Empowering Natuna's local fishermen by optimizing regional development parameters

[1]Andriamampionona L. Tienh, [1]Budi Setiyono, [2]Amiek Soemarmi, [2]Nanik Trihastuti, [2]Lazarus T. Setyawanta, [3]Zafimahery Lalanantenaina

[1] Faculty of Social and Political Sciences, Universitas Diponegoro, Prof Soedarto, S.H. street, Semarang 50275, Indonesia; [2] Faculty of Law, Universitas Diponegoro, Prof Soedarto, S.H., Tembalang, Semarang 50275, Indonesia; [3] Institut Universitaire de Formation des Enseignants, Université de Genève, 24 rue general dufour 1211 Genève. Corresponding author: A. L. Tienh, tienhlai@gmail.com

Abstract. Indonesia's affirmation as an archipelagic country with enormous marine resources must consider the role and function of regional parameters from a local economic development perspective. Maintaining marine sovereignty is not exclusive to weapons at sea because the community, especially fishers, must be involved in optimizing the advantage and management of marine resources through the optimization of fishers as professionals. By employing secondary data of regional development parameters, such as gross regional domestic product (GRDP), poverty rate, expected length of schooling (education), and human development index (HDI) from 2006 to 2019 obtained from the Indonesian Central Statistics Agency 2021, this study aims to determine the relationship between regional development parameters that can strengthen fisheries' potential, development, and growth in Natuna Regency. Furthermore, the discussion further elaborates on the possibility of economic integration to achieve sustainable utilization of Natuna's fishery resources. Data processing using the vector error correction model on Eviews v.10 proves that education as the dependent variable has a long-run causality with the GRDP and the HDI. Increasing the GRDP and HDI by 1% can increase the expected length of schooling (education) by 0.012% and 2.66%, respectively. Considering that the overall education is under the scheme of the general HDI, improving education represented by school expectations is proven to be faster when the HDI is set as the priority. Therefore, the government is expected to prioritize education as an investment in local economic development by strengthening the GRDP and the HDI. Regional economic development with the blue economy orientation must integrate facilities and infrastructure, be built on principles that favor the community, uphold accessibility for all groups, and involve community elements in natural resource optimization policies.
Key Words: blue economy, education, human development index, marine resources, vector error correction model.

Introduction. Based on the 2022 Land Registration Certificate, more than 99% of the Natuna area consists of the sea. In addition, 127 over 154 islands in the Natuna Regency are uninhabited. The Minister of Maritime Affairs and Fisheries of Indonesia (KKP Indonesia), Sakti Wahyu Trenggono, stated that the Natuna Islands have the potential to become a Special Economic Zone (KKP 2021). As an area with great potential in the capture fishery and aquaculture sectors, Natuna waters have high economic value, especially if various fishery activities are integrated, such as production, processing, and logistics.

Although the KKP Indonesia stated that the economic growth of the fisheries sector in Natuna waters is exceptionally high, the goal of optimizing the fishery resources productivity must be oriented towards the economic development of the outer islands that adhere to the blue economy principle where the sustainability of marine ecosystems gets deserving attention as well. The economic development of the outer islands, including the Natuna waters, is influenced by the physical aspects of the area itself. Unfortunately, the government does not prioritize many small outermost islands with distance as an excuse. Physical aspects such as islands and natural resources in these areas are needed for national development. Therefore, Natuna Regency needs special

attention to optimizing the development of its islands, which in turn can diminish economic inequality.

The condition of the border areas in various provinces in Indonesia often encounters obstacles in the economic, social, defense, and security domains. Moreover, the border area, the area closest to foreign countries, is mainly considered a security belt, with defense at the border being the top priority. Nevertheless, security without economic stability is nothing like a gun with no bullets. According to resource endowment theory, the development gap and regional economic development are influenced by the natural resources of an area and how the commodities produced from these resources respond to market demands (Harvey & Lowdon 1961). Several studies related to the growth of neoclassical regions (Borts 1960; Siebert 1969; Richardson 2016) found that a region's economy is determined by three main factors: labor, availability of capital, and technological progress. Judging from the geopolitical, social, economic, defense, and security aspects, Natuna has difficulties in the availability of capital, labor, and technological progress, even though it has high natural resource potential as a border area.

Nurzaman (1997) found that economic factors were the most distinguishing aspects in explaining regional disparities. Furthermore, several studies (North 1990; Dholakia 2003) found that inequality and economic growth were influenced by political factors, leader power, and groups with particular interests in law enforcement. The solutions to these multilayer obstacles can be solved only by those governing powers. The government's approach to improving community welfare and security is often carried out simultaneously, although the emphasis on state security stability is still a priority in the Natuna Regency. This circumstance was exacerbated by the government's centralized system, which had long been embraced, causing border areas to be waitlisted in terms of economic and educational development.

In recent decades, econometric models have become an increasingly popular field of research among academics as this science also touches several other significant fields such as statistics, technology, and engineering, simply knowing the current trend and predicting the probability of the trend occurring. Economic models specifically refer to many fields of science, such as mathematical economics (Hull & White 1987; Hirsa & Neftci 2013), financial applications (Karlin & Taylor 1981; Karatzas & Shreve 1991; Duffie 2001; Steele 2001), and parametric and nonparametric methods (Fan & Yao 2003; Tsay 2005; Gao 2007; Li & Racine 2007). Such methods are helpful in many examinations and experiments that reveal causality checks and integration phenomena, including regional economic development within the maritime area.

Studies by Emmers (2009) defined three main attributes for a country to be prosperous in optimizing its maritime area: territory, natural resources, and power distribution according to international relations and security priorities. Furthermore, an area associated with national boundaries can provide strategic economic benefits for a country if its influence in the international transaction system follows a positive market activity pattern. Camagni & Capello (2013) stated that tangible and intangible local assets consisting of nature, humans, and artificial products are competitive resources that can encourage the local development parameters in economic independence: gross regional domestic product (GRDP), expected years of schooling (education), human development index (HDI), poverty level, and investment scheme coordination. Lack of attention to Natuna can weaken economic integration and the achievement of national development goals, which weakens the aspect of economic independence as a foundation.

Suyanto (1996) asserted that the problems faced by traditional fishermen are structural. The social structure they suffer is a contagion effect that they fail to break before realizing they are part of the structural suffering. Ironically, access to critical resources to achieve economic independence cannot be separated from impartial economic and political policies. Economic incapacity characterized by low regional incomes makes people often unable to continue their education to a higher level, affecting the intelligence and skills needed at work (Achenbaum 2013; Wekke & Hamid 2013; Jackson 2014; Roy 2014). Underdevelopment in the ability to compete in a

regional, national, and global community environment on an ongoing basis impacts other variables such as poverty, income, and the HDI. The three variables of welfare development are interrelated. Therefore, persistent problems with these variables will only put the Natuna Regency in prolonged economic problems, forcing them to live below a good standard of living.

A study by Anggraeni et al (2020) found that the mining and quarrying sector is the main contributor to the GRDP of Natuna Regency (73.30%). Although the mining sector is known as one of the commodities with high prices, this sector has not been able to bring a multiplier impact that can accelerate the economic growth of Natuna Regency. An overview by Bentley (2002) on global oil and gas depletion finds that natural gas and mining as non-renewable natural resources in many regions and countries have gone over the Hubbert curve peak, emphasizing that oil supply shortages are inevitable. Therefore, Natuna Regency needs to find better sources of sustainable growth, especially by optimizing renewable resources. In the future, Natuna Regency needs to carry out better development planning by paying more attention to renewable resources such as the fisheries sector.

According to Siska (2016), the concept of regional development has five main foundations: a) optimization of leading sectors; b) characterization of regional features; c) resources execution in a comprehensive and integrated manner; d) good prospects for now and in the future; e) satisfactory implementation of autonomy and decentralization principles. Therefore, optimum development with good management in the fisheries sector to avoid over-exploitation against sustainable resources is essential. Considering that feeble outer islands when sitting straight to foreign countries resemble a nightmare, a preventive perspective explaining how economic and resource sustainability in the Natuna region can stand independently and powerfully is significant.

Regional development parameters such as GRDP, poverty level, education, and HDI can explain economic strength in a region. In addition, the integration of various fishery activities such as production, processing, and logistics can also strengthen regional development parameters. Concepts that provide a better view of the border areas' development to improve community welfare are indispensable for all regions (Ma'rif 2016). Therefore, this study desires to define the relationship between regional development parameters that can strengthen the development of resource potential and regional economic growth in the Natuna Regency. The discussion also continued with the possibility of economic integration to achieve sustainable natural resources.

Methods. Analyzing potential impacts that can become recommendations for economic development by providing an academic perspective is a methodology for social-oriented transformation (Earl & Carden 2002). The analysis results were chosen to ascertain what changes in variables had an effect and how these effects could be positively optimized by considering social, political, cultural, economic, historical, and environmental factors (Dyer 2012).

This study employed secondary data of regional development parameters from 2006 to 2019 obtained from the Indonesian Central Statistics Agency (2021), consisting of GRDP, poverty level, expected years of schooling (education), and HDI. The Augmented Dickey-Fuller unit root test (Dickey & Fuller 1979) was done to check the data stationarity. The unit root test can identify whether the data used was stationary or not. If the data was not stationary, the differencing method revealed the order of integration. For the data can be processed, each variable should be in the level/order I(0) or first difference/order I(1). Therefore, all variables must be stationary before performing the autoregressive distributed lag (ARDL) model. Furthermore, it is necessary to avoid variable stationery in the second difference/I(2); otherwise, the ARDL model could not be applied, and causality analysis cannot be done.

In determining the optimum lag, the Akaike information criterion (AIC) was used through vector autoregression estimates (VAR) to test all variables one by one. The best way to choose the optimum lag is by seeing the smallest value of AIC. Later, the optimum lag was inputted when running ARDL cointegrating and long run form with the below formulae:

$$\Delta\ln\ GRDP_t = \alpha_\circ + \alpha_T T + \alpha_{GRDP}\ln GRDP_{t-1} + \alpha_{PV}\ln\ PV_{t-1} + \alpha_{EDU}\ln EDU_{t-1} + \alpha_{HDI}\ln HDI_{t-1} + \sum_{i=1}^{p}\alpha_i\Delta\ln GRDP_{t-i} + \sum_{j=0}^{q}\alpha_j\Delta\ln PV_{t-j} + \sum_{k=0}^{l}\alpha_K\Delta\ln EDU_{t-k} + \sum_{l=0}^{m}\alpha_l\Delta\ln\ HDI_{t-l} + \varepsilon_t \quad \text{.....(1)}$$

$$\Delta\ln\ PV_t = \alpha_\circ + \alpha_T T + \alpha_{PV}\ln PV_{t-1} + \alpha_{GRDP}\ln\ GRDP_{t-1} + \alpha_{EDU}\ln EDU_{t-1} + \alpha_{HDI}\ln HDI_{t-1} + \sum_{i=1}^{p}\alpha_i\Delta\ln PV_{t-i} + \sum_{j=0}^{q}\alpha_j\Delta\ln GRDP_{t-j} + \sum_{k=0}^{l}\alpha_K\Delta\ln EDU_{t-k} + \sum_{l=0}^{m}\alpha_l\Delta\ln\ HDI_{t-l} + \varepsilon_t \quad \text{.....(2)}$$

$$\Delta\ln\ EDU_t = \alpha_\circ + \alpha_T T + \alpha_{EDU}\ln EDU_{t-1} + \alpha_{GRDP}\ln\ GRDP_{t-1} + \alpha_{PV}\ln PV_{t-1} + \alpha_{HDI}\ln HDI_{t-1} + \sum_{i=1}^{p}\alpha_i\Delta\ln EDU_{t-i} + \sum_{j=0}^{q}\alpha_j\Delta\ln GRDP_{t-j} + \sum_{k=0}^{l}\alpha_K\Delta\ln PV_{t-k} + \sum_{l=0}^{m}\alpha_l\Delta\ln\ HDI_{t-l} + \varepsilon_t \quad \text{.....(3)}$$

$$\Delta\ln\ HDI_t = \alpha_\circ + \alpha_T T + \alpha_{HDI}\ln HDI_{t-1} + \alpha_{GRDP}\ln\ GRDP_{t-1} + \alpha_{PV}\ln PV_{t-1} + \alpha_{EDU}\ln EDU_{t-1} + \sum_{i=1}^{p}\alpha_i\Delta\ln HDI_{t-i} + \sum_{j=0}^{q}\alpha_j\Delta\ln GRDP_{t-j} + \sum_{k=0}^{l}\alpha_K\Delta\ln PV_{t-k} + \sum_{l=0}^{m}\alpha_l\Delta\ln\ EDUc_{t-l} + \varepsilon_t \quad \text{.....(4)}$$

where: Ln GRDP = gross regional domestic product;
Ln PV = poverty;
Ln EDU = education;
Ln HDI = human development index;
t = trend variables composing the ARDL model and bound tests;
$\alpha_\circ, \beta_0, \phi_\circ, \varphi_0$ = drift components;
$\alpha_T, \beta_T, \phi_T, \varphi_T$ = time trends;
ε_t = white noise error.

In order to find the causality of one variable to another, it is necessary to prove the presence or absence of long-run cointegration. The cointegration results from ARDL cointegrating and long run dorm were later compared with the upper critical bound (UCB) and lower critical bound (LCB) to define the long-run cointegration between variables following hypotheses as follows (Pesaran et al 2001):

- F-statistics > UCB= cointegration;
- F-statistics < LCB= no cointegration;
- LCB < F-statistics < UCB = the model is incorrect.

Because long-run cointegration in the present study was found, the vector error correction model (VECM) was carried out to find a causal relationship through the following equations:

$$\Delta\ln\ GRDP_t = \alpha_{o1} + \sum_{i=1}^{l}\alpha_1\Delta\ln GRDP_{t-i} + \sum_{j=1}^{m}\alpha_2\Delta\ln PV_{t-j} + \sum_{k=1}^{n}\alpha_3\Delta\ln EDU_{t-k} + \sum_{l=1}^{o}\alpha_4\Delta\ln HDI_{t-l} \quad \lambda ECT_{t-1} + \varepsilon_t \quad \text{.... (5)}$$

$$\Delta\ln\ PV_t = \beta_{o1} + \sum_{i=1}^{l}\beta_1\Delta\ln PV_{t-i} + \sum_{j=1}^{m}\beta_2\Delta\ln GRDP_{t-j} + \sum_{k=1}^{n}\beta_3\Delta\ln EDU_{t-k} + \sum_{l=1}^{o}\beta_4\Delta\ln HDI_{t-l} \quad \lambda ECT_{t-1} + \varepsilon_t \quad \text{.... (6)}$$

$$\Delta\ln\ EDU_t = \phi_{o1} + \sum_{i=1}^{l}\phi_1\Delta\ln EDU_{t-i} + \sum_{j=1}^{m}\phi_2\Delta\ln GRDP_{t-j} + \sum_{k=1}^{n}\phi_3\Delta\ln PV_{t-k} + \sum_{l=1}^{o}\phi_4\Delta\ln HDI_{t-l} \quad \lambda ECT_{t-1} + \varepsilon_t \quad \text{.... (7)}$$

$$\Delta\ln\ HDI_t = \varphi_{o1} + \sum_{i=1}^{l}\varphi_1\Delta\ln HDI_{t-i} + \sum_{j=1}^{m}\varphi_2\Delta\ln GRDP_{t-j} + \sum_{k=1}^{n}\varphi_3\Delta\ln PV_{t-k} + \sum_{l=1}^{o}\varphi_4\Delta\ln EDU_{t-l} \quad \lambda ECT_{t-1} + \varepsilon_t \quad \text{.... (8)}$$

where: Ln GRDP = gross regional domestic product;
Ln PV = poverty;
Ln EDU = education;
Ln HDI = human development index;
t = trend variables composing the ARDL model and bound tests;
$\alpha_\circ, \beta_0, \phi_\circ, \varphi_0$ = drift components;

$\alpha_T, \beta_T, \phi_T, \varphi_T$ = time trends;
ε_t = white noise error;
λECT = vector of the error correction term.

In order to find how one variable influences other variables in the long run, this study employs the Hsiao-Granger procedure under VECM (Kollias et al 2004). Later, the relationship between the variables will be further discussed with the integration of fisheries activities to understand Natuna's blue economy perspective better.

Results and Discussion. The Augmented Dickey-Fuller unit root test (Dickey & Fuller 1979) for checking the data stationarity found that the order of integration of GRDP, PV, and EDU was stationary at first difference/I(1), while HDI was stationary at the level/I(0), as presented in Table 1.

Table 1

Unit root test

Variable	*t-statistics*	*Stationary level*	*Prob.**
Gross regional domestic product (GRDP)	-5.464626	1st difference	0.0037
Poverty (PV)	-4.764486	1st difference	0.0081
Education (EDU)	-3.855594	1st difference	0.0292
Human development index (HDI)	-5.008801	Level/I(0)	0.0047

Note: * indicates the value is significant at a 5% level.

The unit-roots test using Augmented Dickey-Fuller found that no variable is cointegrated into the I(2), emphasizing that the present data is not spurious. Engle & Granger (1987) stated that the causality check for all variables could give invalid results when one or more variables are integrated with the I(2).

Before running the ARDL model to find the causality relationship, it is necessary to find the optimum lag for all variables as a group. The present study employed annual data from 2010 to 2019; therefore, lag-1 or lag-2 is recommended. Otherwise, too much lag will lose a degree of freedom, cause multicollinearity, bring problems in serial correlation, and generate misspecification errors. Optimum lag results through VAR estimates lag order selection criteria are presented in Table 2.

Table 2

A vector autoregressive lag order selection criteria

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	64.17411	NA	1.8411	-13.37203	-13.28437	-13.56119
1	100.6789	32.44867*	3.3913*	-17.92864*	-17.49036*	-18.87444*

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

Since the model in this study used AIC to determine the optimum lag through VAR lag order criteria, the optimum lag (lag 1) marked with an asterisk is indicated as the best for the model (AIC with the smallest value). This optimum lag (lag 1) was inputted in the model when running ARDL cointegrating and long run form to find the long-run cointegration. The cointegrating and long run form results are presented in Table 3.

Table 3

ARDL cointegrating and long run form

Dependent variable	*CointEq(-1)*
GRDP	0.3368
PV	0.1759
EDU	0.0496
HDI	0.7549

When the EDU was set as the dependent variable, it was found to have long-run cointegration with other variables (significant at 5%). To make sure the long-run cointegration exists, the bound test was done for those two variables, as shown in Table 4.

Table 4

ARDL bounds test

Dependent variable	*F-statistic*
EDU	6.170614

The F-statistic for EDU was 6.170614. After comparing the F-statistic of EDU with LCB and UCB as presented in Table 5, it is concluded that EDU as a dependent variable has the long-run cointegration because its F-statistic is higher than UCB at the 5% level.

Table 5

Critical value bounds

Significance	*I0 bound*	*I1 bound*
10%	2.76	3.67
5%	3.43	3.84
2.50%	3.79	4.87
1%	4.23	5.63

It is concluded that EDU as a dependent variable has the long-run cointegration because its F-statistic is higher than UCB at the 5% level. Because EDU as the dependent variable has cointegration, the test must be continued with the VECM on EDU as an endogenous variable. The results of the VECM test on EDU are presented in Table 6.

Table 6

Vector error correction model test results for EDU

Variable	*Coefficient*	*Std. error*	*t-statistics*	*Prob.*
GRDP	0.012131	0.005229	2.320099	0.0094
PV	0.046319	0.035586	1.301614	0.2408
HDI	2.665337	0.114021	23.37594	0.0000
C	-9.319032	0.494883	-18.83077	0.0000

Based on Table 6, it can be seen that the GRDP and HDI variables have a long-run cointegration toward EDU, seen by those two variables' prob are significant ($\alpha < 0.05$). Therefore, when EDU is used as the dependent variable, GRDP and HDI as independent variables can affect the EDU as much as the provided coefficients. For example, if the Natuna Regency government can increase the GRDP by 1%, then the expected years of schooling can increase by 0.012%. In addition, if the Natuna Regency government can increase HDI by 1%, then the expected years of schooling can increase by 2.66%.

Gross regional domestic product and education development. Regional development should fundamentally focus on balancing economic growth and commodity competitiveness. The Natuna population's high dependence on small-scale fishing activities affects the overall social structure. Therefore, the community's welfare will slow down if small-scale fishing activities are not put in thought. In Indonesia, 14.58 million over 16.2 million fishermen are not economically empowered and live below the poverty line (Chryshna 2021). In addition, 75% of fishers are small-scale (Yonvitner et al 2021), and 60% of fishers in rural areas still have difficulty meeting the most basic life needs (Orsini et al 2013). It is a common understanding that fishers are the group of people who suffer the most from being left behind socially, economically, and politically. The fishing community cannot be separated from the negative stigma.

Poverty is the main trap that cripples people from vital access to health services, education, and information technology systems. The prolonged underdevelopment of coastal communities to these vital aspects has resulted in a significant disparity between regional and national development. Moreover, many citizens and the media still define the fishing profession as an unpromising career that becomes a trap for poverty.

GRDP between 2011 and 2019 by type of resources in the fisheries sector in Natuna Regency has fluctuated since 2013 (Figure 1). Economically speaking, the Riau Communications and Informatics Service (2022) stated that of the seven cities and regencies in the Riau Islands Province, Natuna Regency's economic growth was the fourth (0.02%), after Batam (3.43), Karimun (2.37), and Bintan (0.23). Whereas based on population density, Natuna Regency is an area with a minuscule population among six other regencies and cities in the Riau Islands Province due to the dominance of the ocean area compared to the land ones. Furthermore, according to the 2022 Riau Island Province Land Registration Certificate Office, more than 99% of the Natuna area consists of the sea. In addition, 127 of the 154 islands spread in the Natuna Regency are uninhabited (Riau Communications and Informatics Service 2022). This situation causes the mobility of people in Natuna Regency to slow down, which causes the competition for economic growth between districts in Riau Island Province to be increasingly fierce.

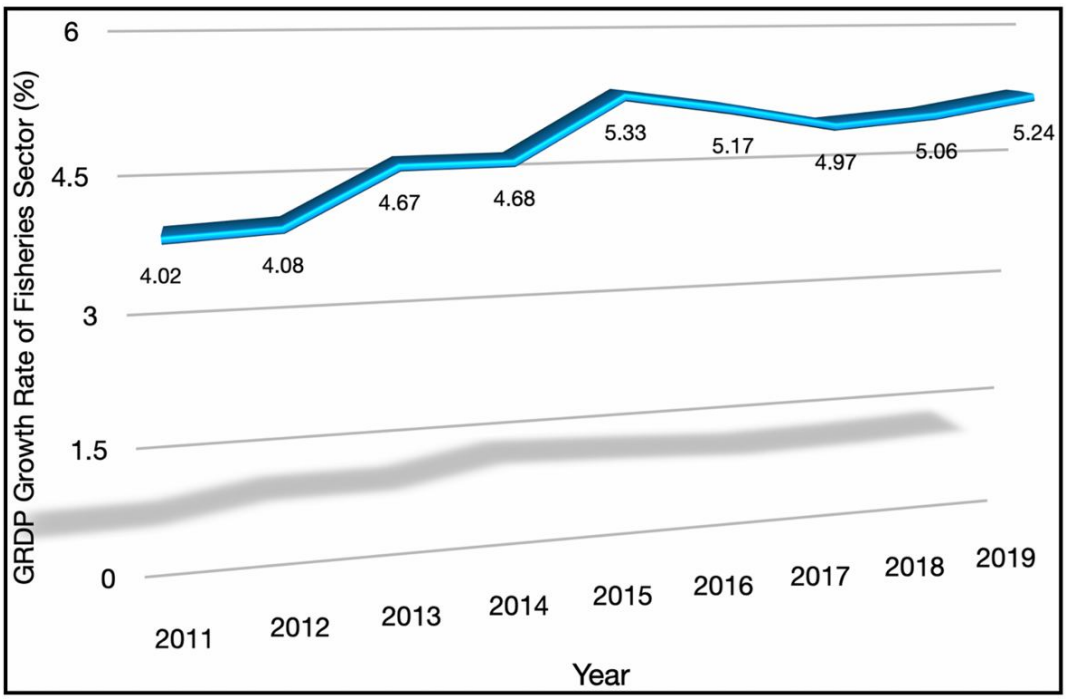

Figure 1. Natuna's gross regional domestic product growth rate 2011-2019.

According to Yudha & Dina (2020), the 2018 GRDP of the fisheries and agriculture sector in Natuna Regency contributed up to 70% to the total GRDP. However, this potential is far from optimal because the majority of fishery and agricultural products are sold as raw goods. In order to optimize income in this sector, the government of Natuna Regency must be able to manage its resource potential independently so that the fishery products in Natuna Regency have maximum added value. For a region to increase its income, the local government must be able to explore the regional economic potential, use potential resources optimally, take into account the current and future potential, and carry out supportive development to support existing resources. As a strategic area located on the Strait of Malacca, which is infamous for the heaviest world trade traffic, it takes courage by the local government to form an identity in the development of the Natuna Regency.

Yudha & Dina (2020) through their studies on national share and national growth effect found that the fisheries sector in Natuna Regency is included in the top five

sectoral GRDP that plays a vital role in national economic growth. Furthermore, Putri (2021) also studied the Natuna Regency through location quotient (LQ) analysis and a growth ratio model covering the study area and regional growth ratio. Through LQ analysis, they found that Natuna Regency has an LQ > 1, emphasizing that Natuna Regency has a base sector that affects local economic growth. However, the base sector in each Regency and city varies according to geographical differences and the resources available in each region, and the fisheries sector is a specialization of economic activity in Natuna Regency.

Given that Natuna Regency has a high potential for fishery products, the increase in regional income and positive economic growth from this sector can provide an overview of the development status that the government has implemented. The present findings show that an increase in GRDP by 1% can increase the expected years of schooling by 0.012%. Although the local government of Natuna Regency has tried to optimize macroeconomic growth by implementing various economic strategies, misconceptions about optimizing fishery resources and holistic economic development often occur. As a result, the dream capacity of natural resource development cannot be achieved optimally (Busega & Postoiu 2015). Putri & Salim (2020) found that human resources in Natuna are relatively underdeveloped due to low education and high emigration. Besides, natural resources such as gas, oil, and fishery products are being extracted for the benefit of other regions, with low investment and local businesses primarily acting as price takers because the GRDP cannot accommodate education in the most proper way.

The fishing community is known as a community with no ability other than catching fish, yet fishing activities require good skills and knowledge for the catches to be optimal. Educational level is closely related to productivity (Wekke & Cahaya 2015). In addition, Katz (2013) found that low education was the cause of the low optimization of fisherman productivity in their profession. A productive person generally has a high level of education. Because productivity is closely related to income, someone who has a high income is assured to be productive and has a good education. High community income will contribute to regional and national economic growth.

Theoretically, an increase in regional economic growth in a region indicates an increase in the ability of the community to meet the basic needs of life (Daher & Haz 2011). That ability that has become the obsession of many regions is inseparable from education, which is the primary motor that brings people skillful in carrying out their activities, including being a fishing community. According to several studies (Katz 2013; Lynch et al 2017; Khatami et al 2018), low expected years of schooling are one of the factors that cause fishing communities to become underdeveloped, along with other factors such as ecosystem degradation, risk of vulnerability, and government policies that are not proactive with fishers. Furthermore, Suyanto (1996) stated that the most significant problems suffered by the fishing community today are: 1) inadequate access to education and health services; 2) access to services in obtaining capital needs is not affordable; 3) unable to determine the price; 4) limited control over the means of production; 5) limited fishing area due to inadequate production equipment.

In short, low levels of education, malnutrition, and limited access to health are the causes of the low productivity of fishers. The level of education also makes fishers unable to adopt new technologies that support their activities. As a result, the efforts of fishermen as marginalized communities are getting less in achieving a better quality of life. Considering that the education variable has a long-term causality with the GRDP, the focus of the Natuna Regency government on these variables must be emphasized so that regional development in Natuna Regency can be accelerated. Therefore, serious attention from the government to the education factor is very much needed so that regional economic growth and regional development can be optimally achieved.

Human development index and education development. Policies that focus on economic growth and development help holistically improve the HDI, improve economic status, provide social stability in society, and increase expected years of schooling. Furthermore, people with good skills due to high education will gain proper access to

essential institutions in optimizing fishery production and market. Independence over individual management can spread economic success and strengthen the economic performance of communities collectively.

According to previous studies (Mas et al 1996; Guild 2000), the complexity of socioeconomic interactions in border areas requires a unique, comprehensive, integrated planning instrument. Those instruments should essentially consider regional development based on the type of resources that support national sovereignty in border areas. Threats and disturbances to national sovereignty in border areas are crucial issues that affect the HDI, which will harm regional and national development. In the plenary session of the Riau Island Province's Statement of Accountability Report 2020 on Monday, March 03, 2020, the Regent of Natuna, Hamid Rizal, said that the HDI of Natuna Regency in 2020 increased from 72.63 to 72.72 from the previous year. However, per capita expenditure decreased by 0.8%, the rate of per capita income decreased from IDR 81.29 million to IDR 78.21 million, poverty increased by 0.3%, and the open unemployment rate increased to 4.1%.

The development of the HDI in border areas is an integral part of living standards improvement, sustainable development, harmonization between various economic sectors, and development acceleration in disadvantaged areas (Şlusarciuc 2015). Therefore, an increase in the HDI does not necessarily mean that the poverty rate and unemployment can be reduced since the decline in the regional economy will make people look for a better life elsewhere due to limited employment opportunities. Although the attributes of poverty and unemployment are under the HDI, the present study found that a 1% increase in HDI will increase expected years of schooling by 2.66%. Education has a competitive power to be developed to create positive economic growth, and therefore a mature fisheries sector based on regional development planning can run optimally.

According to Van Evera (1998), the factors influencing the government's policy are security, geographical, socio-political, and diplomatic conditions. These factors also include distributional inequalities and sensitive inequalities, mainly because these two inequalities deeply touch on multidimensional poverty, which causes a low HDI (Tsui 2002; Decancq & Lugo 2008; Bourguignon & Chakravarty 2019). Inequality can also lead to low harmonization between communities, and this is a critical aspect to consider in creating a high level of life satisfaction in society. Inequality among the people of Natuna Regency must be avoided because it will narrow employment opportunities, cause lifestyle changes that bring social disorder, and eliminate the identity of the Natuna people, who have long been associated with fishery resources.

According to Hamid & Widianto (2001), the main issue that is still the main focus in Natuna Regency is the lack of health, education, economic, and security services. Those problems cause the Natuna Regency, an area that borders other countries with abundant natural resources, to be confronted with the inability to optimize its assets. This statement is reinforced by Putri & Salim (2020), who found that natural resources such as gas, oil, and fishery products in the Natuna Regency are widely used to benefit other regions. As a result, this potential is not optimal because most existing resources are still widely sold as raw products (Yudha & Dina 2020).

Sustainability of fishery resources. The study using direct backward linkage by Anggraeni et al (2020) found that the fisheries sector in Natuna Regency has a significant direct backward linkage index, which indicates that the sector requires additional inputs to optimize integration processes from other sectors, including the fisheries sector itself.

The theory of Jacobsen et al (2014) related to the economic multiplier effect illustrates that one sector can be a multiplier factor that affects the income of a region's economic sector. The greater the multiplier value of a sector, the greater its influence on the regional economy. Based on the results of the input-output analysis by Anggraeni et al (2020), the education services sector has the highest multiplier value to total production and income, emphasizing that people who have good skills due to adequate education will gain access to essential institutions in optimizing fishery production and market. Therefore, the sustainability of Natuna's fishery resources can be backed up by

proper education, leading to the community's ability to create better integration that bolsters the fisheries activities within the society. When the demand for a commercial sector increases, the GRDP of a region will certainly increase competitively. Several studies (Goimawan 2012; Syarief et al 2014; Panggabean 2016) found that GRDP and total production were linearly related. Therefore, an increase in output with a good multiplier effect will positively affect GRDP.

The role of the fisheries sector in the economy of the Natuna Regency needs to be increased through integration with other sectors, either directly or indirectly, to maximize development. The integration between production, processing, and logistics in an integrated fisheries system allows fishers to be optimal in carrying out their activities because access to the three integrated aspects makes it easier for them to interact, transact, and collaborate. A study by Dahuri (2001) stated that Indonesia's marine resources could be a prime mover if the development of a sustainable marine resource perspective is implemented by the government firmly with economic integration; that is, the blue economy requires supporting efforts that must be executed carefully.

Understanding the development of the economic value of fishery natural resources requires planning with a basis on economic and ecological sustainability. Gulo (2015) stated that focusing on the center of economic growth with a principle on sustainable sectors can accelerate regional development, increase economic progress, and improve facilities that support the integration of a robust economic system. Therefore, to support the implementation of the blue economy in Natuna Regency, the government needs: 1) emphasize the importance of maritime diplomacy that can suppress illegal fishing practices; 2) urge foreign fishers not to catch in the Natuna area; 3) suppress illegal fishing through strict legal regulations; 4) increase the number of knowledgeable local fishers who can also act as community supervisory groups; 5) perfecting and facilitating the integration of the fishery sector to encourage fishers carrying out their profession with pride; 6) consider the multiplier effect that supports the fisheries sector in a superior way.

Conclusions. This study proves that when the education variable is set as the dependent variable, the VECM model reveals a long-run causality of education with GRDP and HDI. An increase in the GRDP and HDI by 1% can increase the expected years of schooling by 0.012% and 2.66%, respectively. Besides, since education is under the collective scheme of the HDI, the improvement of education represented by expected years of schooling has proven to be faster if the HDI becomes the top priority.

Natuna Regency, as an area bordering other countries, must have economic independence so that the defense and security of Indonesia as an archipelagic country gets back up from people who have strong independence in their profession as fishing communities. The Natuna Regency has a strategic value from an economic perspective whose development is influenced by various regional development factors such as GRDP, poverty, education, and HDI. Therefore, the government is expected to prioritize education as an investment in local economic development by strengthening the GRDP and HDI. Considering that various foreign interests geographically and politically surround the Natuna Regency, the diverse potential of natural resources available should be wisely guarded. The loss of this potential will have a domino effect on a massive decline in regional growth, leaving local communities with no options. In regional economic development, the blue economy orientation must be built on principles that favor the community, coordinate and integrate between facilities and infrastructure, uphold accessibility for all groups, and involve community elements in natural resource optimization policies.

Acknowledgements. We thank the people involved in completing this research project for their generosity, effort, and support.

Conflict of interest. The author declares that there is no conflict of interest.

References

Achenbaum W. A., 2013 Cutler and the case of the resurrected horse: social work and the story of poverty in America, Australia, and Britain. Journal of Social History 47(2):566-568.

Anggraeni M., Rustiadi E., Yulianto G., 2020 Peranan sektor perikanan terhadap perekonomian Kabupaten Natuna. Jurnal Kebijakan Sosial Ekonomi Kelautan dan Perikanan 10(1):11-23. [in Indonesian].

Bentley R. W., 2002 Global oil & gas depletion: an overview. Energy Policy 30(3):189-205.

Borts G. H., 1960 The equalization of returns and regional economic growth. The American Economic Review 50(3):319-347.

Bourguignon F., Chakravarty S. R., 2019 The measurement of multidimensional poverty. In: Poverty, social exclusion and stochastic dominance. Chakravarty S. (ed), Springer, Singapore, pp. 83-107.

Busega I., Postoiu C., 2015 Inter-regional disparities in the European Union. Romanian Review of Regional Studies 11(1):3-14.

Camagni R., Capello R., 2013 Regional competitiveness and territorial capital: a conceptual approach and empirical evidence from the European Union. Regional Studies 47(9):1383-1402.

Chryshna M., 2021 Hari nelayan nasional: potensi kelautan dan potret nelayan Indonesia. Kompas Gramedia. Available at: https://kompaspedia.kompas.id/baca/paparan-topik/hari-nelayan-nasional-potensi-kelautan-dan-potret-nelayan-indonesia Accessed: May, 2022. [in Indonesian]

Daher M., Haz A. M., 2011 Changing meanings through art: a systematization of a psychosocial intervention with Chilean women in urban poverty situation. American Journal of Community Psychology 47(3-4):322-334.

Dahuri R., 2001 Pengelolaan ruang wilayah pesisir dan lautan seiring dengan pelaksanaan otonomi daerah. Mimbar: Jurnal Sosial dan Pembangunan 17(2):139-171. [in Indonesian]

Decancq K., Lugo M. A., 2008 Measuring inequality of well-being: a proposal based on a multidimensional Gini index. [Conference presentation]. Preliminary version, University of Oxford, the UK. Available at: http://www.accessecon.com/pubs/scw2008/generalpdfscw2008/scw2008-08-00289s.pdf. Accessed: May, 2022.

Dholakia R. H., 2003 Regional disparity in economic and human development in India. Economic and Political Weekly 38(39):4166-4172.

Dickey D. A., Fuller W. A., 1979 Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical association 74(366a): 427-431.

Duffie D., 2001 Dynamic asset pricing theory. Princeton University Press, New Jersey, the USA, pp. 293-310.

Dyer K., 2012 Making 'evidence' the plural of 'anecdote': a work in progress using outcome mapping and the logframe in governance and accountability programming in Tanzania. OM Lab, Beirut, Lebanon, pp. 1-7.

Earl S., Carden F., 2002 Learning from complexity: the international development research centre's experience with outcome mapping. Development in Practice 12(3-4):518-524.

Emmers R., 2009 Geopolitics and maritime territorial disputes in East Asia. Routledge, London, 208 pp.

Engle R. F., Granger C. W. J., 1987 Co-integration and error correction: representation, estimation, and testing. Econometrica: Journal of the Econometric Society 55(2): 251-276.

Fan J., Yao Q., 2003 Nonlinear time series: nonparametric and parametric methods. Springer, New York, pp. 195-192.

Gao, J., 2007 Nonlinear time series: semiparametric and nonparametric methods. Chapman and Hall/CRC, New York, 237 pp.

Goimawan, 2012 Perencanaan pengembangan perikanan budidaya air tawar di Kabupaten Bogor Provinsi Jawa Barat. Master's thesis, Institut Pertanian Bogor Press, Bogor, Indonesia, 120 pp. [in Indonesian]
Guild R. L., 2000 Infrastructure investment and interregional development. Public Works Management and Policy 4(4):274-285.
Gulo Y., 2015 Identification of growth and hinterland area in developing Nias District. Widyariset 18(1):37-48.
Hamid S. H. M., Widianto T., 2001 Kawasan perbatasan Kalimantan: permasalahan dan konsep pengembangan. Pusat Pengkajian Kebijakan Teknologi Pengembangan Wilayah (PPKTPW) BPPT, Jakarta, 149 pp. [in Indonesian]
Harvey S. P., Lowdon W. J., 1961 Natural resources endowment and regional economic growth. Resources for the future. Washington, DC, the USA, pp. 191-212.
Hirsa A., Neftci S. N., 2013 An introduction to the mathematics of financial derivatives. Academic Press, Oxford, the UK, pp. 301-312.
Hull J., White A., 1987 The pricing of options on assets with stochastic volatilities. The Journal of Finance 42(2):281-300.
Indonesian Central Statistics Agency, 2021 [Indonesian economic and financial statistics]. Available at: https://natunakab.bps.go.id/subject/11/produk-domestik-bruto.html#subjekViewTab3. Accessed: May, 2022. [in Indonesian]
Jackson P. S., 2014 The crisis of the "disadvantaged child": poverty research, IQ, and muppet diplomacy in the 1960s. Antipode 46(1):190-208.
Jacobsen K. I., Lester S. E., Halpern B. S., 2014 A global synthesis of the economic multiplier effects of marine sectors. Marine Policy 44:273-278.
Karatzas I., Shreve S. E., 1991 Brownian motion and stochastic calculus. Springer Verlag, Berlin, pp. 128-238.
Karlin S., Taylor H. E., 1981 A second course in stochastic processes. Elsevier, Amsterdam, Netherlands, 520 pp.
Katz M. B., 2013 The land of too much: American abundance and the paradox of poverty. Journal of American History 100(3):900-901.
Khatami A. M., Yonvitner Y., Setyobudiandi I., 2018 Tingkat kerentanan sumberdaya ikan pelagis kecil berdasarkan alat tangkap di perairan utara Jawa. Journal of Tropical Fisheries Management 2(1):19-29. [in Indonesian]
KKP (Kementerian Kelautan dan Perikanan), 2021 Menteri trenggono sebut natuna potensial dijadikan KEK kelautan. Kilas Berita KKP. Available at: https://kkp.go.id/kkp/artikel/29871-menteri-trenggono-sebut-natuna-potensial-dijadikan-kek-kelautan Accessed: May, 2022. [in Indonesian]
Kollias C., Naxakisb C., Zarangasb L., 2004 Defence spending and growth in Cyprus: a causal analysis. Defence and Peace Economics 15(3):299-307.
Li Q., Racine J. S., 2007 Nonparametric econometrics: theory and practice. Princeton University Press, 768 pp.
Lynch A. J., Cowx I. G., Fluet-Chouinard E., Glaser S. M., Phang S. C., Beard T. D., Bower S. D., Brooks J. L., Bunnell D. B., Claussen J. E., Cooke, S. J., 2017 Inland fisheries-invisible but integral to the UN Sustainable Development Agenda for ending poverty by 2030. Global Environmental Change 47:167-173.
Ma'rif S., 2016 Strategi pengembangan perdesaan kawasan perbatasan, studi kasus: kawasan perbatasan Republik Indonesia-Ambenu Republik Demokratik Timor Leste. TATALOKA 14(1):75-89. [in Indonesian]
Mas M., Maudos J., Pérez F., Uriel E., 1996 Infrastructures and productivity in the Spanish regions. Regional Studies 30(7):641-649.
North D., 1990 Institutions, institutional change and economic performance. Cambridge University Press, Cambridge, the UK, pp. 118-130.
Nurzaman S. S., 1997 Tinjauan kesenjangan wilayah di Indonesia. Jurnal Perencanaan Wilayah dan Kota Institut Teknologi Bandung 8(4):11-21. [in Indonesian]
Orsini F., Kahane R., Nono-Womdim R., Gianquinto G., 2013 Urban agriculture in the developing world: a review. Agronomy for Sustainable Development 33(4):695-720.

Panggabean M. A., 2016 Studi peran subsektor perikanan dalam pengembangan wilayah di Kota Sibolga. Jurnal Ilmu Tanah dan Lingkungan 18(1):49-55. [in Indonesian]
Pesaran M. H., Shin Y., Smith R. J., 2001 Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16(3):289-326.
Putri F. S., 2021 Analisis pengembangan potensi ekonomi kota dan kabupaten di provinsi Kepulauan Riau Tahun 2014-2018. Master's thesis, Fakultas Ekonomi dan Bisnis UIN Jakarta, 109 pp. [in Indonesian]
Putri H., Salim W., 2020 The Maritime Silk Road's potential effects on outer island development: the Natuna Islands, Indonesia. Island Studies Journal 15(2):155-172.
Riau Communications and Informatics Service, 2022 Tertinggi di Kepri, pertumbuhan ekonomi Batam capai 4,75 Persen. Dinas Komunikasi dan Informatika. Available at: https://mediacenter.batam.go.id/2022/03/02/tertinggi-di-kepri-pertumbuhan-ekonomi-batam-capai-475-persen/. Accessed: May, 2022. [in Indonesian]
Riau Island Province Land Registration Certificate Office, 2022 Sekretariat Surat Keterangan Pendaftaran Tanah (SKPT) Natuna. Indonesia's Ministry of Marine Affairs and Fisheries. Available at: https://kkp.go.id/SKPT/natuna/page/1181-skpt-natuna. Accessed: May, 2022. [in Indonesian]
Richardson P. B., 2016 Beyond the nation and into the state: identity, belonging, and the 'hyper-border'. Transactions of the Institute of British Geographers 41(2):201-215.
Roy M., 2014 Urban poverty in Bangladesh: slum communities, migration and social integration. Urban Studies 51(2):453-457.
Siebert H., 1969 Regional economic growth: theory and policy. Int. Textbook Company, Scranton, Pennsylvania, USA, 217 pp.
Siska D., 2016 Strategi pengembangan berbasis agroindustri di kawasan andalan Kandangan Kalimantan Selatan. Jurnal Bina Praja 7(2):1-12 [in Indonesian]
Şlusarciuc M., 2015 The economic potential of crossborder areas. Opportunities and threats. Procedia Economics and Finance 32:801-808.
Steele J. M., 2001 Stochastic calculus and financial applications. New York, Springer, pp. 231-261.
Suyanto B., 1996 Perangkap kemiskinan: problem dan strategi pengentasannya dalam pembangunan desa. Aditya Media, Jogjakarta, Indonesia, pp. 119-124. [in Indonesian]
Syarief A., Rustiadi E., Hidayat A., 2014 Analisis subsektor perikanan dalam pengembangan wilayah Kabupaten Indramayu. Jurnal Tataloka 16(2):84-85. [in Indonesian]
Tsay R. S., 2005 Analysis of financial time series. John Wiley & Sons, New York, the USA, pp. 156-192.
Tsui K. Y., 2002 Multidimensional poverty indices. Social Choice and Welfare 19(1):69-93.
Van Evera S., 1998 Offense, defense, and the causes of war. International Security 22(4):5-43.
Wekke I. S., Hamid S., 2013 Technology on language teaching and learning: a research on Indonesian pesantren. Procedia-Social and Behavioral Sciences 83:585-589.
Wekke I. S., Cahaya A., 2015 Fishermen poverty and survival strategy: research on poor households in bone Indonesia. Procedia Economics and Finance 26:7-11.
Yonvitner Y., Wafi H., Yulianto G., Boer M., Kurnia R., 2021 Small-scale fishermen: poverty as a challenge to achieve Sustainable Development Goals (SDGs) in Sunda Strait. Masyarakat, Kebudayaan dan Politik 34(1):81-92.
Yudha E. P., Dina R. A., 2020 Pengembangan potensi wilayah kawasan perbatasan negara Indonesia (studi kasus: Ranai-Natuna). Tata Loka 22(3):366-378. [in Indonesian]

Received: 07 June 2022. Accepted: 14 July 2022. Published online: 28 August 2022.
Author:
Andriamampionona Lalaina Tienh, Faculty of Social and Political Sciences, Universitas Diponegoro, Prof Soedarto, S.H., Tembalang, Semarang 50275, Indonesia, e-mail: tienhlai@gmail.com
Budi Setiyono, Faculty of Social and Political Sciences, Universitas Diponegoro, Prof Soedarto, S.H, Tembalang, Semarang 50275, Indonesia, e-mail: budisetiyono@lecturer.undip.ac.id
Amiek Soemarmi, Constitutional Law, Faculty of Law, Universitas Diponegoro, Prof Soedarto, S.H., Tembalang, Semarang 50275, Indonesia, e-mail: amiek_hk@yahoo.com
Nanik Trihastuti, International Law, Faculty of Law, Universitas Diponegoro, Prof Soedarto, S.H., Tembalang, Semarang 50275, Indonesia, e-mail: naniktrihastuti@gmail.com
Lazarus Tri Setyawanta, Faculty of Law, Universitas Diponegoro, Prof Soedarto, S.H., Tembalang, Semarang 50275, Indonesia, e-mail: syclosundip@yahoo.com
Zafimahery Lalanantenaina, Institut Universitaire de Formation des Enseignants, Université de Genève, 24 rue general dufour 1211 Genève, e-mail: maheryaaronoa@gmail.com

How to cite this article:
Tienh A. L., Setiyono B., Soemarmi A., Trihastuti N., Setyawanta L. T., Lalanantenaina Z., 2022 Empowering Natuna's local fishermen by optimizing regional development parameters. AACL Bioflux 15(4):2191-2204.