Poortinga, Jokinen, and Pohjolainen (2019) also employ logistic regression to observe energy-saving behaviors. Hopefully, this method could answer the research question well

This study utilizes the data from the National Socioeconomic Survey of Indonesia (SUSENAS) year of 2017. SUSANA'S is a regular survey conducted by the Central Bureau of the Statistics Republic of Indonesia (BPS) to obtain information related to socio-economic aspects. In detail, this survey captures data and information in various areas such as education, criminality, employment, health, family planning, housing, environment, household consumption, etc. SUSANA'S 2017 dataset is matched with the needs

of this study since it contains specific information related to the behaviors of households in consuming energy. This kind of information does not exist in other SUSENAS survey. Furthermore, the data consists of 187,790 households who have electricity connections in their homes. By considering that an increase in population is accompanied by an increase in electricity consumption, the 2017 data is quite relevant to current conditions.

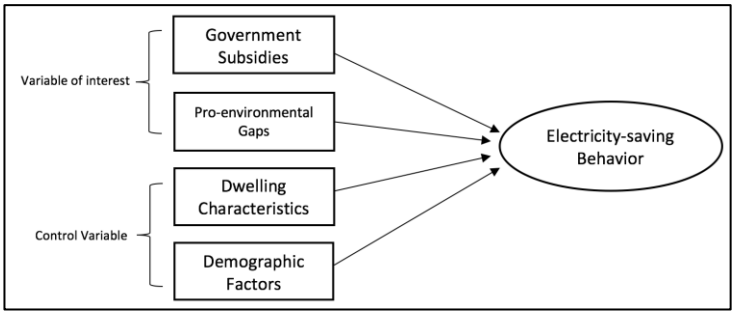

Figure 5. Method diagram for electricity-saving behavior

The overview of the methodology of this study can be seen in figure 5. This study will focus on habitual energy-saving behaviors, specifically, the electricity-saving habit of a household since one of the approaches of energy-saving actions is habitual energy-saving behaviors (B. Wang, Wang, Guo, Zhang, & Wang, 2018). Besides, habitual energy-saving is more easily adopted since such activity requires a little cost. To represent a household's electricity-saving behaviors as a dependent variable, this study selects information from SUSENAS whether or not a family turns off electrical appliances when unused. This type of action is also used in previous studies such as Zhang et al. (2018), Hori et al., (2013), Yue et al. (2013), and Sardianou (2007).

Financial factors have an essential role in determining consumer behaviors. Hence, this study takes into account electricity subsidies as the variable of interest as shown in figure 5. Electricity subsidies are expected to affect the electricity-saving behaviors of households due to differences in electricity rates. In this study, subsidized families are categorized based on the requirement from the government, namely those who have 450 VA and 900 VA of electricity capacity installed. From the result of the grouping, it appears that 79% of households receive electricity subsidies.

Another variable of interest in this study is the household's pro-environmental gap. There is frequently a sizeable inconsistency between people's intentions and observable behaviors in the environmental aspect. Sheeran and Webb (2016) explain this inconsistency as the intention-behavior gap. In the environmental context, some people have good pro-environmental intentions but do not implement them as a real habit or vice versa. To measure the environmental intentions and acts, household heads were being asked for their opinion about some environmental statements and behaviors followed by a Likert-type scale of 1-4, as shown in table 1 and table 2. Then, the environmental gap is calculated by subtracting the total value of the intentions and acts. As the gap increases, the level of pro-environmental intention is higher but not accompanied by the rise in pro-environmental behaviors.

Table 1: Pro-environmental intentions.

No	Statements*
1	Households need to provide water absorption areas
2	Not burning garbage can reduce air pollution
3	Households need to do waste separation before disposed
4	Households need to bring their shopping bag when shopping
5	Prefer to use mass transport compared to private vehicle
6	Motor vehicle engines need to be regularly maintained
7	Households need to grow plants at home
8	Households need to participate in environmental community service in the neighborhood

**) 1=Disagree, 2=Partially Agree, 3=Agree, 4=Totally Agree*

Table 2: Pro-environmental Acts

No	Questions*
1	Does the household provide water absorption areas?
2	Does the household not burn trash?
3	Does the household do waste sorting before disposed of?
4	Does the household bring their shopping bag when shopping?

5	Does the household prefer to use mass transport compared to the private vehicle?
6	Does the household regularly maintain motor vehicle engines?
7	Does the household grow plants at home?
8	Does the household participate in environmental community service in the neighborhood?

**) 1=Never, 2=Sometimes, 3=Often, 4=Always*

Furthermore, sociodemographic characteristics and dwelling features are included in the estimation as control variables as shown in figure 5. In detail, table 3 shows the variables included in the model and the summary statistics. The household sizes range from 1 to 22, with an average of one family having four members. They all live in urban and rural areas with a ratio of almost 50:50. Approximately 81% of them own their house while the rest do not. The average age of household heads is 47.6, and concerning education level, most of them are educated up to high school level for approximately 89 %. Moreover, regarding dwelling characteristics, table 3 shows that the size of the house is varied among households with an average of 86.13 m^2. Each family has about 1 to 2 types of essential electrical appliances in their home on average. Moreover, the number of rooms in their house also varied with around seven rooms on average.

Table 3: Variables included in the analysis: summary statistics

	Average	SD	Min	Max
Dependent Variables				
Electricity-saving Behaviors (1= 100% electricity-saving; 0= otherwise)	0.65	0.48	0	1
Independent Variables				
Electricity Subsidies (1=subsidized household; 0=unsubsidized household)	0.80	0.40	0	1
Pro-environmental intentions	22.82	2.80	8	32
Pro-environmental acts	17.33	3.38	8	32
Pro-environmental gap	5.50	3.70	-21	22
Household Size	3.98	1.62	1	22
Marital Status (1=married ; 0=single)	0.85	0.36	0	1
Age	47.57	12.36	18	97
Gender (1=Male, 1=Female)	0.89	0.32	0	1
Education level (1= above high school; 0=high school and below)	0.11	0.31	0	1
Poor (1= poor; 0=non poor)	0.12	0.33	0	1
Monthly Expenditure (logarithmic)	15.09	0.64	12.23	18.58
Household location (1=urban ; 0=rural)	0.51	0.50	0	1
Ownership Status (1= Owned; 0=Not Owned)	0.81	0.39	0	1
Size of House (m^2)	86.13	62.17	3	997
Number of Room	6.79	2.28	1	26
Number of types of electrical appliances	1.23	1.21	0	6

4. Results and Discussions

This study runs logistic regression and calculates the marginal effect of each variable to analyze the more profound correlation between variables and electricity-saving behavior. Four models are developed to strengthen the analysis. In the first model, only the variables of electricity subsidies and environmental gaps are included in the specification to examine the result without controlling sociodemographic and dwelling characteristics. This study then includes sociodemographic and dwelling characteristics in models 2, 3, and 4, as seen in table 4.

Table 4: Marginal effects of estimated parameters

Variable	Model 1	Model 2	Model 3	Model 4
Electricity Subsidies	-0.037***	-0.060***	-0.061***	-0.061***
	(0.003)	(0.003)	(0.003)	(0.003)
Pro-environmental intentions		-0.002***		
		(0.000)		
Pro-environmental acts			0.002***	
			(0.000)	
Pro-environmental gap	-0.002***			-0.003***
	(0.000)			(0.000)
Household Size		-0.009***	-0.009***	-0.009***
		(0.001)	(0.001)	(0.001)
Marital Status		-0.004	-0.006	-0.006
		(0.005)	(0.005)	(0.005)

Age	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)
Gender	-0.008	-0.008	-0.008
	(0.005)	(0.005)	(0.005)
Education level	0.044***	0.042***	0.042***
	(0.004)	(0.004)	(0.004)
Poor	0.009**	0.009**	0.009**
	(0.003)	(0.003)	(0.003)
Monthly Expenditure (logarithmic)	-0.041***	-0.041***	-0.041***
	(0.002)	(0.002)	(0.002)
Household location	0.020***	0.020***	0.021***
	(0.002)	(0.002)	(0.002)
Ownership Status	-0.024***	-0.025***	-0.025***
	(0.003)	(0.003)	(0.003)
Size of House	-1.5×10^{-6}	-2.63×10^{-6}	-3.42×10^{-6}
	(0.000)	(0.000)	(0.000)
Number of Room	-0.007***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)
Types of electrical appliances	-0.005***	-0.006***	-0.006**
	(0.001)	(0.001)	(0.001)

**significant at the 10%; **significant at the 5% level; ***significant at the 1% level*

As can be seen in Table 4, the relationship between electricity subsidies and electricity-saving habit is significant in model 1. Moreover, the pro-environmental gap shows a meaningful and negative connection to the electricity-saving behaviors of households. In other words, the increasing gap leads to a decreasing probability of saving electricity. However, we cannot directly conclude since confounders are not included. This model could be suffered from omitted variable bias.

After controlling sociodemographic and dwelling characteristics, the results reveal that unsubsidized families tend to have electricity-saving behaviors more than subsidized ones. This consistent with the hypothesis that subsidized households have a disincentive to save electricity since they experience a lower price. Mizobuchi and Takeuchi (2013) state that electricity-saving behaviors are not only about public goods such as being pro-environmental but also of private goods, such as saving money. Therefore, by doing electricity-saving, unsubsidized households can save or allocate funds for other needs. The results also show that electricity subsidies have the highest marginal effect on the behaviors, which means that financial factors become the most electricity-saving drivers compared to the other elements. This finding matches with Jia, Xu, Fan, & Ji, (2018) which explain that financial incentives are the most crucial determinant encouraging the public to apply energy-saving measures in daily life.

For the household environmental aspect, this study involves the variable of pro-environmental intentions, acts, and the gap in the separated model. In model 2, the regression result shows that higher pro-environmental intentions do not always make individuals save electricity. Unlike pro-environmental intentions, the pro-environmental acts variable shows a different relationship with electricity-saving behaviors. Families with higher pro-environmental intentions are not necessarily likely to save electricity, while households with pro-environmental routines are likely to do so.

The contradictive result between pro-environmental intentions and acts become interesting findings. Therefore, this study further examines the environmental aspect by observing the intention-behaviors gap. Model 4 shows that the household pro-environmental gap is negatively significant in correlating electricity-saving behaviors. It means that if families have more pro-environmental intentions but do not fully implement them as daily routines, they are less likely to have the electricity-saving behaviors. This finding is interesting since the intention-behaviors gap is a phenomenon that is recognized by many researchers. Frederiks, Stenner, and Hobman (2015) realize that even if people receive sufficient knowledge of how to save energy and proclaim the desire to perform it, many consumers still fail to implement as real acts. . Therefore, this study believes that to intensify electricity-saving routines, the households' pro-environmental gap should be minimized.

There are some possibilities for why intention-behavior gaps exist. Blake (1999) explains that individuality, responsibility, and practicality become the barrier to do pro-environmental actions. Practicality constraints such as lack of time, lack of money, and lack of information; for example, could encourage people not to act environmentally friendly regardless of their intentions. However, most researchers realize that the intention-behavior gap is a complex issue; therefore, it is recommended to observe this issue in a future study.

As expected before, financial incentives play a crucial role in influencing consumers' behaviors. The empirical results reveal that an electricity subsidies policy for particular households reduces the

electricity-saving habit. This reaction makes sense since subsidized homes receive lower tariffs compared to unsubsidized ones. Moreover, an interesting finding is obtained in terms of non-financial considerations, where families with higher pro-environmental intentions are not necessarily likely to save electricity due to the existence of intention-behavior gaps. The increasing gap leads to diminishing electricity-saving practices of households. This study demonstrates that the intention-behavior gaps also exist in pro-environmental terms, and interestingly correlates with electricity-saving habit. Besides, this finding significantly contributes to research on the energy-saving issue since there are not many researchers who specifically address the pro-environmental gaps in electricity-saving behaviors.

Further policy measures could be implemented with the factors examined above taken into account. Firstly, subsidies reform should be carried out gradually. The study, which is also supported by previous research, shows that financial aspects mostly encourage consumers to change their behaviors in consuming energy. Furthermore, policymakers should not only focus on increasing knowledge and awareness concerning pro-environmental behaviors but also try to make sure people will manifest into real acts. The government can take advantage of technological developments to solve this problem. One way is to build a comprehensive system to monitor the behaviors of the consumers. This kind of system enables consumers to measure their behaviors when consuming electricity. Indeed, policymakers should first pay attention to factors that could influence the inconsistency between the intentions and acts such as social norms, cost and benefit, and previous experience with the environmental problem, and this important for them to examine in further research.

5. Conclusions

The relationship between electricity subsidies and pro-environmental factors of household in electricity-saving become the main focus of this research. It is hypothesized that electricity subsidies correlate with electricity-saving habit since those who receive subsidies pay the lower price. Besides, the discrepancy between pro-environmental intentions and acts may influence the behaviors of the households. Previous studies reveal that sociodemographic, dwellings, environmental aspects, and government policies affect the behaviors of families in consuming electricity. Then, to analyze the hypotheses, logit regression is applied by using Indonesian household microdata.

This study noted that electricity subsidies are the primary driver to discourage households from doing do electricity-saving routines. After controlling sociodemographic and dwelling characteristics, subsidized homes are less likely to save electricity compared to unsubsidized ones. Since the subsidized families experience a lower price, they have a disincentive to save the electricity in their home, and this is in line with the hypotheses. On the other hand, unsubsidized families can save or allocate money for different needs by applying electricity-saving. Therefore, the government should conduct subsidies reform gradually. The expected response of this reform is a behavioral change in consuming electricity, such as reducing air conditioning usage, turning off electrical appliances when unused, and shifting to use more energy-efficient appliances. Furthermore, these behavioral changes are expected to make a positive contribution to reducing CO_2 emissions to support SGDs. However, since there are a few substitutes for electricity sources in Indonesia, a gradual reduction in electricity subsidies is recommended instead of eliminating the subsidies.

An interesting finding is obtained when examining the correlation of the pro-environmental gap on electricity-saving routines. The pro-environmental gap is negative and significant, associating the electricity-saving behaviors of households. It means that increasing differences between intention and real acts leads to decreasing the probability of families saving electricity. Moreover, the intention-behaviors gap shows that what individuals proclaim and what they do are two different things. This discrepancy explains why education programs and government campaigns about pro-environmental habits and SGDs often fail to induce a behavioral change of the consumers. Consequently, to reduce the pro-environmental gap, policymakers should not only focus on increasing pro-environmental knowledge and awareness but also try to make sure that the people fully translate the intentions as habits. The government could develop a comprehensive system as a new approach to monitor the behaviors of the consumers. However, policymakers should firstly examine factors that affect the inconsistency between the intentions and acts.

Overall, by paying attention to financial incentives and the gap between intentions and actual behavior in society, the policymakers are expected to be able to implement appropriate policies to support electricity-saving behaviors that have a direct impact on the achievement of the SDGs as well. Moreover, the current pandemic condition also allows changes in household behavior in consuming

electricity. Therefore, future research could focus on observing determinants influencing the pro-environmental gaps such as social norms, sociodemographic, and cost-benefit. Besides, the relationship between the pandemic situation and the behavior of the household could be also an interesting study in the future.

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References

Barr, S., Gilg, A. W., & Ford, N. (2005). The household energy gap: examining the divide between habitual- and purchase-related conservation behaviors. *Energy Policy*, *33*(11), 1425–1444. https://doi.org/10.1016/J.ENPOL.2003.12.016

Blake, J. (1999). Overcoming the "value-action gap" in environmental policy: Tensions between national policy and local experience. *Local Environment*, *4*(3), 257–278. https://doi.org/10.1080/13549839908725599

Burke, P. J., & Kurniawati, S. (2018). Electricity subsidy reform in Indonesia: Demand-side effects on electricity use. *Energy Policy*, *116*(June 2017), 410–421. https://doi.org/10.1016/j.enpol.2018.02.018

Ding, Z., Wang, G., Liu, Z., & Long, R. (2017). Research on differences in the factors influencing the energy-saving behavior of urban and rural residents in China–A case study of Jiangsu Province. *Energy Policy*, *100*(September 2016), 252–259. https://doi.org/10.1016/j.enpol.2016.10.013

Erell, E., Portnov, B. A., & Assif, M. (2018). Modifying behaviour to save energy at home is harder than we think…. *Energy and Buildings*, *179*, 384–398. https://doi.org/10.1016/j.enbuild.2018.09.010

Fiorillo, D., & Sapio, A. (2019). Energy saving in Italy in the late 1990s: Which role for non-monetary motivations? *Ecological Economics*, *165*(August 2018), 106386. https://doi.org/10.1016/j.ecolecon.2019.106386

Frederiks, E. R., Stenner, K., & Hobman, E. V. (2015). Household energy use : Applying behavioural economics to understand consumer decision-making and behaviour. *Renewable and Sustainable Energy Reviews*, *41*, 1385–1394. https://doi.org/10.1016/j.rser.2014.09.026

Hong, J., She, Y., Wang, S., & Dora, M. (2019). Impact of psychological factors on energy-saving behavior : Moderating role of government subsidy policy. *Journal of Cleaner Production*, *232*, 154–162. https://doi.org/10.1016/j.jclepro.2019.05.321

Hori, S., Kondo, K., Nogata, D., & Ben, H. (2013). The determinants of household energy-saving behavior : Survey and comparison in five major Asian cities. *Energy Policy*, *52*, 354–362. https://doi.org/10.1016/j.enpol.2012.09.043

IESR. (2019). Brown to Green: Transisi G20 Menuju Ekonomi Rendah Karbon, *53*(9), 1689–1699.

International Energy Agency. (2017). *Energy Efficiency 2017*.

J. Walsh, M. (1989). *Energy tax credits and housing improvement*. *Energy Economics* (Vol. 11). https://doi.org/10.1016/0140-9883(89)90043-1

Jamaludin. (2020). Understanding Perception and Interpretation of Malaysian University Students on Renewable Energy. *Aims Energy*, *8*, 6.

Jia, J. J., Xu, J. H., Fan, Y., & Ji, Q. (2018). Willingness to accept energy-saving measures and adoption barriers in the residential sector: An empirical analysis in Beijing, China. *Renewable and Sustainable Energy Reviews*, *95*(July), 56–73. https://doi.org/10.1016/j.rser.2018.07.015

Liu, C., & Lin, B. (2020). Is increasing-block electricity pricing effectively carried out in China ? A case study in Shanghai and Shenzhen. *Energy Policy*, *138*(April 2017), 111278. https://doi.org/10.1016/j.enpol.2020.111278

Ministry of Energy and Mineral Resources Republic of Indonesia. (2018). *Handbook of Energy and Economic Statistics of Indonesia*. Jakarta. Retrieved from https://www.esdm.go.id/assets/media/content/content-handbook-of-energy-and-economic-statistics-of-indonesia.pdf

Mizobuchi, K., & Takeuchi, K. (2013). The influences of financial and non-financial factors on energy-saving behaviour: A field experiment in Japan. *Energy Policy*, *63*, 775–787. https://doi.org/10.1016/j.enpol.2013.08.064

Nakano, R., Zusman, E., Nugroho, S., Kaswanto, R. L., Arifin, N., Munandar, A., … Fujita, T. (2018). Determinants of energy savings in Indonesia: The case of LED lighting in Bogor. *Sustainable Cities and Society*, *42*(May), 184–193. https://doi.org/10.1016/j.scs.2018.06.025

Nusrat Afroz, & Zul Ilham. (2020). Assessment of Knowledge, Attitude and Practice of University Students towards Sustainable Development Goals (SDGs). *The Journal of Indonesia Sustainable Development Planning*, *1*(1), 31–44. https://doi.org/10.46456/jisdep.v1i1.12

Ohler, A. M., & Billger, S. M. (2014). Does environmental concern change the tragedy of the commons? Factors affecting energy saving behaviors and electricity usage. *Ecological Economics*, *107*, 1–12. https://doi.org/10.1016/j.ecolecon.2014.07.031

Oikonomou, V., Becchis, F., Steg, L., & Russolillo, D. (2009). Energy saving and energy efficiency concepts for policy making. *Energy Policy*, *37*(11), 4787–4796. https://doi.org/10.1016/J.ENPOL.2009.06.035

Ritchie, J. R. B., Mcdougall, G. H. G., Claxton, J. D., Mcdougall, G. H. G., & Claxton, J. D. (1981). Complexities of Household Energy Consumption and Conservation Linked references are available on JSTOR for this article : Complexities of Household Energy Consumption and Conservation. *Journal of Consumer Research*, *8*(3), 233–242.

Ru, X., Wang, S., & Yan, S. (2018). Exploring the effects of normative factors and perceived behavioral control on individual's energy-saving intention: An empirical study in eastern China. *Resources, Conservation and Recycling*, *134*(96), 91–99. https://doi.org/10.1016/j.resconrec.2018.03.001

Sardianou, E. (2007). Estimating energy conservation patterns of Greek households. *Energy Policy*, *35*(February 2003), 3778–3791. https://doi.org/10.1016/j.enpol.2007.01.020

Schleich, J., Mills, B., & Dütschke, E. (2014). A brighter future? Quantifying the rebound effect in energy efficient lighting. *Energy Policy*, *72*, 35–42. https://doi.org/10.1016/j.enpol.2014.04.028

Sheeran, P., & Webb, T. L. (2016). The Intention–Behavior Gap. *Social and Personality Psychology Compass*, *10*(9), 503–518. https://doi.org/10.1111/spc3.12265

Trotta, G. (2018). Factors affecting energy-saving behaviours and energy efficiency investments in British households, *114*(December 2017), 529–539. https://doi.org/10.1016/j.enpol.2017.12.042

Uidhir, T. Mac, Rogan, F., Collins, M., Curtis, J., & Gallachóir, B. P. Ó. (2020). Improving energy savings from a residential retrofit policy: A new model to inform better retrofit decisions. *Energy and Buildings*, *209*. https://doi.org/10.1016/j.enbuild.2019.109656

Umit, R., Poortinga, W., Jokinen, P., & Pohjolainen, P. (2019). The role of income in energy efficiency and curtailment behaviours: Findings from 22 European countries. *Energy Research and Social Science*, *53*(August 2018), 206–214. https://doi.org/10.1016/j.erss.2019.02.025

Vogiatzi, C., Gemenetzi, G., Massou, L., Poulopoulos, S., Papaefthimiou, S., & Zervas, E. (2018). Energy use and saving in residential sector and occupant behavior: A case study in Athens. *Energy and Buildings*, *181*(2018), 1–9. https://doi.org/10.1016/j.enbuild.2018.09.039

Wang, B., Wang, X., Guo, D., Zhang, B., & Wang, Z. (2018). Analysis of factors influencing residents' habitual energy-saving behaviour based on NAM and TPB models: Egoism or altruism? *Energy Policy*, *116*(January), 68–77. https://doi.org/10.1016/j.enpol.2018.01.055

Wang, S., Lin, S., & Li, J. (2018). Exploring the e ff ects of non-cognitive and emotional factors on household electricity saving behavior. *Energy Policy*, *115*(32), 171–180. https://doi.org/10.1016/j.enpol.2018.01.012

Wang, Z., Zhang, B., Yin, J., & Zhang, Y. (2011). Determinants and policy implications for household electricity-saving behaviour: Evidence from Beijing, China. *Energy Policy*, *39*(6), 3550–3557. https://doi.org/10.1016/J.ENPOL.2011.03.055

Webb, D., Soutar, G. N., Mazzarol, T., & Saldaris, P. (2013). Self-determination theory and consumer behavioural change: Evidence fromahousehold energy-saving behaviour study. *Journal of Environmental Psychology*, *35*, 59–66. https://doi.org/10.1016/j.jenvp.2013.04.003

Yang, S., Zhang, Y., & Zhao, D. (2016). Who exhibits more energy-saving behavior in direct and indirect ways in china? The role of psychological factors and socio-demographics. *Energy Policy*, *93*, 196–205. https://doi.org/10.1016/j.enpol.2016.02.018

Yue, T., Long, R., & Chen, H. (2013). Factors in fl uencing energy-saving behavior of urban households in Jiangsu Province. *Energy Policy*, *62*, 665–675. https://doi.org/10.1016/j.enpol.2013.07.051

Zhang, C., Yu, B., Wang, J., & Wei, Y. (2018). Impact factors of household energy-saving behavior : An empirical study of Shandong Province in China. *Journal of Cleaner Production*, *185*, 285–298. https://doi.org/10.1016/j.jclepro.2018.02.303

Zhao, X., Cheng, H., Zhao, H., Jiang, L., & Xue, B. (2019). Survey on the households' energy-saving behaviors and influencing factors in the rural loess hilly region of China. *Journal of Cleaner Production*, *230*, 547–556. https://doi.org/10.1016/j.jclepro.2019.04.385

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Commentary

Expanding Middle Class in Indonesia

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1. Introduction

The Indonesian economy has been one of the promising economies, with an average annual economic growth of about 5% in the last decade. With income per capita US$ 4050 as of 2019, Indonesia is now moving to attain upper-middle-income country status. Indonesia escaped from the lower-middle-income trap that the country has faced since 1985 by improving its human capital through increased attention to education and reduction in poverty. Alongside a significant poverty reduction, the middle class or middle-income population has been significantly growing. According to the National Socio-Economic Survey (SUSENAS), the middle-class household grew from only 9% in 1993 to more than 20% in 2019. The middle class also works as an engine for growth, supporting nearly half of total national consumption. They are more likely of having better human capital, work as white-collar workers, and mostly living in urban areas. Due to the greater education and skills most of those in the middle class, have greater access to working in the formal sector jobs, and some are increasingly running productive business or entrepreneur which drives growth and creating jobs for others (Bank, 2019).

The size and characteristics of the middle class depend on how welfare is defined (D. S. Pratomo, 2020). Asian Development Bank, for example, characterized the middle class as comprising a population with daily per capita expenditure between $2-20 per day (Afif, 2014). World Bank (Bank, 2019) in their report "Aspiring Indonesia – Expanding the Middle Class" defined the middle class as those who have less than 10 percent probability of going into poverty and vulnerability in the following year (specifically whose per capita household consumption is around 3.5-17 times the poverty line). According to their estimates, using both the National Socio-Economic Survey (SUSENAS) and Indonesian Family Life Survey (IFLS), the middle class in Indonesia was between 16%-20%. This paper reviews some issues related to the potential growing number of middle-class jobs in Indonesia, related to education, youth unemployment, entrepreneurship, and digital competitiveness, and urbanization.

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2. Education and Youth Unemployment

The expansion of higher-level education (secondary and tertiary levels) has had an enormous impact on the growth of the middle class in Indonesia. Almost 80% of the middle class now complete at least senior high school, and about one-third continue to attend some tertiary levels of education (Bank, 2019). Nearly all those who have tertiary education are categorized also as a middle (and upper) class. Hence, expanding the middle-class group will require more individuals finishing senior secondary school that can prepare them with the skills needed. For many of them, this was also an entrance ticket into the formal work sector or permanent sector employment. There was a significant expansion of formal sector employment, particularly in services during the last decade which has accounted for a large share of jobs for tertiary education graduates (D. Pratomo & Manning, 2019).

Although universal education was increased from 9 years to 12 years, including senior secondary school, in 2016, the National Labor Force Survey (Sakernas) shows that the Indonesian workforce is still dominated by a lower level of education (D. S. Pratomo, 2020). In general, almost 60% of the total Indonesian labor force has an education equivalent to junior high school or below, while only 12% of the total labor force has a high tertiary education in 2019. However, the young age groups (20-29 years old) showed a significant positive trend of improving education rather than the total labor force. The World Bank (Bank, 2019) study also supported that the younger Indonesian cohort (up to 44 years old) mostly completes senior high school. However, from a regional comparison, there are very large differences in higher education completion levels between provinces. Some provinces in Indonesia, where the majority of the young labor force has at least a high school education, include DKI Jakarta, Yogyakarta, Riau Islands, North Sumatra, Bali, and Maluku (G. W. Jones & Pratomo, 2016).

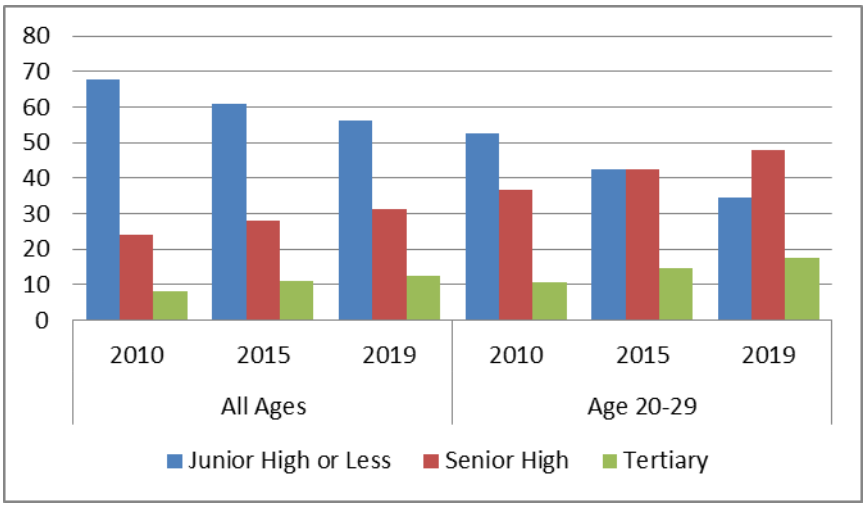

Figure 1. Education Attainment Among Labour Force (%), 2010, 2015, and 2019. Source: Sakernas.

The significant changes in the national budget policy in 2002, which requires a minimum of 20% of the national budget for education, is one of the triggers for the success in increasing the education levels of the young labor force. For more than a decade, the expansion of vocational education has also been a serious concern. The government expands vocational education at the Senior High School level (SMK) as one solution to the lack of technical middle-level employment. The number of SMK increased more than doubled (over 10,000), accounting for close to half of all Senior High School enrollments (Manning & Pratomo, 2018). Moreover, the expansion of tertiary education has been even more rapid than at the secondary level. Indonesia is now also becoming one the largest and fastest-growing tertiary education sectors, with more than 5 million students enrolled in about 3600 institutions which are mainly administered by the Ministry of Education and Culture and the Ministry of Religious Affairs (Hill & Wie, 2013).

Another challenge of higher education in Indonesia has been the high rates of unemployment among educated people compared with the total labor force. First, previous studies showed that there is a severe mismatch between education, particularly higher education, and the labor market. Allen (Allen, 2016) reported that only 40% of the employed workers in 2015 were well-matched with the educational requirement of their occupation, while more than 50% were under-qualified and about 8% were overqualified. Di Gropello (Gropello, 2013) also showed that about 80% of the manufacturing and services

sectors have difficulties to find the right person for their vacancy. This suggests the need for the education sector to increase the relevance of secondary and tertiary education to the needs of the labor market in terms of expanding the potential people with middle-class jobs.

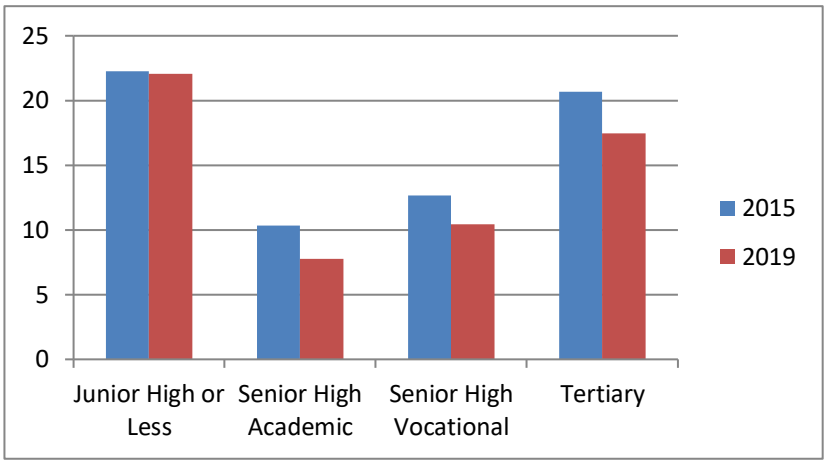

Figure 2. Youth Unemployment Rates by Education Attainment (%), 2015 and 2019. Source: Sakernas.

Second, some educated young people prefer and choose to wait until they get the right job, mostly the formal sector work (so-called educated choosy youth) (Devanto Shasta Pratomo, 2017). Research from Allen (Allen, 2016) has shown that one-third of unemployed young people must wait for one year to enter the labor market, especially to enter the formal sector labor market. The mindset that the formal sector is always better, making most of them are waiting for opportunities to work in the formal sector, rather than enter the informal sector or starting up their own business. This is also considering that those unemployed with higher education are usually coming from families with a good economic background (luxury unemployment).

3. Entrepreneurship and Digital Competitiveness

Entrepreneurship is often considered to be a significant driver of growth because of creating a new product or innovation and also creates jobs for others (D. S. Pratomo, 2020). The entrepreneurial skill development system for the new entrants as well as for those who are no longer in the formal education system is needed. World Bank (Bank, 2019) noted that the middle class represents nearly half of all business owners with permanent employees. Based on Sakernas, although most of the middle class are wage employment (80%), there is a significant growth of the middle-class entrepreneurs or self-employed (18%), providing an alternative of limited wage employment jobs. Hence, some policy recommendations related to starting-up or ease of doing business are importantly needed.

Kusumawardhani (Kusumawardhani, Suryadarma, Tiberti, & Indrio, 2019) found an interesting result about the skills needs by entrepreneurial success in Indonesia. They found that fluid intelligence (abilities that independent of education and experience) had sizeable and positive returns on business, while crystallized intelligence (problem-solving abilities influenced by their education, experience, or culture) had a positive and large effect only in sectors that required intense concentration or computers. The majority of household businesses in Indonesia tend to be labor-intensive that use low capital and simple technology, where high levels of crystallized intelligence would be of no significant advantage. Therefore, training programs might only be an effective tool to support the crystallized intelligence types in brain-intensive industries that require more innovation and higher technology. Developing industries with digital innovation orientation is one possible solution.

Compared to other countries, the digital competitiveness index of Indonesia is lagging behind some other countries in Asia. However, plenty of young and productive labor force during this demographic dividend period must be considered an opportunity, because the younger generation is the future generation that is more friendly to technological changes and digitalization. Digital technology has also been proven as a tool to expand middle-class jobs. Based on Sakernas 2019, about 78% of middle-class workers used digital technology in their work operation, mostly wage employment and self-employed.

Interestingly, female middle-class workers have higher utilization of digital technology compared to males workers, suggesting potential areas for female workers to be developed.

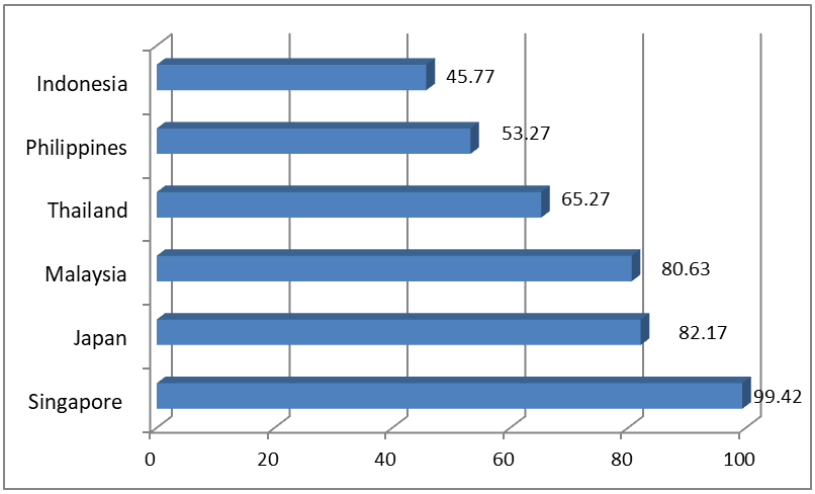

Figure 3. Digital Competitiveness Index in Some Asian Countries. Source: IMD World Competitiveness Centre.

Given the changing character of work, the competencies needed have also changed. Education or training policy must also be led towards providing a graduate that is friendly to digitalization. The involvement of the industry in the preparation of competency standards and educational curricula is mandatory. Completion of the educational curriculum, in addition to covering the composition of hard-skills and soft-skills, must also be introduced to digital skills. Besides, such as job training, apprenticeship, vocational education, and re-training of active workers will also be important.

4. Urbanization

Indonesia has achieved a major milestone by increasing the percentage of the population living in urban areas by more than 50% in 2015. The number is expected to keep increasing, making the majority of Indonesia's population never again live in rural areas (G. Jones & Mulyana, 2015). Three possible elements contribute to the increasing proportion of the urban population (so-called urbanization) including natural population growth, reclassification of local status from rural to urban, and rural-urban migration. Unlike China and India, World Bank (Bank, 2018) reported that rather than migration, in Indonesia the process of urbanization is driven largely by the reclassification into the urban status of areas previously classified as rural (43%). This is then followed by natural population growth (38%). The significant numbers of area reclassifications in Indonesia are consistent with the decentralization policy in Indonesia that had been begun in 1999, growing many localities outside the cities. In contrast, most of the urbanization in China has been driven by rural-urban migration (56%), while natural population growth had contributed significantly to urbanization in India (44%).

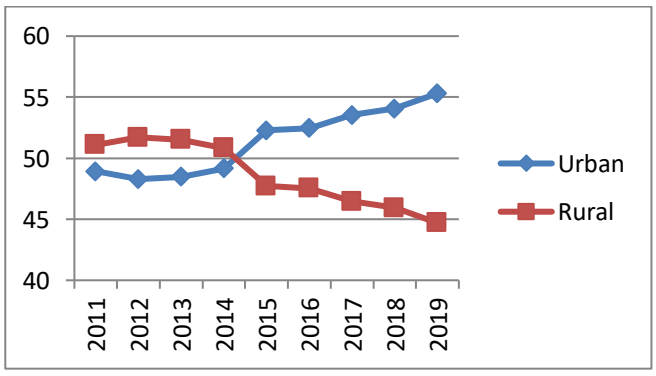

Figure 1. Labour Force in Urban and Rural Areas (%), 2011-2019. Source: Sakernas.

Urbanization has been usually associated with a structural shift in economic activity from the agriculture sector in rural areas to the manufacturing, trade, and service sectors (modern sectors) in urban areas. The types of activities that require highly skilled workers (with usually higher wages) are more likely to be located in urban areas (Tadjoeddin & Mercer-Blackman, 2018). Manufacturing and services, of course, might be located in rural areas, but their main concentration is in urban areas (G. Jones & Mulyana, 2015). However, if manufacturing grown in a rural area, that area is likely to become an urban area due to the potential reclassification of areas. Moreover, although most traditional farm activities remain a large part of rural economies, this does not necessarily mean that all the rural population is working in the agriculture sector. In 2019, for example, there are significant shares of workers living in rural areas working in trade (18%), manufacturing (11%), and services (10%). A significant part of circular and commuting migrants from rural areas also works in urban areas, almost always in non-agricultural activities (Manning & Pratomo, 2018).

Consistent with the existence of agglomeration economies, the growth of the urban population has a strong positive relationship with better economic opportunities (Bank, 2018). Urbanization has delivered on its potential, offering more stable, productive, higher-paying jobs in the modern sector and lower poverty rates. About the middle class, the World Bank (Bank, 2019) stated that 76% of the middle class live in urban areas. Consistently, SAKERNAS 2019 also supported that around 80% of middle-class workers are living in urban areas. Most of them worked in services (30%), trade (19%), and manufacturing (20%). In contrast, only less than 10% of workers living in rural areas are categorized as middle-class workers. This implies that policies to support the expansion of middle-class jobs will need a strong urban dimension.

While urbanization is often framed as a driver of prosperity, it is not without its challenges. World Bank (Bank, 2019), for example, stated that the probability of a migrant entering the middle class has weakened, particularly in the city that suffers from urban congestion. Jakarta, in particular, is the most desired destination for the Indonesian middle class due to having the highest per capita income, which is far above any other Indonesian cities. As the center of governance, business, finance, trade, and services, Jakarta is now shouldering an overwhelming burden. Jakarta is also struggling under a huge environmental burden, whereas air quality in the city has plunged over the last few months. Housing is another issue, where construction has been unable to match the housing demand of the middle class in the last decade, creating a housing bubble where the growth of housing prices is much higher than workers' earnings. To address and relieve some of the burdens on Jakarta, in 2019 President Jokowi has announced that two regencies in East Kalimantan, Penajam Paser Utara, and Kutai Kartanegara districts are to be the site of the country's new capital city. Java is home to 60% of the country's population and more than half of its economic activity, while Kalimantan is almost four times bigger in size, but accounts for less than a tenth of the Gross Domestic Product, bringing some equal distribution of the economy across the region.

A growing urban population has also some important policy implications for the working-age population in rural areas, particularly in terms of maintaining the welfare of the people. The expansion of education for young people to have at least senior secondary education is one possible recommendation to seek employment outside traditional rural farms. Based on National labor force survey (SAKERNAS) 2019, the labor force in rural areas is dominated by a population with primary and junior secondary education. The expansion of agricultural mechanization is another potential policy that will increase the value-added of the rural agricultural sector. Also, there has to be an excellent perspective to be backed up on the upstream-downstream pattern in its supply chain to improve the productivity of the sector.

Reference

Afif, S. (2014). *The Rising of Middle Class in Indonesia: Opportunity and Challenge*.

Allen, E. R. (2016). Analysis of Trends and Challenges in the Indonesian Labor Market. In *ADB Papers on Indonesia No. 16*. Manila: Asian Development Bank, Manila.

Bank, W. (2018). *Time to ACT: Realizing Indonesia's Urban Potential*.

Bank, W. (2019). *Aspiring Indonesia – Expanding the Middle Class*.

Gropello, E. Di. (2013). Role of The Education and Training Sector in Addressing Skill Mismatch in Indonesia. In *Education in Indonesia2*. Singapore: Institute of Southeast Asian Studies, Singapore.

Hill, H., & Wie, T. K. (2013). Indonesian Universities: Rapid Growth, Major Challenges. In D. S. & G. Jones (Ed.), *Education in Indonesia*. Singapore: Institute of Southeast Asian Studies, Singapore.

Jones, G., & Mulyana, W. (2015). *UNFPA Indonesia Monograph Series: No. 4: Urbanization in Indonesia*.

UNFPA Indonesia.

Jones, G. W., & Pratomo, D. (2016). Education in Indonesia: trends, differentials, and implications for development. In *Contemporary Demographic Transformations in China, India, and Indonesia* (pp. 195–214). Springer, Cham.

Kusumawardhani, N., Suryadarma, D., Tiberti, L., & Indrio, V. T. (2019). *What Skills Lead to Entrepreneurial Success? Evidence from Non-Farm-Household Enterprises in Indonesia*.

Manning, C., & Pratomo, D. (2018). Labour Market Developments in the Jokowi Years. *Journal of Southeast Asian Economies*, *35*(2).

Pratomo, D., & Manning, C. (2019). *The role of job transitions in supporting the growth of formal sector jobs*.

Pratomo, D. S. (2020). *Angkatan Kerja di Indonesia: Jalan Panjang Menuju Kelas Menengah, in Transformasi Ekonomi Indonesia Menuju Negara Maju dan Berdaya Saing*. Jakarta: INDEF.

Pratomo, Devanto Shasta. (2017). Fenomena Pengangguran Terdidik di Indonesia. *Sustainable Competitive Advantage (SCA)*, *7*(1).

Tadjoeddin, M. Z., & Mercer-Blackman, V. (2018). Urbanization & Labor Productivity in Indonesia. In E. Ginting, C. Manning, & K. Taniguchi (Eds.), *Indonesia: Enhancing Productivity Through Quality Jobs*. The Asian Development Bank.

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Book Review

Tourism and Earthquake

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A book entitled *Tourism and Earthquake* is very interesting since it discusses two contradictory topics, tourism, and earthquakes. These two words are instinctively avoided to signify and occur together. It will be challenging to run a tourism attractions within or surrounded by disasters prone area. However, in reality, there are a lot of natural tourist attractions (natural-based tourist areas) that turn out to be crossed or are in areas prone to disasters.

The progression of disaster science offers a very scientific approach to mix and match tourism and disaster. This book offers a variety of interesting case studies for you to read. Disaster governance has become a branch of science that has been of great interest in the last few decades. The main concept of disaster governance proposes a collaborative work approach between various institutions, making this concept simultaneously used to explain the phenomenon of disaster (Mardiah, 2018), including in the context of the relationship between tourism and earthquakes as well as the studies presented in this new book.

This book sufficiently explains a variety of case studies, among others: a case study on how the community's perspective on tourism destinations that are located in seismic risk areas in Italy; a case study on communication crises and disasters in Nepal; a case study on mitigation of tourism areas in Bali, Indonesia; and a case study on post-disaster in Christchurch, New Zealand; as well as a comprehensive study on the post-disaster recovery in the Jogjakarta. In short, this book provides various analyses of how to deal with earthquakes in the context of tourism.

The religious and tourism case studies in this book provide practical and theoretical advantages for those interested in disaster governance. Some articles, for example, focus on the impact and response of disasters in the context of tourism, while several other articles also highlight the post-disaster recovery process, and how the economic recovery process should be implemented to restore the normalcy of the community's livelihood. This book also offers a combination of research methods that might be valuable for particular readers, especially for those who want to implement a similar research but from a different point of view. Furthermore, many researches presented in this book are not only using single methods such as either qualitative or quantitative but also using mixed methods. The various method used to address the problem of disaster is needed to provide a broader aspect of analysis. The different location of the case study and method used in this book provides substantial case studies' lessons and knowledge for disaster scientist and policymaker across the globe.

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An interesting article on the post-disaster recovery process is offered by Andri N.R. Mardiah and Jon Lovett. This article is essential, especially for the policymaker to deal with the post-earthquake disaster since it provides substantial suggestion on how to make a speedy recovery to the highly-affected area. Taking case studies in Jogjakarta and Bantul, this article provides an in-depth analysis of the recovery process for MSMEs (Micro and Small Medium Enterprises) after the earthquake in 2006. This article argues that affirmative and stimulant policies at all levels of government must be carried out to accelerate the process of economic recovery, especially for people who are highly dependent on the tourism sector around the earthquake-affected areas. This article is recommended to be read by the city manager and policymaker, who is working in the disaster recovery process and tourism sector in Indonesia.

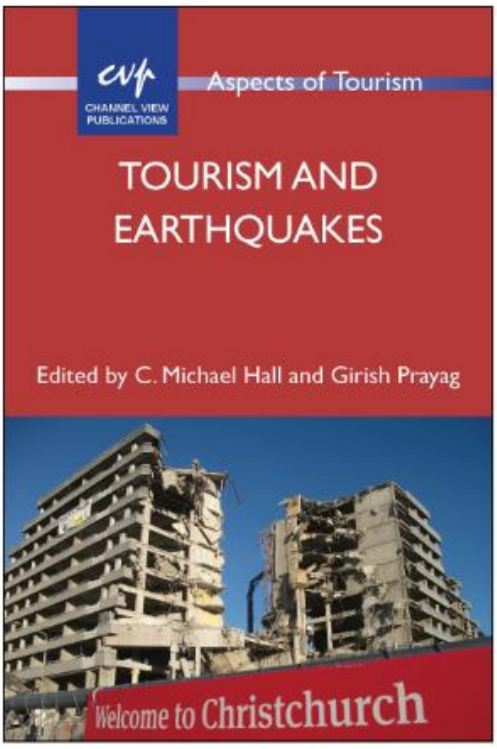
This book is also sufficient enough to provide an in-depth analysis of the impact of the earthquake on individuals, communities, and countries. However, one thing that is still lacking in elaboration is the importance of prioritizing collaborative governance in the handling of cases of all cycle of disasters (pre-, during- and post-disaster). Indeed, managing disaster needs more than the involvement of formal institutions; it also needs an active role by a non-formal institution such as a religious institution for instance. In this sense, collaborative governance will be very much needed, especially to accelerate the post-disaster recovery process (Warganegara & Samson, 2020). In general, the study in this book focuses more on post-disaster recovery from based analyses of the economic and technical aspects of the disaster. Whereas in a broader context, the impact of disasters should not only relate to the economic target, but also cover and highlight the political, social, and cultural as well as demography impact. Enjoy this exceptional book!

References

Mardiah, A. N. R. (2018). *Interface between Disaster and Development: Local Economic Revival through Collaborative Post-Disaster Recovery Governance and Network in Indonesia*. University of Leeds.

Warganegara, A., & Samson, M. G. (2020). Collaboration and disaster: critical responses after tsunami events in Indonesia. *Environmental Hazards*.

COVER BOOK REVIEW



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This journal aimed at studying the issues of sustainable development from around the world to later be used as policy material in sustainable development planning in Indonesia, developing countries, and the world in general. This journal absorbs theoretical scientific studies as well as empirical experiences from researchers around the world, primarily from researchers who specialize in developing countries, to then publish them all widely to international forums as an applicable and innovative knowledge.

This journal gives important weight to the issue of sustainable development planning with regard to the mental and spiritual development of the people of Indonesia and the people of the world in terms of politics, economics, social, culture, environment, peace and justice, energy, and other strategic issues about sustainable development planning.

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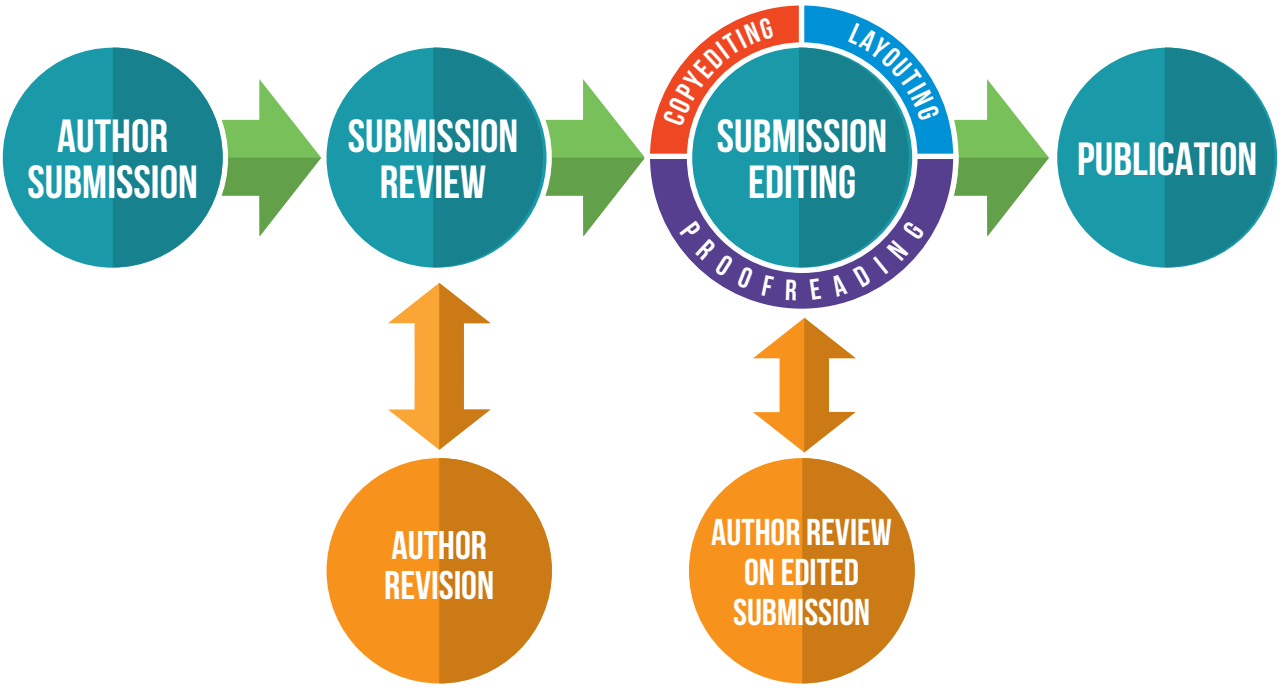

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