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Connectivity Infrastructure Spending and Its Indicator Achievement: Case Study of Southern Sumatra Region

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ABSTRACT
Connectivity infrastructure is one of the crucial aspects in the development of a region. The Indonesian government has allocated a significant budget for connectivity infrastructure spending. The effectiveness of infrastructure spending reflects how much the connectivity infrastructure indicators have been achieved. The increase in connectivity infrastructure spending must be directly proportional to the rise in the quality and quantity of connectivity infrastructure. This study aims to analyze the correlation between connectivity infrastructure spending and the achievement of its indicators, especially in the Southern Sumatra region. The analysis method used is the Pearson Correlation analysis method, an approach to analyzing growth and the effectiveness of connectivity infrastructure spending. The results show that infrastructure spending and the achievement of its indicators have a relatively weak and negative correlation for roads and bridges. This study provides implications that the Southern Sumatra Region still needs improvement and evaluation between the distribution of government spending and program implementation for better regional development effectiveness.
Keyword: Government Spending, Connectivity Infrastructure, Achievement Indicators, Southern Sumatra

1. Introduction

Connectivity infrastructure is an important aspect of the development of a region. Infrastructure such as roads, bridges, ports, airports and telecommunications networks connect various regions, encouraging economic growth and improving people's welfare (World Bank, 2018). In addition, good connectivity infrastructure is important for economic growth, equalizing development and reducing regional disparities. Adequate infrastructure can increase access to basic services, such as education, health and employment (Estache & Fay, 2009). Development of connectivity infrastructure such as ports, airports, roads and good telecommunications can increase economic growth (Pranoto & Setiawan, 2019), agricultural sector productivity (Wijayanti & Kusuma, 2021), reduce poverty levels (Suryahadi et al al., 2020), increasing direct investment flows (Firmanzah & Handoyo, 2022). However, there is still a gap in the achievement of connectivity infrastructure indicators between Indonesia's western and eastern regions (Susanto & Priyarsono, 2020). Apart from that, the quality of infrastructure in several areas is still below standard, which can have an impact on logistics efficiency (Hadi et al, 2021), as well as a lack of consideration of sustainability aspects, especially those related to environmental impacts and climate change (Rahmawati & Firman, 2023).

Connectivity infrastructure is crucial to a country's economic and social development. Investments in connectivity infrastructure, such as roads, ports, airports and telecommunications networks, not only facilitate the movement of people and goods but also drive economic growth, increase productivity and improve people's quality of life. The Indonesian government has allocated a significant budget for spending on connectivity infrastructure in recent years (Indonesian Ministry of Finance, 2021). Spending on connectivity infrastructure has become a priority for many developing countries, including Indonesia, to accelerate economic development and reduce regional disparities. Several studies previously discussed spending infrastructure

connectivity and reached the indicator, showing mixed results. Various studies show the influence of connectivity infrastructure spending on the achievement of road infrastructure indicators. Pratiwi & Suryana (2021) study found that every 1% increase in connectivity infrastructure spending correlates with an increase in road length of 0.3% per year. A study by Widodo et al. (2022) shows that an increase in infrastructure spending by 10% contributes to an improvement in the road condition index of 5.7%. This index includes the flatness of road surface, structural strength, and drainage. Besides that, Sulistyo & Handayani (2023) show that a 1% increase in road infrastructure spending contributes to an average road condition reduction in travel time of 0.4% in urban areas.

Purnomo et al. (2021) show that an increase in road infrastructure spending by 10% is correlated with a decrease in the fatal accident rate by 3.2% per year. Utomo & Sari (2022) found that a 5% increase in infrastructure spending contributed to an increase in road capacity (measured in units of passenger cars per hour) of 2.1%. A study by Rahardjo & Kusuma (2023) shows that an increase in road infrastructure spending by 1% contributes to an increase in the inter-regional connectivity index by 0.5%. This index measures the ease of movement of people and goods between provinces. Nugroho & Firdaus (2020) evaluated the impact of spending on connectivity infrastructure on the accessibility of remote areas in Eastern Indonesia. The results found that an increased allocation of infrastructure spending by 5% for remote areas increased the road connectivity ratio (road length per area area) by 2.8% over five years. Furthermore, Pratama and Suryahadi's (2019) study found that an increase in connectivity infrastructure spending of 1% was associated with an increase in bridge length of 0.3% in Indonesia. A study by Wibowo et al. (2018) shows that budget allocation for connectivity infrastructure has a positive impact the number and quality of bridges on the island of Java. A comparative study by Abidin et al. (2021) found that Indonesia has a relatively high elasticity (0.52) compared to the ASEAN average (0.38). Longitudinal research by Kusuma & Prasetyo (2022) found that increasing connectivity infrastructure spending has a long-term effect on bridge construction, with a lag effect of around 2-3 years.

In terms of ICT infrastructure indicator achievements, a study from Sari & Nugroho (2020) found that an increase in connectivity infrastructure spending of 10% correlated with an increase in broadband internet penetration of 3.5% in Indonesia. A study from Wijaya et al. (2019) shows that budget allocation for connectivity infrastructure has a significant positive effect on increasing 4G network coverage in Indonesia. Additionally, it was found that every IDR 1 trillion increase in connectivity infrastructure spending was associated with an increase in 4G coverage of 2.1% of the total area. Hermawan and Firdaus (2021) found an elasticity of 0.62, meaning that every 1% increase in connectivity infrastructure spending is associated with a 0.62% increase in the ICT development index. A comparative study by Rahman et al. (2022) compares the effectiveness of connectivity infrastructure spending on ICT infrastructure development in Southeast Asian countries. They found that Indonesia has a moderate elasticity (0.58) compared to the ASEAN average (0.65). The results of previous research analyzing the influence of connectivity infrastructure spending on air infrastructure achievements show relatively similar results. Studies by Sudarmo & Wibowo (2020), Permana & Kistiani (2023) and Kusuma & Hartono (2021) found that increasing spending on connectivity infrastructure is associated with increasing airport capacity in Indonesia. A study by Pratiwi et al. (2019) shows that budget allocation for connectivity infrastructure has a significant positive impact on increasing the number and quality of runways in Indonesia.

The effectiveness of infrastructure spending reflects how much connectivity infrastructure indicators are achieved. Increased connectivity infrastructure spending must be directly proportional to increases in the quality and quantity of connectivity infrastructure. In addition, the correlation of connectivity infrastructure spending with indicators such as road length, port capacity, number of airports, and so on can be achieved well (Donaldson, 2018; Yoshino & Abidhadjaev, 2017). The effectiveness of spending on connectivity infrastructure also needs to consider its impact on social aspects and equitable development. It is important to conduct research on the effectiveness and correlation of connectivity infrastructure spending on the achievement of connectivity infrastructure indicators. The results of this research can provide an overview of how government spending in this sector has been effective and efficient in achieving connectivity infrastructure development targets. Research findings can also provide input for policymakers in optimizing budget allocations and future strategies for developing connectivity infrastructure (Calderón & Servén, 2010). By understanding the effectiveness and correlation of connectivity infrastructure spending with the achievements of related indicators, it is hoped that the central or regional government can take strategic steps to optimize investment in this sector. This will ultimately encourage sustainable economic growth, increase

the nation's competitiveness, and realize equitable development throughout Indonesia, especially in Bengkulu Province (Bappenas, 2020).

2. Method

Methodology research used in the study This is with approach descriptive quantitative. Sourced data from Directorate General Treasury Bengkulu Province from 2018 to 2022. The unit of analysis is infrastructure connectivity in the land, sea, and air sectors of Bengkulu Province. The data analysis method uses three (3) stages of analysis: analysis description with count growth achievements indicators per field, calculations effectiveness spending, and analysis correlation (Pearson analysis). Calculation growth achievements indicator formulated as follows:

$$\textit{Connectivity Ind. Achievement Growth} = \frac{C.Indc\ Connect_t - C.Indc\ Connect_{t-1}}{C.Indc\ Connect_{t-1}} \quad (1)$$

Next, for count effectiveness, infrastructure connectivity spending can written down as follows:

$$\textit{Infra.Connect Spending effectiveness} = \frac{Realization\ of\ Connec.Infr\ Spending}{Connect.Infr\ Spending\ Target} \quad (2)$$

The third analysis model is the Pearson Correlation Coefficient, which is used to know the relationship/correlation between independent and dependent variables. The formulation model Pearson Correlation Coefficient is written as follows:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \quad (3)$$

Pearson Correlation Coefficient test results are then described in statistics. Where the value of the Pearson Correlation Coefficient is more valuable than 0.5, a strong correlation/relationship exists between independent and dependent variables. If the Pearson Correlation Coefficient has a value of 0.3 to 0.5, then there exists a correlation/relationship currently between variables, and if the Pearson Correlation Coefficient is not enough of 0.3, then it is interpreted that the independent and dependent variables have a correlation or weak relationship. In addition, the signs (+) and (-) on the Pearson Correlation Coefficient indicate the connection between positive or negative inter-independent and dependent variables.

3. Result and Discussion.

Based on Table 1, achievements indicator infrastructure connectivity land consisting of indicator stability path and stability bridge experience enhancement achievements in 2020 compared to the year previously. Enhancement stability road of 74.06% and stability bridge 94.42%. But in yr next, namely 2021 and 2022, experience contraction achievements indicator infrastructure roads and bridges. Next, achievements indicate infrastructure connectivity air proxied with the number of departure aircraft in Bengkulu Province and KM seat availability domestically.

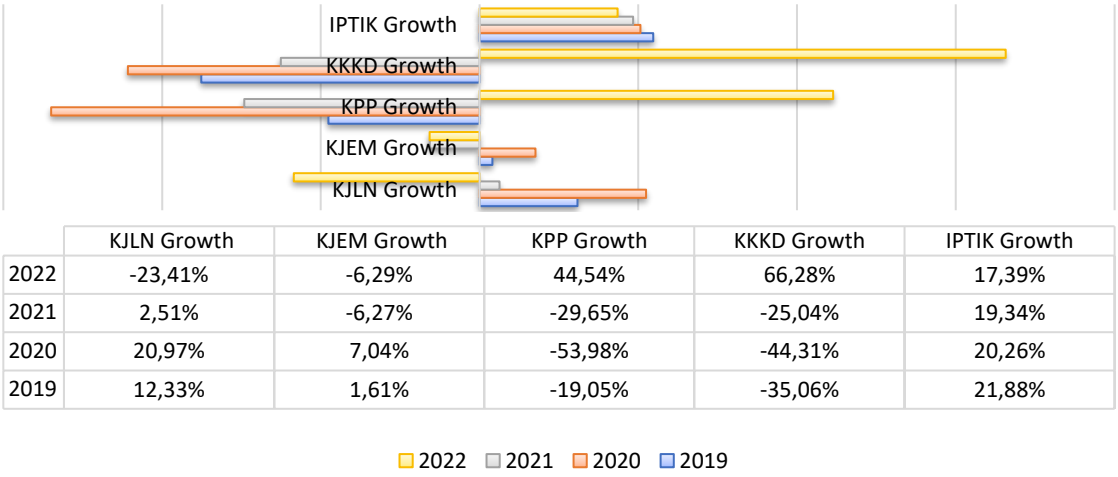
Table 1. Achievements indicator infrastructure connectivity in Bengkulu Province in 2018-2023

Years	Bengkulu Province					
	KJLN	KJEM	KPP	KKKD	JSRP	IPTIK
2018	54.50	86.81	4925	536441971	1	4.88
2019	61.22	88.21	3987	348353307	1	5.21
2020	74.06	94.42	1835	193996975	1	5.5
2021	75.92	88.50	1291	145419175	1	5.85
2022	58.15	82.93	1866	241801826	1	5.95
2023	59.87	-	-	-	-	-

Description:
KJLN : stability of provincial national roads (percent)
KJEM : stability of provincial national bridges (percent)
KPP : provincial aircraft departures
KKKD : availability of domestic seat KM
JSRP : Number of coastal radio stations by province
IPTIK : index of technology, information and communication development

Amount departure aircraft Bengkulu Province experienced contraction from 2018 to 2021 and experienced enhancement return in 2022, amounting to 44.54%, i.e., from 1291 to 1866 departures aircraft. Additionally,

availability chair domestic experienced the same thing with the departure aircraft that experienced contraction from 2018 to 2021. On indicators of infrastructure connectivity, the sea is proxied by several coastal radio stations in Bengkulu Province. Amount Beach radio station in Bengkulu only has one beach radio station from 2018 to 2022. Indicators infrastructure connectivity field information and communication technology proxied with an index that ICT development is experiencing enhancement every year.



	KJLN Growth	KJEM Growth	KPP Growth	KKKD Growth	IPTIK Growth
2022	-23,41%	-6,29%	44,54%	66,28%	17,39%
2021	2,51%	-6,27%	-29,65%	-25,04%	19,34%
2020	20,97%	7,04%	-53,98%	-44,31%	20,26%
2019	12,33%	1,61%	-19,05%	-35,06%	21,88%

Figure 1. Growth achievements indicator infrastructure connectivity field land, air and ICT in 2019-2022 in Bengkulu Province

Growth spending infrastructure connectivity land experience contracted in 2020; increased return with growth reached 48.54%. However, in 2022, there was no experience of growth in spending infrastructure connectivity. On spending infrastructure connectivity sea shows that 2021 growth realization spending experience enough contractions significantly reached 94.78%. Growth increased significantly in 2022, reaching 396.17 %. On realization of spending infrastructure connectivity, air shows relative growth . The same is true with the growth realization of spending in the field, land, and sea.

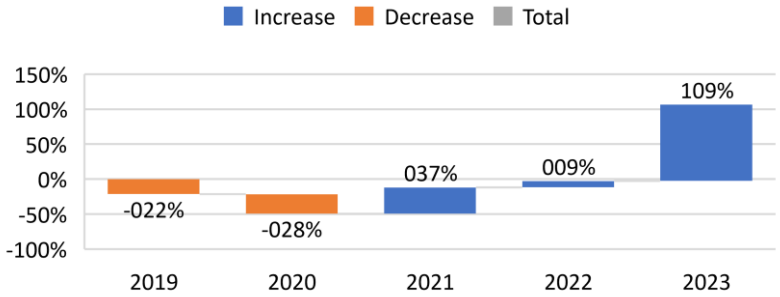
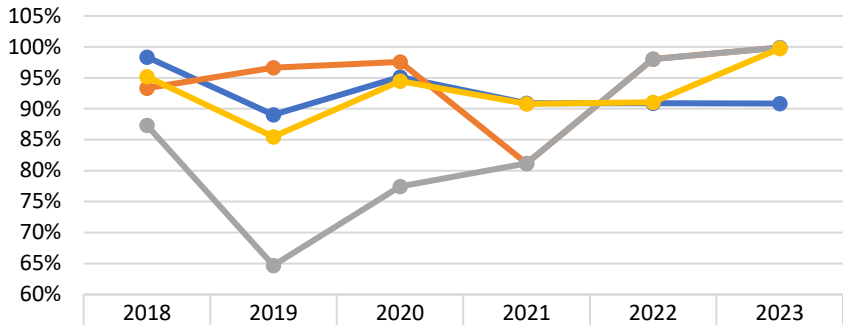


Figure 2. Growth Realization on Infrastructure Connectivity Spending in Bengkulu Province 2019-2023

Figure 2 shows the growth of total spending infrastructure connectivity in Bengkulu Province. Growth in 2020 experienced contraction, amounting to 27.64%. However, the year next experienced an increase in growth, amounting to 37.58%. In 2022, total spending growth in infrastructure connectivity experienced growth, but it was relatively Not significant. In 2023, realization spending on infrastructure connectivity experienced growth fast, reaching 109.40% compared to the previous year.



	2018	2019	2020	2021	2022	2023
Efektivitas BIK Darat	98,36%	89,03%	95,15%	90,90%	90,90%	90,83%
Efektivitas BIK Laut	93,30%	96,66%	97,58%	81,17%	98,02%	99,88%
Efektivitas BIK Udara	87,33%	64,69%	77,43%	81,17%	98,02%	99,88%
Efektivitas BIK	95,19%	85,49%	94,47%	90,82%	91,07%	99,72%

Figure 3. Effectiveness of Infrastructure Connectivity Spending based on group field 2018-2023 in Bengkulu Province

Figure 3 shows the effectiveness of spending infrastructure connectivity based on group fields, that is field, land, sea, air, and total expenditure. On infrastructure connectivity, field land shows that effectiveness spending in 2019 experienced a contraction of 89.03% compared to the previous year previously, amounting to 98.36%. In 2020, experienced enhancement. Enough significance reached 95.15%, but in the year, the next experience will be a decline from 2021 to 2023 and will be relatively stable. In the infrastructure connectivity field, sea found that the effectiveness of spending experience enhancement until 2020 had a time contraction in 2021 with an effectiveness of 81.17% compared to the year previously. In 2021 and 2022, shop infrastructure connectivity tends again to be very effective. On spending infrastructure connectivity field air show that 2018 , 2021, 2022 and 2023 relatively effective. While in 2019 and 2021, the effectiveness of the spending experience contracted. Total spending infrastructure connectivity shows that spending is relatively effective.

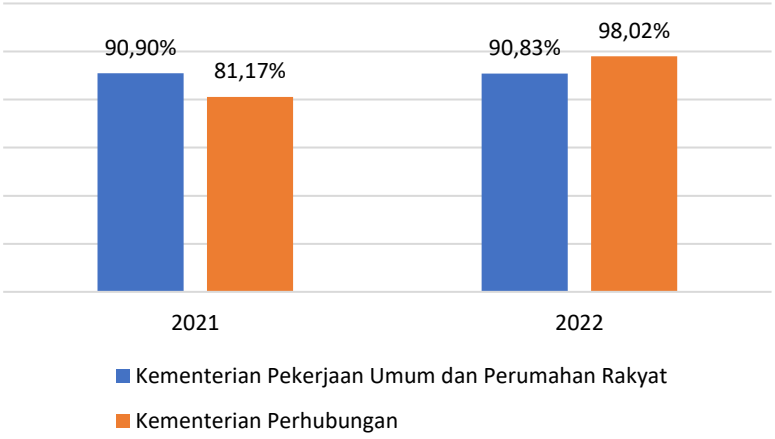


Figure 4. Effectiveness of infrastructure connectivity spending in Bengkulu Province in 2021 and 2022 based on the Ministry

Figure 4 shows that the Ministry's work, public and public housing (PUPR) and the ministries' relationship experience enhanced the effectiveness of spending infrastructure connectivity in Bengkulu Province. Enhancement effectiveness in 2022 will reach 98.02 % in Ministry relationships versus a year previously, amounting to 81.17%. At the Ministry work, public and public housing effectiveness in 2022 reached 90.83 % compared year previously, namely 90.90%. Even though the Ministry of PUPR has a budget that is far bigger than the Ministry of Transportation in Bengkulu Province, the development side of the absorption of budget spending infrastructure connectivity by the ministry relationship is more effective compared to the Ministry of PUPR in 2021 and 2022. Correlation Pearson aims To evaluate the connection between the effectiveness of spending infrastructure connectivity and reach indicator infrastructure connectivity in Bengkulu Province in 2018-2022. Correlation test results related to the effectiveness of spending infrastructure connectivity and reach indicator infrastructure connectivity show that the relative correlation is weak and not significant. On infrastructure connectivity land with proxy stability road show a correlation negative meaning between

effectiveness spending infrastructure connectivity and indicators stability road own negative linear relationship. On the other hand, stability bridges its own correlation positively, which means its own linear positive relationship. The correlation value of Pearson's stability road is 0.2075 (p>0.005), meaning that the level of effectiveness of spending infrastructure connectivity land is explained by 4.3% of the variation in stability road. Meanwhile, the mark correlation Pearson stability bridge value is 0.2591 (p>0.05), meaning the level of effectiveness of spending infrastructure connectivity land explained 6.7% of the variation in stability bridges.

Table 2. Correlation Test Results Pearson Effectiveness Spending Infrastructure Connectivity and Achievement Indicator Infrastructure Connectivity 2018-2022 in the SUMBAGSEL Region

Connectivity Infrastructure Indicator Achievements	BIK Effectiveness
	Coefficient Pearson Correlation
Land Connectivity Infrastructure	
• Road Stability	-0.2075 (0.7377)
• Bridge Stability	0.2591 (0.6738)
Air Connectivity Infrastructure	
• Aircraft Departure	-0.2381 (0.6997)
• Availability of Domestic Seat KM	0.0124 (0.9842)
Technology, Information & Communication Infrastructure	
• ICT Development Index	-0.1444 (0.8168)
Sea Infrastructure	*Missing Value*
Total of Observation	5

Noted : strength correlation (strength of association) 0.1<|r|) < 0.3 correlation weak ; 0.3<|r|<0.5 correlation Enough strong ; |r|>0.5 correlation strong .
Source: processed data author , 2024

On the field air, level effectiveness spending infrastructure connectivity air and reach infrastructure connectivity consisting of the number of departure aircraft and seat KM availability domestically correlated weakly and insignificantly. Meanwhile, in the field, marine No can test correlation because of limited achievement data indicator infrastructure connectivity field the sea yet available with Good. The same results are also shown by the levels of effectiveness of spending infrastructure ICT connectivity and index correlated ICT development weak and insignificant. The realization of spending on connectivity infrastructure is an important indicator in measuring central and regional government efforts to improve the quality and quantity of infrastructure in a region. However, several recent studies show a negative correlation between the realization of spending on connectivity infrastructure and the stability of bridges, which is an indicator of infrastructure quality (Sulistyo et al., 2019; Pradana & Saleh, 2020). This raises questions about the factors that cause this negative relationship and what solutions can be taken to overcome them.

Several factors can cause a negative correlation between actual spending on connectivity infrastructure and bridge stability. First, there needs to be a better understanding between planning and implementation of bridge infrastructure projects, which can cause a decrease in construction quality (Wibowo & Alfen, 2015). Second, weak supervision and maintenance of the bridge after it is completed can accelerate damage and reduce stability (Mulyono et al., 2017). Third, the budget allocation could be more efficient and on target, so infrastructure spending does not significantly impact improving the quality of bridges (Siagian et al., 2020). To overcome this problem, several improvements are needed. First, improving the quality of bridge infrastructure project planning, by ensuring suitability of design, material selection and construction standards (Suprayitno & Soemitro, 2018). Second, strengthening the bridge monitoring and maintenance system involves community participation and the application of information technology (Hartanto & Susilo, 2019). Third, optimizing the connectivity infrastructure budget allocation, prioritizing projects that significantly impact increasing bridge stability and considering sustainability aspects (Setiawan et al., 2021).

Table 3. Realization of Connectivity Infrastructure Expenditures and Land Infrastructure Indicators

Connectivity Infrastructure Indicator Achievements	BIK realization per Field *Coefficient Pearson Correlation*
Land Connectivity Infrastructure	
• Road Stability	-0.3054 (0.6172)
• Bridge Stability	-0.8625* (0.0600)
Air Connectivity Infrastructure	
• Aircraft Departure	0.9374** (0.0186)
• Availability of Domestic Seat KM	0.9825*** (0.0028)
Technology, Information & Communication Infrastructure	
• ICT Development Index	-0.3773 (0.5313)
Sea Infrastructure	*Missing Value*
Total of Observation	5

Note : strength correlation (strength of association) 0.1<|r|) < 0.3 correlation weak ; 0.3<|r|<0.5 correlation Enough strong ; |r|>0.5 correlation strong .
Source : processed data author , 2024

The realization of spending on connectivity infrastructure plays a vital role in developing and improving the quality of transportation infrastructure, including air infrastructure. Recent studies show a positive correlation between actual spending on connectivity infrastructure and air infrastructure indicators, such as seat availability and aircraft departures (Sari & Widiastuti, 2021; Pramono & Ledysia, 2019). These findings indicate that increasing spending on connectivity infrastructure can encourage growth in the air transportation sector and improve connectivity between regions. The positive correlation between actual spending on connectivity infrastructure and seat availability and aircraft departures can be explained through several mechanisms. First, increasing spending on connectivity infrastructure allows the construction and expansion of airports, including the addition of terminal facilities, runways and other supporting infrastructure (Suharno et al., 2017). This can increase the airport's capacity to accommodate more airlines and flight routes, so that the availability of seats and the frequency of aircraft departures increases (Saraswati & Hanaoka, 2014).

Second, spending on connectivity infrastructure to improve air navigation technology, security systems and other supporting facilities can increase airport operational efficiency and reduce flight waiting times (Saputra & Kurniawan, 2018). This can attract more airlines to open new routes and increase flight frequency, so seat availability and aircraft departures also increase. Third, increasing spending on connectivity infrastructure can also encourage the development of areas around airports, such as the construction of road access, public transportation and commercial facilities (Setiani, 2015). This can increase accessibility and attract more passengers to air transportation, so demand for seat availability and aircraft departures also increases. However, it should be noted that the positive correlation between actual spending on connectivity infrastructure and air infrastructure indicators is also influenced by other factors, such as economic growth, aviation sector policies, and public preferences (Warnock-Smith & Potter, 2005). Therefore, connectivity infrastructure spending policies must accompany a comprehensive air transportation sector development strategy and consider other relevant aspects. By understanding the positive correlation between actual spending on connectivity infrastructure and seat availability and aircraft departures, it is hoped that the government can optimize budget allocations for developing air infrastructure and improving connectivity between regions in Indonesia.

The realization of spending on connectivity infrastructure is an important factor in the development of technology, information and communication (ICT) infrastructure. However, several recent studies show a negative correlation between actual spending on connectivity infrastructure and ICT infrastructure indicators, such as internet penetration, speed, and telecommunications network availability (Ariyanti, 2021; Setiawan & Pradana, 2019). This finding is quite surprising, considering that connectivity infrastructure should support

ICT infrastructure development. Therefore, it is necessary to examine further the factors that cause this negative correlation. One factor that can explain the negative correlation between spending on connectivity infrastructure and ICT infrastructure is the misalignment of priorities and budget allocations. In some cases, spending on connectivity infrastructure is prioritized for developing physical infrastructure, such as roads, bridges and ports. In contrast, the budget allocation for ICT infrastructure development is relatively limited (Susanti et al., 2020). This can lead to gaps in ICT infrastructure development, especially in less developed areas. Another factor contributing to the negative correlation is the need for more synergy and coordination between government agencies in planning and implementing ICT infrastructure projects (Nainggolan et al., 2018). When spending on connectivity infrastructure is not accompanied by planning integrated with ICT infrastructure development, project implementation overlaps or discrepancies can occur. This can hinder the development of effective and efficient ICT infrastructure.

Besides that, negative correlation can also be caused by external factors, such as geographic and demographic conditions (Ramadhani & Farda, 2021). Areas with challenging geographic conditions, such as mountains or islands, can make it difficult to develop ICT infrastructure, although spending on connectivity infrastructure still needs to be completed. Likewise, areas with low population density or low levels of digital literacy may hinder the adoption and utilization of ICT infrastructure, even though physical infrastructure is available. Several comprehensive strategies and policies are needed to overcome the negative correlation between actual spending on connectivity infrastructure and ICT infrastructure. First, there must be synergy and good coordination between government agencies in planning and implementing ICT infrastructure projects, considering regional needs and priorities (Wibowo et al., 2019). Second, budget allocations for ICT infrastructure development must be increased and optimized, considering aspects of equity and sustainability (Haryono & Prasetyo, 2018). Third, there must be supporting programs to increase digital literacy and technology adoption in society, especially in less developed areas (Nugraha, 2020).

4. Conclusion

Based on the study's results show that connectivity infrastructure spending negatively correlates with various road and ICT infrastructure indicators in Bengkulu Province. This is suspected to be due to a mismatch between the planning and implementation of infrastructure projects, weak supervision and maintenance, and inefficient or inappropriate budget allocation so that infrastructure spending does not provide a negative correlation. On the other hand, connectivity infrastructure spending positively correlates with the achievement of air infrastructure indicators in Bengkulu Province. The effectiveness of infrastructure spending in achieving these indicators also depends on other factors such as budget management efficiency, planning quality, and synergy with other sectors. Therefore, further research is needed to optimize the impact of connectivity infrastructure spending on achieving road infrastructure indicators.

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