Finance, Accounting and Business Analysis
Volume 4 Issue 2, 2022
http://faba.bg

Is There A Trade-Off Between Economic and Environmental Factors in Traditional Oil Mine Management?

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Info Articles

Keywords:
environment, economic, social, factor analysis, willingness to pay

Abstract

Oil mining that is managed by the public can increase local income but on the other side inflict environmental damage. The aim of this research is to analyze the link between the environmental, economic, and social factors and to test whether there is a trade-off between economic and environment factor for traditional oil mining in Wonocolo Village, Kedewan Sub-district, Bojonegoro Regency. The respondents are 84 traditional oil miners in Wonocolo Village. The method of collecting data is by using questionnaire. The analysis tool for analyzing the data is using Factor Analysis by Principal Component Analysis method. The variables consist of Income, Education, Age, Distance from home to mine, and Willingness to Pay (WTP). The result shows that income and education are related positively to WTP which means the higher the income and education, the bigger the WTP. Age and distance from the mine are related negatively to WTP which means the older and the farther the house from the mine, the smaller the WTP. The higher the income, the bigger the WTP shows that there is no trade-off between economic and environment factors for traditional oil mining. Policy implications is that trade-off does not happen between economy and environment quality which means mining activity in Wonocolo is still doable to increase GDRP without degrading the quality of environment. However, this activity needs evaluation especially on how rapidly crude oil reserves depleted and to prepare about green technology that can substitute non-renewable natural resources such as crude oil.

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INTRODUCTION

Natural resources are one of the development of capitals. Indonesia is known for its abundance of natural resources. One of natural resources that has its own fair share in development of national and regional economic is mineral resources (Widayat, 2017). Crude oil is one of the most valuable mineral resources that contribute for economic to improve human welfare (Handayani et al., 2022; Kozminski & Baek, 2017; Lin & Raza, 2020; Pujiati et al., 2019, 2022). Management and utilization of the crude oil resource for national and regional development must obliged to the principle of sustainable development as to prevent environmental issue in the future (Pujiati et al., 2020, 2017; Wann-Ming, 2019).

The coordinated development of the environment quality and the socio-economy has always been a concern of the global community (Broman & Robèrt, 2017; Oktavilia et al., 2019; Peng et al., 2019; Pujiati et al., 2022; Sundram et al., 2021; J. Wang et al., 2018). Exploiting this development opportunity though poses several trade-offs, although bringing significant economic benefit, it also plays great impact on adverse environmental impacts (Damania et al., 2018; Godby et al., 2018). According to Marsiglio and Privileggi (2021) their study showed that independently of the relative weight of economic and environmental goals, capital will initially overshoot its long run level in order to the decrease over time while pollution will monotonically increase during the transition towards the long run equilibrium. There is a sort of trade-off between environment and production, providing insights that, policies directed toward protecting the environment may harm economic activities Wesseh and Lin (2022) meaning also that if policies directed toward growing the economy may harm the environment quality. Herziger et al. (2020) higher income individuals could practice sustainable consumption without depleting discretionary spending resources. The kind of natural resources that cannot be regenerated such as crude oil, if the management and the utilization does not base itself on the principle, it will cause great scarcity.

According to Central Statistical Agency (2021), the amount of crude oil production, condensat, and natural gas in Indonesia has been depleted since 2017 to 2021. Crude oil and condensat reserve in 2017 were 292 million barrel and it has declined to the position of 240 million billion barrel in 2021. The decrease in oil production in Indonesia is 21,6% or approximately 52 million barrels since 2017 and natural gas production in 2017 was 2.781 MMscf (Million Standard Cubic Feet) and it has declined to the position of 2.433 MMscf in 2021, the decrease in natural gas is 14% or approximately 347 MMscf. The declining trend required wiser management so that the next generation can relish crude oil as natural resources. Indonesia's crude oil reserves spread through many blocks, one of the biggest oil reserve blocks is Blok Cepu. With its own potential up to 729 million barrel, Blok Cepu is the biggest after Blok Rokan. Regions that are part of the Blok Cepu will potentially increase regional revenues. Blok Cepu is in 3 districts, namely Blora, Bojonegoro and Tuban Regencies. The existence of petroleum resources has contributed greatly to the GRDP revenue for the mining and quarrying sector.

Table 1. GRDP Distribution Based on Current Prices by Business Field in the Mining and Quarrying Sector in 2017-2021 (%)

Regency	2017	2018	2019	2020	2021
Blora	24,52	26,67	25,01	18,89	24,31
Bojonegoro	47,41	49,61	49,36	43,42	50,14
Tuban	9,10	9,30	8,90	8,94	9,15

Source: (Badan Pusat Statistik, 2022a, 2022b, 2022c)

The era of regional autonomy provides broad opportunities for regions to increase revenue through the management of natural resources owned by each region (Pujiati et al., 2018, 2020). Among the *Blok* Cepu, the distribution of Gross Regional Domestic Product (GRDP) based on business field on current prices, Bojonegoro Regency mining and quarrying sector has the highest percentage of total GRDP of each district. Bojonegoro Regency has traditional oil mining in Wonocolo Village, Kedewan sub-district, the relics of the Netherlands amounted to 494 oil wells with average production of 500 BOPD (Barrels Oil Per Day). Management of oil mining still uses simple tools. The absence of a good treatment system has caused heavy metal pollution in soil, water and, air pollution (de Brito et al., 2019; Meng et al., 2020; Mondal et al., 2019). This is caused by oil spills and residual waste from the processing of oil which is discharged into nature without going through processing that has occurred for years. Whereas spills and oil waste that pollute the ground can reach the location of ground water or other water sources so that it will endanger areas that still rely on ground water as the main source of clean water and drinking water (de Brito et al., 2019). Another problem is that there are still illegal drilling (illegal mining) and illegal oil refining activities. Even though economically mining produces high Gross Regional Domestic Product (GRDP), the exploitation of natural resources that do not heed the ability and carrying capacity of the environment will cause a decline in environmental quality (Canare & Francisco, 2019; Kurniawan &

Managi, 2018)

Development comes with an impact that is undeniable to environment but on the other hands it raises the GRDP. With the negative impact or damage caused to the surrounding environment it must be compensated by economic size so that the environment can be managed again if the oil mining activities are no longer in operation. This raises the principle that the polluter must pay for pollution arising from its production activities and become a consideration in calculating the cost of accommodation for external or environmental costs (Saidi et al., 2018). The principle of pollutants must pay for the pollution that results will make individuals or groups consider the cost or value they are willing to pay, as a form of responsibility in maintaining and restoring post-mining environmental conditions.

The value of willingness to pay as compensation for environmental improvement depends on several factors of income, education, age, distance from home to mine. Income and willingness to pay have a positive relationship (Cahyati et al., 2019). Someone who has greater income will be able to meet their daily needs so that person is willing to set aside his income to participate in efforts to improve environmental quality. This is because there is a tendency for people who are able to meet their needs to pay more attention to their health and comfort. The higher one's education, the higher the awareness to protect the environment so that the opportunity for willingness to pay for WTP is greater (Ito & Zhang, 2020; Mutaqin & Usami, 2019; Vo et al., 2021). According Muazzinah and Aidar (2017), age variable does not have any significant effect on the value of WTP. The distance between the house and the location of natural resources being managed has negative relationship, the farther the distance traveled the more costs incurred so that the willingness to pay WTP is getting smaller (Prasmatiwi et al., 2011).

Natural resources are development of capitals that can generate income. The high contribution of natural resource management in terms of income must be balanced with the high environment that is maintained. There has been many research conducted on Willingness to Pay but there has not one that has been done about WTP in regards to natural resource management especially on traditional oil mining. The urgency of this study is trying to prevent the environmental degradation in other places that still manage to have traditional oil mining so that won't be any trade-off between GRDP and environment. The purpose of this study was to test whether the trade-off between economy and environment happen. This research is expected to contribute academically and practically by proving whether there is a trade-off between economic and environmental factors in traditional oil mine management.

LITERATURE REVIEW

Relationship between Income to Environment

Keynes's theory of consumption explains that the factor affecting consumption is income. According to (Ikhsan & Syahrival, 2014) if one does a labor therefore, one will receive a remuneration in the form of money as income. Income and consumption have a positive correlation, the higher the income, the higher the ability to consume (Saptutyningtyas, 2007). A person consumes not only to meet the needs of private goods, but also public goods, namely environment goods. According to (Sayyidah, 2013; Ladyance & Yuliana, 2014) there is a positive and significant relationship between income and people's willingness to pay related to environmental improvement. This means that if the income owned by the community is greater, then their willingness to pay tends to be greater. There is a tendency that the greater the income, a person will pay more attention to their health and comfort, including the environment.

Other research linking wealth with WTP is from Shao et al (2018) found that rich people have stronger WTP regarding environmental protection. However, by increasing people's income, the marginal WTP for environmental protection will decrease and there will be a reversal of the top income level, so that WTP is not always accompanied by an increase in income and the middle class has the strongest WTP for environmental protection. Wang et al (2020) also found that the behavior of hoarding food is driven by several motivations and subjective perceptions of risk, stating that women with higher education and a high-income consumer category tend to hoard food on a large scale, but the WTP for hoarding food immediately is influenced by income. Liu et al (2019) found that young people with high levels of education and high income tend to have a higher WTP for self-driving vehicle technology. Vo et al (2021) found differences in WTP based on gender, area of residence, monthly income, and risk of COVID-19.

Relationship between Education to Environment

Human resource is one of the capitals for development. The increasing number of populations will become the capital of development if it is balanced with the quality of human resources improvement. Increased quantity must be balanced with quality. Improvement and development of human resources can be achieved through education, both formal and non-formal. The higher the education, the higher the awareness of the importance of protecting the environment. A person's awareness in maintaining environmental conditions which is getting higher has a positive correlation with the level of education.

The high level of education causes the opportunity for the willingness to pay to improve environmental quality will be even greater (Nwofoke, Onyenekwe, & Agbo, 2017). This is supported by research conducted by Peng et al (2019), the higher a person's education level, the higher his willingness to pay new technology such as self-driving vehicles. Research (Yuen & Chu, 2008) states that education is the factor that has the highest influence on WTP to clean the air. Liu et al (2019) found that young people with high levels of education and high income tend to have a higher WTP for self-driving vehicle technology. Ntanos et al (2018) found that using the binary logit model, WTP is positively related to education, energy subsidies, and assistance from the state regarding renewable resources. Sanchez et al (2022) found that by using the Random Parameter Latent Class (RPLC) many homeowners with low education tend to be insensitive to information about fire risk compared to homeowners with higher education.

Relationship between Age and Environment

In making decision, a person is influenced by the level of maturity. Age is a way to measure maturity. There is a positive link between age and mindset in making decisions for the benefit of both personal and other people or society. Awareness of protecting the environment is a shared responsibility and is needed by people who have a mature mindset. With the older a person's age, it is considered that they will have a more mature mindset in making decisions and the level of awareness in protecting the environment will be better that their tendency of willing to pay for environmental improvements is getting bigger (Nwofoke, Onyenekwe, & Agbo, 2017; Amanda, 2009). According to Peng et al (2019) age is one of the factors affecting WTP on new technology. Liu et al (2019) found that young people with high levels of education and high income tend to have a higher WTP for self-driving vehicle technology. Chua et al (2022) found that age and distance to health facilities were the main predictors of WTP using telemedicine.

Relationship between Distance from Home to Mine and Environment

Willingness to pay for environmental improvement is influenced by distance, namely the travel time from the house to the destination. The farther the distance must be traveled, the greater the cost and time to spend. So, the assumption is that the farther a person has to travel, the smaller his willingness to pay will be, due to the large consumption or costs that must be incurred. Then the research of Nwofoke, Onyenekwe, & Agbo (2017) shows a negative relationship between distance and someone's willingness to pay. Where the farther the farmer's house is from the rice mill, the lower the chance of his willingness to pay due to the reduced air pollution they consume. Wana dan Sori (2022) used the logit model found that WTP for obtaining improved water availability is influenced by household income, family size, education level, and distance from water sources.

METHOD

The research is conducted in Wonocolo Village, Kedewan District, Bojonegoro Regency. This type of quantitative research, primary data source with a questionnaire method. Respondents in the study are 84 traditional oil miners. The research variable used is environment which can be assesed through willingness to pay (WTP) as the dependent variables. The independent variables are income, education, age, and distance from home to mine.

According to Muazinnah and Aidar (2017) and Lazaridou (2019), Willingness to Pay is willingness of individuals to pay for an environmental condition resulting from the use of resources in order to improve environmental quality. The value of willingness to pay (WTP) for environmental improvement is used to measure the value of willingness to pay someone for environmental damage caused by mining in rupiah units. The calculation of WTP uses the contingent valuation method (CVM) that has been done by Li and Kallas (2021). The following stages: Creating a Hypothetic Market by explaining to the community the solutions to overcome post-mining soil contamination in the form of a bioremediation program, auction value or payment offer (WTP) for the bioremediation program, Calculating Average WTP Value, and aggregating the WTP value. WTP someone for environmental damage caused by mining in rupiah units. Income is measured by total income per month from working as a traditional oil miner in Rupiah. Education is measured by the number of years of formal education that has been taken in years. The age is measured by the age of the miners in years. The distance from the house is measured from the house to the traditional oil mine location in kilometres.

The analytical tool used to analyze the link between the environmental, economic, and social factors and to test whether there is a trade-off between economic and environment factor for traditional oil mining uses factor analysis with the principal component analysis method. A factor analysis is applied to systemically integrate the variables. Factor Analysis is a technique of dimension reduction and data simplification (Hao et al., 2019; Shrestha, 2021). Factor Analysis is used to extract two factors and could explain 57,66% of the common variance of food group variables, while five components were extracted,

explaining 26.25% of the total variance of food group variables (Santos et al., 2019). According to Noora (2021) Factor Analysis can be combined with Principal Component Analysis (PCA) and can be used to examin whether the statements represent identifiable factors related to touris satisfaction. PCA can signify to the statistical process used to underline variation for which principal data components are calculated and bring out strong patterns in the dataset. The analysis stage begins with testing the feasibility of a factor analysis tool with a collinearity test between variables using the Kaiser-Meyer-Olkin (KMO) Barlett's Test of Sphericity, Measure of Sampling Adequacy (MSA), Extraction, and Rotation.

RESULTS

Analysis of the Amount of WTP with the CVM Method

CVM (Contingent Valuation Method) approach is used in calculating the value of willingness to pay for environmental damage caused by traditional oil mining in Wonocolo Village. The stages and results are as follows: First, create a hypothetical market by providing an explanation and knowledge of the impact of environmental damage arising from traditional oil mining activities, especially when mining activities are no longer exist or after mining. The solution offered is to reduce environmental damage on soil pollution with a bioremediation program. Second, Obtain WTP Auction Value with the bidding game technique, namely by repeatedly asking respondents questions until they get a certain amount of payment value. The auction value or payment offer (WTP) for the bioremediation program is IDR 2,000, IDR 3,000, IDR 5,000, IDR 10,000, and IDR 15,000 per month. Third, calculate the average value of WTP and aggregate the value of WTP. There were 40 respondents (48%) who are willing to pay WTP and 44 people (52%) are unwilling to pay. Respondents who are not willing to pay WTP have reasons: there is no mutual agreement between the community and the manager about large irregular income and basic household needs and environmental damage that have occurred over a long period of time. The average WTP that respondents are willing to pay is Rp. 3,369 per month (Table 2).

Table 2 shows the description of the variables noted with WTP for Willingness to Pay, INC for Income, EDU for Education, AGE for Age, and DIST for Distance. Respondent's income has the highest range among other variables, which means that there is a high gap in terms of respondent's income. The average age of the respondents is 37 years, which means that they are classified as young and productive. Average education is 9 years or junior high school completion and includes low education. The average income of the miners is Rp. 2,700,000 / month, the distance from the house to the oil mining site is an average of 5 km. The average WTP who is willing to be paid is Rp. 3,369 per month or Rp. 3,370 if rounded off.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean
WTP	84	.00	15.00	3.3690
INC	84	8.00	80.00	27.1310
EDU	84	4.00	12.00	8.9286
AGE	84	22.00	75.00	37.4643
DIST	84	1.00	10.00	4.5679
Valid N (listwise)	84			

Source. Processed primary data

Several steps were taken to see the accuracy of the analysis tools. Factor analysis requires that the data matrix must have sufficient correlation, so a correlation test is carried out using the KMO measure, Barlett's Test of Sphericity, and the Measure of Sampling Adequacy (MSA). In Table 3, the KMO value is 0.547. Factor analysis can be continued if the KMO value is> 0.5. Barlett's Test of Sphericity value is significant at 0.00. Based on these two criteria, the factor analysis can be continued.

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.547
Bartlett's Test of Sphericity	Approx. Chi-Square	37.177
	df	6
	Sig.	.000

The next step for factor analysis is to look at the MSA of each variable. In the MSA calculation in Table 4, it shows that all variables used, namely income, age, education, and distance have an MSA of 0.50 which means that all variables meet the requirements of the factor analysis test. MSA for age is 0.527,

education is 0.531, income is 0.640 and distance is 0.646. Factor analysis basically classifies the variables into factors. The next step is to perform extraction and rotation.

Table 4. Anti-image Matrices

		Zscore (AGE)	Zscore (EDU)	Zscore (INC)	Zscore (DIST)
Anti-image Correlation	Zscore (AGE)	.527[a]	.527	-.018	.032
	Zscore (EDU)	.527	.531[a]	-.232	.125
	Zscore (INC)	-.018	-.232	.640[a]	.099
	Zscore (DIST)	.032	.125	.099	.646[a]

Note. a. Measures of Sampling Adequacy (MSA)

The next stage in factor analysis is Extraction. Extraction in factor analysis aims to classify the variables into factors and how many factors are formed that can explain the overall variation in the model formed. Table 5 shows that of the four variables, two factors are formed (eigenvalues> 1 become one factor). Factor 1 can explain 43.04% of the variation, factor 2 can explain 25.02%. Both factors overall can explain 68.07%.

Table 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	1.722	43.044	43.0 44	1.722	43.044	43.044	1.558
2	1.001	25.021	68.065	1.001	25.021	68.065	1.165
3	.843	21.064	89.129				
4	.435	10.871	100.000				

Note. Extraction Method: Principal Component Analysis.
Source. Processed primary data

Table 6 shows the rotation results of the variables which are grouped into two factors with a loading factor > 0.5. The two factors, factor 1, age and education, respectively, the loading factor is 0.880 and 0.837, factor 2 is income and the distance are the loading factor of 0.605 and 0.858, respectively. Factor 1 can be given a new variable name social and factor 2 can be given a new variable name economy.

Table 6. Rotated Component Matrix[a]

	Component	
	1	2
Zscore (INC)	.281	.605
Zscore (EDU)	.837	.246
Zscore (AGE)	-.880	.022
Zscore (DIST)	.063	-.858

Note. Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 3 iterations.

The results of the rotation in table 6 show that the age variable as one of the social variables shows that the loading factor value is 0.880 which is negative, meaning that if the age of a person increases, the WTP value that is willing to be paid to improve environmental quality will decrease due to unable to savour the benefit of their sacrifice for the better-off of environment in long term. These results indicate that the miners in Wonocolo village with an increasingly old age, their level of concern and awareness in protecting the environment are getting lower. The results of this study do not support Amanda (2009) which explains that there is a positive influence between age and willingness to pay WTP. The difference between this research and Amanda's is that Amanda's research is about the willingness to pay on tourist attractions where visitors pay and can enjoy sacrifices for environmental improvement. For traditional oil mines, the sacrifices made by traditional miners by paying WTP in the long term they don't enjoy so that the older they get the more they don't want to pay.

Based on the data description, the number of respondents who are willing to pay WTP is 40 people (48%). The age of respondents who are willing to pay WTP is at most 30-40 years old as much as 37.5%, aged <30 years as much as 25%. This means that the young people are willing to pay the remaining 62.5% of the old age group. The older, the concern for the environment is measured by the willingness to share

the less the WTP. The reason people who are old age do not want to pay WTP because the environmental damage that is happening now is that it has been hereditary, so they feel it is not their responsibility to pay for environmental damage. This study supports Bowen's theory regarding the definition of public goods, including the environment. Public goods are goods where exceptions cannot be determined, if public goods are available then no one can be exempted from the benefits of these goods. The environment includes public goods that have non-exclusive and non-rivalry characteristics. Nonexclusive (not special) means that a person cannot be excluded from the benefit of consuming public goods whether the person pays or not. Nonrivalry means that if there is additional consumption there is no additional cost for consuming the goods. The results of the research show the importance of socialization, environmental awareness campaigns in every joint activity so that the goals of sustainable development are achieved. The results of development are not only for the present generation but for future generations.

The loading factor value of the education variable is 0.837 and has a positive sign, so that it can be interpreted that if the higher the education a person has taken, the greater the value of WTP that is willing to be paid will increase. Education is one of the social variables that affects the willingness to pay and has a different relationship with the age variable. Results These results support research Gravitiani et al. (2017), Muazzinah and Aidar (2017), and Nwofoke et al. (2017) the higher the level of education a person has, the higher the WTP value they are willing to pay will be greater. This happens because the level of knowledge and understanding of people who have higher education will be considered better than those whose education is still below it. As mentioned on another studies from Ahmed et al. (2015) and Jianjun (2015) that level education plays a huge role on the willingness to pay for environment quality.

The income variable has a loading factor value of 0.605 and has a positive sign. This can mean that if the level of income a person has is getting bigger, the WTP value paid will be even more. This result is supported by research from Tuaputy et al. (2014) regarding the externalities of gold mining community in Buru Regency, Maluku, explains that if the miners' income is higher, the WTP value for environmental improvement will be higher. This result is interesting because the greater the income, the greater the WTP value, which means that the environment is getting better.

Income is one of the factors of economic variables. Evidence from developing countries indicates that water pollution yields no measurable benefits without collaboration among local governments and strong implementation and enforcement. Therefore, government has to trade off economic growth with environmental governance, which presents the possible dilemma of economic recession without environmental improvement (J. Li et al., 2020). Yet, despite widespread consensus that economic and environmental policy preferences are substitutes, empirical efforts to evaluate this economy-environment trade-off remain uneven (Mildenberger & Leiserowitz, 2017). Also, the fact that this study shows that the higher the income, it also increases the willingness to pay for the environment around it. These results prove that there is no trade-off between economic and environmental variables. The mining community proves that the greater the income they get, the greater the willingness to pay for environmental damage because mining processing is still traditional.

The house distance variable is the result of the loading factor value of 0.858 and has a negative sign and it can be interpreted that if the distance from the house to one's work location is further away, the greater the value of the WTP that is willing to be paid will be smaller. Commuting and wages can be attributed to the sorting of workers into certain firms at various distance (Dauth & Haller, 2020). The location of the mine that is outside the residential area causes costs and time to be sacrificed to reach the mining location, this results in a negative relationship to the value of the WTP because the farther the miner's house is from the mining location, the greater the cost and the greater the value. less is willing to pay for environmental improvement. These results support Prasmatiwi et al. (2011). The economic distance between the house and the mining location is calculated as a cost. The farther the distance, the greater the costs incurred. If the costs incurred are greater, the willingness to pay for environmental damage will be smaller. This is different from the income variable which is an economic variable which has a positive relationship with the willingness to pay for environmental damage.

CONCLUSION

People's willingness to pay for environmental damage or WTP is related to factors of age, education, income, and the distance from the house to the mining site. Social factors consisting of age and education variables have different relationships. Age is negatively related to willingness to pay WTP, the older the willingness to pay WTP is smaller. while education is positively related, the higher the education the greater the willingness to pay WTP. Economic factors, which consist of income and the distance between the house and the mining site, also have a different relationship. Income has a positive relationship, the higher the income the greater the willingness to pay WTP so that the environment is getting better. This proves that there is no trade-off between the economy as measured by income and the environment in the

case of traditional oil mining. The distance between the house and the willingness to pay WTP has a negative relationship. The farther the distance, the smaller the willingness to pay the WTP so that the environment is also getting worse. The absence of a trade-off between economic and environmental variables is only proven for the income variable, for the variable distance between the house and the mining location, there is still a trade-off between economic and environmental variables.

Practical Implications

According to this research, trade-off does not happen between economy and environment quality which means mining activity in Wonocolo is still doable to increase GDRP without degrading the quality of environment. However, this activity needs evaluation especially on how rapidly crude oil reserves depleted and to prepare about green technology that can substitute non-renewable natural resources such as crude oil (Azadi et al., 2020; Chen et al., 2022; Huang et al., 2020; Jinzhong et al., 2020; Y. Wang & Yu, 2021).

Limitations and Future Research Agenda

Limitations of the study, the CVM method in calculating WTP requires sufficient time, cost and understanding of the community about the environment to obtain preferences that can show how much the community cares for the environment. With such limitation, the future research agenda is to use more efficient and effective method such as benefit transfer method. This method can be used by using the results of studies/research in other places that have the same/almost the same characteristics and typology (Hanley & Czajkowski, 2019; Lawton et al., 2021; Rauner et al., 2020).

REFERENCES

Ahmed, A., Masud, M. M., Al-Amin, A. Q., Yahaya, S. R., Rahman, M., & Akhtar, R. (2015). Exploring factors influencing farmers' willingness to pay (WTP) for a planned adaptation programme to address climatic issues in agricultural sectors. *Environ Sci Pollut Res 22*, 9494–9540. https://doi.org/https://doi.org/10.1007/s11356-015-4110-x

Amanda, S. (2009). Analisis Willingness to Pay Pengunjung Obyek Wisata Danau Situgede dalam Upaya Pelestarian Lingkungan (skripsi). *Fakultas Ekonomi Dan Manajemen Institut Pertanian Bogor*. https://doi.org/http://repository.ipb.ac.id/handle/123456789/14375

Azadi, M., Northey, S. A., Ali, S. H., & Edraki, M. (2020). Transparency on greenhouse gas emissions from mining to enable climate change mitigation. *Nature Geoscience*, *13*(2), 100–104. https://doi.org/10.1038/s41561-020-0531-3

Badan Pusat Statistik. (2021). *Statistik Pertambangan Minyak dan Gas Bumi 2017-2021*. https://www.ptonline.com/articles/how-to-get-better-mfi-results

Badan Pusat Statistik. (2022a). *Kabupaten Blora dalam Angka 2022*.

Badan Pusat Statistik. (2022b). *Kabupaten Bojonegoro dalam Angka 2022*.

Badan Pusat Statistik. (2022c). *Kabupaten Tuban dalam Angka 2022*.

Broman, G. I., & Robèrt, K.-H. (2017). A framework for strategic sustainable development. *Journal of Cleaner Production*, *140*, 17–31. https://doi.org/https://doi.org/10.1016/j.jclepro.2015.10.121

Cahyati, W., Prameswari, W. H., Wulandari, G. N., & Karnowo, C. (2019). Kajian Stunting di Kota Semarang. *Jurnal Riptek*, *13*(2), 101–106. http://riptek.semarangkota.go.id

Canare, T., & Francisco, J. P. (2019). Decentralization, Fiscal Independence, and Poverty in the Philippines. *Public Budgeting and Finance*, *39*(4), 94–117. https://doi.org/10.1111/pbaf.12241

Chen, L., Zhao, T., & Huang, J. (2022). Analysis on the effect of green transformation of China's mining industry based on key indicators of mine development. In X. Qu (Ed.), *International Conference on Sustainable Technology and Management (ICSTM 2022)* (p. 29). SPIE. https://doi.org/10.1117/12.2647835

Chua, V., Koh, J. H., Koh, C. H. G., & Tyagi, S. (2022). The Willingness to Pay for Telemedicine Among Patients With Chronic Diseases: Systematic Review. *Journal of Medical Internet Research*, *24*(4), e33372. https://doi.org/10.2196/33372

Damania, R., Russ, J., Wheeler, D., & Barra, A. F. (2018). The road to growth: Measuring the tradeoffs between economic growth and ecological destruction. *World Development*, *101*, 351–376. https://doi.org/https://doi.org/10.1016/j.worlddev.2017.06.001

Dauth, W., & Haller, P. (2020). Is there loss aversion in the trade-off between wages and commuting distances? *Regional Science and Urban Economics*, *83*, 103527. https://doi.org/https://doi.org/10.1016/j.regsciurbeco.2020.103527

de Brito, J. F., Bessegato, G. G., de Toledo e Souza, P. R. F., Viana, T. S., de Oliveira, D. P., Martínez-Huitle, C. A., & Zanoni, M. V. B. (2019). Combination of Photoelectrocatalysis and Ozonation as a

Good Strategy for Organics Oxidation and Decreased Toxicity in Oil-Produced Water. *Journal of The Electrochemical Society*, *166*(5), H3231–H3238. https://doi.org/10.1149/2.0331905jes

Godby, R., Taylor, D. T., & Coupal, R. (2018). Wind development, tax policy and economic development tradeoffs. *The Electricity Journal*, *31*(5), 46–54. https://doi.org/https://doi.org/10.1016/j.tej.2018.06.001

Gravitiani, E., Rahardjo, M., & Pratiwi, N. S. (2017). Are Tourists Willing to Pay for Mitigation of Abrasion? A study on Coastal Areas in Yogyakarta, Indonesia. *Global Journal of Business & Social Science Review*, *5*(2), 46–51. https://doi.org/Gravitiani, Evi and Rahardjo, Mugi and Pratiwi, Norma Sagita, Are Tourists Willing to Pay for Mitigation of Abrasion? A Study on Coastal Areas in Yogyakarta, Indonesia (April 9, 2017). Global Journal of Business & Social Science Review, Vol. 5(2), p. 46-51, 2017, Available at SSRN: https://ssrn.com/abstract=3002423

Handayani, B. D., Yanto, H., Pujiati, A., Ridzuan, A. R., Keshminder, J. S., & Shaari, M. S. (2022). The Implication of Energy Consumption, Corruption, and Foreign Investment for Sustainability of Income Distribution in Indonesia. *Sustainability*, *14*(23), 15915. https://doi.org/10.3390/su142315915

Hanley, N., & Czajkowski, M. (2019). The Role of Stated Preference Valuation Methods in Understanding Choices and Informing Policy. *Review of Environmental Economics and Policy*, *13*(2), 248–266. https://doi.org/10.1093/reep/rez005

Hao, Y., Liu, H., Chen, H., Sha, Y., Ji, H., & Fan, J. (2019). What affect consumers' willingness to pay for green packaging? Evidence from China. *Resources, Conservation and Recycling*, *141*, 21–29. https://doi.org/10.1016/j.resconrec.2018.10.001

Herziger, A., Claborn, K. A., & Brooks, J. S. (2020). Is there hope for the double dividend? How social context can shape synergies and tradeoffs between sustainable consumption and well-being. *Ecological Economics*, *176*(C). https://doi.org/10.1016/j.ecolecon.2020.106736

Huang, J., Guo, D., & Hou, H. (2020). An Analysis of Progress and Models of Local Green Mining. *IOP Conference Series: Earth and Environmental Science*, *558*(2), 022022. https://doi.org/10.1088/1755-1315/558/2/022022

Ifabiyi, I. P. (2011). Willingness to pay for water at household level in Ilorin, Kwara State, Nigeria. *Global Journal of Human Social Science*, *11*(2), 1–10.

Ito, K., & Zhang, S. (2020). Willingness to Pay for Clean Air: Evidence from Air Purifier Markets in China. *Journal of Political Economy*, *128*(5), 1627–1672. https://doi.org/10.1086/705554

Jinzhong, Y., Yuling, Z., & Weiling, Y. (2020). Technical Research on Remote Sensing Monitoring of Green Mine. *E3S Web of Conferences*, *194*, 05005. https://doi.org/10.1051/e3sconf/202019405005

Kozminski, K., & Baek, J. (2017). Can an oil-rich economy reduce its income inequality? Empirical evidence from Alaska's Permanent Fund Dividend. *Energy Economics*, *65*, 98–104. https://doi.org/10.1016/j.eneco.2017.04.021

Kurniawan, R., & Managi, S. (2018). Economic Growth and Sustainable Development in Indonesia: An Assessment *. *Bulletin of Indonesian Economic Studies*, *54*(3), 339–361. https://doi.org/10.1080/00074918.2018.1450962

Lawton, R., Fujiwara, D., Mourato, S., Bakhshi, H., Lagarde, A., & Davies, J. (2021). The economic value of heritage in England: A benefit transfer study. *City, Culture and Society*, *26*, 100417. https://doi.org/10.1016/j.ccs.2021.100417

Lazaridou, D., Michailidis, A., & Mattas, K. (2019). Evaluating the Willingness to Pay for Using Recycled Water for Irrigation. *Sustainability*, *11*(19), 5220. https://doi.org/10.3390/su11195220

Li, J., Shi, X., Wu, H., & Liu, L. (2020). Trade-off between economic development and environmental governance in China: An analysis based on the effect of river chief system. *China Economic Review*, *60*, 101403. https://doi.org/https://doi.org/10.1016/j.chieco.2019.101403

Li, S., & Kallas, Z. (2021). Meta-analysis of consumers' willingness to pay for sustainable food products. *Appetite*, *163*, 105239. https://doi.org/10.1016/j.appet.2021.105239

Lin, B., & Raza, M. Y. (2020). Analysis of energy security indicators and CO2 emissions. A case from a developing economy. *Energy*, *200*, 117575. https://doi.org/10.1016/j.energy.2020.117575

Liu, P., Guo, Q., Ren, F., Wang, L., & Xu, Z. (2019). Willingness to pay for self-driving vehicles: Influences of demographic and psychological factors. *Transportation Research Part C: Emerging Technologies*, *100*, 306–317. https://doi.org/10.1016/j.trc.2019.01.022

Marsiglio, S., & Privileggi, F. (2021). On the economic growth and environmental trade-off: a multi-objective analysis. *Annals of Operations Research*, *296*. https://doi.org/http://hdl.handle.net/2318/1670627

Meng, M., Chen, Z., Liao, X., Wang, J., & Shi, L. (2020). A well-testing method for parameter evaluation of multiple fractured horizontal wells with non-uniform fractures in shale oil reservoirs. *Advances in*

Geo-Energy Research, *4*(2), 187–198. https://doi.org/10.26804/ager.2020.02.07

Mildenberger, M., & Leiserowitz, A. (2017). Public opinion on climate change: Is there an economy–environment tradeoff? *Environmental Politics*, *26*(5), 801–824. https://doi.org/https://doi.org/10.1080/09644016.2017.1322275

Mondal, S., Rana, U., Das, P., & Malik, S. (2019). Network of Polyaniline Nanotubes for Wastewater Treatment and Oil/Water Separation. *ACS Applied Polymer Materials*, *1*(7), 1624–1633. https://doi.org/10.1021/acsapm.9b00199

Muazzinah, M., & Aidar, N. (2017). Willingness To pay Kualitas Udara Bersih Di Kota Banda Aceh. *Jurnal Ilmiah Mahasiswa Ekonomi Pembangunan*, *2*(3), 431–442.

Mutaqin, D. J., & Usami, K. (2019). Smallholder Farmers' Willingness to Pay for Agricultural Production Cost Insurance in Rural West Java, Indonesia: A Contingent Valuation Method (CVM) Approach. *Risks*, *7*(2), 69. https://doi.org/10.3390/risks7020069

Ntanos, S., Kyriakopoulos, G., Chalikias, M., Arabatzis, G., & Skordoulis, M. (2018). Public Perceptions and Willingness to Pay for Renewable Energy: A Case Study from Greece. *Sustainability*, *10*(3), 687. https://doi.org/10.3390/su10030687

Nwofoke, C., Onyenekwe, S. C., & Agbo, F. U. (2017). Willingness to pay (WTP) for an improved environmental quality in Ebonyi State, Nigeria. *Journal of Environmental Protection*, *8*(02), 131. https://doi.org/http://doi.org/10.4236/jep.2017.82011

Oktavilia, S., Sugiyanto, F. X., Firmansyah, Pujiati, A., & Setyadharma, A. (2019). Effect of Energy Consumption and Economic Growth towards the environmental quality of Indonesia. *E3S Web of Conferences*, *125*(201 9), 7–10. https://doi.org/10.1051/e3sconf/201912510007

Peng, L., Deng, W., Zhang, H., Sun, J., & Xiong, J. (2019). Focus on economy or ecology? A three-dimensional trade-off based on ecological carrying capacity in southwest China. *Natural Resource Modeling*, *32*(2), e12201. https://doi.org/https://doi.org/10.1111/nrm.12201

Prasmatiwi, F. E., Irham, I., Suryantini, A., & Jamhari, J. (2011). Kesediaan membayar petani kopi untuk perbaikan lingkungan. *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi Dan Pembangunan*, *12*(2), 187–199. https://doi.org/https://doi.org/10.23917/jep.v12i2.192

Pujiati, A., Bowo, P. A., & Nihayah, D. M. (2018). The Urban Sustainability Index in Urban Aglomeration. *Jejak*, *11*(2), 294–305. https://doi.org/10.15294/jejak.v11i2.16052

Pujiati, A., Murniawaty, I., Nihayah, D. M., Muarrifah, I., & Damayanti, N. (2022). A Simulated Policy towards Green Public Transportation in a Metropolitan in Indonesia. *International Journal of Energy Economics and Policy*, *12*(5), 162–168. https://doi.org/10.32479/ijeep.13121

Pujiati, A., Oktavilia, S., Fafurida, F., Wahyuningrum, I. F. S., & Damayanti, N. (2020). Environmental Quality and Regional Autonomy in Indonesia. *International Journal of Business and Management Science*, *10*(2), 217–228.

Pujiati, A., Sarungu, J. J., & Soesilo, A. M. (2017). Kontribusi Kepemimpinan dan Tata Kelola Kota Terhadap Kota Berkelanjutan. *PROCEEDINGS*, *1*(1).

Pujiati, A., Setiaji, K., Purasani, H. N., & Farliana, N. (2019). Integration of Environmental Economics to Build Economic Behaviors. *E3S Web of Conferences*, *125*(201 9). https://doi.org/10.1051/e3sconf/201912502009

Rauner, S., Bauer, N., Dirnaichner, A., Dingenen, R. Van, Mutel, C., & Luderer, G. (2020). Coal-exit health and environmental damage reductions outweigh economic impacts. *Nature Climate Change*, *10*(4), 308–312. https://doi.org/10.1038/s41558-020-0728-x

Saidi, S., Shahbaz, M., & Akhtar, P. (2018). The long-run relationships between transport energy consumption, transport infrastructure, and economic growth in MENA countries. *Transportation Research Part A: Policy and Practice*, *111*(October 2017), 78–95. https://doi.org/10.1016/j.tra.2018.03.013

Sánchez, J. J., Holmes, T. P., Loomis, J., & González-Cabán, A. (2022). Homeowners willingness to pay to reduce wildfire risk in wildland urban interface areas: Implications for targeting financial incentives. *International Journal of Disaster Risk Reduction*, *68*, 102696. https://doi.org/10.1016/j.ijdrr.2021.102696

Santos, R. de O., Gorgulho, B. M., Castro, M. A. de, Fisberg, R. M., Marchioni, D. M., & Baltar, V. T. (2019). Principal Component Analysis and Factor Analysis: differences and similarities in Nutritional Epidemiology application. *Revista Brasileira de Epidemiologia*, *22*. https://doi.org/10.1590/1980-549720190041

Shao, S., Tian, Z., & Fan, M. (2018). Do the rich have stronger willingness to pay for environmental protection? New evidence from a survey in China. *World Development*, *105*, 83–94. https://doi.org/10.1016/j.worlddev.2017.12.033

Shrestha, N. (2021). Factor Analysis as a Tool for Survey Analysis. *American Journal of Applied Mathematics*

and Statistics, *9*(1), 4–11. https://doi.org/10.12691/ajams-9-1-2

Sundram, V. P. K., Hashim, N., Shariff, S. H., Pujiati, A., & Ardiansari, A. (2021). Sustainable Transportation on University Campus: A Case at UiTM Selangor, Puncak Alam Campus, Malaysia and Universitas Negeri Semarang, Indonesia. *Asian Journal of University Education*, *17*(2), 262–272. https://doi.org/10.24191/AJUE.V17I2.13407

Tuaputy, U. S., Putri, E. I. K., & Anna, Z. (2014). Eksternalitas pertambangan emas rakyat di kabupaten buru maluku. *Journal of Agriculture, Resource and Environmental Economics*, *1*(1), 71–86. https://doi.org/https://doi.org/10.29244/jaree.v1i1.11301

Vo, N. X., Huyen Nguyen, T. T., Van Nguyen, P., Tran, Q. V., & Vo, T. Q. (2021). Using Contingent Valuation Method to Estimate Adults' Willingness to Pay for a Future Coronavirus 2019 Vaccination. *Value in Health Regional Issues*, *24*, 240–246. https://doi.org/10.1016/j.vhri.2021.01.002

Wana, H. (2022). *ACTA SCIENTIFIC AGRICULTURE (ISSN : 2581-365X) Determinants of Household Willingness to Pay for Improved Water Supply in Horo Woreda , Oromia National Regional State , Western Ethiopi ... Determinants of Household Willingness to Pay for Improved Water S*. *May*.

Wang, E., An, N., Gao, Z., Kiprop, E., & Geng, X. (2020). Consumer food stockpiling behavior and willingness to pay for food reserves in COVID-19. *Food Security*, *12*(4), 739–747. https://doi.org/10.1007/s12571-020-01092-1

Wang, J., Wei, X., & Guo, Q. (2018). A three-dimensional evaluation model for regional carrying capacity of ecological environment to social economic development: Model development and a case study in China. *Ecological Indicators*, *89*, 348–355. https://doi.org/https://doi.org/10.1016/j.ecolind.2018.02.005

Wang, Y., & Yu, L. (2021). Can the current environmental tax rate promote green technology innovation? - Evidence from China's resource-based industries. *Journal of Cleaner Production*, *278*, 123443. https://doi.org/10.1016/j.jclepro.2020.123443

Wann-Ming, W. (2019). Constructing urban dynamic transportation planning strategies for improving quality of life and urban sustainability under emerging growth management principles. *Sustainable Cities and Society*, *44*, 275–290. https://doi.org/10.1016/j.scs.2018.10.015

Wesseh Jr, P. K., & Lin, B. (2016). Modeling environmental policy with and without abatement substitution: a tradeoff between economics and environment? *Applied Energy*, *167*, 34–43. https://doi.org/https://doi.org/10.1016/j.apenergy.2016.01.031

Wesseh, P. K., Benjamin, N. I., & Lin, B. (2022). The coordination of pumped hydro storage, electric vehicles, and climate policy in imperfect electricity markets: Insights from China. *Renewable and Sustainable Energy Reviews*, *160*, 112275. https://doi.org/10.1016/j.rser.2022.112275

Widayat, R. M. (2017). Analisis Dampak Keberadaan Pertambangan Emas Liar Masyarakat Terhadap Lingkungan (Studi Kasus Di Desa Lunyuk Rea Kecamatan Lunyuk Kabupaten Sumbawa). *Gane Swara*, *11*(2), 80–84.