# Downstreaming The Energy: Do Local Communities Get Left Behind?

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## Abstract

The ambitious effort to escalates the economic growth through an energy-raw materials downstream policy might be able to support developing countries in escaping the resources curse. However, the policymakers should be aware on potential inequal benefits distribution, especially for the local community. This study aims to examine whether the nickel downstream in Indonesia could provide an inclusive development for the society. Trough combination of two impact evaluation tools, synthetic control method and difference-in-difference, the research reveals that the downstream policy might partially boost the health indicators, yet, unable to foster the access in education and energy. This result illustrated that the Indonesian nickel downstream program needs to be more inclusive, in supporting the native to achieve better life condition.

## Introduction

Energy-producer economies are often linked with the resources curse, defined as a condition where heavy reliance on natural commodities could damage the economy and threaten the social condition [1]. To escape from this symptom, many countries have attempted to implement a downstream policy towards its mineral commodities. Through this industrialization process, the economy might increase its growth and long-term stability by improving product complexity and sectoral linkages [2]. Furthermore, in the local context, the downstream process potentially escalates regional economic growth and provides job creation [3]. Therefore, fostering the downstream of mineral commodities is favorable for the resource-rich countries.

Indonesia has been considered the largest nickel deposit site, while simultaneously becoming the nickel major producer in the world [4]. To foster economic growth, the Indonesian government has proposed downstream intensification of its natural resources, particularly nickel [5]. In recent years, nickel has become an important commodity serving as a key component of batteries, which are considered essential for renewable energy sources [6]. The downstream policy is expected to contribute to the nation's economic growth, and “should” ideally benefit local communities by enhancing job creation in the region and potentially improving better living conditions. Ref. [7] simulates that if nickel is fully utilized for domestic battery and electrical vehicle production, it could stimulate an additional 1.5% of GDP and generate around 500,000 job opportunities.

However, the effectiveness of the nickel downstream strategy in delivering on these promises should be questioned. Ref [8] reports that despite outstanding growth (more than 20% year-on-

year), the nickel downstream region in Indonesia experiences drawbacks in well-being indicators (slow poverty rates reduction, decline in middle-class consumption growth, and disruption in food availability). Furthermore, Ref [9] reveals that local communities in downstream project areas face more intense exposure to toxic air, which is linked to increased mortality risk, and potential economic losses amounting to US$2.63 billion. Consequently, the nickel downstream program in Indonesia is suspected to be not inclusive and didn't distribute an equal benefit, especially for the native society.

The narration on unequal well-being distribution of downstream action has been widely discussed in the literatures. Previous studies have examined the socioeconomic implications of a mineral-based industrialization strategy. Ref [10] reveals that the mineral-based industry in India contributes to tremendous economic growth, yet, doesn't generate economic benefits for poor communities (especially those that rely on the agriculture sector). In alignment, Ref [11] also found that mineral-based downstream has two distinct effects, (a) fostering economic growth and (b) broadening the social inequality gaps and deteriorating the environment, in Africa, Asia, and Latin America. Furthermore, Ref [12] shows that the regions that focus on resource processing (especially on single commodity) tend to have problems with economic inequality, which is reflected by significant increases in housing prices and cost of living. These issues put an alarm on the well-being of marginalized groups, especially those with low-income levels.

Despite the numerous attempts, previous studies unable to provide clear evidence of mineral-based industrialization's impact on the development indicators. Whereas, this topic is crucial to ensure that the local community isn't excluded from gaining benefits from their land and resources. Henceforth, **this study aims to quantify the impact of nickel downstream practices on the basic need variables (access on health, education, and energy) at the local level, specifically in Indonesia nickel downstream site.** This research seeks not only to contribute to the academic literature but also to provide a robust scientific investigation into emerging policies. As a result, our study will offer practical and impactful policy recommendations for governments, particularly in improving sustainable business practices within the downstream strategy.

## Methodologies

### *Study Area*

Indonesia is one of the world's largest nickel producers, with production concentrated on the islands, especially Sulawesi. This island holds the majority of the country's nickel reserves, estimated at 2.9 billion tons [13]. The significant nickel potential in Sulawesi has led to the development of industrial zones, particularly for the nickel industry. The production hub is located in Central Sulawesi, at the Indonesia Morowali Industrial Park (IMIP), which implements the downstream strategy. IMIP, constructed in 2013 and operates since 2015, was designated as a national strategic project and vital national asset in 2019. As the largest nickel industry in Southeast Asia, IMIP commanded a 50% market share of Indonesia's downstream production in 2018.

### *Methods*

To achieve our objective of measure the impacts of the nickel downstream activities on the development indicators at the local level, the study employs Synthetic Control Method (SCM) and Difference-In-Difference (DID) as an impact evaluation tool.

*Impact Evaluation: Synthetic Control Method (SCM)*

The proposed study will utilize the Synthetic Control Method (SCM) to evaluate the impact of nickel downstream activities on the development indicators of Morowali. According to Ref. [14] SCM offers several advantages for conducting reliable impact assessment. First, SCM provides robust estimates by controlling for potential biases arising from both time-variant and time-invariant variables. Moreover, SCM is well-suited for cases with a small sample size, making it ideal for assessing intervention at an aggregate level (i.e. districts). Lastly, since SCM is a data-driven method, it ensures an objective and transparent research process.

The fundamental concept of SCM is to compare the treated area that experienced a certain intervention (policy or event) with its synthetic counterparts. Whereas, this "synthetic unit" is constructed from a weighted combination of several control districts that have similar pre-treatment characteristics with the Morowali, however, with the absence of the intervention [15]. Furthermore, SCM measures the impact of intervention by calculate the outcome differences between treated and synthetic units during post intervention periods [16].

In mathematical way, the basic formula of impact evaluation is expressed as follow.

$$a_{1,t} = Y_{1t}^{1} - Y_{1t}^{0}, \text{ for periods } t_0 + 1, t_0 + 2, t_0 + 3, \dots, t \tag{1}$$

where, $t_0$ refer to the time where intervention occurred, $a_{1,t}$ defined as the impact of intervention, $Y_{1t}^{1}$ denotes the outcome of observed unit with the intervention, and $Y_{1t}^{0}$ represent the outcome of observed unit that did not experience the intervention. However, the formula (1) has a serious obstacle, since the $Y_{1t}^{0}$ is unobservable. SCM could solve this issue by construct the synthetic control unit, the counterfactual of treated unit ($Y_{1t}^{1}$). Moreover, the synthetic control unit is a weighted average of units in donor pool. Henceforth, if $J + 1$ is a set of potential counterfactual units and the weight is represented by vector $W = (w_2, \dots, w_{J+1})$, then, the $Y_{1t}^{0}$ and $a_{1,t}$ could be adjusted to:

$$\hat{Y}_{1t}^{0} = \sum_{j}^{J+1} w_j Y_{jt} \tag{2}$$

And

$$\hat{a}_{1,t} = Y_{1t}^{1} - \sum_{j}^{J+1} w_j Y_{jt} \tag{3}$$

Meanwhile, the SCM algorithm would choose the vector $W^*$ that minimize the weighted distance between pre-intervention characteristics of treated unit ($X_1$) and pre-intervention characteristics of untreated unit ($X_0$), which defined in the following formula.

$$|X_1 - X_0|V = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 \mathrm{W})} \tag{4}$$

where, $V$ is a matrix that allow the weight to be assigned to the variables in $X_1$ and $X_0$, reflecting the importance of each variable.

*Impact Evaluation: Difference-In-Difference (DID)*

To ensure the robustness of our analysis, the present study employs the traditional impact evaluation tools, Difference-In-Difference (DID). This method was widely use to reveals the evidence of program, both in micro and macro lens. Moreover, recent studies have employed DID to unveils the inclusivity of the government programs on the natural resource commodities [17, 18, 19]. The DID model that used in the study denotes as follow.

$$Y_{it} = \beta_0 + \beta_1 post_t + \beta_2 treated_i + \beta_3 post_t \times treated_i + \vartheta x_{it} + \varepsilon_{it} \quad (5)$$

where, $Y_{it}$ defined as the outcome indicators, $post_t$ is a time dummy variable (1= post construction & operation of IMIP, 0=pre-intervention), $treated_i$ express the region dummy variable (1=the location of IMIP, 0=otherwise), and $post_t \times treated_i$ describes represent the impact of IMIP on the development indicators. Meanwhile, $x_{it}$ is the control variables and $\varepsilon_{it}$ represent the error terms.

***Data***

Our dataset consisted from several reliable sources, including BPS, Indonesia Database for Policy and Economic Research (INDO-DAPOER), and World Development Indicators (WDI) by the World Bank. Moreover, we also incorporate the NPP-VIIRS dataset that sourced from NOAA/NGDC to obtain the nighttime light variable. The research incorporates **Morowali** and 19 districts in donor pool that span from 2002 to 2020 periods. The restriction on number of donor units is an essential procedure in SCM to produce a relevant counterfactual, which are the units with similar characteristics as the treated unit and the untreated unit that unaffected by the treatment, i.e. spillover effect [20,21]. The basic criteria on the control selection in the study is a region in eastern part of Indonesia, which are assumed to have a similar economic development condition. Ref. [22] underscore the economy in east Indonesia, which are dominated with extractive activity (e.g. agriculture and mining), whereas, these sectors do not require a high-skilled labor. Moreover, we also neglect the region that adjacent with Morowali from the dataset to avoid the intervention externalities on the estimation. Furthermore, the data cover multiple socio-economic variables, corresponding to the research aims in examines the impact of nickel downstream strategy on sustainable development indicators. The further information on the variables sources and description are depicted in Table 1, while the descriptive statistics are provided in Table 2.

**Table 1**. Variables notation and measurement.

| Variable | Notation | Measurement | Data Period | Data sources |
|---|---|---|---|---|
| Gross Regional Domestic Product | GDP | Total output in Rupiah (transformed into natural logarithm) | 2002 – 2020 | INDO DAPOER |

| | | | | |
|---|---|---|---|---|
| Literacy rate | Literacy | Percentage of the population aged 15 years and above who can read and write | 2002 – 2020 | INDO DAPOER |
| Number of population | Population | Total resident in 100,000 number of people | 2002 – 2020 | INDO DAPOER |
| Number of labor | Labor | Number of people in labor force | 2002 – 2020 | INDO DAPOER |
| Household Access to safe Sanitation | Sanitation | Percentage of households with access to safe and adequate sanitation facilities | 2002 – 2020 | INDO DAPOER |
| Household Access to Safe Water | Water | Percentage of households with access to clean water sources | 2002 – 2020 | INDO DAPOER |
| Birth attended by Skilled Health worker | Birth | Percentage of births attended by trained health workers | 2002 – 2020 | INDO DAPOER |
| Net Enrollment Ratio: Senior Secondary | School | Net enrollment ratio of students enrolled in senior secondary school | 2002 – 2020 | INDO DAPOER |
| Household Access to Electricity | Electricity | Percentage (%) of households with access to electricity | 2002 – 2020 | INDO DAPOER |

**Table 2**. Descriptive statistics of samples

| **Variables** | **N** | **Mean** | **Standard Deviation** | **min** | **max** |
|---|---|---|---|---|---|
| Ln (GDP) | 380 | 14.81 | 0.746 | 13.23 | 17.60 |
| Literacy | 380 | 86.17 | 29.51 | 0 | 103.3 |
| Population | 380 | 1.759 | 1.210 | 0 | 7.911 |
| Labor | 380 | 5.846 | 5.607 | 0 | 23.03 |
| Sanitation | 380 | 48.78 | 24.64 | 0 | 91.56 |
| Water | 380 | 47.09 | 23.57 | 0 | 92.94 |
| Birth | 380 | 65.14 | 29.17 | 0 | 100 |
| School | 380 | 45.05 | 20.58 | 0 | 86.74 |
| Electricity | 380 | 76.93 | 31.42 | 0 | 100 |

## Results and Discussion

### *Results*

*Synthetic Control Method (SCM)*

The results of SCM are showed from Figure 1 to Figure 5[1]. The left-side graphs depict the impact of IMIP since initial construction (2013), while the right-side graphs express the impact since the IMIP officially operates (2015). The health indicators, proxied by access to safe sanitation, access to safe water, and birth attended by skilled health worker, shows different magnitudes when IMIP initiated. The Morowali's safe sanitation and safe water access exhibits a significant growth that

[1] The SCM results, in term of synthetic Morowali's similarity with the actual, is depicted in Table A1 and Table A2.

has huge gap with the similar indicator of its synthetic, especially after the initial operation of downstream program (See Figure 1&2). However, the impact of nickel downstream is not necessary improve the percentage of birth process that attended by skilled health workers, as shown in Figure 3.

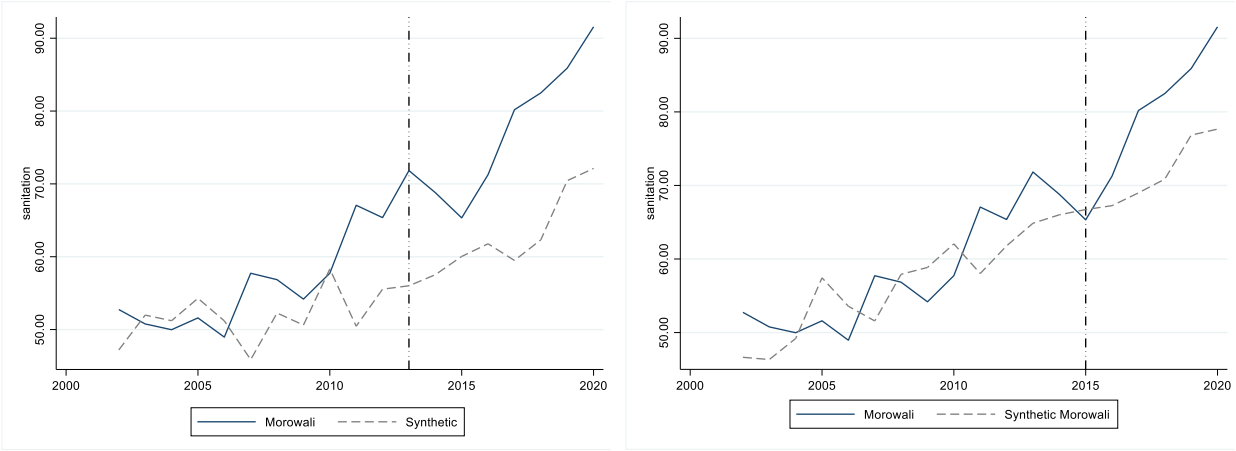



**Figure 1**. Household Access to Safe Sanitation Trajectories of Treated Region and Their Synthetic Units

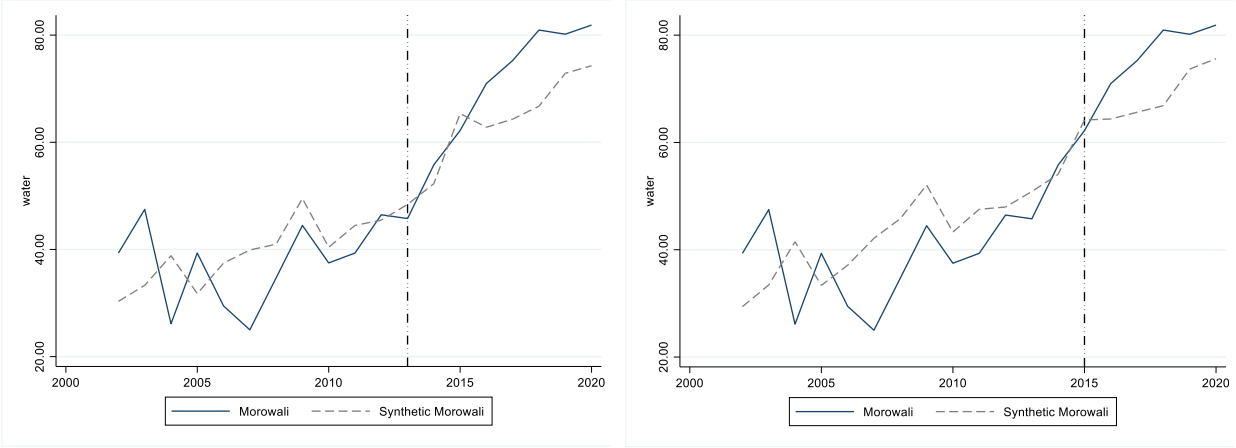



**Figure 2**. Household Access to Safe Water Trajectories of Treated Region and Their Synthetic Units

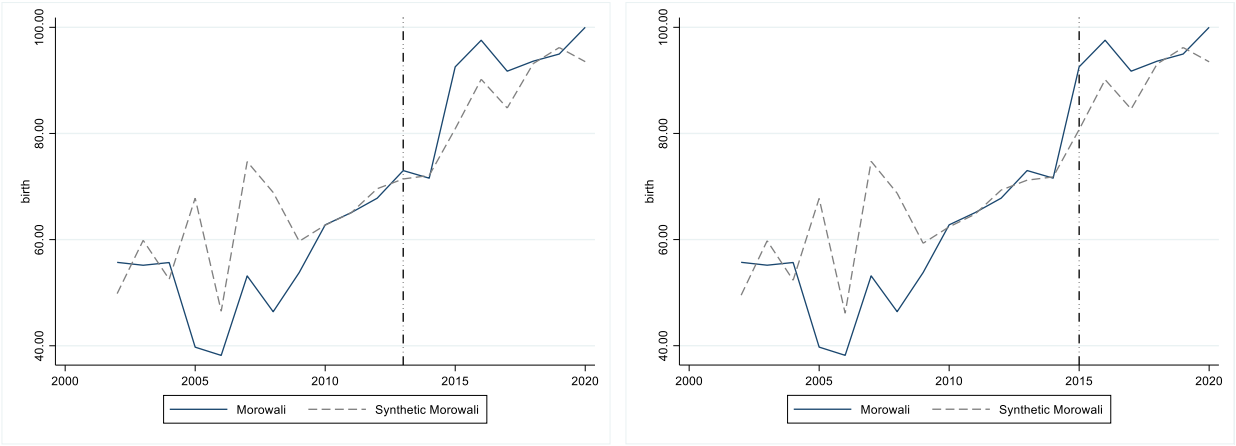



**Figure 3**. Birth attended by Skilled Health worker Trajectories of Treated Region and Their Synthetic Units

The educational access in the current study is represent by the senior secondary net enrollment ratio. Figure 4 shows that the pre-treatment condition of this variables between Morowali and its counterpart do not necessary vary, which indicates a good-fit synthetic control. Furthermore, the post-treatment condition tends to have a similar pattern, where the gaps between the Morowali and Synthetic Morowali are not significantly differ across time. This situation is identical with the result of access on energy variable (proxied by electricity). There are relatively no different between the Morowali and its synthetic in term of electricity access, as suggested in Figure 5. Henceforth, it's fair to say that the nickel downstream policy in Morowali didn't provide a significant change on the education and energy access for local community.

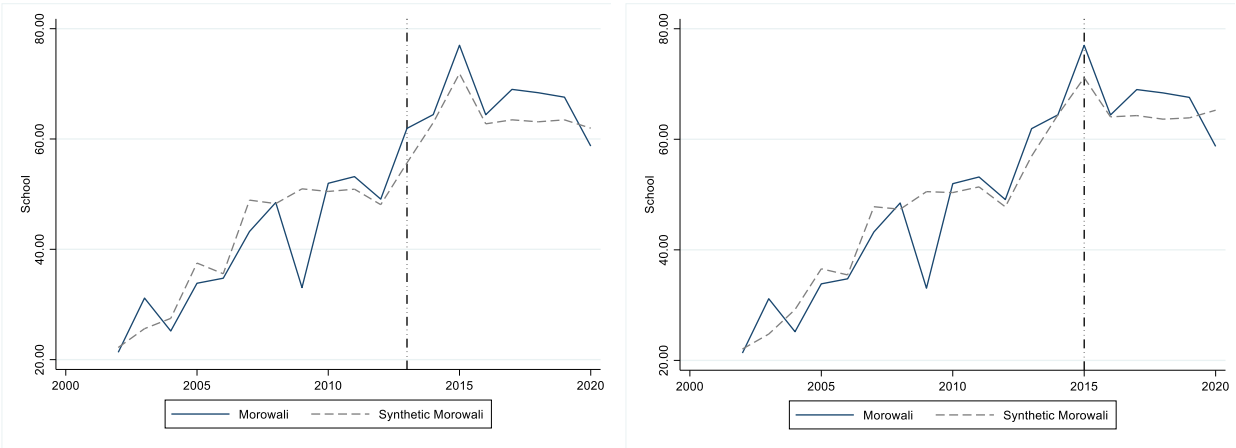



**Figure 4**. Net Enrollment Ratio Trajectories of Treated Region and Their Synthetic Units

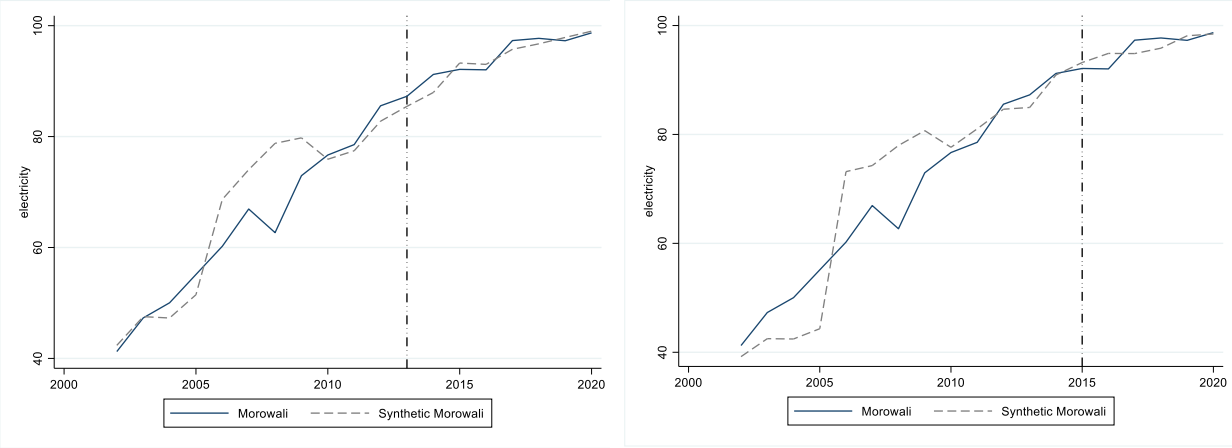



**Figure 5**. Household Access to Electricity Trajectories of Treated Region and Their Synthetic Units

*Difference-In-Difference (DID)*

As robustness check, our study employs DID approach in estimating the impact of nickel downstream strategy on several indicators. To ensure the similarity of treated and control group in DID, this study construct the counterfactual group from region that assigned with weight in SCM approach (see Table A3). The estimated impacts are depicted in Table 3 and Table 4. Whereas, the DID provide relative similar results as SCM.

Table 3. Difference-in-Difference (DID) Results (Since Initial Construction Process)

| Variables | Sanitation | Water | Birth | School | Electricity |
|---|---|---|---|---|---|
| DID | 4.700 | 5.961 | 0.936 | 6.230 | 9.466** |
| | (3.605) | (3.744) | (5.002) | (4.228) | (4.209) |
| Constant | -133.3 | 221.2 | 254.8 | 68.54 | 68.54 |
| | (111.7) | (140.9) | (288.8) | (131.3) | (131.3) |
| Control | Yes | Yes | Yes | Yes | Yes |
| Dummy year | Yes | Yes | Yes | Yes | Yes |
| Dummy treated | Yes | Yes | Yes | Yes | Yes |
| Observation | 64 | 65 | 64 | 77 | 77 |
| R-squared | 0.973 | 0.893 | 0.916 | 0.843 | 0.843 |

Table 4. Difference-in-Difference (DID) Results (Since Initial Operation)

| Variables | Sanitation | Water | Birth | School | Electricity |
|---|---|---|---|---|---|
| DID | 9.305 | 15.55* | -10.18 | 1.223 | -1.205 |
| | (6.446) | (8.509) | (9.732) | (5.928) | (6.471) |
| Constant | -253.4*** | -72.07 | 359.1 | 158.8 | -85.96 |
| | (93.80) | (225.0) | (253.2) | (152.8) | (119.7) |
| Control | Yes | Yes | Yes | Yes | Yes |
| Dummy year | Yes | Yes | Yes | Yes | Yes |
| Dummy treated | Yes | Yes | Yes | Yes | Yes |
| Observation | 77 | 65 | 64 | 77 | 65 |
| R-squared | 0.971 | 0.858 | 0.918 | 0.868 | 0.876 |

***Discussion***

The results of this study indicate that the downstreaming of nickel has impacted the improvement of several basic needs in Morowali Regency. In general, the economic growth resulting from this sector, which subsequently increases formal employment opportunities, leads to an improved

quality of life for the local community. Additionally, the increase in regional revenue generated by the nickel downstream sector is used to fund infrastructure projects related to clean water and sanitation in industrial areas [23]. For example, the development of water pipelines and wastewater treatment systems. This improvement is reflected in the enhanced and expanded access to sanitation and clean water in Morowali. Furthermore, several companies involved in the industry have implemented corporate social responsibility (CSR) programs that include providing clean water and sanitation facilities for surrounding communities [24].

However, the impact of nickel downstream on the percentage of births attended by skilled health workers did not automatically improve. The extraordinary expansion of the nickel downstream industry has attracted a significant influx of migrant workers and their families from various regions of Indonesia to key hubs like Morowali. This population surge has exacerbated the demand for social services, including healthcare [25]. On the other hand, the existing healthcare infrastructure in Morowali is insufficient. This is supported by the fact that the distribution of healthcare services in Morowali is still uneven when compared to other regions in Central Sulawesi. According to data from the Central Statistics Agency, there is variation in the number of healthcare workers in each district. In 2019, Morowali Regency only had 52 doctors and 188 nurses, whereas Poso had 71 doctors and 743 nurses, meaning that healthcare access, including for childbirth, was more readily available in Poso.

Although the downstreaming of nickel has improved the local economy and infrastructure development around industrial areas, its impact on education access remains limited. The increased number of high school children arriving through migration is not matched by the availability of adequate secondary schools [1][25]. Therefore, even though the number of children needing enrollment in schools has increased, the educational infrastructure in areas like Morowali has not developed rapidly enough to accommodate the rising number of students. The limited number of schools has resulted in teaching activities in Morowali being divided into multiple shifts. The Morowali Education and Culture Office reported that in densely populated areas, some schools are forced to operate in three shifts per day to accommodate the growing number of students, especially at the elementary and secondary levels. This can affect the quality of learning and educational participation, particularly for students who attend the night shift. Furthermore, the downstreaming of nickel has not provided significant changes in electricity access for local communities because the energy infrastructure in Morowali has been largely developed to meet the enormous energy needs of the nickel downstream industry. The high energy demand has led to a shortage of electricity available for local communities, especially in remote areas. There are two subdistricts, Bumiraya and Witaponda, with the highest population in Morowali Regency, which regularly experience power outages because electricity supply is prioritized for industrial activities.

## Conclusion

This study aims to examine whether the nickel downstream in Indonesia could provide an inclusive development for the society. By using the Synthetic Control Methods (SCM) and using district level data 380 observation for SCM and 64 for DiD. Trough combination of two impact evaluation tools, synthetic control method and difference-in-difference, the research reveals First, that the downstream policy might partially boost the health indicators, yet, unable to foster the access in

education and energy. Second, the results of this study indicate that the downstreaming of nickel has impacted the improvement of several basic needs in Morowali Regency. Third, although the downstreaming of nickel has improved the local economy and infrastructure development around industrial areas, its impact on education access remains limited This result illustrated that the Indonesian nickel downstream program needs to be more inclusive, in supporting the native to achieve better life condition.

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**Appendix**

**Table A1. Comparison Between Actual and Synthetic Treated Units and the Donor Regions: Since Initial Construction Process**

| Variables | Sanitation | | Water | | Birth | | School | | Electricity | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali |
| GDP | 15.4025 | 15.0226 | 15.4025 | 14.7839 | 15.4025 | 14.8073 | 15.4025 | 15.0954 | 15.4025 | 14.9386 |
| Literacy rate | 95.5055 | 96.5284 | 95.5055 | 92.0931 | 95.5055 | 91.9363 | 95.5055 | 79.4882 | 95.5055 | 87.4921 |
| Population | 11.9165 | 12.309 | 11.9165 | 12.2054 | 11.9165 | 12.1773 | 11.9165 | 12.1917 | 11.9165 | 12.175 |
| Labor | 11.4723 | 11.4916 | 11.4723 | 11.4506 | 11.4723 | 11.4263 | 11.4723 | 11.384 | 11.4723 | 11.4223 |
| (2002) | 52.75 | 47.2049 | 39.33 | 30.3208 | 55.7126 | 49.8295 | 21.33 | 22.2018 | 41.24 | 42.3598 |
| (2006) | 48.96 | 51.1916 | 29.46 | 37.4656 | 38.1862 | 46.5111 | 34.76 | 35.5689 | 60.23 | 68.6725 |
| (2010) | 57.7352 | 58.3225 | 37.488 | 40.406 | 62.7758 | 62.7291 | 51.97 | 50.4902 | 76.6779 | 75.9115 |

**Table A2. Comparison Between Actual and Synthetic Treated Units and the Donor Regions: Since Initial Operation**

| Variables | Sanitation | | Water | | Birth | | School | | Electricity | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali | Morowali | Synthetic Morowali |
| GDP | 15.4392 | 15.0947 | 15.4392 | 14.8766 | 15.4392 | 14.8561 | 15.4392 | 15.0851 | 15.4392 | 15.0737 |
| Literacy rate | 95.6116 | 91.35 | 95.6116 | 91.4281 | 95.6116 | 92.5692 | 95.6116 | 83.5516 | 95.6116 | 85.0433 |
| Population | 11.869 | 12.2929 | 11.869 | 12.1871 | 11.869 | 12.1765 | 11.869 | 12.1862 | 11.869 | 12.1391 |
| Labor | 11.488 | 11.4549 | 11.488 | 11.4946 | 11.488 | 11.4277 | 11.488 | 11.3964 | 11.488 | 11.4387 |
| (2002) | 52.75 | 46.6379 | 39.33 | 29.3937 | 55.7126 | 49.5168 | 21.33 | 22.0555 | 41.24 | 39.2027 |
| (2006) | 48.96 | 53.5766 | 29.46 | 37.1177 | 38.1862 | 46.1213 | 34.76 | 35.4659 | 60.23 | 73.1729 |
| (2010) | 57.7352 | 62.0552 | 37.488 | 43.3014 | 62.7758 | 62.3945 | 51.97 | 50.3621 | 76.6779 | 77.6427 |
| (2014) | 68.799 | 66.01 | 55.7965 | 54.0594 | 71.5732 | 71.8069 | 64.42 | 64.4091 | 91.202 | 90.9151 |

**Table A3**. The Weights of Regions within Donor Pool in the Construction of Synthetic Units

| Region | Post Construction Periods | | | | | Post Operation Periods | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Morowali | | | | | Morowali | | | | |
| | Sanitation | Water | Birth | School | Electricity | Sanitation | Water | Birth | School | Electricity |
| Boalemo | **0.4090** | **0.2230** | 0.0000 | 0.0000 | **0.3290** | **0.0770** | **0.2290** | 0.0000 | 0.0000 | **0.1280** |
| Bolaang Mongondow Selatan | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Bolaang Mongondow Timur | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Bolaang Mongondow Utara | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Bolaang Mongondow | 0.0000 | **0.1990** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Bone Bolango | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Kep. Siau Tagulandang Biaro | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Kepulauan Sangihe | **0.0030** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | **0.1380** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Kepulauan Talaud | 0.0000 | 0.0000 | 0.0000 | **0.0280** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | **0.0820** | 0.0000 |
| Majene | 0.0000 | **0.2340** | **0.5600** | 0.0000 | 0.0000 | 0.0000 | **0.2740** | **0.5720** | 0.0000 | 0.0000 |
| Mamasa | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Mamuju Utara | 0.0000 | 0.0000 | 0.0000 | **0.0240** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | **0.4250** |
| Mamuju | 0.0000 | **0.3440** | **0.1470** | 0.0000 | **0.3110** | 0.0000 | **0.4390** | **0.1450** | **0.0990** | **0.1580** |
| Minahasa Selatan | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Minahasa Tenggara | **0.0220** | 0.0000 | **0.300** | **0.2930** | **0.0640** | **0.0890** | 0.0000 | **0.0280** | **0.2690** | 0.0000 |
| Minahasa Utara | 0.0000 | 0.0000 | 0.0000 | **0.1950** | **0.1360** | 0.0000 | 0.0000 | 0.0000 | **0.1340** | 0.0000 |
| Minahasa | **0.5660** | 0.0000 | **0.2630** | **0.4590** | **0.1600** | **0.5370** | **0.0590** | **0.2550** | **0.4150** | **0.2890** |
| Pohuwato | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | **0.1590** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Polewali Mandar | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |