Improving Rural Accessibility in Indonesia: Fuel Subsidy versus Infrastructure Development

Maghfira Ramadhani

April 2023

Indonesia has been subsidizing fuel prices for a long time. However, people in rural areas still experienced unreasonable high prices due to limited access to subsidized fuel. Starting in 2016, the government introduce the One Price Fuel program in collaboration with the National Oil Company and appointed 55 new remote gas stations to guarantee fuel availability in the last miles. On the other hand, started in 2015 the Indonesian government put a lot of commitment to decentralizing development to the village level by introducing village fund transfers in which the village government received a higher fiscal transfer. It is believed that decentralizing development is better at bringing infrastructure to remote areas. This research measures the impact of the One Price Fuel program and rural infrastructure development on accessibility and analyzes the efficiency of each program. This research finds out that both rural fuel distribution program and inter-government transfer significantly reduces unit transportation cost in rural areas. The village fund transfer successfully reduces unit transport cost by 1 Rp/km per million Rp spent, while the fuel program reduces unit transport cost by 0.77 Rp/km per million Rp spent. The fund transfer to local government is statistically more efficient in improving rural accessibility when compared in transportation cost reduced per million Rp spent in the program.

Maghfira Ramadhani: Ph.D. student at Georgia Institute of Technology, maghfira.ramadhani@gatech.edu

Replication code available here

1. Introduction

Research question. Although Indonesia has been subsidizing fuel for a long time, high fuel prices were still observed in rural areas in the last decade since they were unable to get the fuel from the official fuel supply chain (Wicaksono 2016; Birra 2017). Therefore since 2016, the government initiated the One Price Fuel program to guarantee the availability of subsidized fuel in these areas. The government in collaboration with the National Oil Company started to build a new gas station in the targeted outermost and less-developed village so that they get the fuel at the same price as any other gas station. This program is expected to bring development to the village level by reducing energy costs which could improve the overall village's economic activity. On the other hand, decentralization of development to the village level has been implemented since 2014, when the central government initiate an annual fiscal transfer to the village government to improve their financial capability in bringing development to the last miles[1]. This research measures the impact of these government programs in improving rural accessibility at the village level and exercising the efficiency of each specific program.

Answer to the question. In addressing the research question, this research uses unit transportation cost to measure accessibility. Specifically in rural areas, Sambodo and Novandra (2019) find that transportation spending dominates energy spending which could limit people's mobility and slow economic development. On the other hand, the lack of adequate and reliable infrastructure drives up the transportation cost (Sandee 2016). I treat the unit transportation cost as the willingness to pay for transportation in rural areas, therefore we control for other factors affecting the demand structure to get the causal effect. I use panel data analysis to measure the impact of the two programs in improving rural accessibility. Regarding the fuel program, I obtain the list of 55 government-appointed new distributor locations from the National Oil Company (NOC). I use the village fund transferred to the village government as a proxy for village infrastructure development. From a political economy perspective, infrastructure development is managed by the government directly, while the fuel subsidy is managed through the National Oil Company (NOC) as a delivery agent (Ichsan, Lockwood, and Ramadhani 2022). This research evaluates the efficiency of the program by comparing the reduction of transportation cost per budget spent as the benefit-cost ratio.

[1] See Village Law No. 6 of 2014

Related literature. This paper builds on the literature on rural development and fossil fuel subsidy in Indonesia. Related literature has indicated that both subsidizing fuel and inter-government transfer contributed to improving the general economic condition in rural areas (Sambodo and Novandra 2019; Ichsan et al. 2021; Hartojo et al. 2022). Sambodo and Novandra (2019) find that villages with better access to energy tend to divert away their spending more productively thus having better health outcomes. Ichsan et al. (2021) argued that the fuel program is a short-term remedy for reducing transportation costs in rural areas, and believes that infrastructure development is the sustainable way to do so. On the effect of village fund transfer, Hartojo et al. (2022) show that the transfer effectively improved rural economic growth in rural areas. This research is the first to evaluate and compare the impact of both programs in improving accessibility at the village level.

Outline. The rest of the paper is organized as follows. I develop the institutional context and conceptual framework for the discussion in Section 2. Section 3 describes the data and its summary statistics. The empirical strategy is explained in Section 4. Section 5 discusses the findings and evaluates the benefit-cost analysis of the programs. Section 6 provides a concluding remark of the discussion.

2. Institutional Context and Conceptual framework

In this section, I discussed the institutional context of Indonesia and build a conceptual framework for understanding the impact of how the fossil fuel program and village development can improve rural accessibility.

2.1. Accessibility in rural area

Accessibility challenge in Indonesia. Following Sandee (2016), regarding rural accessibility in Indonesia, the challenge mainly related to intra-island connectivity —links within individual islands— is linking underdeveloped regions to growth centers. In the densely populated part of Java island, the city is the center of growth, the challenges of connectivity are mostly congestion-based challenges causing high-cost for mobility. In contrast, in the rural areas of Java, we can still find a village that we can only access by motorcycle or even only by foot. This challenge is somewhat similar in other main islands such as Sumatra, Kalimantan, Sulawesi, and Papua. In these other mainlands, the challenges are the existence of adequate and reliable infrastructure that drives up transportation costs. The government initiatives in attracting foreign capital and facilitating public-private partnerships in bringing a large-scale infrastructure development have been a policy priority since 2015 (Smith et al. 2016; Utomo 2019). However, the policy only affects the already developed region and rarely affects the most remote areas.

Transportation cost as a measure of accessibility. We can treat unit transportation cost as the willingness to pay or demand for transportation. I follow previous literature on willingness to pay for rural transportation from revealed preference, the affecting factors include travel time, convenience, and trip purpose i.e. work or education (Phanikumar et al. 2006). In the context of rural areas in Indonesia, most of the rural areas are located in the mountain or valleys, with less comforting roads to travel. Also, related to education, parents usually take their children to the closest school up until the elementary school level, as each village usually has at least one elementary school. Not all of the villages have Junior High School or Senior High School, so students usually travel daily for this level of education. Also, following Sambodo and Novandra (2019), I tried to control the village's economic condition as the village with higher transport costs tends to be the village with less productivity.

2.2. Fossil fuel subsidy regime

Political economy of fuel subsidy. Indonesia used to be a large oil exporter in the oil boom period in the 1970s and 1980s and the National Oil Company (NOC), Pertamina contributed a big part in delivering the fuel subsidy to the public (Ichsan, Lockwood, and Ramadhani 2022). However, as the production declined, there has been increased pressure for subsidy reform. The Indonesian government has gradually decreased the amount of fuel subsidies. The decision to reduce fuel subsidies is politically hard in Indonesia as it is usually opposed by the parliament as well as protests by the general public.

Even without the removal of the fuel subsidies, people in rural areas already experienced high-priced fuel (Wicaksono 2016; Birra 2017). The extreme price gap indicates poor infrastructure in remote areas, including the lack of roads, pipelines, and storage facilities (Ichsan et al. 2021). To address this issue, the government introduced the One Price Fuel policy in 2016 aimed at ensuring the distribution of Solar and Premium at a single price across Indonesia, including 500 remote areas, by 2024. The government claimed that One Price Fuel would improve the affordability of subsidized fuels for people in rural areas, where prices varied from Rp 7,000 to 100,000/liter[2]. However, Pertamina's profitability was also affected by the introduction of the One Price Fuel policy[3]. Without the allocation of a supporting budget from the government, the assigned companies (Pertamina and AKR Corporindo) were forced to invest in infrastructure directly. In some cases, where the cost of such infrastructure was prohibitive, the companies resorted to extremely expensive short-term measures such as transporting fuel to remote regions by air[4]. To add, only 2.6 percent of Pertamina fueling stations is fully owned and operated by Pertamina in 2019 (Pertamina 2020). This implies that Pertamina needs to rely on partnerships with local entrepreneurs to have the capacity to build a new remote gas station. Thus, the selection of the candidates for the Fuel Program is not random and follows certain screening criteria set up by the government, and then the feasibility is evaluated financially by Pertamina.

Fuel price regime. The introduction of the One Price Fuel policy implies a single fuel price at every gas station in Indonesia. Previously the government used to set the fuel price based on its economic price which is different for each specific area. The historical controlled price for the Solar and Premium is shown in Figure A1. For this research, we assume that the price control regime implies the variation in transportation costs in rural areas is driven by the fuel distribution problems that drive the fuel price higher than it should be. In reality, people usually buy fuel from the closest gas station and then transport them in a plastic container to the remote village using a motorcycle, and resell the fuel at a higher price. This practice is considered illegal by the law, however, the limited capacity of Pertamina to reach remote areas had allowed this practice to sustain. Therefore, we consider the One Price Fuel policy as an improvement in fuel distribution meaning the people located near the new gas station location will have the benefit of lower fuel price than what it was before.

2.3. Decentralization of development

Developing countries believe decentralization and local government reform are more efficient in bringing local development (Martinez-Vazquez, Lago-Peñas, and Sacchi 2017) and providing public goods better than central government (Arends 2020). In 2014 the government enacted village fund transfer to implement decentralization at the village

[2]See BBM 1 Harga Keadilan Energi Untuk Masyarakat 3T di NKRI, BPH Migas, Jarakta (2019)
[3]See Regulation of Minister of Energy and Mineral Resources No. 36/2016
[4]See https://www.merdeka.com/uang/pertamina-angkut-bbm-papua-gunakan-pesawat-...

level [5]. A similar program is also implemented by the Thailand government (Boonperm, Haughton, and Khandker 2013).

Village fund allocation mechanism. The village fund transfer in Indonesia is initiated in 2015 following the new Village Law being signed in the previous year. In 2015, villages started to receive significantly higher fiscal transfers from the central government. In the early part of the village fund policy implementation in 2015, the government set the amount of transfer to each district following the equity concept. The transfer consists of basic allocation (90%) and formula-based allocation (10%). The basic allocation is distributed evenly depending on the number of villages in the districts, while the formula-based allocation takes into account village conditions, i.e. poverty, population, area, and geographic difficulty into account. In the year 2019, the allocation mechanism changed to account for 72% of basic allocation, 25% of formula-based allocation, and % of affirmation allocation based on the village development index (Hartojo et al. 2022). Figure A2 show how different region have a different distribution of village condition based on the village development index. The nature of this allocation suggests that there is a certain mechanism in setting the amount of village fund transfer, which means there is a possibility that the fund allocation is correlated with village characteristics. However, Lewis (2015) suggested that the implementation of the VF transfer is overly hurried and highly unplanned, with very little consideration of the diversity of the village, as reflected in the low proportion of the formula-based allocation. This means there could be less developed villages that received the relatively same amount of transfer as well-developed villages in the same district. This condition weakly implied that the fund allocation is not correlated with village characteristics.

3. Data

Data source. I obtained the Village Potential Statistics data for the years 2014 and 2018 from Indonesia's Central Bureau of Statistics complemented with village fund transfer data from the Ministry of Village Development. The original survey covers general information about the village, population and employment, housing and environment, natural disaster, education and health, sport and leisure, transportation and communication, land use, economic activity, security, local government, community empowerment, and agriculture. However, not all the variables are published due

[5] See Village Law No. 6 of 2014

to potential inaccuracy issues. The original data consists of consecutively 82,190 and 83,931 observations of villages in rural and urban areas. The data is then cleaned to only include non-urban areas.

Data description. Natural disaster data was reported up to three years before the survey, but I only use the data on landfall and earthquake occurrence from the previous year as it represents the most recent physical condition of the village from the year 2014 and 2018. Geographic data available are binary variables about mainland topography, location relative to the sea, location relative to the forest, and the use of rivers for transportation. The mainland topography variable is equal to 1 if the village is located on a slope or valley and equal to 0 if it is located on a vast land. The binary variable on sea relative location is equal to 1 if the village has a border with the sea, and equal to 0 if otherwise. Similarly, the binary variable on forest relative location is equal to 1 if the village is inside or has a border with the forest, and equal to 0 if otherwise. The river transportation binary variable with the value of 1 indicates that the river is used for transportation in the village.

Regarding infrastructure status, data on education infrastructure and electrification are available. The data on education infrastructure range from the number of schools from elementary to university in the area. However, we only use the number of Senior High Schools data as people usually require daily travel for this level of education, thus will affect the demand for transportation. We did not use the number of Junior High Schools as it has strong collinearity with the number of Senior High Schools. For elementary education, parents are more likely to send their children to the one closest to their village. While for university besides it is usually unavailable at the village level, students usually migrate and move out of their parent's house to live close to the university. I use the number of electricity customer households from the National Electricity Company (PLN).

Regarding the village's economic condition, the only available data from the survey is the number poverty letter statement released by the village government for the year. Other demographic data are not available in the survey. These data are usually available only at the district or sub-district level at the lowest administrative level. In this research, I use the number of poverty letter statements as a proxy for the economic condition of the village.

A variety of data on transportation are available including travel duration (in hours), travel distance (in kilometers), and travel cost (in thousand Rp.). All the variables are measured from the village office to the sub-district office, the district office, the other sub-district office closest to the village, and the other district office closest to the village. For this analysis, I only use the variable measure from the village office to the sub-district office.

I measure rural accessibility using the unit transportation cost (in Rp/km) of each individual village i for the year t. I define unit transportation cost, y_{it}, as the transportation cost from the village i's office to the sub-district office (in thousands Rp) at year t, c_{it}, divided by the distance from the village office i's to the sub-district office (in km) at year t, d_{it} as shown in equation (1).

$$y_{it} = c_{it}/d_{it} \tag{1}$$

I obtain the list of 55 government-appointed new distributor village locations that were built in 2016 and 2017 from the NOC. Figure A3 show the detailed map of these locations. I define all the villages that are in the same sub-district as treated by the program, i.e. $D_{it} = 1$ in the year 2018. Note that in the year 2014, all villages have $D_{it} = 0$. For example, suppose the government in 2016 gives the order for the NOC to build a new distribution point at village A. Village A is in the same sub-district as villages B, C, and D. Then all villages A, B, C, and D are treated. To extend the discussion, I use two different samples at the province level and the district level. The other main explanatory variable is the village fund transfer measured in millions Rp.

The summary statistics of the variables are presented in Table A1 and Table A2. As seen in both tables, the unit transportation cost is on average lower in 2018 than in 2014. Also the village fund transfer on average increased in 2018 than in 2014.

4. Empirical strategy

I follow the following model specification

$$y_{it} = \alpha_i + \theta_t + \delta_1 D_{it} + \gamma_1 VF_{it} + \mathbf{X\beta} + \varepsilon_{it}, \tag{2}$$

where y_{it} represents the unit transportation cost in village i in year t, α_i represents the village fixed effects, θ_t represents time trend or time fixed effects, D_{it} and VF_{it} is the main variable of interests, and $\mathbf{X}$ as vector of covariates affecting demand.

In equation (2) the main effect to be identified are the impact of the fuel program on the transport cost given by the coefficient δ_1; and the impact of the village fund transfer on the transport cost given by the coefficient γ_1. Serial correlation should not be an issue in this model since the panel is 4 years apart. The following paragraphs discuss the strategy to estimate the above model.

Proxy for transportation demand. To control for factors affecting demand for transportation, I use several variables. I use the travel duration from the village office to the district office as the travel time. As a proxy for travel discomfort, I use the mainland topography and border with the forest as the proxy variable. For the trip purpose, I use the number of Junior High Schools as a proxy for the frequency of trip purposes for education.

Endogeneity. As we have discussed in subsection 2.2 and 2.3, there are possible endogeneity threats from Village Fund Transfer (VF_{it}) and Treatment (D_{it}). In the process of allocating village fund transfers, the central and provincial governments take into account the village conditions such as poverty and geographic difficulty. Also, in deciding which location to build a new remote gas station, the government may take into account the village conditions as well when proposing a target area. After the recommended location is proposed to the NOC, the NOC will evaluate the economic feasibility of the new location and assess whether or not an interested business partner to invest in the remote area.

Based on the potential endogeneity problem, I need to identify whether there is a good instrument available in the dataset. For this purpose, I run several first-stage regressions to evaluate potential instrumental variables candidates for (VF_{it}) and (D_{it}) as shown in Table A3 and Table A4. From the possible combination of instruments for both variables, I decided to choose poverty statements, number of electricity customers, earthquake frequency, sea border status, and river transportation use as the instrumental variables as it gives reasonably high F-statistics in the first stage regressions.

If the two main variables are indeed endogenous, the Fixed Effect Instrumental Variable (FEIV) approach (similar to First Difference Instrumental Variable for $T = 2$) can be applied to identify δ_1 and γ_1 in equation (2).

Panel data specification. I perform Hausman (1978) specification test to test against the random effect specification. I test against H_0 that the difference in coefficients is not systematic or that the individual unobserved heterogeneity is correlated with the regressors. We can compute the Hausman statistic as

$$H = (\hat{\boldsymbol{\delta}}_{FE} - \hat{\boldsymbol{\delta}}_{RE})' \left[\hat{\text{Avar}}(\hat{\boldsymbol{\delta}}_{FE}) - \hat{\text{Avar}}(\hat{\boldsymbol{\delta}}_{RE}) \right]^{-1} (\hat{\boldsymbol{\delta}}_{FE} - \hat{\boldsymbol{\delta}}_{RE}) \overset{a}{\sim} \chi^2_M$$

The test yields a χ^2-statistics of 15.65 with P-value of 0.0747. This means under the specification given by equation (2) our hypothesis that village-level effects are adequately modeled by the random-effects model is rejected at least at 10% significant level. This result suggests that we use a fixed-effect model for estimating the village-level effects.

Estimation strategy. Based on the analysis given in the previous paragraph, I would first estimate the equation using FEIV using poverty statements, number of electricity customers, earthquake frequency, sea border status, and river transportation use as the instrumental variables by assuming three different cases. First, we run FEIV assuming VF_{it} is endogenous and perform an endogeneity test on VF_{it}. Second, we run FEIV assuming VF_{it} is endogenous and perform an endogeneity test on VF_{it}. Third, we run FEIV assuming VF_{it} and D_{it} are endogenous and perform an endogeneity test on both. If there is enough evidence from these tests to show that any of the variables are endogenous we can trust the FEIV estimates. Otherwise, it is better to use the panel OLS estimates if we cannot reject that the variables are exogenous. We also exercise the province-level sample and district-level sample.

5. Results

5.1. Main findings

Findings from Panel OLS estimates. Panel OLS estimates as shown in Table A5 indicate that only the fuel program significantly affected unit transportation costs in rural areas at less than 10% significant level when using the province level as the sample. When I use the district level as the sample, the fuel program reduces the unit transportation costs by on average 2,321 Rp/km per gas station built at less than 5% significant level. The village fund also significantly reduces the unit transportation costs by 1 Rp/km per million Rp of fund transfer. We find the time intercept to be statistically insignificant in all cases but have a higher variance when we use control variables.

Findings from FEIV estimates. We generate three FEIV estimates to test the endogeneity of the two explanatory variables as shown in Table A6, A7 and A8. All the FEIV estimates yield insignificant estimates with large standard errors. The endogeneity tests against H_0 that village fund transfer and fuel program are exogenous yield a P-value of consecutively 0.8411 and 0.5578, indicating that the null hypothesis can not be rejected. Also when both variables are assumed to be endogenous the endogeneity test against H_0 that village fund transfer and fuel program are exogenous yields a P-value of consecutively 0.6626 and 0.5166, indicating that the null hypothesis can not be rejected either. Since there is not enough evidence that the fuel program and village fund transfer are endogenous, there is not enough certainty to trust the FEIV estimates.

Findings from Panel OLS estimates with interaction terms. In this further investigation, I add an interaction variable between programs to explore the complementary effect of both programs. The panel OLS estimates as shown in Table A9 yield a statistically insignificant result for the interaction terms. Thus, there is not enough evidence of a complementary effect between the two programs.

5.2. Benefit-cost analysis

Following the estimates from subsection 5.1, the village fund transfer reduces unit transport cost by 1 Rp/km per million Rp spent, while the fuel program reduces unit transport costs by 2,380 Rp/km per gas station built. The capital cost of building one remote gas station is reported to be around 3 billion Rp and the profit margin of sales is 195 Rp/Liter [6] and average total sales per location of 383 kL in the 2016-2017 period [7]. Thus we can estimate the benefit/net cost of the fuel program as

$$
\begin{aligned}
B/C_{Fuel} &= \frac{2,321 \text{ Rp/km}}{\text{location}} \Bigg/ \underbrace{\frac{3,000 \text{ million Rp} - \frac{195 \text{ Rp}}{kL} \times 383 \text{ kL} \times \frac{\text{million Rp}}{10^6 \text{ Rp}}}{\text{location}}}_{\text{Net Cost = Capital Cost – Sales Profit}}. \\
&= \frac{1000 \times |\hat{\delta}_1|}{2999.925} \frac{\text{Rp/km}}{\text{millions Rp spent}} = 0.77 \frac{\text{Rp/km}}{\text{millions Rp spent}}.
\end{aligned}
$$

While we treat the benefit/cost of the village fund transfer as it is, $\hat{\gamma}_1$. From the point estimates, we suggest that the efficiency of the fuel program is lower than the village

[6] See https://www.cnbcindonesia.com/news/20201213090547-4-208715/bangun-spbu-bbm-satu-harga-ternyata-lama-balik-modalnya

[7] The figures is obtained from Indonesian Downstream Oil and Gas Authority

fund transfers. Thus, we can use the Wald test for the following linear hypothesis.

$$\mathrm{H}_0 : B/C_{Fuel} - B/C_{VF} = 0.33|\hat{\delta}_1| - |\hat{\gamma}_1| > 0 \Leftrightarrow -0.33\hat{\delta}_1 + \hat{\gamma}_1 > 0$$

since we know that both $\hat{\delta}_1, \hat{\gamma}_1 < 0$. The Wald test yields a t-statistics of 1.97 which means we can not reject the null hypothesis even at 5% significance level. Thus, we can accept with reasonable certainty that the Village fund transfer is more efficient than the fuel program in increasing rural accessibility.

5.3. Discussion

Based on the result from subsection 5.1, I find that the argument that the explanatory variables are endogenous is not justified. Although the panel OLS estimates yield a desirable result on the effect of village funds, it is only statistically significant when we use the district level as a sample. One possible explanation for this result is the allocation mechanism of the village fund transfer itself. It involves the provincial government and the district government in determining the specific allocation of each village. Some districts that do not have any underdeveloped villages may receive considerably lower village fund allocation at the district level, which means their village fund transfer amount is lower than the villages with the same characteristics that are located in the districts with a higher number of underdeveloped villages. For further investigation, I recommend trying different unit fixed effects, for example by incorporating district-level effects to account for the unobserved effect at the district level.

Regarding the time trends, the panel OLS estimates by using both province level and district level as samples yield an insignificant time-fixed effect. As I use data from only two time periods, there is not much to explore in this part. From the summary statistics, I expect the time trend to be negative as the unit transportation cost on average is lower in 2018 than in 2014. A possible explanation for this is that in each region, the economic condition is in a different phase. For example, village A in 2014 was an attractive tourist object but in 2018 was no longer an interesting place to visit, while village B is just recently developed a new agricultural production that generates economic activity in the village. This issue will be resolved if I have a good proxy of the village's productive structure.

In general, this research successfully identifies the impact of both the fuel program and infrastructure development in improving rural accessibility. However, the variation explained in this model is still very low as reflected in the low R^2 value. Thus, drawing policy implications from this research is not without caveats. Overall, the result of this research is still very limited mainly due to the limited data being used. Further research on this topic, should include village productive structures in the model such as human capital, employment, and agricultural production as suggested by Asher and Novosad (2020). Also, as more data is available, different econometrics techniques can be applied to infer a strong causal inference from these policy implementations such as differences in differences or regression discontinuity design.

6. Conclusion

This research finds out that both rural fuel distribution program and inter-government transfer significantly reduces unit transportation cost in rural areas. The village fund transfer successfully reduces unit transport cost by 1 Rp/km per million Rp spent, while the fuel program reduces unit transport cost by 0.77 Rp/km per million Rp spent. This indicates that the fund transfer to local government is more efficient in improving rural accessibility.

Further recommendation. The limited nature of the data limits the analysis in this paper, thus I suggest collecting more data by adding one more year of observation to be able to implement a more robust analysis on time-varying variation and econometrics methods. Following Abadie and Imbens (2016), I suggest implementing Propensity Score Matching to construct an artificial control group by matching each treated unit with a non-treated unit of similar characteristics.

References

Abadie, Alberto, and Guido W. Imbens. 2016. "Matching on the Estimated Propensity Score." *Econometrica* 84 (2): 781–807.

Arends, Helge. 2020. "The dangers of fiscal decentralization and public service delivery: A review of arguments." *Polit Vierteljahresschr* 61 (3): 599–622.

Asher, Sam, and Paul Novosad. 2020. "Rural Roads and Local Economic Development." *American Economic Review* 110 (3): 797–823.

Birra, Fadhil Al. 2017. "Harga BBM Tembus Rp 25 Per Liter, Warga Ketapang Ancam Bakal....." Jawapos, January 14, Available at: https://www.jawapos.com/berita-sekitar-anda/01179831/harga-bbm-tembus-rp-25-per-liter-warga-ketapang-ancam-bakal (Accessed: April 5, 2023).

Boonperm, Jirawan, Jonathan Haughton, and Shahidur R. Khandker. 2013. "Does the Village Fund matter in Thailand? Evaluating the impact on incomes and spending." *Journal of Asian Economics* 25: 3–16.

Hartojo, Nurlatifah, Mohamad Ikhsan, Teguh Dartanto, and Sudarno Sumarto. 2022. "A Growing Light in the Lagging Region in Indonesia: The Impact of Village Fund on Rural Economic Growth." *Economies* 10 (9).

Hausman, J. A. 1978. "Specification Tests in Econometrics." *Econometrica* 46 (6): 1251–1271.

Ichsan, M, YF Martak, M Ramadhani, CR Septyandrica, and P Yusgiantoro. 2021. "Is cheap fuel policy a (short-term) remedy for costly transportation in rural Indonesia?" *IOP Conference Series: Earth and Environmental Science* 753 (1): 012030.

Ichsan, Muhammad, Matthew Lockwood, and Maghfira Ramadhani. 2022. "National oil companies and fossil fuel subsidy regimes in transition: The case of Indonesia." *The Extractive Industries and Society* 11: 101104.

Lewis, Blane D. 2015. "Decentralising to Villages in Indonesia: Money (and Other) Mistakes." *Public Administration and Development* 35 (5): 347–359.

Martinez-Vazquez, Jorge, Santiago Lago-Peñas, and Agnese Sacchi. 2017. "The Impact of Fiscal Decentralization: A Survey." *Journal of Economic Surveys* 31 (4): 1095–1129.

Pertamina. 2020. "Pertamina Retail Annual Report 2019." Pertamina, December 3, Available at http://home.pertaminaretail.com/docs/Laporan%20Tahunan/Annual%20Report%202019.pdf (Accessed: April 5, 2023).

Phanikumar, C.V., Bhargab Maitra, C.V. Phanikumar, and Bhargab Maitra. 2006. "Modeling Willingness-to-Pay Values for Rural Bus Attributes Under Different Trip Purposes."

Sambodo, Maxensius Tri, and Rio Novandra. 2019. "The state of energy poverty in Indonesia and its impact on welfare." *Energy Policy* 132: 113–121.

Sandee, Henry. 2016. "Improving Connectivity in Indonesia: The Challenges of Better Infrastructure, Better Regulations, and Better Coordination." *Asian Economic Policy Review* 11 (2): 222–238.

Smith, Julian, Rizal Satar, Agung Wiryawan, Tim Boothman, and Graeme Harrison. 2016. "Indonesian Infrastructure: Stable foundations for growth." Available at: https://www.pwc.com/id/en/cpi/asset/indonesian-infrastructure-stable-foundations-for-growth.pdf. Accessed March 23, 2023.

Utomo, Wahyu. 2019. "Indonesia's bold infrastructure plan." Available at: https://kpmg.com/xx/en/home/insights/2019/10/indonesia-bold-infrastructure-plan.html. Accessed March 23, 2023.

Wicaksono, Pebrianto Eko. 2016. "Penjelasan Pertamina Soal Mahalnya Harga BBM di Papua." Liputan 6, April 28, Available at: https://www.liputan6.com/bisnis/read/2494776/penjelasan-pertamina-soal-mahalnya-harga-bbm-di-papua (Accessed: April 5, 2023).

Appendix A. Tables

TABLE A1. Summary statistics of variables with the province-level as sample

	2014					2018				
	Mean	S.D.	Min	Max	Obs.	Mean	S.D.	Min	Max	Obs.
Transportation										
Unit transportation cost in 000s Rp./km	3.29	19.94	0.00	1000.00	38624	3.22	9.36	0.00	800.00	38646
Travel duration (hrs)	1.17	1.44	1.00	99.00	38624	0.50	1.41	0.00	60.50	38646
Natural Disaster										
Landfall occurence average per year	0.11	0.52	0.00	9.00	38624	0.15	0.62	0.00	9.00	38646
Earthquake occurence average per year	0.04	0.29	0.00	9.00	38624	0.23	1.07	0.00	9.00	38646
Infrastructure										
Number of PLN electricity user household	656.51	781.91	0.00	14460.00	38624	738.27	887.98	0.00	17530.00	38646
Number of Junior High School	0.53	0.82	0.00	14.00	38624	0.58	0.86	0.00	12.00	38646
Number of Senior High School	0.26	0.70	0.00	40.00	38624	0.31	0.74	0.00	11.00	38646
Geographic condition										
=1 if slope/valleys, =0 vast land	0.25	0.43	0.00	1.00	38624	0.22	0.41	0.00	1.00	38646
=1 if border with sea, =0 no border with sea	0.19	0.39	0.00	1.00	38624	0.19	0.39	0.00	1.00	38646
=1 if inside or border with forest, =0 outside forest	0.31	0.46	0.00	1.00	38624	0.28	0.45	0.00	1.00	38646
=1 if river used for transportation, =0 otherwise	0.09	0.28	0.00	1.00	38624	0.08	0.27	0.00	1.00	38646
Economic condition										
Number of poverty statement request	73.52	155.02	0.00	13705.00	38624	80.54	327.46	0.00	10101.00	38646
Inter-government Transfer										
Revenue from village fund transfer	116.08	213.26	0.00	7716.00	38624	121.07	143.42	0.00	13662.00	36630

The sample is all the villages in the provinces where the fuel program exists.

TABLE A2. Summary statistics of variables with the district-level as sample

	2014					2018				
	Mean	S.D.	Min	Max	Obs.	Mean	S.D.	Min	Max	Obs.
Transportation										
Unit transportation cost in 000s Rp./km	5.14	21.02	0.00	1000.00	3407	4.93	12.47	0.00	400.00	3411
Travel duration (hrs)	1.27	1.27	1.00	30.00	3407	0.74	2.36	0.00	60.50	3411
Natural Disaster										
Landfall occurence average per year	0.07	0.37	0.00	6.00	3407	0.10	0.49	0.00	9.00	3411
Earthquake occurence average per year	0.04	0.35	0.00	7.00	3407	0.46	1.60	0.00	9.00	3411
Infrastructure										
Number of PLN electricity user household	366.92	610.20	0.00	6726.00	3407	422.79	651.77	0.00	6468.00	3411
Number of Junior High School	0.54	0.85	0.00	9.00	3407	0.61	0.89	0.00	12.00	3411
Number of Senior High School	0.27	0.66	0.00	7.00	3407	0.33	0.73	0.00	8.00	3411
Geographic condition										
=1 if slope/valleys, =0 vast land	0.22	0.42	0.00	1.00	3407	0.19	0.39	0.00	1.00	3411
=1 if border with sea, =0 no border with sea	0.41	0.49	0.00	1.00	3407	0.41	0.49	0.00	1.00	3411
=1 if inside or border with forest, =0 outside forest	0.37	0.48	0.00	1.00	3407	0.35	0.48	0.00	1.00	3411
=1 if river used for transportation, =0 otherwise	0.17	0.37	0.00	1.00	3407	0.17	0.38	0.00	1.00	3411
Economic condition										
Number of poverty statement request	59.08	141.93	0.00	4106.00	3407	69.00	282.43	0.00	9999.00	3411
Inter-government Transfer										
Revenue from village fund transfer	113.55	129.92	0.00	1253.00	3407	158.93	289.35	0.00	13662.00	3172

The sample is all the villages in the districts where the fuel program exists.

Table A3. First Stage Regression on Village Fund Transfer (VF_{it})

	(1)	(2)	(3)	(4)	(5)
Number of poverty statement request	0.023***	0.018***	0.018***	0.017***	0.017***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of PLN electricity user household		0.009***	0.009***	0.014***	0.014***
		(0.001)	(0.001)	(0.001)	(0.001)
Earthquake occurence average per year			0.573	1.609***	1.211**
			(0.506)	(0.490)	(0.489)
=1 if slope/valleys, =0 vast land				-8.500***	
				(1.458)	
=1 if inside or border with forest, =0 outside forest				9.147***	
				(1.553)	
=1 if border with sea, =0 no border with sea				27.892***	29.487***
				(1.951)	(1.911)
=1 if river used for transportation, =0 otherwise				71.659***	74.990***
				(4.352)	(4.264)
Constant	118.469***	112.830***	112.737***	96.855***	97.031***
	(0.687)	(0.962)	(0.979)	(1.275)	(1.064)
Observations	76602	76602	76602	76602	76602
R^2	0.001	0.003	0.003	0.019	0.018
Adjusted R^2	0.001	0.003	0.003	0.019	0.018
F	34.737	56.489	37.845	108.260	121.972

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A4. First Stage Regression on Treatment (D_{it})

	(1)	(2)	(3)	(4)	(5)
Number of poverty statement request	-0.000***	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of PLN electricity user household		-0.000***	-0.000***	-0.000***	-0.000***
		(0.000)	(0.000)	(0.000)	(0.000)
Earthquake occurence average per year			0.002***	0.002***	0.002***
			(0.001)	(0.001)	(0.001)
=1 if slope/valleys, =0 vast land				-0.001**	
				(0.001)	
=1 if inside or border with forest, =0 outside forest				0.000	
				(0.001)	
=1 if border with sea, =0 no border with sea				0.011***	0.011***
				(0.001)	(0.001)
=1 if river used for transportation, =0 otherwise				0.004***	0.004***
				(0.001)	(0.001)
Constant	0.004***	0.006***	0.006***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	87826	87826	87826	87826	87826
R^2	0.000	0.001	0.001	0.006	0.006
Adjusted R^2	0.000	0.001	0.001	0.006	0.006
F	12.311	102.613	69.105	39.775	55.156

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A5. Panel OLS estimates

	(1)	(2)	(3)	(4)
Treatment	-2.204*	-2.173*	-2.321**	-2.430**
	(1.146)	(1.147)	(1.176)	(1.178)
Village Fund transfer	0.000	0.000	-0.001*	-0.001*
	(0.000)	(0.000)	(0.001)	(0.001)
Time trend	-0.086	-0.072	0.243	0.306
	(0.113)	(0.111)	(0.306)	(0.284)
Observations	75254	75254	6579	6579
R^2	0.000	0.000	0.008	0.003
Adjusted R^2	0.000	0.000	0.006	0.002
Sample	Province	Province	District	District
Controls	Yes	No	Yes	No
Time Fixed Effects	Yes	Yes	Yes	Yes
Village Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A6. FEIV estimates with D_{it} and VF_{it} as endogenous variables

	(1)	(2)	(3)	(4)
Treatment	76.259	75.971	71.691	50.250
	(97.978)	(98.910)	(86.854)	(65.278)
Village Fund transfer	-0.002	-0.003	0.025	0.016
	(0.010)	(0.010)	(0.030)	(0.022)
Time trend	-0.800	-0.782	-8.628	-6.037
	(0.893)	(0.886)	(10.137)	(7.648)
Observations	73228	73228	6336	6336
Sample	Province	Province	District	District
Controls	Yes	No	Yes	No
Time Fixed Effects	Yes	Yes	Yes	Yes
Village Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A7. FEIV estimates with VF_{it} as endogenous variable

	(1)	(2)	(3)	(4)
Village Fund transfer	0.004	0.004	0.005	0.003
	(0.003)	(0.003)	(0.007)	(0.007)
Treatment	-2.626**	-2.604**	-2.720**	-2.728**
	(1.201)	(1.203)	(1.369)	(1.353)
Time trend	-0.086	-0.082	0.017	0.145
	(0.113)	(0.112)	(0.397)	(0.387)
Observations	73228	73228	6336	6336
Sample	Province	Province	District	District
Controls	Yes	No	Yes	No
Time Fixed Effects	Yes	Yes	Yes	Yes
Village Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A8. FEIV estimates with D_{it} as endogenous variable

	(1)	(2)	(3)	(4)
Treatment	63.154	61.217	14.268	11.390
	(40.892)	(39.601)	(21.832)	(20.519)
Village Fund transfer	-0.001	-0.001	-0.002	-0.002
	(0.001)	(0.001)	(0.002)	(0.002)
Time trend	-0.682*	-0.652*	-1.470	-1.129
	(0.397)	(0.386)	(2.102)	(1.989)
Observations	73228	73228	6336	6336
Sample	Province	Province	District	District
Controls	Yes	No	Yes	No
Time Fixed Effects	Yes	Yes	Yes	Yes
Village Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A9. Panel OLS estimates with interaction terms

	(1)	(2)	(3)	(4)
Interaction terms	0.001	0.001	0.002	0.003
	(0.003)	(0.003)	(0.003)	(0.003)
Treatment	-2.482	-2.419	-2.774*	-2.995*
	(1.615)	(1.617)	(1.658)	(1.659)
Village Fund transfer	0.000	0.000	-0.001*	-0.001*
	(0.000)	(0.000)	(0.001)	(0.001)
Time trend	-0.086	-0.072	0.247	0.311
	(0.113)	(0.111)	(0.306)	(0.284)
Observations	75254	75254	6579	6579
R^2	0.000	0.000	0.008	0.003
Adjusted R^2	0.000	0.000	0.006	0.002
Sample	Province	Province	District	District
Controls	Yes	No	Yes	No
Time Fixed Effects	Yes	Yes	Yes	Yes
Village Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix B. Figures

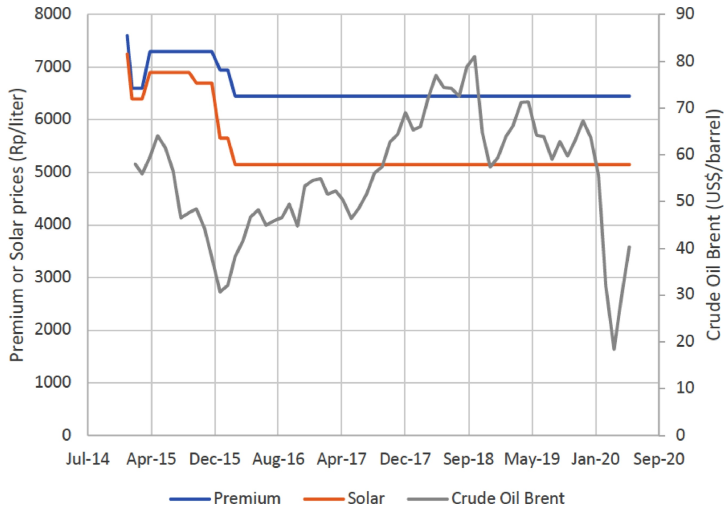
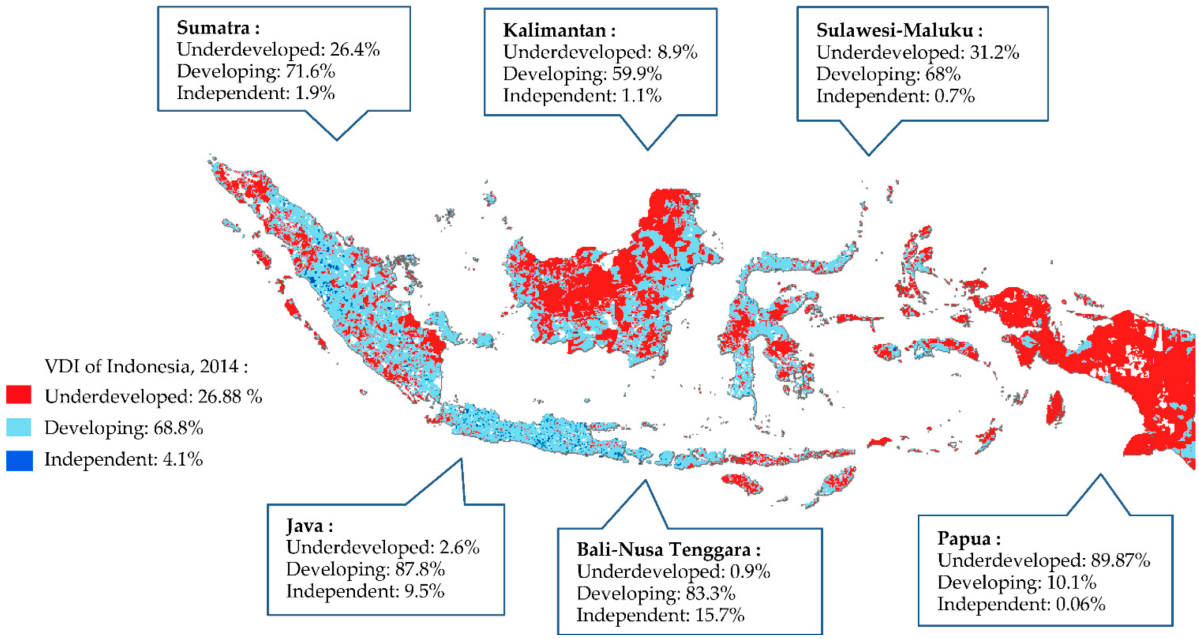
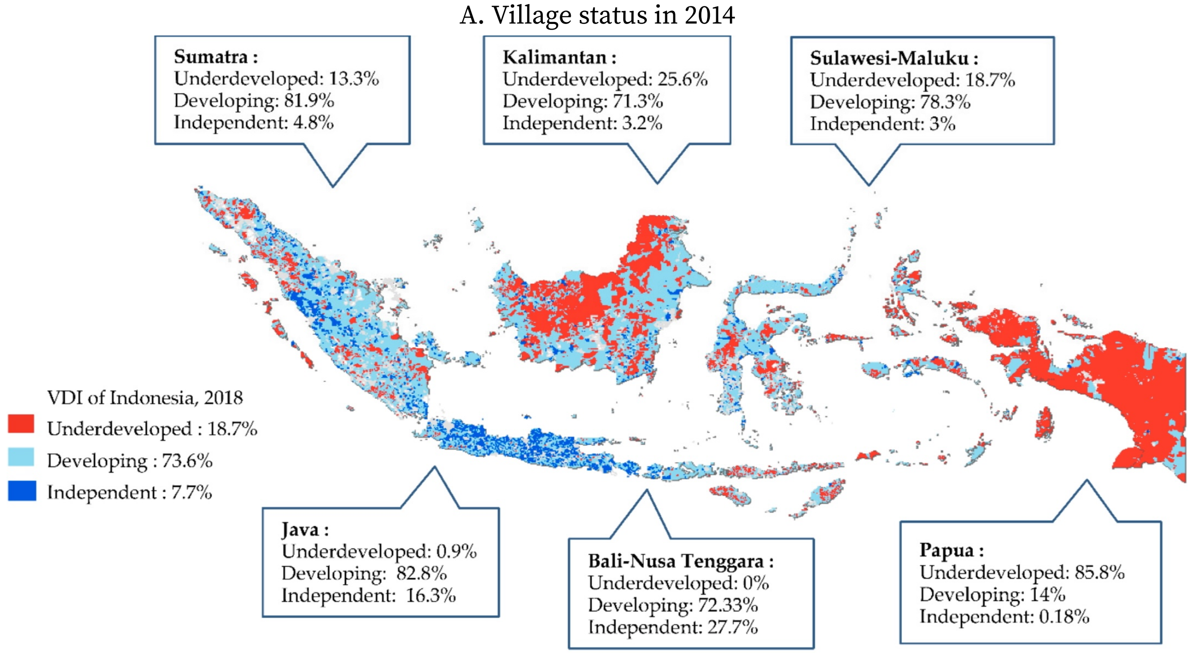


FIGURE A1. Subsidized Fuel Price at Government's Price Control 2014-2018

Source: Ichsan, Lockwood, and Ramadhani (2022)



A. Village status in 2014



B. Village status in 2018

FIGURE A2. Indonesia's Village Development Index status

Source: Statistics Indonesia from Hartojo et al. (2022)

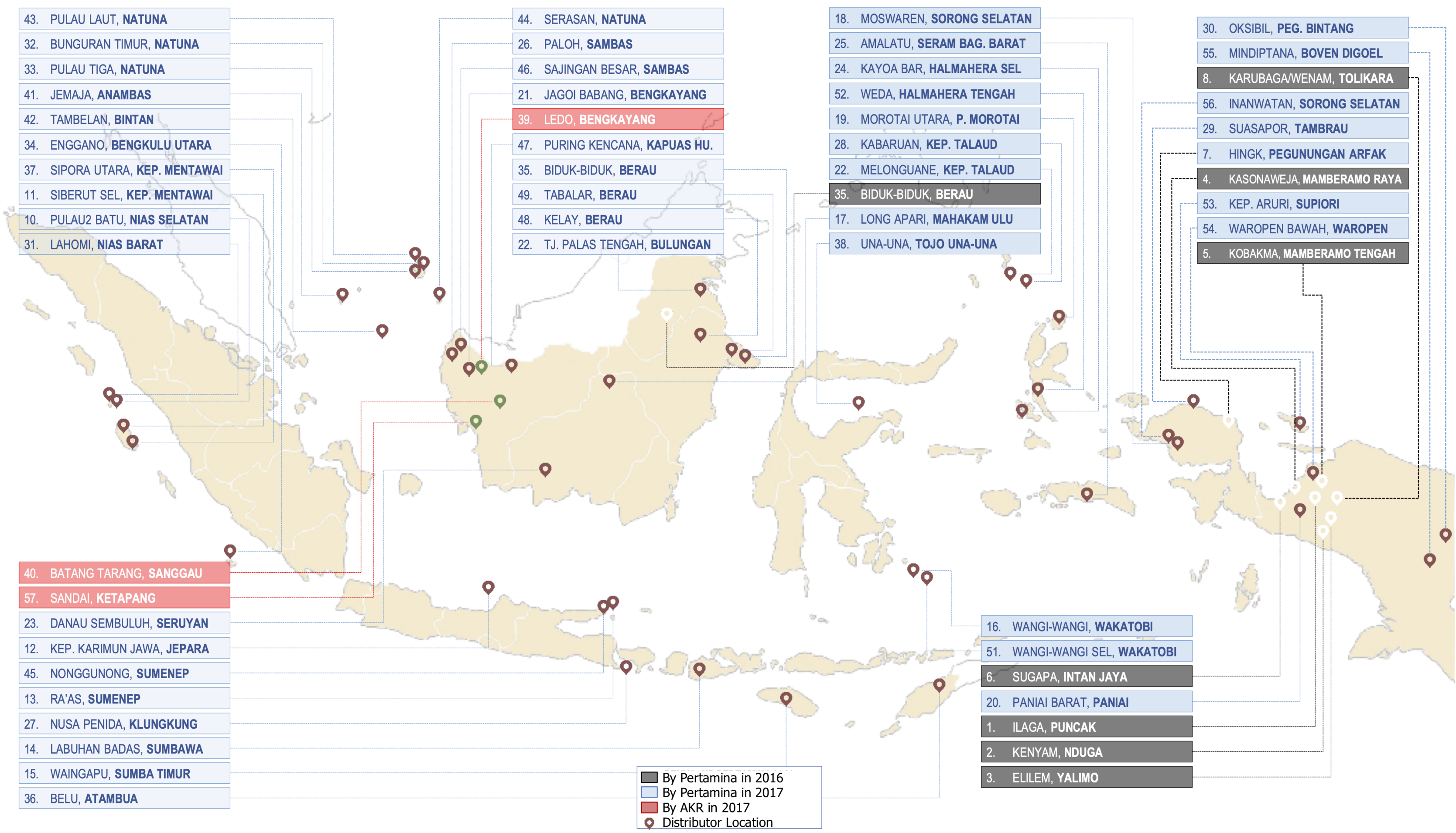


FIGURE A3. Location of the One Price Fuel Program in 2016-2017