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Research/Review

Impact of Infrastructure Development and Poverty on Human Development Index in East Java (2018-2022) Using GWPR

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Abstract: In the last ten years, Indonesia has been carrying out massive infrastructure development. The goal is to facilitate community mobility which has an impact on economic growth. Infrastructure development also aims to increase the Human Development Index even though it does not directly affect it. One of the provinces that contributed to infrastructure development was East Java, with the Human Development Index during the 2018-2022 period increasing and tending to stagnate. For this reason, the purpose of this study is to identify the influence of infrastructure development on the Human Development Index, including identifying the influence of poverty on the Human Development Index. The research methodology used is quantitative with a *Geographically Weighted Panel Regression* (GWPR) approach that allows to comprehensively identify the Regional Development Index in East Java. The results obtained were that the variables of Infrastructure Development with the dimensions of Road Length (6,172) and Number of Schools (2,686) had an impact on the Human Development Index in East Java. Meanwhile, the poverty variable (-6,139) has no effect on the Human Development Index (HDI). However, simultaneously the variables of Infrastructure Development and Poverty affect the National Development Index (HDI) with a calculation of 64.42 > 2.4202.

Keywords: Infrastructure, Poverty, Human Development Index, In East Java, GWPR.

1. Introduction

Development in Indonesia in the last 10 years has been quite massive, especially in the field of infrastructure, by carrying the vision of Indonesia-centric development with the hope that development can be enjoyed by all levels of Indonesian society. The latest BPS data shows that the infrastructure development that has been carried out includes roads with a length of 2,103 km, 40 dams, 27 new airports, as well as other projects such as railway roads and the Nusantara Capital City (IKN). In addition, to support connectivity between regions, it is strengthened by the construction of Trans-Papua, Trans-Kalimantan, and Trans-Sumatra lines, which are designed to connect areas that have been isolated. It is hoped that connectivity between islands can help economic growth.

Unfortunately, Human Resources is not a development priority even though it has a significant correlation. Although human resources are not a development priority in this sector is no less important during the 2018-2020 period, it is recorded that the development of human resources pays attention to several things such as first, basic education services which are divided into several parts such as the development of elementary schools with a percentage increase of 0.10% from 2019 with the construction of massive elementary schools carried out by the private sector. At the junior high school / MTS level has received quite good attention in 2020 there are 9.65 percent of sub-districts in Indonesia that already have junior high school / MTS infrastructure, there are still 6 provinces that do not have all junior high schools / MTs such as North Sumatra, Riau Islands, North Kalimantan, Southeast Sulawesi, West Papua, and Papua. As for SMA/MA/SMK education, 90.40 percent of sub-districts already have SMA/MA/SMK infrastructure. Although the willingness of

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SMA/MA/SMK is quite adequate, there are still provinces that do not have SMA/MA/SMK such as Riau, Bangka Belitung Islands, DKI Jakarta, Banten, East Kalimantan and North Maluku. As for universities with a percentage of 86.19% of districts/cities in Indonesia, there are already universities. Unfortunately, it is still dominated by swasti universities compared to the state.

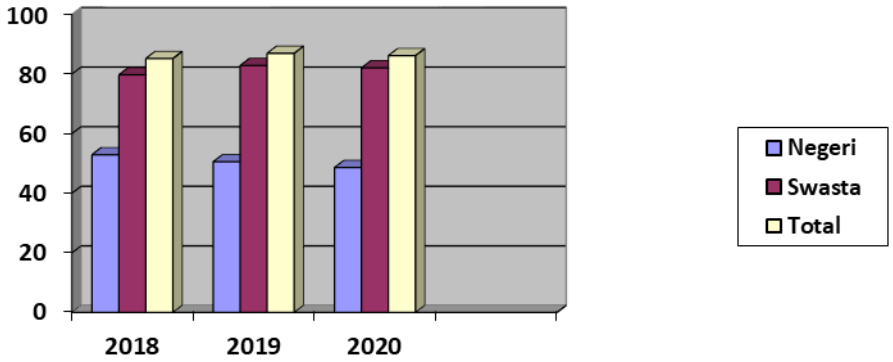


Figure 1. Percentage of Regencies/Cities with Higher Education in Indonesia, 2018-2021

The health sector is also a vital aspect in efforts to realize quality human resources, for this reason the optimization of the health sector is important, especially the availability of health facilities such as the number of hospitals and health centers that can be easily reached by the community. During the 2018-2020 period, the number of hospitals and health centers increased, recorded in 2019 amounting to 2,791 and in 2020 to 2,915 hospitals spread across various provinces with the highest number of hospitals in the provinces of East Java, West Java, and Central Java. On the other hand, the number of maternity homes tends to decrease, recorded during the 2018-2020 period from 1,169 to 457 maternity homes. Therefore, development on the human side needs to be prioritized by the government, because basically human development is an important capital of the sustainability of a country to support the sustainability of the state. Humans are expected to be active in the development process when they are the subject of development, as well as when as an object of development humans are required to have quality over themselves. The main goal in human development is to ensure that every right that human beings have can be fulfilled for everyone. Human beings must have basic capital that refers to education as an effort to improve their quality, but also refers to variables in other types of human investment such as health.

To assess the success of infrastructure development in building human resources, it can be used by paying attention to the Human Development Index (HDI) which has dimensions in three things, namely decent living, knowledge and longevity. The value of life expectancy has indicators of knowledge, health, and average length of schooling. So the value of the Human Development Index (HDI) indicates the success of the country's economic development [1]. One of the factors that can affect HDI is the formation of capital that will be able to support human resources and lead to economic growth. This means that capital formation is the main entrance in economic development which is manifested in the form of certain expertise. Capital formation can be directed to the realization of infrastructure development that is formed on investment rather than the government [2]. Familoni said that *basic essential services* as infrastructure in the development process are the existence of social infrastructure and physical infrastructure which are important elements in facilitating mobility and human activities. Because the main function of infrastructure is as an input to production activities and a means of distributing the production of goods or services to boost the economy [3].

Another factor that is able to affect the Human Development Index is poverty. Robert Solow said that capital is one of the important aspects in supporting capabilities by obtaining facilities that are able to improve individual competencies such as education and health which can be easily obtained with capital. For this reason, poverty can hinder the pace of the Human Development Index (HDI) [4]. This research itself will seek to pay attention to the Human Development Indesk in the East Java region during the 2018-2022 period with HDI growth tending to be stagnant and at a moderate level.

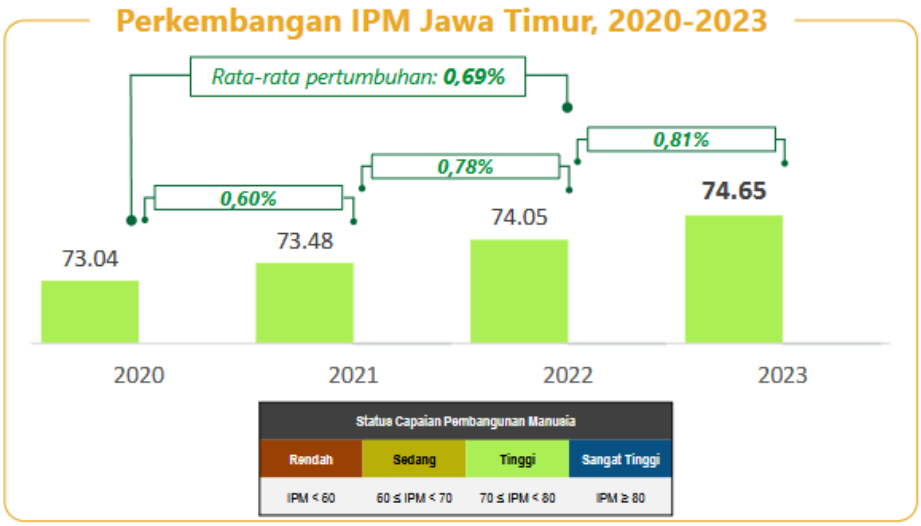


Figure 2. East Java Human Development Index Table 2020-2024

The visualization of the image shows that the Human Development Index 2020-2023 has increased, although not significantly. during the 2020-2023 period, the average HDI growth per year was 0.73%, better than in 2020-2022 which had an average growth of 0.63 with a moderate growth level. Thus, this study seeks to identify the influence of infrastructure and poverty on the Human Development Index (HDI) using the Geographycally Weighted Panel Regression (GWPR) approach, which allows to identify areas that need special attention in Human Resource Development, so as to formulate policies that are appropriate to the needs of each region in East Java.

2. Preliminaries or Related Work or Literature Review

Infrastructure Development

Economic development or the transformation of a traditional society into a modern society requires quite a lot of dimensions. Rostow, (2013) assuming that economic growth is not only influenced by fundamental aspects but also by external aspects such as political conditions and the correlation between society and the state. Todaro & Smith, (2013) also argued the same thing by explaining that economic growth requires a social, institutional, unemployment, inequality and community attitude transformation so that the goals of economic development can be achieved. With the hope that inequality will not occur and eradicate poverty so that welfare for the community can be guaranteed.

Capital formation and population growth also participate in economic growth. For example, capital formation contributes by providing the role of both domestic and foreign investment through Foreig Direct Investment (FDI) which has a direct impact on economic growth [7]. Through this FDI, it will move on government programs such as infrastructure

development that requires a lot of capital, including in efforts to develop human resources through allocations for schools that increase community productivity. In addition, FDI also contributes to tourism development with community income (Dwi Agvita Berutu et al., 2021).

In addition, economic development also emphasizes the importance of government policies for sustainable development by involving human competence and capabilities. For this reason, government policies need to prioritize program integration, wide coverage, equal distribution of income and basic services, and the development of family development models [9]. In the implementation of the program, it is certainly necessary to pay attention to fiscal reallocation which has an essential role, especially in developing countries, including the institutional structure of the national financial sector which requires restructuring as a preference and conditioning of human resources (Abdullah, 2014). With the reallocation in the Netherlands such as health, education will have an impact on the Human Development Index (HDI).

Therefore, it is important to encourage investment in the world of education by increasing the allocation of education financing. In addition, another action that the government can take is to build cooperation with the private sector to encourage technology imports from developed countries. With assistance from the private sector, it will encourage infrastructure development such as transportation, the provision of financing for the construction of railways to canals that encourage economic growth [9]. With infrastructure development, it can increase the mobilization and distribution of goods at a high speed as well as improve the quality of transportation services [11]. The short-term impact on infrastructure builders is that it can create jobs in sectors that receive allocations from FDI such as construction. Meanwhile, the medium and long-term impacts are the efficiency and productivity of various economic sectors. So that infrastructure development is considered the right strategy to encourage economic growth [12]. The World Bank report states that infrastructure is categorized into three, namely economic infrastructure that prioritizes physical assets in providing services and providing for mass production and consumption such as *public utilities* and *public works*. Second, social infrastructure includes assets that support health and wellness. Third, administrative infrastructure such as law enforcement, coordination and administrative control [13].

H_1: Infrastructure Development has a positive effect on the Human Development Index (HDI).

Poverty.

Poverty is formed and identified from the measurement of a group of people or groups referred to as the poor. In general, countries have different poverty criteria. This condition is caused by the relative poverty conditions in each country. This means that the definition of poverty is only based on certain criteria such as average income, purchasing power or average consumption ability [14]. The problem of poverty will trigger other problems, especially for developing countries. Poverty itself is divided into two, namely absolute and relative, absolute poverty is caused by the inability to access basic needs such as food, clothing and shelter. Meanwhile, poverty is relatively caused by economic inequality which correlates with inequality (Todaro & Smith, 2013).

Koznet explained that the poor have a relatively good ability to obtain resources through existing opportunities. Although outside assistance is sometimes needed, it is not just certain, so the community depends on outside support [6]. This empowerment approach is

considered unsuccessful because no community lives and develops if it is isolated from other community groups. This isolation will cause a passive attitude, and even tend to lead to an increasingly poor state [15]. Syofya, (2018) has identified a positive between poverty and economic growth on the Human Development Index (HDI). This is due to the fact that the competency improvement facilities are received less than those with financial competence. Tahan Upoyo Trisno et al.,(2021) also identified that the relationship between poverty and the Human Development Index (HDI) is positively correlated, if then the condition of the poor population is increasingly unable to meet their basic needs then it is impossible for them to meet their secondary and tertiary needs.

H_2: Poverty has a positive impact on the Human Development Index (HDI)

Human Capital

Human competence is innate and needs to be continuously improved by investing in human capital. *The World Bank* explains that human capital in general consists of knowledge, skills and health [16]. So human capital is not only in material capital but includes all aspects such as knowledge, abilities and skills that he has acquired and accumulated from time, which supports them to acquire the feasibility of life as an individual. Capital theory explains that humans will be more productive if they have knowledge and skills [9].

The main goal of investment in human capital is to increase productivity which has an impact on increasing economic responsiveness, however, education is a human element in increasing opportunities for progress, reducing corruption to underdevelopment [17]. This means that if an individual is able to access quality education, training or skills will increase their chances of living a more decent life and have a direct impact on innovations that support economic growth [18]. Human capital has an intrinsic value that can be measured, so that it becomes a component of human resources, namely the Human Development Index (HDI) which covers three aspects, namely survival, school, and health [13]. With the following equation: Human Capital Indeks = *Survival* x *School* x *Health. First, Survival* is the probability from living to the age of 5 years, for children who are unable to live until childhood will never become a productive adult which has consequences for the future as future employment will be reduced [19]. School which is measured through the expectancy of school length with children obtaining full education from 14 years to 18 years, For children who obtain 10 years of education are estimated to experience a decrease in productivity by 32% (the difference of four years of education is multiplied by 8% per year [20]. *Third*, Health which consists of survival for the age of 15 to 60 years and the fraction for children under 5 years old is not stunted. The contribution of health to health is relative in nature based on the full health measure which is understood as the absence of stunting and survival to adulthood by 100% [21]. Another indicator that can be used as a comparison is the socio-economic development presented annually by UNDP.

3. Proposed Method

The research methodology used is qualitative with an explanantory research approach which aims to identify the influence of the independent variable on the dependent variable [22]. For this reason, this study seeks to elaborate from the influencers of infrastructure development and poverty to the Human Development Indeks for each region of East Java.

The data used is panel data obtained through the website of the Central Agency for Statistics of East Java and the publication of TKDD posture data of districts/cities in East Java.

To assist in the analysis, GWPR analysis was used to identify the Human Development Index (HDI) in each region in East Java, which made it possible to formulate policies that could support the Human Development Index (HDI). So from that the equation obtained is:

$$Y_i = \beta 0\ (ui, ui) + \sum_{k=1}^{p} \beta k\ (ui, ui) xik + \epsilon i$$

With the value of yi as the observation value of the ith dependent variable. xik is the value of the kth explanatory observation in the observation location, while β0 (ui, ui) is the constant value of the ith observation (ui, ui) as the geographical location coordinates of the ith observation location, βk (ui, ui) is the coefficient value of the kth penetrating variable of the ith observation location and $\epsilon i$is the erro standard of the observation.

4. Results and Discussion

Hypothesis testing and modeling require stages that need to be fulfilled as in the initial stage through descriptive analysis, with the aim of identifying the maximum and minimum values for each variable:

Table. 1 Descriptive Statistics of Independent and Dependent Variables

Variabel	Minimum	N	Maksimum	Mean
Y (IPM)	**61.00**	**190**	**82.74**	**71.94**
X1 (PJ)	**0.00**	**190**	**2985.00**	**451.26**
X2 (JS)	**1.21**	**190**	**3924.00**	**1238.08**
X3 (KM)	**6.63**	**190**	**276.58**	**114.73**

From the visualization of the table, it shows that first, the HDI variable in the East Java region for the 2018-2022 period is highest in the city of Surabaya with a value of 82.74 while the lowest HDI is in Sampang district with a value of only 61.00. Meanwhile, the average HDI in the East Java region is at a value of 71.94. Second, the construction of roads reached 2,985 KM, with 8 areas with the lowest 0 Km consisting of Trenggalek, Probolinggo, Ngawi, Madiun, Probolinggo city, Mojokerto city, and Madiun city. The average construction area of the road length in the East Java region is 451.26 Km. Third, the highest number of schools is 3924 schools in the Surabaya city area and the lowest is only 1.21 in the Madiun area. With the Madiun area with an average number of schools of 1238.0. Fourth, the highest poverty of 276.58 is in the Malang regency area and the lowest is 6.63. Average poverty in East Java 114.73.

Model Regrssion Global

The next stage to analyze GWPR requires a global regression model, this global regression model allows choosing the best model among the factors that affect the Human Development Index (HDI). The panel data regression model is divided into three, namely: *Fixed Effect Model* (FEM) a combination of time series and cross section data assuming that the intercept has a difference between the subject and the subject slope. The results of the FEM estimates are as follows:

Tabel 2. *Fixed Effect Model* (FEM)

	Estimate	Std Error	t-Value	Pr (>I t I)
Road Length (X1)	**6.1722**	**6.9775**	**8.8459**	**2.419**
Number of Schools (X2)	**2.6865**	**6.5403**	**4.1076**	**6.570**

Poverty (X3)	**-6.1393**	**2.7192**	**-2.2578**	**0.02541**

Estimation model obtained Y = 6.1722 PJ + 2.6865 JS - 6.1393 KM. The results of the fixed effect model showed that there were two independent variables that affected the Human Development Index (HDI) with 6.1722 and 2.68655 respectively and the resulting correlation was positive. Meanwhile, poverty has a negative value of -6.1393 against the Human Development Index of the East Java Region. The *Fixed Effect Model* (FEM) is considered the best model. For this reason, the Chow and Hausman tests show that FEM is the best model:

Table 3. Test Chow and Hausman

No	Test	Statistik Calculation	P-Value	Decision
1	Uji Chow	F_{hitung} = 272.99	< 0.05	FEM model is better than REM
2	Uji Hausman	x_k^2 = 38.668	0.05	FEM model is better than PLS

The table visualization shows that *the Fixed Effect Model (FEM)* is the best model with a f-value of 272.99 with a P-Value of < 0.05.

GWPR Model Estimation

The GWPR model estimation also requires a bandwidth value through the AIC (Akakei Information Criterion) method. The basis for making decisions on the AIC model is if the model has the least AIC value. The following are the values from the AIC:

Table 4. AIC Values

Function Kernel	Bandwith	AIC
Fixed Gaussian	0.554032	245.258
Fixed Bisquare	0.568651	243.2117
Tricube	0.5702475	243.3158

The following will also be presented with bandwidth for each region in East Java:

Table 5. Band of each Regency/City

Kab/Kota	Bandwith	Kab/Kota	Bandwith
Pacitan	377.3388	Magetan	378.2254
Ponorogo	378.7926	Ngawi	379.5618
Trenggalek	379.6255	Bojonegoro	380.3215
Tulungagung	380.6037	Tuban	380.4234
Blitar	381.3739	Lamongan	382.3677
Kediri	380.0671	Gresik	383.195
Malang	383.0671	Bangkalan	383.6759
Lumajang	385.3711	Sampang	385.4708
Jember	397.1972	Pamekasan	386.278
Banyuwangi	389.7211	Sumenep	387.9282
Bondowoso	387.6485	Kediri city	380.8095
Situbondo	388.3313	Blitar city	381.3355
Probolinggo	385.2807	Malang city	383.1278
Pasuruan	384.0759	Probolinggo city	385.2902
Sidoarjo	383.383	Pasuruan city	384.1386
Mojokerto	382.497	Mojokerto city	382.397
Jombang	381.6143	Madiun city	389.7211
Nganjuk	380.3458	Surabaya city	383.5364

Madiun	**378.9274**	**Batu city**	**382.7514**

The table visualization shows that Fixed Bisquare selects the minimum oprimum and AIC bandwidth. So this research uses a bisquare fixed kernel with a value of 243,211. The GWPR modeling for each weight per year is different so it is unlikely to be repeated. The bissquare weighting results in variations in the bandwidth value for each region. The difference in bandwidth value is useful for estimating the GWPR parameter of each observation location. Although bandwidth varies, these values are considered the same and consistent from year to year:

The following is an example of the observation of the GWPR model used for the observation location of the City of Surabaya:

IPM = 6.172 PJ (X1) + 2.686 JS(X2) – 6.139 KM(X3)

The model that has been obtained is then partially tested by identifying the *goodeness of fit* of the GWPR model. In table 11, it appears that the P value is <0.005 so that the H_0 hypothesis is rejected.

Model Fit Test

The next stage is a model feasibility test which aims to find out the difference between GWPR and the panel data regression model with a confidence level of 5%.

Table 6. Model fit test

Result	Conclusion
F = 64.42, F > 2.4202 dan p-value > 0.10	**H_0 ditolak**

From the visualization of the image, it appears that the independent variable has a significant influence on the HDI variable in each region with a P-Value for each region < 0.05. Then identify the most effective model in influencing the Human Development Index (HDI) as follows:

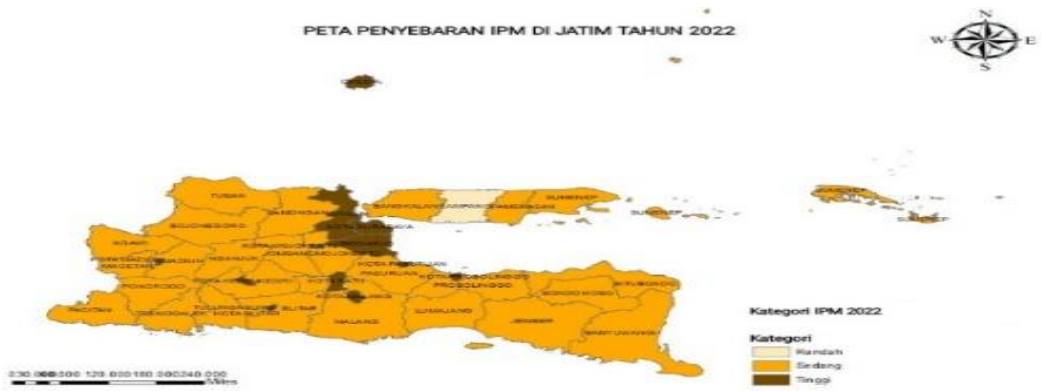
Table 7. Global comparison and GWPR

Model Regresi	R^2
GWPR	**0.50967**
Regresi Global	**0.50957**

The results of the analysis show that the GWPR value has a higher value of 0.50967 or 50.96% compared to the global regression of only 0.50957 or 50.95%

Discussion

The distribution of the East Java Human Development Index (HDI) during the 2018-2022 period has increased which tends to be stagnant. This is due to the uneven development of the Human Index. This inequality is caused by the fact that access to human development is only accessible to those in urban areas. In contrast to those in rural areas who are not fluent in gaining access to efforts to improve their capabilities. In addition, it is suspected that



inequality is also caused by the location between regions that have spatial diversity for the Human Development Index.

Figure 3. HDI Distribution Map in East Java in 2022

The visualization of the image shows that the diversity of human development in the East Java region is at a moderate level. However, there is a relatively high Human Development Index (HDI) in the city of Surabaya, Sidoarjo Regency, Pasuruan City, Malang City, Batu City with brown color. Meanwhile, in areas with light brown colors, it shows low human development as happened in Sampan Madura district. This visualization also argues that the distribution of human development in the East Java region is only in urban areas, because access to competency improvement is limited to urban areas only. Compared to rural areas that are almost untouched on the aspect of human development

First, Infrastructure Development against the Human Development Index (HDI) in East Java. Infrastructure development is divided into two dimensions, namely the length of the road and the number of schools. The length of the road was identified as being able to affect the Human Development Index (HDI). However, the significance of road construction has a positive impact on several areas such as Tuban Regency, Pacitan Blitar City, Batu City, etc. The development of road access in areas that have an impact on the economy is actually driven by the characteristics and characteristics of the region. Just like Pacitan is very dependent on tourism, the construction of roads allows access to tourist attractions to be done easily. Meanwhile, in the northern region such as Tuban, access to the distribution of goods is fast and efficient. So that it contributes to the income and economy of the northern part of East Java. With access to road construction helps increase individual income which allows people to be able to access facilities that can improve the capabilities of their children such as education, training and certification. As stated by Solow, human development will be directly related to the capital owned by each individual. Hartanto et al., (2023), Rosyid & Lukito, (2019), Weya & Lubis, (2022) also explained that economic improvement is able to get access to quality and better education:

Figure 4. Significance of Variable Distribution

The number of schools also has a positive impact on the Human Development Index (HDI). The number of schools significantly affects several areas such as Jember district, Malang City, Malang Regency, Pasuruan Regency and others. This means that the number of schools is needed to provide equal opportunities to each individual to access educational facilities so that it is possible to increase productivity and innovation that has an impact on the quality of life and economic growth. Vania Grace Sianturi et al., (2021), Budhijana, (2020), Maryozi et al., (2022) found that education is able to increase community productivity through individual skills and qualifications to actively participate in the economic development process.

Second, poverty is negatively correlated with the Human Development Index (HDI) in the East Java region. This means that poverty does not directly impact human development in the East Java region. This is due to several factors, such as the development model of the East Java region which is closely related to empowerment as is the case in the Banyuwangi and Situbondo regions. Empowerment is considered unsuccessful and tends to isolate the community. Garnella et al., (2020), [17], Irwanda et al., (2020), Anggraini et al., (2023) said that the isolation carried out by himself or his community caused a deadly attitude, and accepted their poor condition. In fact, the poor still have a relatively better ability to obtain existing sources of opportunity. Although sometimes it needs help and support from outside.

5. Conclusions

Infrastructure development affects the human development index in Regencies/Cities in East Java. *First*, the length of the road that is able to increase people's mobility which has an impact on economic changes that result in increasing community capacity. *Second*, the number of schools also has a positive impact on the Human Development Index (HDI) by providing decent education that results in productivity and individual participation in creating innovations that contribute to economic growth. *Third*, poverty does not have a significant impact and is negatively correlated because poverty occurs due to structural poverty that needs to be reviewed.

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