Nexus of Fisheries and Agriculture Production and Urbanization on Ecological Footprint: New Evidence from Indonesian Economy

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ABSTRACT

The current examination is motivated to identify the link between fisheries, agriculture, urbanization, and the environment. In doing so, the present study is motivated to examine the Indonesian economy due to its massive population, marine-centered location, and almost equal rural-urban ratio. Hence, the current examination analyzed the influence of fisheries production, Agriculture production, and urban development (UD) on the ecological footprint (EF) in Indonesia. The novelty of the present study lies in being the pioneer examination to study the joint effect of the mentioned variables on EF. We applied a novel methodology of auto regressive distributed lag (ARDL) bound testing cointegration to confirm the long and short run connection between fisheries, agriculture, UD, and EF in Indonesia. The results of ARDL confirm that UD, agriculture, and fisheries production has a positive and significant impact on the EF in the long-run. However, only a negative impact is found from agriculture production to EF in the short-run period in Indonesia. The present study recommended that the Indonesian government need to introduce some technology-oriented production system for fisheries and agriculture sector in order to reduce the EF in the Indonesian Economy.

Keywords: Fisheries Production, Urban Development, Ecological Footprint, Indonesia
JEL Classifications: Q22, Q57, R51

1. INTRODUCTION

The increase in world population and densification have resulted in greater climate and land pressure. The augmented needs of the population have both direct and indirect effects on natural eco-system and environmental condition. On the one hand, expansion in urbanization is directly related to a reduction in forest land, habitat loss, and depletion of natural resources. On the other hand, the excessive demand for goods and services increased due to modernization and mobility put exaggerated pressure on consumption in several industrial segments, including fisheries, agriculture, trade, and production, etc.

Given the rising trends in fishery produce, there is a relative ambiguity in current time regarding its impact on marine life and natural habitat. Due to the flawed awareness of marine conservation and functions, there is insufficient knowledge regarding the distinction between natural change in marine habitat and human-altered change. All inclusive, it has been observed that in the current era, numerous fish species are overexploited, and several stocks have fallen. In this regard, Barange et al. (2014) stated that developing human populaces and changing dietary inclinations are expanding worldwide requests for fish, adding strain to worries over fisheries sustainability. Such enhanced demand for fisheries is more evident in densely populated countries, such as Indonesia, that play a major part in enhancing the ecological burden on fish produce (Glaeser et al., 2017). This emergency alongside has augmented worries over the stream regarding the impacts this can exert on biological systems (Zhou

et al., 2010). Hence, following the immobilize marine structure, a reconsideration of environment based fisheries over conventional fisheries management has emerged that can maintain the balance between human needs and marine eco-balance (Zhou et al., 2010).

Moreover, the effects of agriculture are also considered eminent for environmental stability as it guarantees natural quality through progressions and innovation in agriculture produce (AP) along with the maintenance of fields, plants, and trees. In such a manner, the job of agriculture is additionally viewed as famous in diminishing eco-burden (Liu et al., 2017). The reliance on agriculture regularly debilitates other mechanical extensions and shields from a few unfriendly results of contamination and natural resource exhaustion. Besides, with the rise in ecological mindfulness, agriculture landowners have turned out to be rapid in adopting eco-accommodating and privately adjusted rural frameworks that convey numerous social and natural advantages. These included the broadened use of cutting edge techniques, for example, improved seed, manures, and other agro-engineered mixes, instruments, and water system (Sheahan and Barrett, 2017). Also, plants and trees in cultivating help to hold and pour water to underground aquifers that reduce human effort and energy consumption. However, in the absence of refined methods and use of technologies in agriculture, orthodox agriculture can be a source of increasing ecological footprints (EFs). The inefficient methods can alter the quality of products and incur time cost. Together, they can enhance environmental pressure and increase human demand from natural habitat.

Moreover, urbanization is also critical in altering environmental change. It has a tendency to enhance the EF. The notion of EFs measures the influence of an economy or country on nature regarding land, water, and air (Al-Mulali et al., 2015b). It is believed that due to humans rising demand for resources greater than the actual limit of the planet affects future sustainability. In this regard, Hubacek et al. (2009) established that rural to urban mobility, modernization in urban areas, and extensive societal transition, especially in Asia had played a vital part in raising EFs. Given the rising trend and densely populated country of the region, Indonesia has also been discussed in the literature regarding its growing urbanization and the impact it exerts on environment (Kurniawan and Managi, 2018; Sodri and Garniwa, 2016; Zhu and Simarmata, 2015; Hasibuan et al., 2014; Delinom et al., 2009; Firman, 2009).

In line with the above-mentioned discussion, the current examination is motivated to identify the link between fisheries, agriculture, urbanization, and environment. In doing so, the present study is motivated to examine the Indonesian economy due to its massive population, marine-centered location, and almost equal rural-urban ratio (World Bank, 2017). Hence, the current examination analyzed the influence of fisheries produce (FP), AP, and urban development (UD) on the EF in Indonesia. The novelty of the present study lies in being the pioneer examination to study the joint effect of the mentioned variables on EF. Moreover, against the conventional approach of measuring degradation with carbon-dioxide emission (Munksgaard et al., 2000; Suzuki and Oka, 1998; Ang and Pandiyan, 1997; Suzuki et al., 1995), the current study followed recent literature (Destek and Sarkodie,

2019; Ozturk et al., 2016; Al-Mulali et al., 2015a; Al-Mulali and Ozturk, 2015; Rehman et al., 2019) and analyzed the impact of the studied variables on EF, due to its relevance and popularity for being a more diversified measure of environmental degradation (Sharif et al., 2019). After such prudence, the results derived from the current examination are expected to increase the understanding regarding the variables of interest and can enhance the value of the relevant existing literature.

The remaining parts of the current investigation are discussed in the following. After chapter one, chapter two of this study analyzed the existing literature related to environmental Kuznets curve examinations and its link with crucial ecological indicators, including energy price. Later in chapter three, the explanation regarding the methods of the study are discussed. In chapter four, the empirical results and their interpretations are presented. In the end, chapter five offers study conclusion and implications.

2. LITERATURE REVIEW

Given the increase in environmental degradation, modern literature is motivated to examine numerous dynamics of economic, social, and monetary changes on the environmental condition. Analyzing the impact of urbanization on environment, Al-Mulali and Ozturk (2015) investigated the influence of energy, UD, trade liberalization, output, and political steadiness on the environment. The study used the data from the period of 1996-2012 and analyzed the sample of fourteen MENA nations. For statistical analysis, the authors used the technique of FMOLS. The findings of the investigation reported that all variables are significant to impact the sustainability of the environment. Particularly, the study found that UD brought a positive impact on environmental degradation, indicating that the rise in urbanization augments ecological burden.

Liddle (2014) also investigated the influence of population and UD on the environment. In order to measure the environmental impact of the variables, the study used the proxies of energy consumptions and carbon emanations. The findings of the investigation reported that UD is significant to impact the sustainability of the environment. Particularly, the study found that UD brought a positive impact on both energy utilization and carbon emanation, indicating that the rise in urbanization augments ecological burden. Also, Zhang et al. (2014) investigated the influence of output development and UD on the environmental condition. The study used the data from the period of 1978 to 2011 and analyzed the sample of the Chinese economy. For measuring degradation, the authors used levels of carbon emanations. The findings of the investigation reported that both variables are significant to impact the sustainability of the environment. The results suggested that output development decrease carbon emanations. However, the study found that UD brought a positive impact on environmental degradation, indicating that the rise in urbanization augmentscarbon emanation.

Wang et al. (2016) also examined the influence of energy and UD on the environment. The study used the data from the period of 1980 to 2009 and analyzed the panel of ASEAN nations. For statistical analysis, the authors used the technique of FMOLS. The findings

of the investigation reported that both variables are significant to impact the sustainability of the environment. Particularly, the study found that UD brought a positive impact on environmental degradation, indicating that the rise in urbanization augments ecological deterioration in the ASEAN region. In another panel investigation, Al-Mulali et al. (2012) investigated the influence of energy and UD on the environment. The study used the data from the period of 1980 to 2008 and analyzed the mixed panel of seven World regions. For statistical analysis, the authors used the technique of FMOLS. The findings of the investigation reported that both variables are significant to impact the sustainability of the environment. Particularly, the study found that eighty-four percent of the nations in the sample persisted positive impact of UD on environmental degradation, indicating that the rise in urbanization increased carbon emanations in the regions. On the other hand, sixteen percent of the economies reported negative and insignificant association among the variables.

On the other hand, Liu et al. (2017) investigated the influence of agriculture, renewable, and non-renewable energy on the environment. The study used the data from the period of 1970 to 2013 and analyzed the sample of four ASEAN nations. For statistical analysis, the authors used the technique of DOLS and FMOLS. The findings of the investigation reported that all variables are significant to impact the sustainability of the environment. Particularly, the study found that agriculture development brought a negative impact on environmental degradation, indicating that the rise in agriculture produced decreases carbon emanation in selected ASEAN countries. Similarly, Jebli and Youssef (2017) also investigated the influence of agriculture, renewable, and non-renewable energy on the environment. The study used the data from the period of 1980 to 2011 and analyzed the sample of five North African nations. For statistical analysis, the authors used the technique of DOLS and FMOLS. The findings of the investigation reported that all variables are significant to impact the sustainability of the environment in North Africa. Similar to Liu et al. (2017), the study found that agriculture development carried positive influence on environmental degradation, indicating that the rise in agriculture advancement decreases carbon intensity.

Turner et al. (1999) analyzed the influence of fisheries in deteriorating marine habitat. The study considered the fishing impacts in three regions of New Zealand and Australia. The findings of the investigation reported that fishing is significant to impact the sustainability of the marine habitat. Specifically, it is observed that fishery carried positive influence on loss or degradation of marine life, indicating that rise in fishing deteriorates marine habitat.

Similarly, Pomeroy et al. (2016) analyzed the management of fishery products and the factors that drive the fishing industry. In particular, the study qualitatively discussed the environment of fishery scarcity around the globe. Discussing the influencers of the fishery, the authors stated that attainment of animal protein from fish is the major driver of fishery industry particularly in Cambodia and Indonesia where the consumption of fish is between 50 and 60%. The authors further stated that marine disorder from fishing undermined aquatic ecosystems. This led to enhance marine life

vulnerability to function efficiently to the notion of aquatic balance and sustainability.

3. METHODOLOGY

The current research looks at the association between fisheries production, urbanization, agriculture production, and EF by utilizing a model which is given underneath:

$$EF_t = \beta_0 + \beta_1 (FP_t) + \beta_2 (AP_t) + \beta_3 (UD_t) + \varepsilon_t$$

Where ε_t is the residual term, EF signifies the EF, which is calculated in gha (global hectares). FP explains the fisheries production, which is measured in US dollars, AP denotes the agriculture production, which is measured in US dollars. Moreover, UD signifies UD, which is measured in a number of persons who lived in urban areas out of the total population. The information is gathered from the time of 1980 to 2017. Entireinformationis collected from the World Development Indicators. Finally, the entire information is converted in natural logarithmic series as it provides more accurate results (Afshan et al., 2018; Sharif et al., 2017). In addition, as to check the stationary properties for long haul connection of focused time series information, the present examination uses Augmented Dickey-Fuller (ADF) and Philip Perron (PP) unit root tests. Moreover, the current study also inspects the information at first on the level and afterward on the first differential of all considered variables.

Next, to look at the impact of fisheries and agriculture production and urbanization on EF in Indonesia, the present examination applies auto regressive distributed lag (ARDL) procedure of long-run affiliation which was presented by Pesaran and Pesaran (1997), Pesaran et al. (1999), Pesaran et al. (2001; 2000) is utilized with the assistance of unrestricted vector errorrectification framework to examine the relationship among different variables. The framework has a couple of points of interest on past long-run estimations (like Johansen and Juselius Cointegration and further). This technique could be important regardless of whether time arrangement is absolutely I(0), I(1) or comparably co-integrated. The ARDL framework is anticipated for the examination is as per the following:

$$\Delta EF = \varphi_0 + \varphi_1 \sum_{i=1}^{p} EF_{t-1} + \varphi_2 \sum_{i=1}^{p} FP_{t-1} + \varphi_3 \sum_{i=1}^{p} AP_{t-1} + \varphi_4 \sum_{i=1}^{p} UD_{t-1}$$
$$+ \gamma_1 EF_{t-1} + \gamma_2 FP_{t-1} + \gamma_3 AP_{t-1} + \gamma_4 UD_{t-1} + \mu_t$$

Where, φ_0 is a constant term, and μ_t is an error term, the error modification breaking point is represented to by the sign of summation however the further part of the equation relates to a long run association. The Schwarz Bayesian Criteria (SBC) is utilized to take maximum lag length decision for each factor. In addition, in this structure, the present examination figures the F-statistics significance by using suitable frameworks. Following, the Wald (F-details) test is utilized to look at the long-run connection between the components. In the event that the long-run association is found between agriculture and fisheries production, urbanization and EF, then the present study evaluated the long term coefficients utilizing the associated equation:

Table 1: Results of unit root test

Variables	ADF unit root test				PP unit root test			
	I (0)		I (1)		I (0)		I (1)	
	C	C&T	C	C&T	C	C&T	C	C&T
FP	0.398	0.376	−4.810	−4.767	0.393	0.352	−5.170	−5.075
AP	1.322	1.135	−4.089	−3.924	1.154	1.161	−3.787	−3.684
UD	−1.014	−0.971	−4.761	−4.693	−0.900	−0.904	−4.756	−4.444
EF	−0.690	−0.595	−4.564	−4.593	−0.600	−0.626	−4.544	−4.480

Source: Authors' estimations. The critical values for ADP and PP tests with constant (C) and with constant and trend (C&T) 1%, 5% and 10% level of significance are−3.711, −2.981, −2.629 and−4.394, −3.612 and−3.243 respectively

$$EF_t = \zeta_0 + \zeta_1 \sum_{i=1}^{p} EF_{t-1} + \zeta_2 \sum_{i=1}^{p} FP_{t-1} + \zeta_3 \sum_{i=1}^{p} AP_{t-1} + \zeta_4 \sum_{i=1}^{p} UD_{t-1} + \mu_t$$

Next, if the long-run connection between agriculture and fisheries production, UD, and EF are found with significant value, then, we gauge the short run coefficients by utilizing the following framework:

$$EF_t = \delta_0 + \delta_1 \sum_{i=1}^{p} EF_{t-1} + \delta_2 \sum_{i=1}^{p} FP_{t-1} + \delta_3 \sum_{i=1}^{p} AP_{t-1} + \delta_4 \sum_{i=1}^{p} UD_{t-1} + nECT_{t-1} + \mu_t$$

The error correction model (ECM) demonstrate the speed of modification permit to quantify the long-run symmetry because of a short run shock. The n is the coefficient of errorcorrection term in the model that determines the speed of modification.

4. DATA ESTIMATION AND INTERPRETATION

The present unit clarifies data analysis. Essentially, we used a stationary test to confirm the stationary properties of the taken variables. The outcomes of the unit root test are introduced in Table 1. In this investigation, we utilized two unit root tests to be explicit ADF and PP test to affirm the stationary character of the components. The outcomes avow that agriculture and fisheries production, UD, and EF at first are non-stationary at series of level information while becoming stationary at a series of first differentials. In a fundamental way, from the aftereffects of unit root test, the present examination can surmise that information of the significant number of variables show the stationary characteristic and allow for reports to the long term assessments.

Besides, to investigate the long run association between fisheries and agriculture production, UD, and EF in Indonesia, the present examination associated the model for ARDL. In order to achieve, the essential step is to select the most extreme lag estimation of the significant number of variables. The pattern of this lag estimation is picked by giving guidelines of SBC. Thus, the outcomes of the ARDL bound testing cointegration appears Table 2.

The results of Table 2 confirm the rejection of the null hypothesis of no association among the variables. This is a result of the estimation of the F-statistics is greater than UBC critical value at 1% significance level. Hence, it is in favor of an alternate hypothesis, which suggests that there is a strong long term affiliation occur among fisheries and agriculture production, UD,

Table 2: Results of bound testing for cointegration

Lags order	AIC	HQ	SBC	F-test statistics
0	−4.699	−5.007	−5.117	97.385*
1	−5.745*	−5.417*	−5.319*	
2	−5.408	−5.267	−5.157	
3	−4.907	−4.815	−4.978	

*1% level of significance. Source: Authors' estimation

Table 3: Results of lag length selection

Lag	0	1	2	Nominated lags
	SBC	SBC	SBC	SBC
FP	1.781	−3.683*	−3.466	1
AP	2.063	−3.184*	−3.082	1
UD	1.506	−2.854*	−2.057	1

*Indicate minimum SBC values. Source: Authors' estimation

and EF in Indonesia. The outcomes of lag length determination arereported for in Table 3.

The results of bound testing, therefore, affirm the strength of accomplished results. It is demonstrated that a gigantic long termconnection exists among fisheries production, UD, agriculture production, and EF in Indonesia. Furthermore, in the after the confirmation of long term relationship between the considered variable, the other phase of the analysis is to utilize the method with the purpose of the result the coefficient calculation of long-short run period. As to achieve, the present examination evaluates the lag estimation sequence of whole factors done by the estimation of SBC.

The long-termoutcomes of ARDL technique are shown in Table 4. The results hence set up that fisheries production, UD, and agriculture productionare the significant determinants of EF in Indonesia. Likewise, the outcomes affirm that fisheries production have a positive and significant effect on the EF in Indonesia, which implies that as more the production of fisheries, the greater EF in the country. In addition to this, the results of ARDL also confirm that agriculture production and UD play a noteworthy role to increase the EF in Indonesia which confirm that fisheries and agriculture production are the determinants of EF which enhance the demand from the nature in Indonesia.

The short-run outcomes of ARDL methodare shown in Table 5. The outcomes detailed a legitimate short run connection between UD, agriculture production, fisheries production, and EF in Indonesia. The value of the error term is demonstrating the estimation of around −0.251 recommend that around 25.1% of the variability is adjusted in the present year. Moreover, the results likewise affirm

Table 3: Results of lag length selection

Lag	0	1	2	Nominated lags
	SBC	SBC	SBC	SBC
FP	1.781	−3.683*	−3.466	1
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UD	1.506	−2.854*	−2.057	1

*Indicate minimum SBC values. Source: Authors' estimation

Table 4: Results using ARDL approach (long run)

Variables	Coeff.	t-stats	Prob.
C	0.284	4.835	0.000
EF (−1)	0.215	4.983	0.000
FP	0.337	3.895	0.000
FP (−1)	0.089	2.785	0.000
AP	0.309	5.483	0.000
AP (−1)	0.006	0.936	0.350
UD	0.371	5.839	0.000
UD (−1)	0.148	1.452	0.148
Adj. R^2	0.945		
D.W stats	2.0192		
F-stats (Prob.)		1946.478 (0.000)	

Source: Authors' estimation

Table 5: Results using ARDL approach (short run)

Variables	Coeff.	t-stats	Prob.
C	0.274	2.588	0.010
EF (−1)	0.185	1.781	0.072
FP	0.217	4.467	0.000
FP (−1)	0.047	1.395	0.175
AP	−0.201	−5.432	0.000
AP (−1)	−0.193	−4.494	0.000
UD	0.284	4.995	0.000
UD (−1)	0.147	3.783	0.000
ECM (1)	−0.251	−4.843	0.000
Adj. R^2		0.911	
D.W stats		2.089	
F-stats (Prob.)		1023.589 (0.000)	

Source: Authors' estimation

the noteworthy effect of agriculture production, UD, and fisheries production on the EF in Indonesia in short running also. The results of UD and fisheries production are similar in the short run as well. However, we found different results of agriculture production in the short run period as compared to long-run period. The results of agriculture production confirm a positive impact on the EF in the long run; however, a negative impact in the short runs period.

5. CONCLUSION AND RECOMMENDATION

Given the rising trends in fishery produce, there is a relative ambiguity in current time regarding its impact on marine life and natural habitat. Due to the flawed awareness of marine conservation and functions, there is insufficient knowledge regarding the distinction between natural change in marine habitat and human-altered change. All inclusive, it has been observed that in the current era, numerous fish species are overexploited, and several stocks have fallen. In this regard, it is stated that developing human populaces and changing dietary inclinations are expanding worldwide requests for fish, adding strain to worries over fisheries sustainability. Such enhanced demand for fisheries

is more evident in densely populated countries, such as Indonesia, that play a major part in enhancing the ecological burden on fish produce. This emergency alongside has augmented worries over the stream regarding the impacts this can exert on biological systems. Hence, following the immobilize marine structure, a reconsideration of environment based fisheries over conventional fisheries management has emerged that can maintain the balance between human needs and marine eco-balance.

In line with the above-mentioned discussion, the current examination is motivated to identify the link between fisheries, agriculture, urbanization, and environment. In doing so, the present study is motivated to examine the Indonesian economy due to its massive population, marine-centered location, and almost equal rural-urban ratio. Hence, the current examination analyzed the influence of FP, AP, and UD on the EF in Indonesia. The novelty of the present study lies in being the pioneer examination to study the joint effect of the mentioned variables on EF. We applied a novel methodology of ARDL bound testing cointegration to confirm the long and short run connection between fisheries, agriculture, UD, and EF in Indonesia. The results of ARDL confirm that UD, agriculture, and fisheries production has a positive and significant impact on the EF in the long-run. However, only a negative impact is found from agriculture production to EF in the short-run period in Indonesia.

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