pISSN : 2301 – 8968
JEKT ♦ 17 [2] : 201-224 eISSN : 2303 – 0186

Early Marriage and Human Development Index in Indonesia

ABSTRACT

Early marriage is a violation of children's rights and can have significant negative impacts. Some of the negative impacts of early marriage include physical and mental health risks, barriers to achieving good human resources, and increased risk of maternal and child mortality. This study aims to analyze the determinants of early marriage on the Human Development Index (HDI) using the Geographically Weighted Regression (GWR) method. The estimation results show a significant negative relationship between early marriage and the Human Development Index (HDI), as well as a significant relationship between almost all factors affecting early marriage and HDI, except GRDP per capita, contraceptive use, housing ownership, and child abuse cases. In order to improve human resources and community welfare, the main focus needs to be improving access to education, protecting children's rights, reproductive health, and poverty reduction. Preventing early marriage is key to providing optimal opportunities for children to grow and develop and promoting higher human development.

Keywords: Early Marriage, Human Development Index (HDI), Geographically Weighted Regression (GWR)

Klasifikasi JEL : J10, J,12, J16

1. Introduction

Early marriage is a serious issue that is still faced by many countries, especially in developing countries. Although several efforts have been made through various initiatives and policies issued both globally and nationally, many countries still face high cases of early marriage. The United Nations Children's Fund (2022) shows that the prevalence of early marriage is still a serious problem in several regions. The prevalence rate of early marriage is highest in South Asia, with a proportion of almost half of the world's early marriage cases occurring in South Asia, with a percentage reaching 45 percent. Sub-Saharan Africa, with a prevalence of early marriage, reached 20 percent, followed by East Asia and the Pacific at 15 percent and Latin America and the Caribbean at 9 percent. Early marriage is a social phenomenon that is still prevalent in developing countries. Early marriage is a formal or non-formal marriage between a child under 18 and an adult or other child (UNICEF, 2022). Early marriage is a form of violence against children. It is recognized by The Convention on the Rights of the Child (CRC) as a violation of human rights (United Nations Population Fund, 2012). Children who are forced to marry or, due to certain conditions, must marry under the age of 18 have a great threat of vulnerability in the form of difficulty gaining access to education, the quality of children's health and the lurking risks, the potential to experience acts of violence and live in poverty (PUSKAPA, 2020).

An estimated 115 million boys and men alive today were children when they married. One in five boys, or 23 million boys, were married before they were 15 years old, and one in twenty-five men, or 3.8 percent, were married before they reached the age of 18 (IFRC, 2021). Meanwhile, it is estimated that more than 650 million girls and women alive today were married when they were under 18. Every year, there are at least 12 million early marriages experienced by women (UNICEF, 2018). According to UNFPA (2022), one in every five girls worldwide marries before reaching the age of 18, indicating that child marriage involves millions of girls. In developing countries, it was found that 36 percent of girls recorded as married entered into marriage before reaching 18 years of age, and 10 percent entered into marriage before reaching 15 years of age. Children who marry underage do not face the same risks and consequences due to biological and social differences. However, the practice of

early marriage remains a violation of children's rights for both boys and girls. Early marriage hurts the physical growth, mental development, emotional, and overall health of the individual. Children who experience marriage will be forced to assume the same responsibilities as adults, for which they may not be ready and mature enough to deal; they will face the same economic and other pressures as adults. Many children are forced to drop out of school and get jobs to support their families. However, they often earn low wages as they struggle to access personal development (Edmeades et al., 2022).

Early marriage is a concern in the global development agenda, especially in the 2030 Sustainable Development Goals (SDGs). The SDGs set targets to eliminate all harmful practices that harm women and girls, including child marriage, early marriage, forced marriage, and female genital mutilation (Deputy for Child Rights Fulfillment, Ministry of PPPA, 2021). This target reflects a global effort to eliminate all marriage practices involving children in order to promote sustainable human development and can have a significant impact on human capital. By eliminating these practices, it is expected that women's access to health and education will increase. This can improve human well-being by realizing the goals of human development through improved quality of life, higher educational opportunities, gender equality and the protection of human rights (Hasdiani et al., 2022). The practice of early marriage in developing countries produces adverse effects, especially for women. Women who enter into early marriages have experienced poor health as a result of early pregnancies, disharmonious households due to the inability to manage relationships and stop getting access to education (Plan International, 2013). Early marriage is a serious issue in many countries and has a negative impact on human development. Bangladesh, which has one of the highest rates of early marriage after India, faces serious challenges related to socio-demographic factors such as low access to education, low levels of security, local traditions and customs, economic factors and religious influences. The impact of early marriage in the country is reflected in its HDI ranking of 129th out of 191 countries (UNICEF, 2022).

Economic factors contribute to the increase in child marriage in some countries. In some countries in Sub-Saharan Africa and Asia, child marriage rates are related to Gross Domestic Product (GDP). Poverty is also an issue in terms of economic factors that encourage child marriage (Talukder et al., 2020). Economically deprived families in Bangladesh and other Asian countries see child marriage as an opportunity and a quick solution to economic problems. In this case, countries with high levels of poverty tend not to pay attention to human resources by marrying off their children to reduce the economic burden. In contrast, countries that prioritize welfare tend to prioritize human capital for their children and uphold equality in society (Otoo-Oyortey & Sonita, 2003). In addition to economic factors, religious aspects also often justify and encourage the practice of early marriage. In countries with a religion-based state pattern, religious laws and courts can override civil laws that prohibit the marriage of girls. The influence of conservative views and patriarchal cultures in some countries also reinforce the practice of early marriage (Sisters in Islam (SIS), 2018). Furthermore, geographical factors such as differences between rural and urban areas also play a role in early marriage patterns (Misunas et al., 2019). Rural residents often face limited access to education and health services, making them more vulnerable to early marriage. On the other hand, urban communities with better access tend to prioritize human development (Hotchkiss et al., 2016). In addition, child marriage often occurs in areas with low levels of security. Violence against children, including sexual violence, often occurs in areas with low levels of security or in conflict-prone areas (Sisters in Islam (SIS), 2018).

Every country has the responsibility to take concrete steps to eradicate early marriage in order to realize the ultimate goal of eliminating discrimination and protecting the rights of children, especially girls. Based on data released by UNICEF as an organization that advocates for children's rights, it shows that Indonesia is among the five countries with the largest number of early marriage cases, based on the age of a woman's first marriage before the age of 18. India ranks first with 216.65 million cases, Bangladesh second with 41.58 million cases,

China third with 35.43 cases, Indonesia fourth with 25.53 million cases and Nigeria fifth with 24.38 million cases. Every country has rules governing the minimum legal age for marriage. Indonesia has a regulation in the form of a law that regulates the minimum legal age for marriage which is stated in the Law of the Republic of Indonesia Number 16 of 2019 concerning amendments to Law Number 1 of 1974 concerning marriage. Prior to the amendment, the minimum age of marriage in Indonesia for men was permitted when they were 19 years old and for women was permitted when they were 16 years old. This provision could allow the rampant early marriage of girls, and would also lead to sex discrimination. Therefore, the law was revised by raising the minimum age of marriage for women to a minimum of 19 years old. The minimum age limit for women is adjusted to be equal to the minimum age of marriage for men in order to eliminate the stigma of gender discrimination (Wulandari & Laksono, 2020).

Indonesia is one of the most populous countries in the world with a larger child population. In 2020, Indonesia's population pyramid shows that there is a distinctive feature that attracts attention, namely the young age group which has a large number of residents. This young age group usually consists of children to teenagers, whose ages range from 0 to 20 years old. This large proportion of young people indicates that Indonesia has a relatively young population. In this context, it is important to look at the implications of a large young age group. This can be an indication of the massive practice of early marriage in Indonesia. Based on the explanation of the IFRC (2021), the practice of early marriage has occurred as many as 765 million in the child population before the age of 18, so it is related to the population pyramid figure in Indonesia which shows that the population of children under 18 years of age in Indonesia is one of the ages with the largest population compared to other age groups. The large population under the age of 18 poses a threat of social and economic vulnerability that leads to children choosing to marry rather than improve the quality of human development.

According to the Ministry of National Development Planning and UNICEF (2020), one in ten women aged 20-24 were married before the age of 18 in 2015. The phenomenon of early marriage in Indonesia is inseparable from the influence of social, economic, cultural and religious dynamics that occur in the community. However, religion plays a strong role in the implementation of early marriage in Indonesia. The situation in the country shows that there are several laws that provide leeway and facilitate religious practices by overriding the general rules that apply. For example, marriages involving children can be conducted with the consent of the parents as guardians of the children. In practice, marriages involving children tend to be arranged by families and religious communities. Marriage at a young age is a reflection of a tradition or custom that combines social, cultural and economic factors in society (Judiasih et al., 2018).

Several factors contribute to early marriage in Indonesia, including economic and educational constraints. Economic constraints are caused by the child's parents being unable to provide living expenses, especially the girl's gender, in the end the girl is married off so that she becomes the responsibility of her partner. In this case, early marriage becomes a practical solution that parents think of to reduce the family's economic burden (Wulandari & Laksono, 2020). Then on the education and health side, there are still many children who do not recognize the vulnerability in early marriage which is explained by the IFRC (2021) that it will cause considerable risks and consequences. Pidah et al. (2021) in their research showed that in 2017 there were 7% of men and 12% of women who had engaged in premarital sexual activity and experienced unwanted pregnancies as a result of premarital sexual activity. Early marriage is a practical solution to cover up the shame and disgrace felt by the family, which can increase the number of early marriages. The lack of education about premarital sexual behavior is one of the factors that increase the number of early marriage practices. Parents who have the main function in providing education to children and educational institutions as facilitators outside of parents are very influential on the rate of early marriage because they can provide an understanding of sexual education. Another factor of early marriage is poverty, as many couples do not have proper education or jobs. Then early marriage is also caused by

tradition and religion. Early marriage can also be caused by geographical conditions such as in rural areas. Early marriage often occurs in rural areas and more than from urban areas, this is still low access to educational information (Aryati et al., 2020).

The Indonesian Central Bureau of Statistics (2022) released data on the proportion of early marriages in Indonesia. Early marriage refers to the percentage of marriages that occur in age groups that have not met the legal age requirements for marriage. The data shows that over a period of seven years, early marriage in Indonesia tends to fluctuate. The decline in the trend of early marriage is due to regulations regarding the national planning and development system. Indonesia is one of the countries that supports the realization of the Sustainable Development Goals (SDGs) in this case, especially regarding gender equality, one of the points that is the goal of the SDGs is to eliminate harmful practices that take away the rights of children, in this case, the practice of early marriage (Tan, 2021).

But in reality, the practice of early marriage is still rampant in several provinces. The following diagram shows early marriages based on the provinces that have the highest rates of early female marriage.

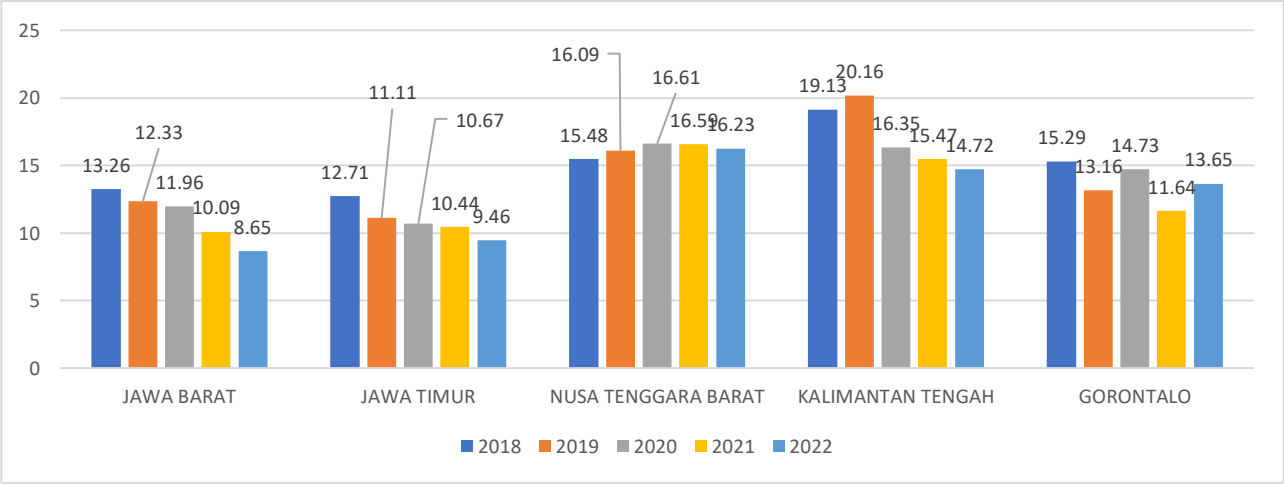

Figure. 1. Provinces in Indonesia with High Early Marriage Rates in 2018 – 2022

Figure 1 shows the provinces that have the highest proportion of early female marriage in 2020. Provinces located on the island of Java have a high rate of early marriage. This is because Java is one of the islands with the highest population density in Indonesia. Geographical conditions are one of the factors that can increase the high rate of early marriage. The high rate of early marriage is caused by the large number of young people who do not have education and health information, which will have a very vulnerable risk to maternal health due to marriage at a young age. The fifth goal of the Sustainable Development Goals (SDGs) is to end violence against women and girls and harmful practices including early marriage. The 2017 SDGs report on gender equality shows that women in Indonesia are more likely to marry before the age of 18 compared to other women in the East Asia and Pacific region (Agtikasari et al., 2019).

High marriage practices lead to a high chance of dropping out of school, which affects the quality of human capital. Although some people who can complete high school may not have the desire to continue to college, this can reduce human capital and affect HDI in a region. Based on the scatter plot, early marriage based on the proportion of women aged 20-24 years who are married before the age of 18 years is negatively related to HDI, this is the basis that people who are married at an early age find it difficult to continue their education. The relationship between early marriage based on the proportion of women aged 20-24 years who are married before the age of 18 years corroborates the analysis of the lack of people to improve education and the quality of human

development, as seen in the two scatter plot images in Figure 2 below.

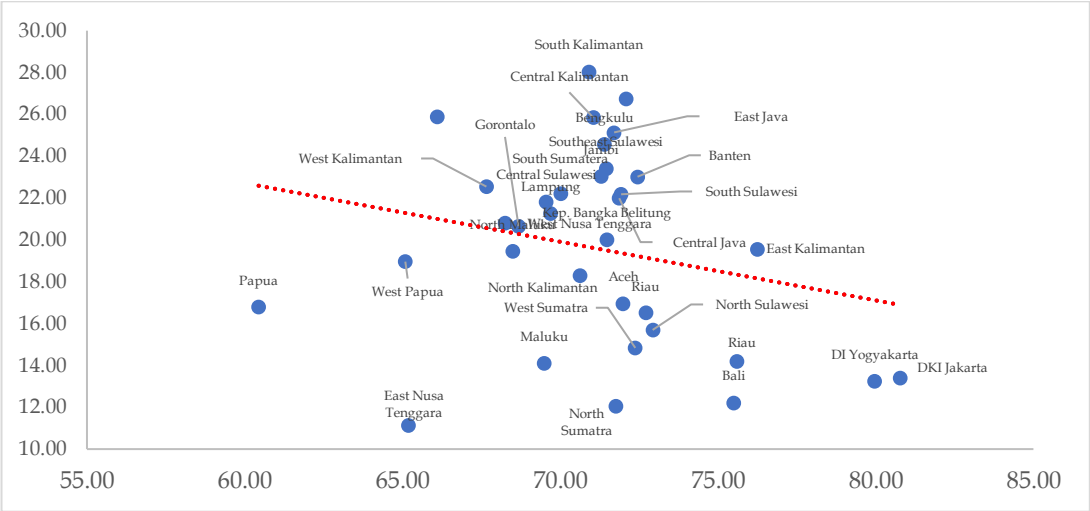

Figure 2. Scatter Plot of Early Marriage with HDI by Province in Indonesia in 2020

The practice of early marriage can strengthen the poverty chain because children who should be getting the right to education are forced to leave and no longer have access and even difficult to continue to the next level (Nurhikmah et al., 2021). In addition, children who experience early marriage practices are vulnerable to discrimination, illiteracy because they are unable to complete their education, and the risk of maternal and infant mortality. Maternal and infant mortality caused by early marriage practices can affect the HDI of an area. Bappenas (2020) in its report shows that women who experience marriage before the age of 18 are one of the highest contributors to maternal and child mortality cases compared to women who experience marriage over the age of 21. Children who become prospective mothers in early marriage practices have a higher risk than prospective mothers who come from marriages at an ideal age. Babies born to women who experience pregnancy under the age of 18 tend to have higher mortality (Wahyudi & Prastiwi, 2022). This leads to an increased risk of maternal mortality and infant mortality due to unideal health factors. The high risk of maternal and child mortality of prospective mothers from early marriage can lead to increased maternal and child mortality rates, which will reduce the HDI in a region (Agus et al., 2022).

The high or low value of HDI in a region cannot be simplified from a single factor, such as early marriage. However, HDI is the result of the interrelationship between various factors that influence each other in the various dimensions that make up HDI in a region. HDI is formed to provide an overview of the quality of life and welfare of humans in various aspects. Factors that have a role in the formation of an HDI include economic, social and health aspects (Siswati & Hermawati, 2018). HDI consists of three main dimensions: education, health and income, which represent economic conditions. Each dimension of the HDI describes a factor that affects the level of human development. In this case, factors such as education participation and education quality are related to school enrollment and literacy rates (Maula et al., 2023). Meanwhile, life expectancy and access to health services can be factors in shaping the health dimension (Jamaruddin & Sudirman, 2022). Per capita income can describe the ability of individuals and families to meet basic needs and improve living standards (Sapaat et al., 2020).

On the other hand, in 2020 the world is faced with the conditions of the Covid-19 pandemic which resulted in the world community experiencing activity restrictions. Activity restrictions implemented to tackle the spread of the virus have created major challenges, especially in efforts to improve human capital through education. Children and adolescents are experiencing restricted access to formal education due to school closures

resulting from activity restrictions and an uneven shift to online learning. These restrictions have the potential to increase the risk of increased cases of early marriage, as some individuals seek other alternatives in the form of marriage as a response to economic uncertainty and educational limitations. In addition, restrictions on access to health facilities also have an impact on community welfare. Efforts to prevent the spread of Covid-19 have resulted in decreased access to reproductive health services and health information (Komnas Perempuan, 2021).

During the Covid-19 pandemic in Indonesia, amidst the public focus on health and economic issues during the COVID-19 pandemic, cases of early marriage continue. It is estimated by BPS that 1 in 9 girls aged 20-24 are at risk of marrying before reaching the age of 18 due to the impact of the pandemic. Furthermore, Bappenas estimates that around 400-500 female students aged 10-17 may be forced to marry due to economic hardships experienced during the pandemic (Fajriyah et al., 2023). The phenomenon of dispensation for marriage emerged as a result of the complexity of social impacts. Dispensation of marriage provides special permission to marry off underage couples, for certain reasons such as pregnancy or other conditions that are considered to have a strong enough reason. This policy is a response to the economic pressure felt by a number of families during the pandemic, where early marriage is considered a strategy to overcome the financial difficulties caused by a massive decline in income and job losses (Ikawati & Anisa, 2023). The phenomenon of marriage dispensation during the Covid-19 pandemic in Indonesia is a point of complexity in efforts to increase human capital as the goal of sustainable human development in a country (Rofiq et al., 2022).

Early marriage in Indonesia is linked to the formation of HDI. The impact of early marriage spans the key dimensions that make up the HDI, namely knowledge, decent standard of living, and health and longevity. However, spatial or geographical factors also play an important role in the pattern of early marriage in different parts of Indonesia. Education, a determinant of the knowledge dimension, can be affected by early marriage as it tends to hinder access to education, especially for women who marry at a young age. This reduces their chances of being able to acquire the knowledge and skills needed to improve their human capital and competencies to enter the wider environment. Spatial factors play a key role in the pattern of early marriage in different parts of Indonesia. Diverse regional conditions coupled with unequal access to human capital enhancement facilities such as education and health services, influence an individual's decision to continue life by getting married. Furthermore, social factors such as differences in cultural norms and social pressures between regions can influence the decision to enter into early marriage.

Considering the complexity of the relationship between early marriage and HDI and incorporating spatial factors, this study aims to analyze the determinants of early marriage on the Human Development Index (HDI) using the Geographically Weighted Regression (GWR) method. This research is expected to provide comprehensive contributions and insights into the challenges and opportunities in shaping human development in Indonesia by considering aspects of early marriage and the Human Development Index (HDI).

2. Materials and methods

This study uses secondary data to obtain an overview, spatial analysis and determination of the effect of early marriage on HDI in Indonesia. Secondary data is data that can be accessed and obtained through third parties/other parties in this case are institutions or agencies that have data through published reports. The data used in this study are data from 34 provinces in Indonesia in 2020. This study uses secondary data obtained from the Ministry of Religion (Kemenag), Ministry of Women's Empowerment and Child Protection (Ministry of PPPA), Central Statistics Agency (BPS), National Socio-Economic Survey (SUSENAS) in 2020. To support the theories and methods used, this research is supported by reference materials from scientific papers and studies that have been conducted by other researchers and are related to this research.

The independent variable used in this study is the HDI of each province in Indonesia in 2020. The independent variables in this study are divided into two, namely the main variables and control variables. The main independent variable of this study is the proportion of first marriages before the age of 18 from each province in Indonesia in 2020. The control variable in this research model is used to consider other factors that can affect the relationship between the independent variable and the non-independent variable. The control variables used in this study are other factors that can influence the effect of early marriage, namely: the proportion of education completion level based on the diploma owned, the level of religiosity based on the number of religious instructors, GRDP per capita, the proportion of pregnancies before the age of 18, the percentage of contraceptive use, the proportion of internet use, the proportion of housing ownership, the number of poor people, the proportion of the level of security in the area of residence and the crime rate against children.

Descriptive analysis and inference analysis are used as an analysis method in this study. Descriptive analysis is used in this method to find out the general description of the HDI that is influenced by early marriage from each province in Indonesia in 2020. To strengthen descriptive analysis to find out the general picture of using thematic maps. Descriptive Analysis In this study it was processed using an analysis tool in the form of geoda and judged software to see the effect of early marriage on HDI considering geographical conditions based on latitude (latitude) and longitude. Inference analysis is used to determine the spatial effect of early marriage on HDI by using geographically weighted regression is processed using an analysis tool in the form of GWR4 software (Agus et al., 2022). The use of geographically weighted regression models in early marriage modeling of HDI in order to know the estimation value locally and better than the use of logistics regression models (Jahra et al., 2021). After the GWR modeling, then the thematic map is made using Arcmap and Geoda software to see the distribution of each research variable in the model.

This study uses a model adapted from Jahra et al. (2021) by adding other factors that affect early marriage as a control variable and use data based on provinces. Linear Regression Model is a model that shows the relationship between the variable not free in this case the HDI variable and the independent variable is the proportion of the first marriage before the age of 18 years. The models in this study were formulated as follows:

$$IPM_i = \beta_0 + \beta_1 PD_i + \beta_2 TPP_i + \beta_3 Relig_i + \beta_4 PDRB_i + \beta_5 KSU_i + +\beta_6 KB_i + \beta_7 AE_i + \beta_8 KTT_i + \beta_9 PM_i + \beta_{10} TK_i + \beta_{11} KKA_i + \varepsilon_i$$

In the equation, IPM_i represents the Human Development Index in region i, while the PD_i illustrates the proportion of early marriage in region i. In this model involving a number of control variables, namely TPP_i as a representation of the level of education completion in region i, $Relig_i$ religiosity from the population in region i, $GDRP_i$ which indicates GRDP per capita region i, KSU_i which describes the proportion of pregnancy before the age of 18 in region i, KB_i which reflects the percentage of use of contraception from population in region i, AE_i which illustrates the proportion of internet use in region i, KTT_i which illustrates the proportion of residential ownership in region i, PM_i which illustrates the number of poor people in region i, TK_i reflects the level of security in region i, and KKA_i indicate the level of crime of children in region i. In addition, there is a variable ε_i as an error term.

Spatial weighting (W) in the GWR model is formed as a diagonal matrix that describes the proximity between observation locations or can be called neighborhood distance (Agus et al., 2022). The function of spatial weights is to adjust the parameter differences from each observation location. The weight has an important role in the GWR model because the value of the weight shows the location of the data between observation locations (Kartika et al., 2020). Spatial weighting can be used in the GWR model if there are coordinates of observation locations in the GWR model. Coordinates that are commonly used in spatial analysis are using latitude and longitude (u,v). Latitude is a horizontal line between the north and south poles that connects the eastern and western parts of the earth, while longitude is a vertical line that connects the north and south poles. Latitude and

longitude coordinates are commonly used as factors in calculating the distance between two points of observation locations (Kusuma & Oktavianto, 2022).

The bandwidth is the radius distance of the circle where if a point is within the radius, it will be considered to affect the formation of parameters in the model at location 'i'. This can result in the matrix of weights becoming larger as the radius distance gets closer (Mei, 2005). The weight matrix for each observation location can be calculated with a kernel function. The kernel function has two types of weights, namely fixed and adaptive. Both types of kernel functions have three variants of kernel functions, namely gaussian, bisquare and tricube. The kernel function with fixed weighting type has one bandwidth value that can be used for all observation locations, while the adaptive weighting type produces different bandwidth values for each observation location. The following are the types of kernel weighting functions that can be used in GWR models (Fotheringham et al., 2007):

1. Fixed Kernel Gaussian

$$W_j(u_i, v_i) = exp\left(-\frac{1}{2}\left(\frac{d_{ij}}{h}\right)^2\right)$$

2. Fixed Kernel Bisquare

$$W_j(u_i, v_i) = \begin{cases} \left(1-\left(\frac{d_{ij}}{h}\right)^2\right)^2, & if\ d_{ij} \le h \\ 0, & if\ d_{ij} \ge h \end{cases}$$

3. Fixed Kernel Tricub

$$W_j(u_i, v_i) = \begin{cases} \left(1-\left(\frac{d_{ij}}{h_i}\right)^3\right)^3, & if\ d_{ij} \le h_i \\ 0, & if\ d_{ij} \ge h_i \end{cases}$$

4. Adaptive Kernel Gaussian

$$W_j(u_i, v_i) = exp\left(-\frac{1}{2}\left(\frac{d_{ij}}{h_i}\right)^2\right)$$

5. Adaptive Kernel Bisquare

$$W_j(u_i, v_i) = \begin{cases} \left(1-\left(\frac{d_{ij}}{h_i}\right)^2\right)^2, & if\ d_{ij} \le h_i \\ 0, & if\ d_{ij} \ge h_i \end{cases}$$

In estimating the parameters of the GWR model using Weighted Least Square, the model requires different weights at each location of the observation area. For spatial weights, it comes from information about the neighborhood distance between observation locations. Furthermore, Euclidean distance can be used to determine the distance between observation locations. Euclidean distance is a method that can be used to calculate the distance between two points of observation locations. It is a mathematical approach that can measure the length of a straight line between two points in space. The use of the Euclidean distance method in the GWR model in spatial weighting is to help measure how close or far the observation location is from other locations (Suparmi & Soeheri, 2020). Euclidean distance can be formulated as follows:

$$d_{ij} = \sqrt{(u_i - u_j)^2 + (v_i - v_j)^2}$$

Where the Euclidean distance is denoted as dij which is the Euclidean distance between the observation location $(u_i - u_j)$ to the observation location $(v_i - v_j)$, while h is the notation of the smoothing parameter or bandwidth (Kartika et al., 2020).

Bandwidth is the radius distance of a circle around a point or observation. If the observation is inside the circle, it will be considered to have an influence in shaping an i-th location model parameter. This is used as one of the bases for setting a weight in each observation in the regression model at that location. When using GWR to estimate parameters at a particular location, each observation is weighted based on its proximity to that location. Closer observations tend to have a greater weight, while more distant observations tend to have a lower weight (Fadli et al., 2018).

The choice of method in determining the bandwidth plays an important role in the aspect of accurate kernel function estimation. When the radius distance value is on a very small scale, it will have an impact on the data variation that will be significant. If the bandwidth value is very small, the number of observations affecting a radius will be limited. However, if the bandwidth value changes drastically, the variation in the estimation results will be more limited (Kartika et al., 2020). Choosing the right bandwidth value avoids non-uniform variations in the results of parameter estimation due to an increase in the bandwidth value. There are several methods that can be used to select the most optimal bandwidth value (Fotheringham et al., 2007). The following methods can be used in spatial research models.

1. Cross Validation (CV)

$$CV = n\sum_{i=1}^{n}\left(y_i - \hat{y}_{\neq i}(b)\right)^2$$

2. Generalized Cross Validation (GCV)

$$GCV = n\sum_{i=1}^{n}\frac{\left(y_i - \hat{y}_{\neq i}(h)\right)^2}{(n - v_1)^2}$$

3. Akaike Information Criterion (AIC)

$$AIC = 2nlog_e(\hat{\sigma}) + nlog_e(2\pi) + n + tr(S)$$

4. Bayesian Information Criterion (BIC)

$$BIC = -2nlog_e(L) + klog_e(n)$$

The method to find the most suitable radius distance or bandwidth is by using the Cross Validation (CV) method. Through the process of minimizing the CV equation above, the most optimal bandwidth value will be found. In practice, determining the optimal bandwidth can be done by utilizing spatial software (Fadli et al., 2018).

Geographically Weighted Regression or GWR is one of the spatial analysis methods commonly used to analyze spatial diversity by providing different weights for observations in each location. Generally, the GWR method is used as an exploration of spatial non stationary and defines the nature and significant relationship between variables at each location (Maulana et al., 2019). GWR model parameters are estimated for each geographic coordinate, so each coordinate has a different regression estimate (Sinaga et al., 2021). The GWR model is formulated as follows:

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{p}\beta_k(u_i, v_i)x_{ik} + e_i$$

In the GWR model, it is defined that y_i is the observation value at the *i*-th observation, then x_{ik} is the observation value of the *k* independent variables at the *i*-th observation. Furthermore, β is defined as the coefficient of regression, (u_i, v_i) is the coordinate point of location *i* and e_i is the i-th error. The shape of the error term $(e_1, e_2, \ldots, e_n)$ is assumed to be independent, identical and follows a normal distribution with zero mean and constant variance, namely $e_i \sim iid\ N(0, \sigma^2)$ (Agus et al., 2022).

Spatial autocorrelation refers to the correlation that occurs between the independent variable and itself. In testing spatial effects, especially spatial autocorrelation, there are two methods that can be used, namely the Moran's I index test and the Local Indicator of Spatial Association (LISA) (Jahra et al., 2021).

Moran's I test is a spatial test that has local properties and aims to detect spatial autocorrelation at a particular location. Moran's I index test can be used to identify a spatial regression model whether there is a spatial relationship pattern between observation values at that location. By analyzing the spatial dependence between individual observations at a point and other points that have a short distance from the observation point (neighborhood), Moran's I test can help to see spatial trends or patterns that may not be found through other statistical analysis methods (Bekti, 2012). Moran's I test can be formulated as follows:

$$I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n}w_{ij}\,(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Where I is Moran's Index. The factor n refers to the number of locations observed in the study. The variables xi and xj are the values observed at the i-th location and j-th location, respectively, referring to the concept of neighborhood. In addition, $\bar{x}$ indicates the average of the observed values. The standardized (weighted) weight is seen in w_ij which describes the relationship between region i and region j (Kartika et al., 2021). If the Moran's index value is between $-1 \leq I \leq 0$, then this illustrates the possibility of negative spatial autocorrelation, and if the Moran's index value is between $0 \leq I \leq 1$ indicates there is a potential positive spatial correlation. As for when the Moran's Index value is at zero or I = 0, this indicates the absence of spatial clustering patterns (Kartika et al., 2021). The results of these calculations can then be analyzed in the context of testing spatial dependence using the following hypothesis: H_0:I = 0, there is no spatial autocorrelation, H_1:I≠0, there is spatial autocorrelation (Kartika et al., 2021).

Furthermore, Moran's index analysis can use scatterplot and mapping methods. Both methods can be used to identify the values of the variables that have been selected at each location, as well as the average of the same values of variables in neighboring locations that

have been standardized. The Moran's index scatterplot consists of four quadrants, each of which has a different indication of the spatial relationship pattern between locations, namely the Low-Low Quadrant (LL), Low-High Quadrant (LH), High-Low Quadrant (HL) and High-High Quadrant (HH) (Kartika et al., 2021). The following is the interpretation of the analysis results using the Moran's index scatterplot:

1. High-High (HH), quadrant 1 indicates that areas with high observed values are surrounded by areas with high observed values.
2. Low-High (LH), quadrant 2 indicates that areas that have low observation values are surrounded by areas that have high observation values.
3. Low-Low (LL), quadrant 3 illustrates that areas that have low observation values are surrounded by other areas that have low observation values.
4. High-Low (HL), quadrant 4 shows that areas that have high observation values are surrounded by areas that have low observation values (Zhukov, 2010).

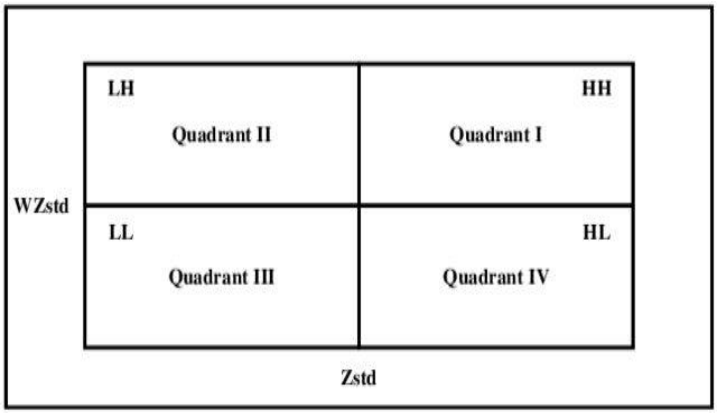

Figure. 3. Index Moran's I Quadrant

LISA testing is used to assess spatial interactions at each point of the region. The LISA statistic is used to test the random distribution hypothesis by comparing the value of each observation at a specific location with the value found in the surrounding area (Jahra et al., 2021).

The GWR model fit test is conducted to test the geographical factors that are at the core of the model (Hapsery & Trishnanti, 2021). The hypothesis used to test the suitability of the GWR model is as follows: $H_0 = \beta_k(u_i, v_i) = \beta_k; i = 1,2, \dots, n; k = 1,2, \dots, p$ (there is no significant difference between the linear regression model and the global spatial model) $H_1 = \beta_k(u_i, v_i) \neq \beta_k$ (there is at least one geographical factor $(\beta_k(u_i, v_i)), i = 1,2, \dots, n; k = 1,2, \dots, p$ (there is a significant difference between the linear regression model and the global spatial model)

The criteria for the GWR model suitability test as follows: H_0 cannot be rejected, if the value of f count < f table, H_0 is rejected, if the value of f count > f table (Hapsery & Trishnanti, 2021). After testing the suitability of the model on the global model and getting the estimated local model results, then the parameter test for local GWR models is partially carried out. This partial parameter test is carried out with the aim of knowing what parameters are significant in influencing the dependent variable (Lutfiani et al., 2019). The formulation of the hypothesis for the partial parameter test is as follows: $H_0 = \beta_k(u_i, v_i) = 0$ (there is no significant effect of independent variable on dependent variable), $H_0 = (u_i, v_i) \neq 0; k = 1, 2, \dots, p$ (There is at least one dependent that affects independent variable). The following partial parameter test criteria: H_0 cannot be rejected, if the value of t count < t table, H_0 is rejected, if the value of t count > t table (Anjas A et al., 2019).

3. Result

Descriptive analysis using the general picture of the map distribution aims to identify spatial patterns and variations in the research variable. In addition, the descriptive analysis method using map distribution can be easier to identify provinces with good or low HDIs, and can see the correlation or association patterns between HDI and early marriage.

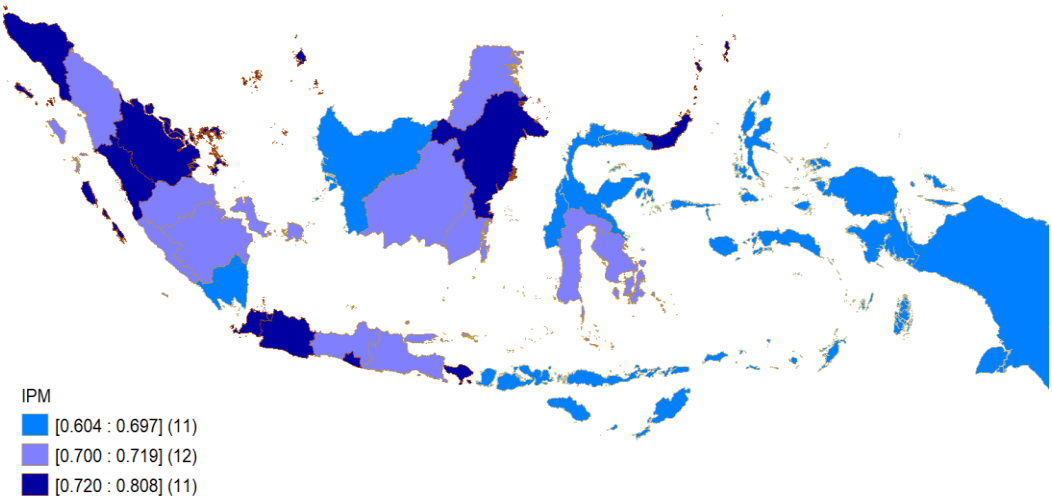

Figure. 4. Map of HDI Distribution in Indonesia by Province in 2020

As an indicator of human development in a region, HDI shows the socioeconomic conditions, health and welfare of the community. Figure 4 shows the mapping of HDI in Indonesia in 2020. The HDI mapping is divided into three categories, the first category is provinces that have low HDI marked in light blue, then the second category is provinces that have medium HDI marked in purple and the third category is provinces that have high HDI marked in dark blue. The legend in Figure 4 shows that 11 provinces have low HDI, 12 provinces have medium HDI and 11 provinces have high HDI. In Figure 4 it can be seen that the provinces that have a high HDI are mostly located in western Indonesia. This shows that human development is uneven because eastern Indonesia is still dominated by light blue, in this case indicating that the HDI value in eastern Indonesia is relatively low.

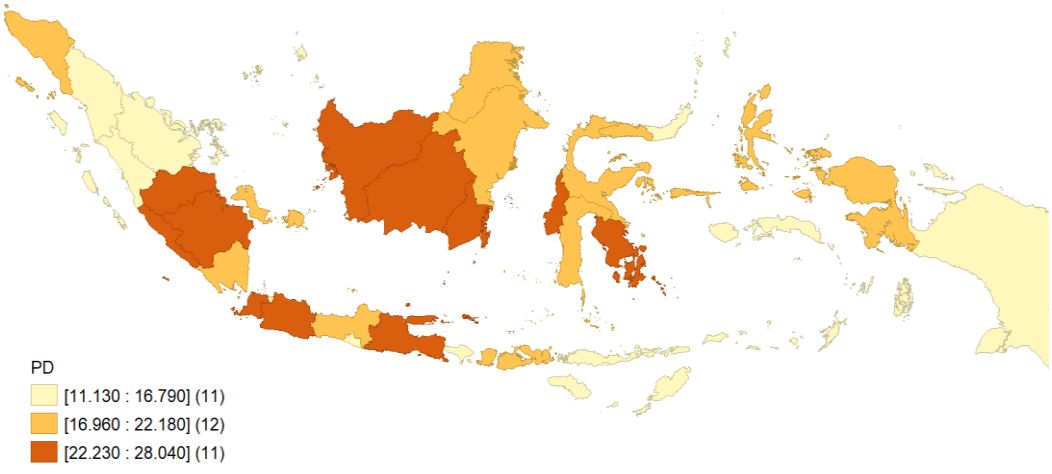

Figure. 5. Map of Early Marriage Distribution in Indonesia by Province in 2020

Based on the map image displayed in Figure 5, it can be seen that the provinces that show high levels of early marriage are mostly located in Java, Kalimantan and Sulawesi. This can be seen in the appearance of orange and brown colors on the map described. However, a different situation is seen in the eastern part of Indonesia. Here, it can be seen that most provinces, especially East Nusa Tenggara, Maluku and Papua, have a low proportion of early marriage. The higher proportion of early marriages in provinces located on the islands of Java, Kalimantan and Sulawesi could be due to various factors such as different social, cultural and economic factors. However, the high proportion of early marriages on Java Island could be due to population as Java Island has a large population compared to other islands.

Descriptive analysis is a method used to summarize and summarize data through statistical forms. This method can help to understand the variations of the values of each variables used in the model. The information obtained can help in developing models and developing understanding through data interpretation.

Table 1. Descriptive statistics of research variables

Variables	Average	Minimum	Maximum
IPM	0.71	0.6	0.81
Early Marriage	19.61	11.13	28.04
Education Completion Rate	26.08	15.47	34.02
Religiosity	1474.03	231	5915
GRDP per capita	42502.2	12961	170089
Pregnancy Before 18 Years Old	45.23	25.8	57.11
Contraceptive Use	62.35	25.95	77.29
Internet Access	42.98	18.13	70.35
Residence Ownership	79.06	45.04	89.2
The poor population	810.29	52.7	4585.97
The Proportion of Security Levels	34.83	18.68	58.48
Child Abuse Cases	2.13	0	6.03

Source: Authors calculations

Table 1 shows the descriptive statistics of the variables in this study. The average Human Development Index (HDI) in Indonesia in 2020 was 0.71, indicating a fairly high level. Variations in HDI were seen from a minimum of 0.60 in Papua to a maximum of 0.81 in DKI Jakarta, reflecting inequalities in human development between provinces. Early marriage has an average of 19.61, with the highest proportion in South Kalimantan (28.04) and the lowest in East Nusa Tenggara (11.13). Significant differences highlight the variation in early marriage practices across Indonesia. Education, measured by not having a primary school certificate, shows an average of 26.08. DKI Jakarta has a low proportion (15.47), while East Nusa Tenggara has a high proportion (34.02), reflecting the disparity in access to education between provinces. Religiosity, measured by the number of religious instructors, has an average of 1474.03, with significant differences between Papua (minimum) and East Java (maximum). GRDP per capita shows economic inequality between provinces, with an average of 42502.2, a minimum in East Nusa Tenggara (12,961), and a maximum in DKI Jakarta (170,089). Pregnancy before 18 years has an average of 45.23, with East Nusa Tenggara as the province with the highest proportion (57.11), indicating a high risk to girls' health. Contraceptive use averages 62.35, with interprovincial variation from Papua (25.95) to South Kalimantan (77.29). Internet access shows significant inequality, with an average of 42.98, a minimum in Papua (18.13), and a maximum in DKI Jakarta (70.35). Housing tenure has an average of 79.06, with differences between DKI Jakarta (minimum) and Central Java (maximum). The number of poor people shows

large differences between provinces, with an average of 810.29 thousand, a minimum in North Kalimantan (52.7 thousand), and a maximum in East Java (4,585.97 thousand). The level of security, measured by individual anxiety, has an average of 34.83, a minimum in Bali (18.13), and a maximum in DKI Jakarta (58.48). Cases of violence against children averaged 2.13 percent, with interprovincial variation from 0 percent in Sulawesi to 6.03 percent in Lampung.

In the GWR model, the determination of weighting using GWR4 software and through four kernel tests, namely fixed gaussian, fixed bi-square, adaptive gaussian and adaptive bi-square. Testing Methods Through Fixed Kernel Using Distance (Distance) as Bandwidth and Adaptive Kernel Method Using the number of observation locations as bandwidth.

Table 2. Kernel test results

Kernel function	Bandwidth	CV
Fixed Gaussian	9705.46	17332.11
Fixed bi-square	19410.93	19090.97
Adaptive Gaussian	3	52110.21
Adaptive bisquare	34	21174.48

Source: Authors calculations

Based on the analysis conducted using GWR4 software shown in Table 2, the optimal bandwidth value is obtained through the application of the golden section method in bandwidth selection. The results show that the kernel function that has the lowest CV among other kernel functions or has a minimum CV is the fixed gaussian kernel function, so the fixed gaussian kernel function is chosen as a method for determining bandwidth. The CV value for the fixed gaussian kernel function is 17332.11, with a bandwidth value of 9705.46. With this bandwidth, points within a radius of 9705.46 kilometers (km) are considered to have an optimal influence in shaping a parameter in the observation location model.

GWR is used to estimate regression model coefficients that vary across observations. Each province has a unique regression model (Nurpadilah et al., 2021). By using GWR, parameter estimates can have positive or negative values for each different observation location. This illustrates that the same independent variable can have a positive or negative influence on the independent variable in different provinces. After conducting spatial analysis and testing, GWR regression in this model uses fixed gaussian kernel function weights with a bandwidth of 9705.46. GWR modeling is performed by incorporating spatial weights that have been determined by the weighted least square method.

Table 3. The results of the global estimation of geographically weighted regression (GWR) Human Development Index (HDI)

Variable	Coefficient
Intercept	7768.42*
	(19.33)
Early Marriage	-0.2034*
	(4.14)
Education Completion Rate	-0.3383*
	(4.58)
Religiosity	0.1601*
	(3.25)
GRDP per capita	-0.0002
	(1.99)
Pregnancy Before 18 Years Old	-0.0366
	(0.75)
Contraceptive Use	-0.0001
	(0.07)
Internet Access	0.2323*
	(7.21)
Residence Ownership	0.0048
	(0.53)
The poor population	-0.0023*
	(4.6)
The Proportion of Security	-0.0576*
	(2.18)
Child Abuse Cases	-0.1417
	(1.06)
R-squared	0.9516

Source: Authors calculations

Robust standard errors in brackets, *p<0.1, **p<0.05, ***p<0.01

Based on the results of the global GWR model estimation in Table 3, it can be seen that the value of the coefficient of determination or r-square obtained in the global GWR regression model estimation is 0.9516 or 95.16%. The model formed is able to explain the HDI variable by 95.16% and 4.84% is explained by other variables outside the model.

The global regression model shown in Table 3, can be interpreted that the early

marriage variable has a global coefficient value of -0.2034, which means that any increase in the proportion of early marriage in Indonesia will significantly reduce HDI by -0.2034 index units. The level of educational completion variable has a global coefficient value of -0.3383, which means that any increase in the proportion of the level of educational completion based on not having a primary school certificate in Indonesia will significantly reduce the HDI by -0.3383 index units. Then, the religiosity variable has a global coefficient of 0.1601, indicating that any increase in the number of religious instructors in Indonesia will significantly increase HDI by 0.1601. The GRDP per capita variable with a global coefficient value of -0.0002, the addition of GRDP per capita will reduce HDI but not significantly by 0.0002. Furthermore, the variable of pregnancy before 18 years of age has a global coefficient value of -0.0366, this means that any increase in the proportion of pregnancies before 18 years of age will significantly reduce HDI by 0.0366 index units. The variable of contraceptive use with a global coefficient value of -0.0001, the addition of the proportion of contraceptive use will reduce HDI but not significantly by 0.0001 index units.
Meanwhile, the internet access variable has a global coefficient value of 0.2323, which means that an increase in the proportion of internet use will significantly increase HDI by 0.2323 index units. The variable of residence ownership has a global coefficient value of 0.0048, in which case an increase in the proportion of residence ownership can increase HDI but not significantly by 0.0048 index units. Meanwhile, the poor population variable has a global coefficient value of -0.0023, with this value, an increase in the number of poor people will significantly reduce HDI by 0.0023 index units. Then, the security level variable with a global coefficient value of -0.0576, which means that an increase in the proportion of security levels based on individual anxiety when doing activities and walking alone in the residential area will significantly reduce HDI by 0.0576 index units. And then, the variable of child abuse cases with a global coefficient value of -0.1417, which means that every increase in child abuse cases will decrease HDI but not significantly by 0.1417 index units.

Spatial autocorrelation test using Moran's I index is one of the methods to identify spatial dependence or relationship between variables in various observation locations that are close to each other (neighborhood).

Table 4. The results of the autocorrelation test spatial index Moran's I

Variable	Index Moran's I
Human Development Index	0.1581
Early Marriage	0.1071
Education Completion Rate	0.2215
Religiosity	0.1802
GRDP per capita	-0.045
Pregnancy Before 18 Years Old	0.5363
Contraceptive Use	0.2619
Internet Access	0.3966
Residence Ownership	-0.0477
The poor population	0.912
The Proportion of Security	-0.0217
Child Abuse Cases	0.1641

Source: Authors calculations

In the estimation results of the Moran's I index test in Table 4, it can be seen that almost all variables show positive autocorrelation. In this case, the values of observations at certain observation locations have a tendency to have the same value at geographically adjacent observation locations. However, different things happen to the variables of GRDP per capita (GRDP), ownership of residence (KTT) and security level (TK) which show negative autocorrelation.

Autocorrelation testing using Local Indicators of Spatial Association (LISA) analysis is used to identify observation locations in the research model that have a significant influence on other observation locations that are neighbors, both in the form of positive influence and negative influence locally. This spatial relationship can be analyzed through the Local Indicators of Spatial Association (LISA) method. The LISA cluster map illustrates areas such as provinces, districts, cities or other observation locations that have positive or negative spatial

autocorrelation with neighboring observation locations (neighbors) (Kartika et al., 2021).

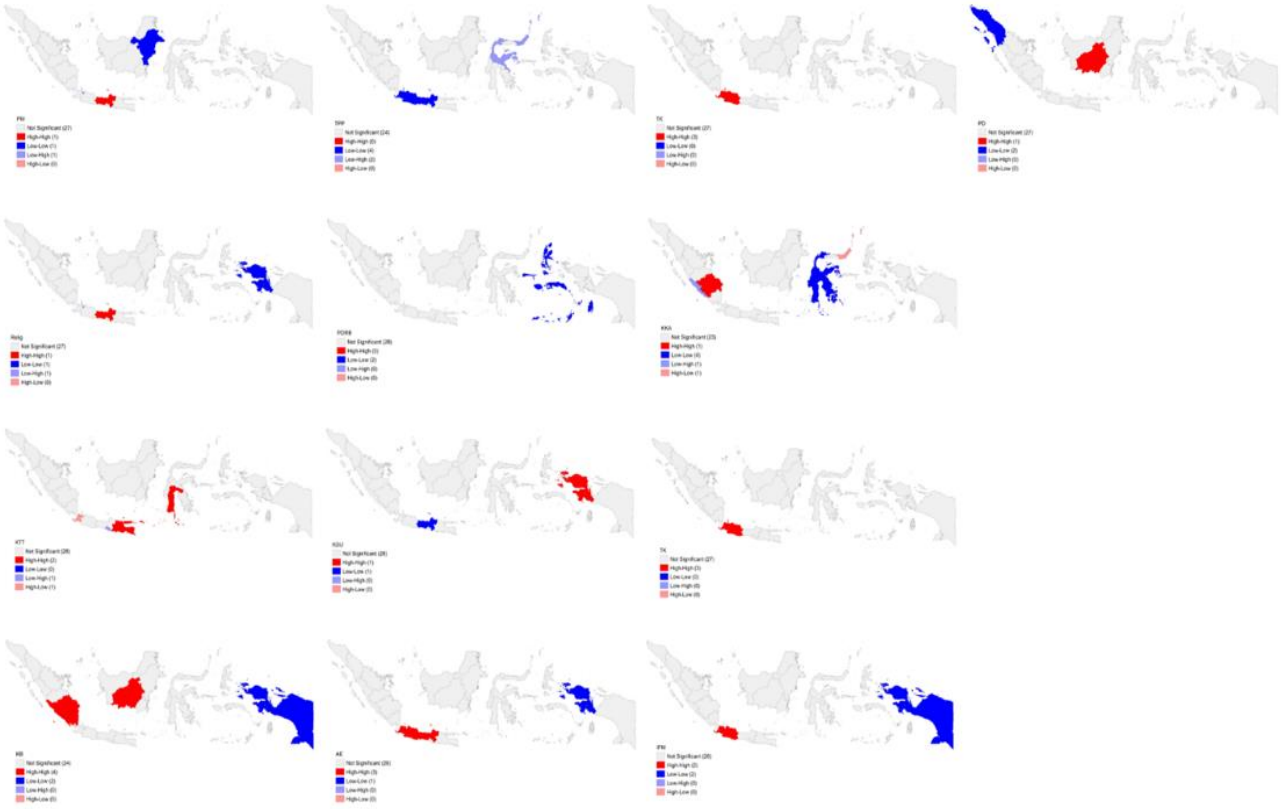

Fig. 6. Local Indicators of Spatial Autocorrelation (LISA) cluster maps on all research variables

The results of the LISA analysis show spatial patterns of variable variation at the provincial level in Indonesia. West Java and Banten provinces stand out with high values on the Human Development Index (HDI), while Papua and West Papua tend to have low values. Early marriage has a strong association in South Kalimantan, while Aceh and North Sumatra show low levels. Central Sulawesi and North Sulawesi have low levels of education completion based on not having a diploma, while Jakarta, West Java and Central Java show high levels. Religiosity is high in Central Java, low in DKI Jakarta, and West Papua has a low score. Maluku and North Maluku show low GRDP per capita, while Central Java and West Papua have high rates of early pregnancy. Contraceptive use is high in Bengkulu, South Sumatra, Lampung, and South Kalimantan, while Papua and West Papua are low. Central Java and West Papua stand out with high poverty rates. Security levels are high in Banten, DKI Jakarta and West Java. Cases of violence against children tend to be low in South Sulawesi, Central Sulawesi, West Sulawesi and North Sulawesi, while high in Bengkulu and South Sumatra. In conclusion, the LISA analysis illustrates interprovincial spatial inequalities in various development and social variables in Indonesia.

Model fit testing is used to test the significance of geographic factors that become the main component in the GWR model. This test was conducted to analyze the influence of location variables on HDI in various provinces in Indonesia.

Table 5. GWR Model Fit Test Results

Model	SS	DF	MS	F
Residual	24307			
Global	6.9	22		
GWR	92558	7.40	12503	
Improvement	.68	3	.28	
Residual	15051	14.5	10311	1.212
GWR	8.2	97	.41	567

Based on Table 5, obtained f count is 1.212567. Meanwhile, *f* table is obtained with a significance of 10% (α=0.1), then the value of f table is 1.895648. Therefore, since *f* count is smaller than *f* table or 1.212567 < 1.895648, it can be concluded that there is no significant difference between the linear regression model and the global GWR model.

4. Discussion

The results show that early marriage has a negative impact on HDI in Indonesia. Regions with high levels of early marriage tend to have various obstacles in making efforts to improve human capacity and economic welfare. This can be seen based on other variables that affect HDI through early marriage. Furthermore, the variable of the level of education completion based on the possession of a primary school diploma shows that this variable has a negative influence on HDI in Indonesia, indicating that early marriage has a relationship with the level of education. Early marriage, which results in low levels of education, can reduce individual capacity and skills. Higher education can be associated with increased productivity, individuals with higher education tend to have a greater ability to participate effectively in economic activities. The impact of early marriage on education levels can have a negative impact on the world of work, especially on child labor participation. Early marriage can be a barrier for children to access optimal education, limiting their contribution to the economy.

On the other hand, the religious variable, measured by the number of religious instructors, has a positive influence on HDI. This can be interpreted as a positive contribution from the presence of religious instructors to aspects of community life, especially in filtering teachings related to early marriage. In the religious dimension, the role of religious instructors in disseminating the right teachings and correcting 'wrong' teachings can make a positive contribution to human development. Religious educators have a role as mediators to change cultural and social norms that are often associated with religion regarding early marriage. The presence of religious educators can shape community attitudes and behaviors that support increased education, have awareness about reproductive health, and sustainable human development. In addition, in dealing with the issue of early marriage, religious instructors can provide a comprehensive view of ethics and morality in religion. By providing a correct understanding of religious teachings related to marriage, religious educators can be effective agents of change in tackling cases of early marriage that are common in society.

Pregnancy before the age of 18 has a negative effect on HDI, indicating that areas with a high proportion of teenage pregnancies tend to have a lower HDI. Teenage pregnancy can have a significant impact on aspects of economic welfare and health in a region. The financial requirements needed to care for a child can put great economic pressure, especially for couples who enter into early marriages. In addition, the impact of suboptimal reproductive health in childhood and adolescence can create serious challenges for maternal and infant health. Poor health at this age can result in extra health care costs. This can hinder a family's economic development and create financial instability. The impact of poor health in childhood and adolescence can extend into the future by reducing the potential for a productive workforce. Health instability in adolescence can hinder individuals' physical and mental development, which in turn can limit their contribution to the region's economy.

Furthermore, the internet access variable has a positive influence on HDI. The positive impact of internet access on HDI indicates that regions with better internet access tend to have a higher HDI. This shows the role of information technology in improving the quality of life and human development in a region. Adequate internet access can provide extensive benefits, especially in human resource development, especially for children and youth. It allows individuals to access educational information, online learning resources and educational opportunities that may not be available locally, thus improving skills and capacities before entering the workforce or pursuing further education, which can support the improvement of HDI in a region. In addition, adequate internet access can also play a role in preventing early marriage. By providing accurate and positive

information about marriage and sexuality, the internet can help shape healthier perceptions and attitudes towards marriage. This educational content can serve as a preventive measure against early marriage, especially protecting children and adolescents from exposure to negative content such as pornography that can influence their views on marriage and sexuality.

The poor population variable has a negative influence on HDI. Regions with a high number of poor people tend to have a lower HDI. Poverty can have a broad impact on the dimensions of human development. The poor often face limitations in accessing various supporting facilities to improve human capital, such as access to education, health services, and decent work. The inability to access these facilities can hinder the poor in developing human capital, resulting in low levels of education and health. As a result of low levels of education and health, decent work opportunities are also limited, creating a vicious cycle of poverty that is difficult to overcome. In this situation, early marriage is often considered a response to the economic pressures faced by poor families. However, early marriage in poor neighborhoods can create a cycle of poverty that is difficult to break, as early marriage is commonly perceived by the poor as a strategy to reduce the family's economic burden.

Low levels of security have a negative impact on HDI in Indonesia. An unstable environment can be detrimental to economic growth and create conditions of insecurity that affect various aspects of people's lives. Businesses tend to be reluctant to open businesses or make long-term investments in areas with low levels of security, creating an unstable economic environment, limiting economic opportunities, and resulting in low levels of job creation and economic growth. In addition, low levels of security can also trigger population migration, as people who feel threatened tend to seek more stable and secure environments. On the other hand, security threats can also be one of the factors that influence early marriage, especially in cases of rape. In situations of high insecurity, rape cases may increase, and rape victims are often faced with social pressure and negative stigma. Early marriage may be considered a solution or response to the social pressure and negative stigma experienced by rape victims, although in many cases, the marriage may not be consensual and a healthy choice. Early marriage triggered by rape can create conditions of insecurity and inequality for girls, as victims are forced into married life without appropriate preparation and choice.

5. Conclusion

Based on the analysis of early marriage and factors that influence early marriage on HDI. The results of the analysis show that early marriage and the factors of early marriage, namely the level of education without a diploma, religiosity, Gross Regional Domestic Product (GRDP) per capita, pregnancy before the age of 18, use of contraceptives, internet access, ownership of housing, poverty level, security level, and cases of violence against children in various provinces in Indonesia, have a diverse impact on HDI. Spatial analysis shows that each variable has both positive and negative autocorrelation variations. In addition, each variable also has at least one province that has Local Indicators of Spatial Autocorrelation (LISA) spatial linkage with varied LISA categories. Geographically Weighted Regression (GWR) modeling shows that the fixed Gaussian kernel function is chosen to determine the weights and bandwidth because it has the minimum Cross-Validation (CV) criteria met. In the local GWR model, the results show that each province has variations in the significance of variables affecting HDI. Adjacent provinces tend to have similarities in the factors that influence HDI, in which case geographically there may be similar factors that influence the level of human development between regions. Through a spatial approach, it can be seen that early marriage is not only a factor that can affect HDI, but there are other factors that can also affect HDI and can increase or decrease early marriage.

Human development needs to pay attention to factors that can encourage early marriage. Individuals who do not participate in education with the output of not having a diploma can increase early marriage and will affect the school enrollment rate and average years of schooling in a province. In addition, human capital will decline as education is a key

milestone in human capital investment to achieve better human development. Infrastructure needs to be considered as a tool for an individual's human capital investment. Access to and use of the internet can be a tool for individuals to improve human capital through easy access to necessary information. However, the availability of internet access has an uneven distribution, especially for provinces that are far from the economic center. Technological advances can have a positive influence if infrastructure is widely considered. In addition to increasing human capacity through positive information obtained on the internet, there are negative influences on the use of the internet. With the widespread and massive use of the internet, it is possible that a lot of negative content is spread on the internet, especially pornographic content. Pornographic content is a threat to an individual's human development, because the content is addictive and will affect other things such as sexual acts that lead to early marriage.

Religious influence can control early marriage, especially in Islam, it is important to pay attention to the teachings that develop in society to protect children from inappropriate understanding and tend to exploit children under the pretext of religious teachings. The spread of Islamic religious instructors needs to be controlled by the quantity and quality of the material they teach in order to avoid misunderstandings, especially related to child marriage. Religious factors, culture and customs that develop in society can affect the human development process of a child, if a child experiences marriage before getting good human capital, the child will have limitations in the future.

Furthermore, economic conditions have a strong role in shaping human development in a province. An increase in GRDP per capita will increase HDI and an increase in the number of poor people will decrease HDI. Both factors are related to economic conditions, the more prosperous an individual or a family is, the lower the occurrence of early marriage experienced by children. Individuals will focus on building human capital for the future and families will not worry about the economic burden of investing in children's human capital. Conversely, if economic conditions worsen and result in an increase in the number of poor people, it will be a threat to a province in forming quality human resources and it is possible that there will be rampant crime as a result of the crush of economic conditions. If economic conditions can improve, it will result in good human development and can achieve the goal of community welfare. One indicator of welfare is the fulfillment of people's needs, such as the need to have a place to live.

Early marriage is a serious problem that will affect health and population growth. Pregnancy before the age of 18 has a high risk. In this case, attention needs to be paid to reproductive education for children. In case of early marriage, knowledge should be given to delay pregnancy until the female partner reaches the ideal age to experience pregnancy and childbirth. The use of contraceptives should be advised for couples who are still determined to have an early marriage to control the pregnancy period of women. However, this does not apply to cases that occur due to sexual intercourse outside of marriage. Education has a very important role, especially sexual education. Teenagers who have high curiosity need control from various parties so that they do not fall into unwanted things and lead to pregnancy before the age of 18.

The security of a province plays a role in relation to early marriage. The level of security can be measured by people's concerns when doing activities and walking alone in their place of residence. Provinces with low levels of security can allow a variety of crimes to occur, one of which is rape. Rape is often something that women fear, especially if they are doing activities alone. However, many phenomena occur in the community when a woman experiences an act of rape, the victim will be forced to marry the perpetrator for certain reasons, one of which is religious and cultural reasons. In addition, it is not uncommon for victims of sexual violence to be children, especially girls. In this case, children who experience rape and are forced to marry the perpetrator, children experience deprivation of rights that cause the child's future to be taken away.

On the other hand, in 2020 the Covid-19 pandemic has become a serious obstacle to the improvement of human capital in Indonesia.

Restricted access to education and health services as a result of the pandemic has been detrimental to human development, especially for children and adolescents who struggle to access necessary learning and health services. The adverse economic impact has also put additional pressure on families, hampering their ability to provide adequate financial support for family education and health. In addition, the social uncertainty that has developed during the pandemic has increased the risk of early marriage, creating an environment that is less conducive to human development. Early marriage, as a social impact of the pandemic, creates a situation where children and adolescents, especially girls, may be forced to enter married life before the ideal time. Restrictions on social activities and increased economic pressures may trigger an increase in early marriage as a response to emergencies or as a family strategy to overcome economic hardship. Early marriage not only hinders adolescents' access to education and health, but can also create a family environment that is not conducive to the full development of human potential.

Finally, this study's weakness is that it has not taken into account the impact before and after the COVID-19 pandemic. Therefore, future research needs to be conducted within a period that has considered the impact of Covid-19. This is important, considering that conditions will be different before and after the COVID-19 pandemic.

References

Abubakar, F. (2019). Islamic Family Law Reform: Early Marriage and Criminalization (A Comparative Study of Legal Law in Indonesia and Pakistan). *Jurnal Ilmu Syariah dan Hukum, 4*(2), 98-118.

Agarwala, S. (1957). The Age at Marriage in India. *Population Index, 23*(2), 96-107.

Agtikasari, N., Soemanto, R. B., & Murti, B. (2019). The Contextual Effect of Social Norm on Early Marriage Among Young Women in Lampung: A Multilevel Analysis Evidence. *Journal of Maternal and Child Health, 4*(1), 1-8.

Agus, K., Nursiyono, J. A., & Chotimah, C. (2022). Determinan Indeks Pembangunan Manusia Jawa Timur Tahun 2020 dengan Pendekatan Geograpichally Weighted Regression. *Journal of Regional Economics Indonesia, 3*(1), 1-16.

Aji, H. M. (2018). The effect of knowledge about halal and Islamic religiosity on attitude toward halal label. *Conference on Islamic Management, Accounting, and Economics (CIMAE) Proceeding, 1*, 1-8.

Amri, K., & Adi, A. R. (2021). Apakah religiositas keislaman memengaruhi ketimpangan pendapatan? Bukti data panel dari Provinsi Aceh. *Jurnal Ekonomi dan Pembangunan, 29*(1), 147-166.

Andriani, R., & Suhrawardi, H. (2022). Hubungan Tingkat Pengetahuan dan Sikap Remaja dengan Perilaku Seksual Pranikah. *Jurnal Inovasi Penelitian, 2*(10), 3441-3445.

Anjas A, M., Sukarsa, I. K., & Kencana, I. P. (2019). Penerapan Metode Geographically Weighted Regression (GWR) pada Kasus Penyakit Pneumonia di Provinsi Jawa Timur. *E-Jurnal Matematika, 8*(1), 27-34 .

Ardiyan, L., Lubis, L., & Siregar, N. I. (2015). Hubungan Sikap terhadap Pornografi dengan Perilaku Seks Pranikah Ditinjau dari Gender. *Jurnal Analitika, 7*(1), 20-30.

Arifin. (2019). Analisis Faktor yang Mempengaruhi Kemiskinan di Indonesia. *Jurnal Administrasi Publik & Bisnis, 1*(2), 58-65.

Aryati, S., Yulianti, S., & Hardinasari, R. (2020). Early marriage in Yogyakarta. *E3S Web of Conferences, 200*(04003), 1-7.

Asnuddin, & Mattrah, A. (2020). Penggunaan media sosial dan peran orang tua terhadap kejadian pernikahan dini. *Holistik Jurnal Kesehatan,, 14*(3), 445-451.

Aulele, S. N. (2014). Geographically Weighted Regression Model Approach to Determine Factors that Influence the Number of Poor Households in Buru Island. *Jurnal Barekeng, 8*(2), 53–57.

Badan Pusat Statistik. (2022). *Badan Pusat Statistik.* Retrieved from Badan Pusat Statistik: https://www.bps.go.id/

Bappenas. (2020). *National Strategy on the Prevention of Child Marriage.* Jakarta:

Badan Perencanaan Pembangunan Nasional.

Barro, R. J. (2001). Human Capital and Growth. *The American Economic Review, 91*(1), 12–17.

Becker, G. S. (1993). *Human Capital: A theoretical and empirical analysis, with special reference to education* (3rd ed.). Chichago: University of Chichago Press.

Bekti, R. D. (2012). Autokorelasi Spasial untuk Identifikasi Pola Hubungan Kemiskinan di Jawa Timur. *ComTech, 3*(1), 217-227.

Bidner, C., & Eswara, M. (2015). A Gender-Based Theory of the Origin of the Caste System of India. *Journal of Development Economic, 114*, 142-158.

Bramastama, R., & Sasana, H. (2021). Pengaruh Internet, Kesejahteraan,Entrepreneur, Pangsa Pasar, dan Nilai Ekspor terhadap Economic Complexity (Studi Kasus: 9 Negara Anggota ASEAN 2009-2018). *Diponegoro Journal of Economics, 10*(1), 1-11.

Claudia, K. S., & Arif, M. (2022). Determinant Analysis of Human Development Index (HDI) in Semarang Residency. *Advances in Economics, Business and Management Research, 655*, 52-58.

Deputi Pemenuhan Hak Anak Kementerian PPPA. (2021). *Buku Pengantar: Berdaya Bersama untuk Pencegahan Perkawinan Anak.* Jakarta: Kementerian PPPA.

Diskominfo Jawa Barat. (2023). *Open Data Jabar*. Retrieved from https://opendata.jabarprov.go.id/

Duflo, E. (2012). Women's Empowerment and Economic Development. *Journal of Economic Literature, 50*(4), 1051-79.

ECPAT. (2016). *Terminology Guidelines for the Protection of Children from Sexual Exploitation and Sexual Abuse.* Bangkok: ECPAT International.

Edmeades, J. D., MacQuarrie, K. L., & Acharya, K. (2022). Child Grooms: Understanding the Drivers of Child Marriage for Boys. *Journal of Adolescent Health, 70*(3), S54-S56.

Elengemoke, J. M., & Susuman, A. S. (2020). Early Marriage and Correlates among Young Women in Sub- Saharan African Countries. *Journal of Asian and African Studies*, 1-24.

Fadli, M. R., Goejantoro, R., & Wasono. (2018). Pemodelan Geographically Weighted Regression (GWR) Dengan Fungsi Pembobot Tricube Terhadap Angka Kematian Ibu (AKI) Di Kabupaten Kutai Kartanegara Tahun 2015. *Jurnal EKSPONENSIAL, 9*(1), 11-18.

Fajriyah, I. M., Marhamah, S., & Anggriani, S. (2023). Dispensasi Perkawinan Anak yang Menjerumuskan: Studi Putusan Hakim di Jawa Timur. *The Indonesian Journal of Socio – Legal Studies, 2*(2), 1-27.

Fayaz, I. (2019). Child Abuse: Effects and Preventive Measures. *The International Journal of Indian Psychology, 7*(2), 872-884.

Fernandes, M., & Ambewadikar, J. (2022). Child Marriage and Human Rights: A Global. *International Journal of Economic Perspectives, 16*(7), 63-72.

Fotheringham, A., Brunson, C., & Charlton, M. (2007). *Geographically Weighted Regression: the analysis of spatially varying relationships.* New Jersey: John Wiley & Sons.

Girum, T., Muktar, E., & Shegaze, M. (2018). Determinants of life expectancy in low and medium human development index countries. *Medical Studies/Studia Medyczne, 34*(3), 218–225.

Hanafi, Y. (2016). Kontroversi Usia Kawin Aisyah RA dan Kaitannya dengan Legalitas Perkawinan Anak di Bawah Umur dalam Islam. *Jurnal of Islamic Law/Jurnal Hukum Islam, 15*(2), 296-319.

Hapsery, A., & Trishnanti, D. (2021). Aplikasi Geographically Weighted Regression (GWR) untuk Pemetaan Faktor yang Mempengaruhi Indeks Aktivitas Literasi Membaca di Indonesia. *Jurnal Riset dan Aplikasi Matematika, 5*(2), 80-91.

Hasanah, U., Pratiwi, R. D., Andriati, R., & Nugraha, D. G. (2021). Early Marriage Determination of Teenagers in Banten Province. *Jurnal Keperawatan Komprehensif, 7*(2), 101-111.

Hasdiani, T., Aliyah, K., Rahma, K., & Siswanto, Y. (2022). Empowering Women Through Women's Organizations in Realizing Family Welfare. *Edukasi, 16*(1), 27-34.

Hillis, S., Mercy, J., Amobi, A., & Kress, H. (2016). Global Prevalence of Past-year Violence Against Children: A Systematic Review and Minimum Estimates. *Pediatrics, 137*(3).

Hotchkiss, D. R., Godha, D., Gage, A. J., & Cappa, C. (2016). Risk factors associated with the practice of child marriage among Roma girls in Serbia. *BMC International Health and Human Rights, 16*(6), 1-10.

IFRC. (2021). *National Society Programming Against Child Marriage.* Geneva: International Federation of Red Cross and Red Crescent Societies.

Ikawati, E., & Anisa, D. (2023). Analisis Meningkatnya Permohonan Dispensasi Kawin Masa Pandemi Covid 19 di Pengadilan Agama Padangsidimpuan dan Pengadilan Agama Panyabungan. *Palita: Journal of Social Religion Research, 8*(1), 1-18.

International Center for Research on Women. (2006). *Child Marriage and Poverty.* India: International Center for Research on Women.

Iujeng P., R., Sukohar, A., Hutahuruk, P., & Putra, A. (2016). Kekerasan dalam Rumah Tangga pada Kasus Pernikahan Dini. *J Medula Unila, 6*(1), 143-148.

Jahra, A., Mahendra, F. T., Dzakiyah, L., & Salsavira. (2021). Spatial Analysis of Prevalence of Early Marriage and HDI in Indonesia. *Jurnal Matematika, Statistika & Komputasi, 18*(1), 31-41.

Jamaruddin, & Sudirman. (2022). Dimensi Pengukuran Kualitas Hidup di Beberapa Negara. *PALLANGGA PRAJA, 4*(1), 51-63.

Jamil, N., & Helda. (2020). Determinant Factors Influence Child Marriage in Cugenang Sub-District, Cianjur District . *International Journal of Scientific and Research Publications, 10*(8), 335-342.

Johnson, F. A., Abu, M., & Utazi, C. E. (2019). Geospatial correlates of early marriage and union formation in Ghana. *PLOS ONE, 14*(10), 1-17.

Judiasih, S. D., Suparto, S., Afriana, A., & Yuanitasari, D. (2018). Women, Law and Policy: Child Marriage Practices in Indonesia. *Jurnal Notariil, 3*(1), 47-55.

Kartika, C. S., Yudita, A. K., & Windiatma, K. A. (2021). Spatial Autocorrelation Analysis of Districts/Cities Gender Inequality in Java Island Using Moran Index and LISA. *Jurnal Sains Informasi Geografi (JSIG), 4*(2), 90-98.

Kartika, S., Sufri, & Kholijah, G. (2020). Penggunaan Metode Geograhically Weighted Regression (GWR) Untuk Mengestimasi Faktor Dominan yang Mempengaruhi Penduduk Miskin di Provinsi Jambi. *Journal of Mathematics: Theory and Applications, 2*(2), 37-45.

Kohno, A., Techasrivichien, T., Suguimoto, S. P., Dahlui, M., Farid, N. D., & Nakayama, T. (2020). Investigation of the key factors that influence the girls to enter into child marriage: A metasynthesis of qualitative evidence. *PLoS ONE, 15*(7), 1-20.

Komnas Perempuan. (2021). *Melihat Dampak Pandemi COVID-19 dan Kebijakan PSBB melalui Kacamata Perempuan Indonesia.* Jakarta: Komnas Perempuan.

Kusuma, A. P., & Oktavianto, A. D. (2022). Analisis Metode Euclidean Distance dalam Menentukan Koordinat Peta pada Alamat Rumah. *Jurnal Teknologi dan Manajemen Informatika, 8*(2), 108-115.

Liczbińska, G., Brabec, M., Gautam, R., Jhariya, J., & Kumar, A. (2023). From little girls to adult women: Changes in age at marriage in Scheduled Castes from Madhya Pradesh and Uttar Pradesh, India. *PLoS One, 18*(2), e0281506.

Lopes, S. B., Brondino, N. C., & Rodrigues da silva, A. N. (2014). GIS-Based Analytical Tools for Transport Planning: Spatial Regression Models for Transportation Demand Forecast. *ISPRS International Journal of Geo-Information, 3*, 565-583.

Lutfiani, N., Sugiman, & Mariani, S. (2019). Pemodelan Geographically Weighted Regession (GWR) dengan Fungsi Pembobot Kernel Gaussian dan Bi-Square. *UNNES Journal of Mathematics, 8*(1), 82-91.

Mardyantari, E., Firdauz, M. A., Pujiningtyas, L. R., Yutifa, H., Susanto, & Sunarsi, S. (2018). Hubungan Media Pornografi dengan Perilaku Seksual Pranikah pada Remaja. *Strada Jurnal Ilmiah Kesehatan, 7*(1), 36-39.

Marino, C., Gini, G., Angelini, F., Vieno, A., & Spada, M. M. (2020). Social norms and e-motions in problematic social media use among adolescents. *Addictive Behaviors Reports, 11*(100250).

Maula, I., Irwandi, Sari, A. L., Sarimin, D. S., & Rondonuwu, R. H. (2023). Pendidikan untuk Pemerataan Pembangunan: Memperjuangkan Hak Semua Anak. *Journal on Education, 5*(4), 13153-13165.

Maulana, A., Meilawati, R., & Widiastuti, V. (2019). Pemodelan Indeks Pembangunan Manusia (IPM) Metode Baru Menurut Provinsi Tahun 2015 Menggunakan Geographically Weighted Regression (GWR). *Indonesian Journal of Applied Statistics, 2*(1), 21-33.

Mei, C. (2005). *Geografically Weighted Regression Technique for Spatial Data Analysis.* Tiongkok: School of Science Suzhou: Xi'an Jiaotong University.

Misunas, C., Gastón, C. M., & Cappa, C. (2019). Child marriage among boys in highprevalence countries: an analysis of sexual and reproductive health outcomes. *BMC International Health and Human Rights, 19*(25), 1-16.

Nashwari, I. P., Rustiadi, E., Siregar, H., & Juanda, B. (2017). Geographically Weighted Regression Model for Poverty Analysis in Jambi Province. *Indonesian Journal of Geography, 49*(1), 42-50.

Nurhikmah, Carolin, B. T., & Lubis, R. (2021). Faktor-Faktor yang Berhubungan dengan Pernikahan Usia Dini pada Remaja Putri. *Jurnal Kebidanan, 7*(1), 17-24.

Nurpadilah, W., Sumertajaya, I. M., & Aidi, M. N. (2021). Geographically Weighted Regression with Kernel Weighted Function on Poverty Cases in West Java Province. *Indonesian Journal of Statistics and Its Applications, 5*(1), 173-181.

Otoo-Oyortey, N., & Sonita, P. (2003). Early marriage and poverty: exploring links and key policy issues. *Gender and Development, 11*(2), 42-51.

Permana, B., Yulmardi, & Junaidi. (2020). Pengaruh komponen indeks pembangunan manusia (IPM) terhadap pertumbuhan ekonomi di Kota Jambi Periode 2004-2018. *e-Jurnal Ekonomi Sumberdaya dan Lingkungan, 9*(2), 110-122.

Pidah, A., Kalsum, U., Sitanggang, H., & Guspianto, G. (2021). Determinan Perilaku Seks Pranikah pada Remaja Pria (15-24 Tahun) di Indonesia (Analisis SDKI 2017). *Jurnal Kesmas Jambi, 5*(2), 9-27.

Plan International. (2013). *Because I am a Girl the State of the World' s Girl s 2013 In Double Jeopardy: Adolescent Girls and Disasters.* Oxford: New Internationalist Publications Ltd.

Ponce, P., Álvarez-García, J., Cumbicus, M., & Río-Rama, M. d. (2021). Spatial Externalities of Income Inequality on Security in Latin America. *Mathematics, 9*(245), 1-19.

Pramitasari, S., & Megatsari, H. (2022). Early Marriage and Various Factors That Affect It. *Media Gizi Kesmas, 11*(1), 275-282.

PUSKAPA. (2020). *Pencegahan Perkawinan Anak Percepatan yang Tidak Bisa Ditunda.* Jakarta: Center on Child Protection & WellBeing.

Ramadanisa, N., & Triwahyuningtyas, N. (2022). Analisis Faktor yang Mempengaruhi Indeks Pembangunan Manusia di Provinsi Lampung. *Sibatik Journal: Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi dan Pendidikan, 1*(7), 1049-1062.

Rofiq, N., Hasbi, M. Z., & Najib, M. A. (2022). Dampak Pandemi Covid-19 Terhadap Peningkatan Dispensasi Kawin (Studi Kasus di Pengadilan Agama Kota Magelang). *Jurnal Studi Hukum Islam dan Pendidikan, 11*(1), 41-58.

Rofita, D., Makmun, I., Amilia, R., Lestari, C. I., & Sofiatun. (2023). Factors Affecting Child Marriage in West Nusa Tenggara. *Jurnal Promosi Kesehatan Indonesia, 18*(1), 16-24.

Rosyadah, J. A. (2021). Determinan Indeks Pembangunan Manusia (IPM) Provinsi Nusa Tenggara Timur (NTT). *Efficient: ndonesian Journal of Development Economics, 4*(1), 1080-1092.

Rumble, L., Peterman, A., Irdiana, N., Triyana, M., & Minnick, E. (2018). An empirical exploration of female child marriage

determinants in Indonesia. *BMC Public Health, 18*(407), 1-13.

Sanjaya, A., Narendra, M. B., Irwanto, Suryawan, A., Irmawati, M., & Efendi, F. (2018). Early Marriage and Its Relationship with Child Development. *Indian Journal of Public Health Research & Development, 9*(9), 193-198.

Sapaat, T. M., Lapian, A. L., & Tumangkeng, S. Y. (2020). Analisis Faktor-Faktor yang Mempengaruhi Indeks Pembangunan Manusia di Provinsi Sulawesi Utara Tahun 2005 - 2019. *Jurnal Berkala Ilmiah Efisiensi , 20*(3), 45-56.

Schultz, T. W. (1963). *The economic value of education.* New York: Columbia University Press.

Schultz, T. W. (1981). *Investing in people: The economic of people quality.* Los Angeles: Universiti of California Press.

Sekarayu, S. Y., & Nurwati, N. (2021). Dampak Pernikahan Usia Dini terhadap Kesehatan Reproduksi. *Jurnal Pengabdian dan Penelitian Kepada Masyarakat (JPPM), 2*(1), 37 - 45 .

Sembiring, R., Nasution, L. N., Faried, A. I., & Novalina, A. (2019). Determinant of Human Development Index (HDI) Towards Poverty in the Regency/City of North Sumatera Province (Case Study Medan, Binjai, Deli Serdang, Karo, and Pematang Siantar). *IOSR Journal of Economics and Finance, 10*(6), 32-36.

Sinaga, J. P., Hendriadi, A., Firdaus, M., Fauzi, A., & Arsanti, I. W. (2021). Analysis of Geographically Weighted Regression (GWR) on Retail Prices of Medium Rice and Red Chili in Java. *Jurnal Manajemen & Agribisnis, 18*(2), 144-155.

Sisters in Islam (SIS). (2018). *Child Marriage: Its Relationship with Religion, Culture and Patriarchy.* Selangor Darul Ehsan: Sisters in Islam (SIS).

Siswati, E., & Hermawati, D. T. (2018). Analisis Indeks Pembangunan Manusia (IPM) Kabupaten Bojonegoro. *Jurnal Ilmiah Sosio Agribis, 18*(2), 93-114.

Solekha, N. A., & Qudratullah, M. F. (2022). Pemodelan Geographically Weighted Logistic Regression dengan Fungsi Adaptive Gaussian Kernel Terhadap Kemiskinan di Provinsi NTT. *Jambura Journal of Mathematics, 4*(1), 17-32.

Strasburger, V. C. (2005). Adolescents, sex, and the media: ooooo, baby, baby-a Q & A. *Adolescent medicine clinics, 16*(2).

Subchi, I., Arsadani, Q., Helmi, M. I., & Faridho, E. (2021). Legal Policy of Child Marriage In the Covid-19 Pandemic Period. *Jurnal Hukum Keluarga dan Hukum Islam, 5*(2), 846-866.

Suparmi, & Soeheri. (2020). Sistem Informasi Geografis Pemetaan Tempat Kost Berbasis Web Menggunakan Metode Euclidean Distance. *InfoSys Journal, 5*(1), 105-113.

Suyanto, B., Sugihartati, R., Hidayat, M. A., Egalita, N., & Mas'udah, S. (2023). The causes and impacts of early marriage: the ordeal of girls in East Java, Indonesia. *Sociologia, Problemas e Práticas, 101*, 71-94.

Sweetland, S. R. (1996). Human Capital Theory: Foundations of a Field of Inquiry. *Review of Educational Research, 66*(3), 341-359.

Talukder, A., Hasan, M. M., Razu, S. R., & Hossain, Z. (2020). Early Marriage in Bangladesh: A Cross-Sectional Study Exploring the Associated Factors. *Journal of International Women's Studies, 21*(1), 68-78.

Tan, W. (2021). Problematika Perkawinan di Bawah Umur dan Tantangan dalam Mencapai Sustainable Development Goals (SDGs). *JUSTISI, 7*(2), 76-88.

Todaro, M. P., & Smith, S. C. (2011). *Economic Development* . PrenticeHaII.

Tyas, D. P., & Sukartini, N. M. (2022). Determinants of the Human Development Index (HDI) in Indonesia. *MediaTrend: Berkala Kajian Ekonomi dan Studi Pembangunan, 17*(2), 481-495.

Ula, M., Daulay, T. A., Hardi, R., Retno, S., Pratama, A., & Sahputra, I. (2023). Clustering Analysis and Mapping of ISPA Disease Spread Patterns in Bireuen District. *Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi), 7*(3), 733 - 742.

UNDP. (2022). *Human Development Report 2021-22: Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World.* New York: United Nations Development Programme.

UNICEF. (2018). *Child Marriage: Latest trends and future prospects*. New York: United Nations Children's Fund.

UNICEF. (2022). *Taking The Field Forward: Investing in Knowledge to End Child Marriage.*) and United Nations Children's Fund.

United Nations Office on Drugs and Crime. (2015). *Elimination of Violence against Children.* Vienna: United Nations.

United Nations Population Fund. (2012). *Marrying Too Young: End Child Marriage.* New York: United Nations Population Fund.

United Nations Population Fund. (2022). *Child marriage - UNFPA*. Retrieved August 5, 2023, from https://www.unfpa.org/child-marriage

Uyumu, E. B., Kilit, F. K., & Barut, Y. (2021). Problematic Internet Use and Marital Adjustment in Married Individuals. *Kastamonu Education Journal, 29*(4), 283-296.

Wahyudi, T. H., & Prastiwi, J. H. (2022). Sexuality and the State: Dispensation of Child Marriage in Indonesia. *Aspirasi: Jurnal Masalah-Masalah Sosial, 13*(2), 205-225.

Wahyudi, T., Hasanbasri, M., Kusnanto, H., & Hakimi, M. (2019). Social Determinants of Health of Child Marriage (Analysis of IFLS 2000, 2007, 2014). *Jurnal Kesehatan Masyarakat, 15*(1), 62-68.

Wibowo, H. R., Ratnaningsih, M., Goodwin, N. J., Ulum, D. F., & Minnick, E. (2021). One household, two worlds: Differences of perception towards child marriage among adolescent children and adults in Indonesia. *The Lancet Regional Health - Western Pacific 8, 100103*, 1-9.

Widiantara, A., & Yuhan, R. J. (2019). Pengaruh Variabel Sosial Ekonomi Terhadap Perkawinan Usia Anak pada Wanita di Indonesia Tahun 2017. *Statistika, 19*(2), 139 – 149.

Wulandari. (2018). Geographically Weighted Logistic Regression dengan Fungsi Kernel Fixed Gaussian pada Kemiskinan Jawa Tengah. *Indonesian Journal of Statistics and Its Applications, 2*(2), 101-112.

Wulandari, R. D., & Laksono, A. D. (2020). Hubungan Status Ekonomi Terhadap Pernikahan Dini Pada Perempuan DI Perdesaan Indonesia. *Jurnal Kesehatan Reproduksi, 11*(2), 115-124.

Yogiantoro, M., Komariah, D., & Irawan, I. (2019). Effects of Education Funding in Increasing Human Development Index. *JEJAK: Journal of Economics and Policy, 12*(2), 482-497.

Zhukov, Y. M. (2010). *Applied Spatial Statistics in R, Section 2 Spatial Autocorrelation* (IQSS ed.). Cambridge: Harvard University.