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What Drives Low-Human Development in South Bangka Regency? Integrating with ARIMA Forecasting

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A B S T R A C T

This research aims to analyze the increase in the components of the human development index (HDI) in South Bangka Regency, namely (1) Life Expectancy (LE), (2) and Mean Years of Schooling (MYS), (3) Per Capita Expenditure (PCE). This research also aims to test the autoregressive integrated moving average (ARIMA) time series model to predict the three HDI components. The data in this study uses secondary data obtained from various sources from 2011 to 2022. The results of our study show that, Life expectancy is influenced by access to clean water and the number of doctors in South Bangka Regency, the mean years of schooling are influenced by the number of elementary school teachers and the education budget, and the increase in per capita expenditure is influenced by the increase in government spending. The prediction results show that this model is accurate enough for forecasting. The research results show that the ARIMA model has the best performance for predicting LE, MYS, and PCE where the LE ARIMA model is (2,2,2), the MYS ARIMA model is (3,1,1), and the ARIMA PKE model is (2,1,2).

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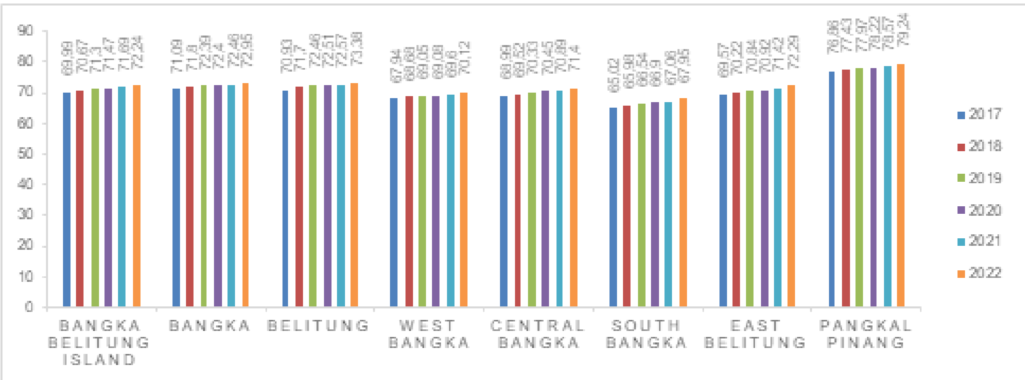
INTRODUCTION

The government plays a role in optimizing economic conditions. One of the state's tasks is to shape economic policies in such a way that economic benefits can be felt by all levels of society. The goal is prosperity and economic equality, which is felt at all levels of society. In several economic theories, achieving prosperity and economic equality can be achieved through economic development (Maryozi et al., 2022; Siahaan et al., 2022). Human development is an indicator of the progress of a region and achieving development cannot be separated from the quality of people in a region. To see the extent of success in human development, the United Development Program (UNDP) has issued an indicator, namely the Human Development Index (HDI) (Alam et al., 2021; Bilbao-Ubillos, 2013; Masduki et al., 2021),

The human development index is used to measure how big the impact is from efforts to increase basic human capital capabilities (Ngoo & Tey, 2019). Human development is a component of development through population empowerment which focuses on improving human basics. Development is calculated using the size of education, health, and purchasing power. The higher the number obtained, the more the development goals will be achieved. Development is a process of making changes for the better (Pamungkas & Dewi, 2022).

Human Development Index is a benchmark for achieving higher-quality human development. There are three basic dimensions as a reference for measuring the Human Development Index, namely including a long and healthy life, knowledge, and a decent standard of living (Dewi et al., 2017; Hasibuan et al., 2020; Syaputro, 2022). Increasing the three components of the Human Development Index is expected to improve people's quality of life (Koohi et al., 2017).

Based on Figure 1, it is known that the Human Development Index for Districts/Cities of the Bangka Belitung Islands Province from 2017 to 2022. Pangkalpinang City is the region that has the highest HDI, namely 76.86 in 2017 and 79.24 in 2022, while the region that has the lowest HDI is South Bangka Regency, namely 65.02 in 2017 and 67.95 in 2022. According to (Bangun, 2020; Fauzi, 2017; Sari & Supadmi, 2016) HDI achievements in a region can be grouped into four categories, namely (1) low category: HDI <60, (2) medium category: 60 ≤ HDI < 70, (3) high category: 70 ≤ HDI < 80, (4) very high category: HDI ≥ 80. From the data above we can conclude that the HDI of South Bangka Regency is in the medium category.



Source: Central Bureau of Statistics and Health Office of South Bangka Regency, 2023

Figure 1.

Human Development Index for Regency/City Bangka Belitung Islands Province 2017-2022

Despite various development efforts made so far, the Human Development Index (HDI) in South Bangka Regency is still below 70, which is categorized as medium and is the lowest among other regencies/cities in the Bangka Belitung Islands Province. This reflects serious challenges in improving the quality of life of the community in the region. Inadequate access to health services, quality education, and a decent standard of living are factors that contribute to the low HDI. Moreover, the negative influence of environmental factors, such as lack of access to clean water and adequate health facilities, worsens the health conditions of the community. Therefore, this study focuses on the identification and analysis of factors that influence the components of the HDI in South Bangka, with the aim of providing policy recommendations that can support improving the quality of life and encourage more equitable development in the region.

Human capital theory plays a vital role by emphasizing the importance of investing in human capabilities to achieve higher productivity and economic growth. The theory posits that improving education, health, and other essential services directly enhances individuals' productivity, ultimately leading to broader economic benefits (Abbas et al., 2024; Goldin, 2024). By aligning with the three dimensions of the Human Development Index (HDI), namely life expectancy, education, and per capita income, Human Capital Theory underscores the importance of strategic investments in human resources to foster regional development. In South Bangka Regency, where the HDI lags compared to other regions, enhancing access to quality healthcare, education, and living standards through targeted government policies is essential to achieving long-term sustainable growth. This research examines these components in light of Human Capital Theory, exploring how government interventions in health, education, and public expenditure can stimulate human capital development and improve HDI outcomes (Serenko, 2024).

Pakistani economist Mahbub ul Haq created the Human Development Index (HDI) idea for the first time in 1990. Mahbub ul Haq, an economist, collaborated closely with a number of specialists, notably Amartya Sen, a well-known Indian economist who was instrumental in the creation of this idea. In order to provide a more comprehensive method of gauging development, Mahbub ul Haq created the Human Development Index (HDI), which takes into account factors like human living standards, health, and education in addition to economic growth (as measured by GDP). Amartya Sen made a contribution as well with his theory of "capabilities," which holds that human development should be evaluated in terms of a person's capacity to lead a fulfilling life rather than merely their outward appearance (Ali, 2024; Liyanage & Kankanamge, 2017; Quinn, 2017).

Encouraging an increase in the human development index comes from three HDI dimensions, the first is the health aspect which is calculated from life expectancy, namely the estimated average number of years a person can live from birth, this represents the level of health in an area (Murray et al., 2000; Tareque et al., 2013; Wahlberg & Rose, 2015). The second is the education dimension which is calculated from a combination of two indicators, namely expected length of schooling and mean years of schooling (Krueger & Lindahl, 2001; Simatupang, 2020; Zhao & Barakat, 2015). Lastly is the dimension of decent living which is measured from the per capita expenditure indicator for each household in an area (Afzal et al., 2015; Martins, 2007). For this reason, by increasing the HDI in South Bangka Regency, we have to analyze these three components, which components are most likely to be encouraged, so that an increase in the community development index in South Bangka Regency can be achieved, by what has been targeted by the regional government, so that development in South Bangka Regency can be felt by the community and the main purpose is to improve welfare.

Previous studies on the evolution of the human development index provide valuable insights into the socio-economic determinants that influence these factors across regions. Şentürk & Ali (2021) analyzed gender-specific life expectancy in Turkey, revealing the significance of education level, purchasing power, and economic growth, while population growth and environmental degradation were insignificant. Similarly, Bilas et al (2014) examined life expectancy in EU countries, highlighting that GDP per capita and educational attainment explained up to 82.6% of the variation in life expectancy. Shaw et al., (2005) found that pharmaceutical consumption had a significant impact on life expectancy in middle-aged and elderly populations, while lifestyle factors such as reduced tobacco use and increased fruit and vegetable consumption further increased longevity. Appiah (2017) and Sabrina et al. (2022) extended these findings by showing the positive effects of education spending on GDP per capita and the human development index, particularly through increased school attendance and improved infrastructure. Together, these studies underscore the important role of economic, educational, and health care factors in shaping human development outcomes, in line with research focus in South Bangka Regency.

Although previous studies have comprehensively examined the socioeconomic factors that influence the human development index in various regions, there are still gaps that need to be filled regarding specific local contexts, especially in developing regions such as South Bangka Regency. Most previous studies have focused on developed countries or regions with more established health infrastructure and systems, such as Turkey (Şentürk & Ali, 2021), the European Union (Bilas et al., 2014) and OECD countries (Shaw et al., 2005). However, there is little in-depth research on how factors such as access to clean water, the number of doctors, the number of teachers and government spending affect HDI dimensions in developing regions. In addition, the application of predictive methodologies, such as ARIMA forecasting, to analyze HDI development and forecast future trends is still rare in the context of human development. Therefore, this research will fill the gap by providing specific analysis for South Bangka Regency and integrating predictive approaches to support future development planning.

METHODOLOGY

This research was conducted in South Bangka Regency, in 2023. This research used secondary data sourced from the Bangka Belitung Islands Provincial Central Statistics Agency, South Bangka Regency Central Statistics Agency, South Bangka Regency Regional Financial Agency, South Bangka Regency Health Service, Education Office and Culture of South Bangka Regency, and the One Stop Integrated Investment Service of South Bangka Regency.

This study uses a mix method approach, which is a combination of qualitative and quantitative methods to provide a more comprehensive analysis of the factors that influence the Human Development Index (HDI) in South Bangka Regency. The qualitative approach is carried out through descriptive analysis which aims to explain in detail variables such as life expectancy, average length of schooling, and per capita expenditure and the factors that influence them. This analysis provides an overview of the actual conditions of the data collected, including trends and patterns that emerge from secondary data during the period 2011 to 2022. Meanwhile, the quantitative approach is carried out using the Autoregressive Integrated Moving Average

(ARIMA) forecasting model, which is one of the time series methods to predict the future development of HDI components based on historical data. The ARIMA model is used because of its strong ability to analyze non-stationary data, as well as to project future trends in life expectancy, average length of schooling, and per capita expenditure in South Bangka Regency. By combining these two methods, this study is not only able to describe current conditions but also provide estimates that can help in better regional development planning.

ARIMA is a time series model used based on the assumption that the time series data used must be stationary, which means the means and variance of the data in question are constant (Adhikari & Agrawal, 2013; Chen et al., 2009; Kumar & Anand, 2014). However, this is not often found in some existing time series data, because the majority of existing time series data is data that is not stationary but integrated (Tholib, 2016). The general form of the autoregressive integrated moving average (ARIMA) model is as follows:

$$Xt = \mu' + \varphi 1Xt\text{-}1 + \ldots + \varphi pXt\text{-}p + et + \theta 1et\text{-}1 - \ldots - \theta qet\text{-}q \quad (1)$$

where Xt is time series data at time t, $Xt-p$ is time series data at time (t-p), $et-q$ is error value at time t-q $\varphi 1, \varphi p, \theta 1, \theta q$ are the model parameters

Box-Jenkins Approach

The Box-Jenkins approach, also known as the ARIMA (Autoregressive Integrated Moving Average) methodology, is a widely used technique for analyzing and forecasting time series data. Developed by statisticians George Box and Gwilym Jenkins in the 1970s, this iterative approach involves identifying, estimating, and validating ARIMA models to make accurate predictions (Abonazel & Abd-Elftah, 2019). The Box-Jenkins methodology consists of the following key steps:

Identification

Determine if the time series is stationary. If not, apply differencing to achieve stationarity. Identify the parameters (p, d, q) of the ARIMA model using autocorrelation function (ACF) and partial autocorrelation function (PACF) plots:

p: Order of the autoregressive (AR) part
d: Degree of differencing (integrated part)
q: Order of the moving average (MA) part

Estimation

Fit the ARIMA model using the identified parameters.
Estimate the model coefficients based on the training data.

Diagnostic Checking

Evaluate the model fit by analyzing the residuals.
Check for autocorrelation in the residuals and ensure they resemble white noise.
Identify any potential overfitting or model inadequacies.

Forecasting

If the model passes the diagnostic checks, use it to make forecasts for future time points.

Assess the forecasting accuracy using a separate test dataset and metrics like RMSE (Root Mean Square Error) or AIC (Akaike Information Criterion). The Box-Jenkins approach assumes that the time series is stationary or can be made stationary through differencing. It also assumes that the data is free from outliers and that the residuals exhibit no discernible patterns.

The period from 2011Q1 to 2022Q4 was selected for this study due to the availability of complete and consistent data for the key variables related to the Human Development Index (HDI) in South Bangka Regency, specifically Life Expectancy (LE), Mean Years of Schooling (MYS), and Per Capita Expenditure (PCE). This period encompasses critical years of development and government interventions aimed at improving human development indicators in the region. The selection of this time frame allows for the capture of trends and changes that reflect the effects of policy implementations and economic fluctuations within the regency. Moreover, it includes the most recent available data, providing relevance and timeliness to the findings and forecasts.

The Autoregressive Integrated Moving Average (ARIMA) model was chosen for this research due to its robust ability to analyze and forecast time series data that exhibit non-stationary behavior. In this study, the HDI components (LE, MYS, and PCE) demonstrate trends over time, which can be efficiently modeled using ARIMA to understand the underlying patterns and predict future movements. ARIMA's flexibility in handling data that may have seasonality, trends, and autocorrelations makes it particularly suitable for forecasting the development of human capital indicators, such as those in South Bangka Regency. Furthermore, the application of ARIMA aligns with the study's objective to provide reliable future projections based on past data, supporting strategic planning for regional development initiatives.

RESULTS AND DISCUSSION

Based on the tabulated data, the results and discussion can be seen as follows. The first analysis is descriptive analysis, which describes or explains the variables of life expectancy (LE), Mean Years of schooling (MYS), and per capita expenditure (PCE). Based on Table 1. below, the mean value of life expectancy is 67.95 years, with a minimum of 67.13 and a maximum of 68.68, showing a standard deviation of 0.52 across 6 observations. This indicates relatively stable life expectancy with minimal variation. In 2018 the percentage of households that had access to a source of adequate drinking water was 73.27% or increased by 4.63%, this increase had an impact on life expectancy, which also increased in 2018. 2018 amounted to 0.51% from 67.13 to 67.47 in 2018. The increase in life expectancy in 2018 was also caused by an increase in the number of doctors from 51 people in 2017 to 61 people in 2018, this increase was 29, 41%. In 2019, the availability of access to clean water for households decreased slightly, namely -0.04%, although life expectancy still experienced a slight increase, namely increasing by 0.64% from 2018, although it was still increasing, this increase was greatly influenced by an increase in the number of doctors which increased by 1.52% in 2019.

In 2020, life expectancy decreased from 0.64% in 2019 to 0.38%. This decrease was caused by a decrease in clean water and the number of doctors, respectively a decrease in growth of -6.03% and -1.49%. In 2021 the number of doctors also decreased from 66 doctors in 2020 to 63 doctors in 2021, or a decrease of -4.55 %, this decrease resulted in the growth of life expectancy also decreasing from 0.38% in 2020, to 0.28% in 2021.

Every year, life expectancy in South Bangka Regency increases, but if we look at the growth, the increase experiences fluctuations in growth. This fluctuation is caused by the independent variables, namely clean water and the number of doctors. Clean water affects life expectancy, because the more people have access to clean water, the more people's life expectancy will increase. Clean water is very important in life, because if the water consumed by people is not clean, it will cause various diseases and will reduce people's life expectancy. The number of doctors also influences the increase in life expectancy in South Bangka Regency, because the more doctors available, the quicker treatment of health problems will be and can be handled well, thereby increasing people's life expectancy.

Table 1.
Life Expectancy (LE), Clean Water (CW), and Number of Doctors (DOC) in South Bangka Regency 2017-2022

Years	LE	%	CW	%	DOC	%
	Years		%		Peoples	
2017	67.13	-	70.03	-	51	-
2018	67.47	0.51	73.27	4.63	66	29.41
2019	67.90	0.64	73.24	-0.04	67	1.52
2020	68.16	0.38	68.82	-6.03	66	-1.49
2021	68.35	0.28	69.15	0.48	63	-4.55
2022	68.68	0.48	74.20	7.30	68	7.94
Mean	67.95		71.45		63.50	
Max	68.68		74.20		68.00	
Min	67.13		68.82		51.00	
Std. Deviation	0.52		2.17		5.80	
Number of Obs.	6		6		6	

Source: Central Bureau of Statistics and Health Office of South Bangka Regency, 2023

Table 2.
Mean Years of Schooling (MYS), Number of Elementary School Teachers (TEA), and Total Education Budget (TEB) in South Bangka Regency for 2018-2022

Years	MYS	%	TEA	%	TEB	%
	Year		Person		IDR	
2018	6.36	3.92	1,343	4.43	232,941,597,867	-4.07
2019	6.42	0.94	1,333	-0.74	197,698,082,842	-15.13
2020	6.67	3.89	1,333	0.00	205,019,202,937	3.70
2021	6.71	0.60	1,333	0.00	194,348,763,882	-5.20
2022	6.89	2.68	1,351	1.35	232,100,315,161	19.42
Mean	6.61		1338.6		212,421,592,537.80	
Max	6.89		1351.0		232,941,597,867.00	
Min	6.36		1333.0		194,348,763,882.00	
Std. Deviation	0.20		7.31		16,772,161,387.12	
Number of Obs.	5		5		5	

Source: Central Bureau of Statistics and Health Office of South Bangka Regency, 2023

This research is in line with research by şentürk & Ali (2021) which states that health and environmental quality reduction have a significant effect on life expectancy. This research is also in line with research Shaw et al. (2005) which states that health seen from drug consumption has a positive effect on increasing life expectancy.

Based on Table 2. below, the mean years of schooling shows a mean of 6.61 years, with a minimum of 6.36 and a maximum of 6.89, and a standard deviation of 0.20 over 5 observations, reflecting gradual improvement in educational attainment. In 2019 the education budget experienced a significant decrease from IDR 232,941,597,867 in 2018 to DR 197,698,082,842 in 2019 or a decrease of -11.06%. This decrease resulted in the mean years of schooling experiencing a decrease in growth from 3.92% in 2018 to 0.94% in 2019. This decrease in growth was also caused by a decrease in the number of elementary school teachers which decreased from 1,343 teachers in 2018 to 1,333 teachers or 4.43% in 2018 to -0.74% in 2019, although the decline was not too significant.

In 2021, the education budget again decreased from 3.70% in 2020 to -5.20%

in 2021. This decrease resulted in the growth of the mean years of schooling also decreasing from 3.89% in 2020 to 0,0% in 2021. The rise and fall of the mean years of schooling in South Bangka Regency is influenced by the independent variables, namely the number of elementary school teachers and the education budget. Over the last five years, the mean years of schooling has increased, but with fluctuating growth. The rise and fall of the mean years of schooling is caused by fluctuations in the independent variables, namely the number of elementary school teachers and the education budget. This research is in line with research Rony (2016) which states that the number of schools and education budget have a significant effect on mean years of schooling. This research is also in line with research Sabrina et al. (2022) which states the importance of increasing the number of teachers and education budgets, especially those devoted to spending on scholarships and increasing educational aid to increase the mean years of schools.

Based on Table 3 below, regarding per capita expenditure, the mean is IDR 11,415,222.22, with a minimum of IDR 10,633,000 and a maximum of IDR 12,341,000. The standard deviation is IDR 551,380.85 across 9 observations, highlighting some fluctuations in economic conditions. Based on that the per capita expenditure of South Bangka Regency during the last 9 years from 2014 to 2022 has increased, except that in 2020 it experienced a decrease of -1.28%. The increase in growth varies each year, the rise and fall of per capita expenditure is caused by fluctuations in South Bangka Regency government expenditure. In 2016 government spending decreased from IDR 800,258,851,089 in 2017 down to IDR 789,883,885,112 in 2017, or from 9.08% to -1.30%. This decrease in government spending caused per capita spending to also experience a decline in growth from 1% to 0.61%, although it was still increasing, the increase was slowing down, due to a slight decline in government spending that year.

Table 3.
Per Capita Expenditure (PCE) and Actual Government Expenditure (GOV) in South Bangka Regency 2011-2022

Years	PCE	%	GOV	%
	IDR		IDR	
2014	10,633,000	0.23	633,342,219,855	10.14
2015	10,824,000	1.80	733,660,643,904	15.84
2016	10,932,000	1,00	800,258,851,089	9.08
2017	10,999,000	0.61	789,883,885,112	-1.30
2018	11,573,000	5.22	795,971,444,900	0.77
2019	11,910,000	2.91	814,913,924,580	2.38
2020	11,757,000	-1.28	739,330,115,040	-9.28
2021	11,768,000	0.09	811,979,690,370	9.83
2022	12,341,000	4.87	932,106,145,004	14.79
Mean	11,415,222.22		783,494,102,206.00	
Max	12,341,000.00		932,106,145,004.00	
Min	10,633,000.00		633,342,219,855.00	
Std. Deviation	551,380.85		75,528,627,794.99	
Number of Obs.	9		9	

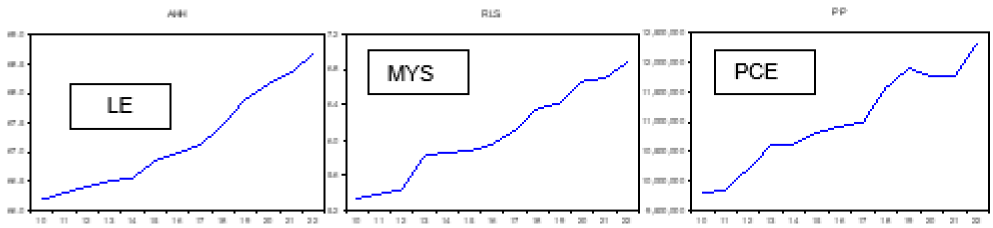
Source: Central Bureau of Statistics and Investment Office of One-Stop Service, and Regional Finance Agency of South Bangka Regency, 2023

In 2020 government spending again decreased very significantly, decreasing from IDR 814,913,924,580 in 2019, to IDR 739,330,115,040 in 2020 or from 2.38% in 2019, decreasing to -9.38% in 2020. This decrease was caused by the Covid-19 pandemic which caused many shifts and budget cuts for recovery costs due to this pandemic. As a result of this decline, per capita expenditure also decreased from IDR 11,910,000 in 2019 to IDR 11,757,000 in 2020 or from 2.91% in 2019 to -1.28% in 2020. The research is in line with research Appiah (2017) which found that government spending has a significant effect on per capita spendings.

Based on the results of the data processing that has been carried out, the following are the results of the ARIMA model analysis of life expectancy, mean years of schooling, and per capita expenditure. Before obtaining forecasting results, there are several stages that must be carried out, so that the model is suitable for forecasting using ARIMA.

Based on Figure 1 below, it can be seen that the movement of LE, MYS, and PCE in South Bangka Regency in 2010-2022. The movement of LE, MYS, and PCE over the last 13 years has tended to increase every year.

Based on the ADF-Test results above, it can be seen that the probability value is less than 0.05 or 5%, meaning that the three variables, namely LE, are stationary at the 2nd Deference, MYS and PCE are stationary at the 1st Deference.



Source: Eviews 9 Processed Data, 2023

Figure 2.

Movement of LE, MYS, and PCE in South Bangka Regency 2010-2022

Table 4.

Stationary Test with Augmented Dickey-Fuller Test

No	Variables	Stage	t-statistic	Probability	Stationary
1	LE	2nd Deference	-3.573055	0.036	Yes
2	MYS	1st Deference	-4.369001	0.007	Yes
3	PCE	1st Deference	-5.401309	0.002	Yes

Source: Eviews 9 Processed Data, 2023

Table 5.

Results of Determining the Potential of the LE, MYS, and PCE Models

LE

RLS Date: 10/13/23 Time: 16:14
Sample: 2010 2022
Included observations: 12

	AC	PAC	Q-Stat	Prob
1	-0.341	-0.341	1.7771	0.183
2	-0.174	-0.329	2.2873	0.319
3	-0.125	-0.401	2.5797	0.461
4	0.112	-0.283	2.8452	0.584
5	0.189	-0.015	3.7057	0.593
6	-0.215	-0.223	5.0018	0.544
7	0.203	0.185	6.3872	0.495
8	-0.215	-0.082	8.3284	0.402
9	0.073	-0.003	8.6228	0.473
10	0.020	0.015	8.6579	0.565
11	-0.027	-0.072	8.7817	0.642

MYS

AHH Date: 10/13/23 Time: 14:39
Sample: 2010 2022
Included observations: 11

	AC	PAC	Q-Stat	Prob
1	-0.271	-0.271	1.0494	0.306
2	-0.484	-0.580	4.4881	0.107
3	0.093	-0.427	4.6191	0.202
4	0.364	-0.085	7.3281	0.120
5	-0.187	-0.199	8.1829	0.147
6	-0.202	-0.210	9.3319	0.156
7	0.182	-0.111	10.515	0.161
8	0.004	-0.335	10.518	0.231
9	0.008	-0.132	10.519	0.310
10	-0.025	-0.119	10.605	0.389

PCE

Date: 10/13/23 Time: 16:23
Sample: 2010 2022
Included observations: 12

	AC	PAC	Q-Stat	Prob
1	-0.102	-0.102	0.1586	0.690
2	-0.640	-0.657	7.0317	0.030
3	0.066	-0.194	7.1119	0.068
4	0.147	-0.543	7.5677	0.109
5	0.021	-0.349	7.5778	0.181
6	0.227	-0.033	9.0209	0.172
7	-0.122	-0.124	9.5237	0.217
8	-0.300	0.003	13.302	0.102
9	0.153	0.089	14.811	0.102
10	0.145	-0.011	16.388	0.090
11	-0.094	-0.015	17.854	0.085

Source: Eviews 9 Processed Data, 2023

Based on the results of the data processing carried out, the results of determining model potential in ARIMA Modeling were obtained. If the data is stationary, ACF and PACF plots are made. To find out the order (p,d,q) in ARIMA. The ACF and PACF plots on the LE variable above show that ACF is significant at the 2nd time lag and from the PACF plot it can be seen that the PACF or partial autocorrelation value is significant at the 2nd time lag, so that the order p = 2, d = 2, is obtained. and q = 2, so the ARIMA LE model is (2,2,2). The ACF and PACF plots on the MYS variable show that ACF is significant at the 1st time lag and from the PACF plot it can be seen that the PACF or partial autocorrelation value is significant at the 3rd time lag, so that the order p = 3, d = 1, and q is obtained. = 1, so the ARIMA MYS model is (3,1,1). The ACF and PACF plots on the PCE variable show that ACF is significant at the 2nd time lag and from the PACF plot it can be seen that the PACF or partial autocorrelation value is significant at the 2nd time lag, so that the order p = 2, d = 1, and q is obtained. = 2, so the ARIMA PCE model is (2,1,2).

The parameters for the model that have been obtained are tested using the Maximum Likelihood Estimator. Based on the parameters in Table 6., the time series model for LE, MYS, and PCEU of South Bangka Regency is obtained as follows.

ARIMA (2,2,2) Yt = 0.021964 - 0.888281AR(2) + 0.584337MA(2) .... (2)
ARIMA (3,1,1) Yt = 0.129774 - 0.162295AR(3) - 1.000000MA(1)……... (3)
ARIMA (2,1,2) Yt = 206456.7 - 0.663611AR(2) - 1.000000MA(2)……..... (4)

By using these models, forecasting and validation of the best model are then used to project LE, MYS, and PCE in the following year.

Based on Table 7, it can be seen that the ARIMA correlogram results for LE (2,2,2), MYS (3,1,1), and PCE (2,1,2).

Table 6.
ARIMA Parameter Estimation Results

LE

Dependent Variable: D(AHH,2)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/13/23 Time: 15:40
Sample: 2012 2022
Included observations: 11
Convergence achieved after 31 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021964	0.027448	0.800210	0.4499
AR(2)	-0.888281	0.784934	-1.131663	0.2950
MA(2)	0.584337	1.216032	0.480528	0.6455
SIGMASQ	0.011604	0.008797	1.319010	0.2287

MYS

Dependent Variable: D(RLS)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/13/23 Time: 16:16
Sample: 2011 2022
Included observations: 12
Failure to improve objective (non-zero gradients) after 13 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.129774	0.011229	11.55758	0.0000
AR(3)	-0.162295	0.313907	-0.517018	0.6191
MA(1)	-1.000000	3534.758	-2.83E-05	1.0000
SIGMASQ	0.005885	4.611709	0.001276	0.9990

PCE

Dependent Variable: D(PP)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/13/23 Time: 16:24
Sample: 2011 2022
Included observations: 12
Failure to improve objective (non-zero gradients) after 8 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	206456.7	10588.02	19.50277	0.0000
AR(2)	-0.663611	0.335689	-1.976862	0.0835
MA(2)	-1.000000	12001.37	-8.33E-05	0.9999
SIGMASQ	8.70E+09	5.22E+13	0.000167	0.9999

Source: Eviews 9 Processed Data, 2023

Table 7.
ARIMA Correlogram Results of LE, MYS, and PCE

LE

Date: 10/13/23 Time: 15:48
Sample: 2010 2022
Included observations: 11
Q-statistic probabilities adjusted for 2 ARMA terms

	AC	PAC	Q-Stat	Prob
1	-0.472	-0.472	3.1904	
2	-0.049	-0.351	3.2291	
3	0.009	-0.277	3.2305	0.072
4	0.137	-0.021	3.8157	0.184
5	-0.149	-0.108	4.1443	0.246
6	-0.048	-0.212	4.2094	0.378
7	0.052	-0.211	4.3089	0.506
8	0.017	-0.201	4.3207	0.633
9	0.008	-0.120	4.3237	0.742
10	-0.003	-0.077	4.3254	0.827

MYS

Date: 10/13/23 Time: 15:48
Sample: 2010 2022
Included observations: 11
Q-statistic probabilities adjusted for 2 ARMA terms

	AC	PAC	Q-Stat	Prob
1	-0.472	-0.472	3.1904	
2	-0.049	-0.351	3.2291	
3	0.009	-0.277	3.2305	0.072
4	0.137	-0.021	3.8157	0.184
5	-0.149	-0.108	4.1443	0.246
6	-0.048	-0.212	4.2094	0.378
7	0.052	-0.211	4.3089	0.506
8	0.017	-0.201	4.3207	0.633
9	0.008	-0.120	4.3237	0.742
10	-0.003	-0.077	4.3254	0.827

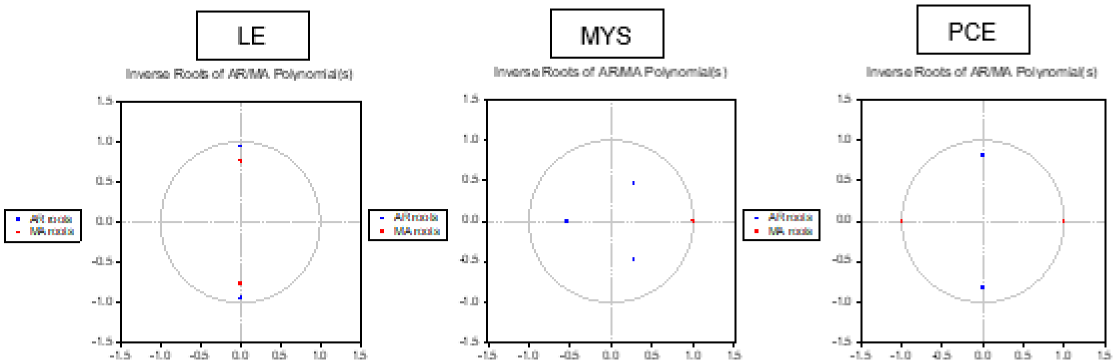
PCE

Date: 10/13/23 Time: 16:18
Sample: 2010 2027
Included observations: 12
Q-statistic probabilities adjusted for 2 ARMA terms

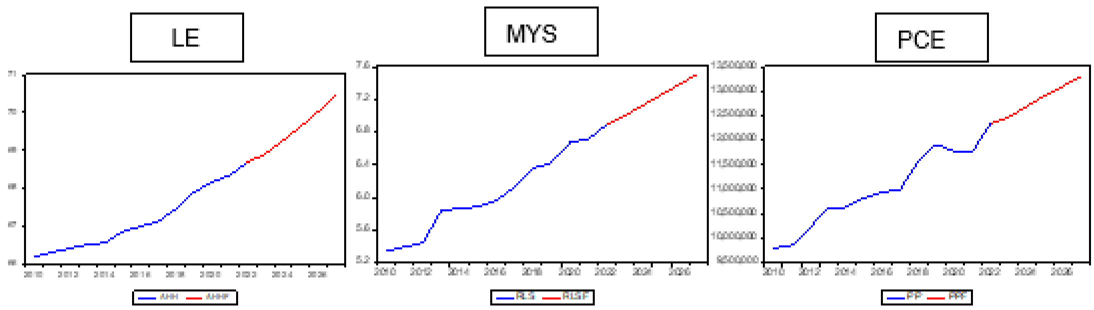
	AC	PAC	Q-Stat	Prob
1	-0.027	-0.027	0.0111	
2	-0.261	-0.262	1.1553	
3	-0.223	-0.257	2.0830	0.149
4	0.023	-0.089	2.0911	0.351
5	0.098	-0.112	2.1290	0.546
6	-0.131	-0.252	2.6092	0.625
7	0.172	0.109	3.0001	0.608
8	-0.094	-0.152	3.6484	0.724
9	0.044	0.027	3.7571	0.807
10	-0.089	-0.051	4.1532	0.843
11	-0.093	-0.067	4.3218	0.888

Source: Eviews 9 Processed Data, 2023

From the results obtained from the autocorrelation and partial correlation values. There is no lag outside the line, this indicates that the model is suitable for forecasting testing.



Source: Eviews 9 Processed Data, 2023
Figure 3.
Inverse Roots AR/MA Polynomial(s)



Source: Eviews 9 Processed Data, 2023
Figure 4.
Graph of ARIMA Forecasting Results

Figure 3. is the result of Inverse Roots AR/MA LE, MYS, and PCE for South Bangka Regency. A feasible model is a model whose points do not come out of the circle line. The results of the inverse roots test below show that nothing comes out of the circle line, meaning this model is suitable for forecasting tests.

Based on Figure 4, it can see the results of forecasting LE, MYS, and PCE of South Bangka Regency from 2023 to 2027, which continue to increase.

The LE of South Bangka Regency from 2023 to 2027 will experience an increase, including increased growth. In 2023 the LE will be 68.90, an increase from 2022 of 68.68 or an increase of 0.31%, while in 2027 the LE will be 70.46, an increase from the previous year of only 70.03 or an increase of 0.62%, over the next five years the average increase in LE will be 0.51%. MYS South Bangka Regency from 2023 to 2027 also experienced an increase. In 2023 MYS will be 7.00, an increase from the previous year of only 6.89 or an increase of 1.59%, while in 2027 MYS will be 7.52 or an increase of 1.76%, over the next five years the average increase of MYS of 1.76%. The PCE of South Bangka Regency from 2023 to 2027 has increased. In 2023 PCE will be IDR 12,466,353 or an increase of 1.02% from 2022, while in 2027 PCE will be IDR 13,301,484 or an

Table 8.
ARIMA Forecasting Results

Years	LE Year	%	MYS Year	%	PCE IDR	%
2010	66.19	-	5.34	-	9,795,000	-
2011	66.31	0.18	5.39	0.94	9,851,000	0.57
2012	66.41	0.15	5.44	0.93	10,216,000	3.71
2013	66.51	0.15	5.83	7.17	10,609,000	3.85
2014	66.56	0.08	5.87	0.69	10,633,000	0.23
2015	66.86	0.45	5.88	0.17	10,824,000	1.80
2016	66.99	0.19	5.96	1.36	10,932,000	1.00
2017	67.13	0.21	6.12	2.68	10,999,000	0.61
2018	67.47	0.51	6.36	3.92	11,573,000	5.22
2019	67.90	0.64	6.42	0.94	11,910,000	2.91
2020	68.16	0.38	6.67	3.89	11,757,000	-1.28
2021	68.35	0.28	6.71	0.60	11,768,000	0.09
2022	68.68	0.48	6.89	2.68	12,341,000	4.87
2023	68.90	0.31	7.00	1.59	12,466,353	1.02
2024	69.25	0.52	7.13	1.85	12,689,782	1.79
2025	69.62	0.54	7.26	1.82	12,906,927	1.71
2026	70.03	0.58	7.39	1.79	13,102,121	1.51
2027	70.46	0.62	7.52	1.76	13,301,484	1.52

Source: Eviews 9 Processed Data, 2023

increase of 1.52%. The average increase in PCE over the last five years was 1.51%.

Human development is a multidimensional concept that encompasses the improvement of people's quality of life through access to education, healthcare, and a decent standard of living. In South Bangka Regency, the Human Development Index (HDI) has consistently been categorized as medium, indicating that while there has been progress, there are still challenges in raising life expectancy, improving education levels, and increasing per capita income. Between 2017 and 2022, South Bangka's HDI ranged from 65.02 to 67.95, reflecting moderate improvements across the three HDI dimensions. However, the pace of growth remains slower compared to other regions in the Bangka Belitung Province. These findings highlight the need for focused interventions in healthcare, education, and economic policies to accelerate human development.

The results of the analysis indicate that life expectancy in South Bangka Regency is significantly influenced by access to clean water and the number of doctors. These findings align with şentürk & Ali (2021), who found that improvements in healthcare infrastructure and environmental quality are critical for enhancing life expectancy. Furthermore, the research by Shaw et al. (2005) supports this conclusion by showing the positive impact of healthcare access on increasing life expectancy, especially through medical services and public health programs.

In terms of education, the analysis reveals that the number of elementary school teachers and the education budget are key determinants of the mean years of schooling. This result is consistent with Sabrina et al. (2022), who highlighted the significance of government spending on education in improving school attendance and educational attainment. Increased teacher availability and education funding have been shown to directly impact educational outcomes, particularly in regions with limited educational resources like South Bangka.

For per capita expenditure, the estimation shows that government spending plays a crucial role in driving economic improvements. This is supported by the findings of Appiah (2017), who demonstrated the positive effects of increased government expenditure on per capita GDP and overall economic well-being. In line with Sofilda et al. (2015), the research indicates that public investments in infrastructure, healthcare, and education are key to boosting household incomes and reducing poverty levels in developing regions.

Based on the findings, several policy recommendations can be made to enhance human development in South Bangka Regency. The local government should prioritize expanding access to clean water and increasing the number of healthcare professionals, particularly doctors. Investments in clean water infrastructure and healthcare services will contribute to higher life expectancy and improve public health outcomes. Increasing the education budget and recruiting more qualified teachers, especially at the elementary level, should be a priority. Providing better teacher training programs and expanding educational facilities will ensure that the mean years of schooling continues to rise, contributing to overall human capital development. To boost per capita income, the government should continue increasing investments in critical sectors such as infrastructure, healthcare, and education. This will generate employment opportunities, stimulate economic activity, and reduce poverty levels, leading to higher standards of living for the population.

CONCLUSION

Life expectancy is influenced by access to clean water and the number of doctors in South Bangka Regency, the mean years of schooling are influenced by the number of elementary school teachers and the education budget, and increasing per capita expenditure is influenced by increasing government spending. The ARIMA model that has the best performance for predicting LE, MYS, and PCE is where the ARIMA LE model is (2,2,2), the ARIMA MYS model is (3,1,1), and the ARIMA PCE model is (2,1,2). The results of forecasting using the ARIMA model show that the three HDI components, namely LE, MYS, and PCE, will increase over the next five years, namely from 2023 to 2027, but with fluctuating growth rates.

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