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Toward National Broadband Equality: The Role of 5G Fixed Wireless Access in Indonesia

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Abstract
This research analyzes the role of Fifth Generation Fixed Wireless Access (5G FWA) in supporting broadband equity in Indonesia as a developing archipelagic country facing geographical challenges and digital infrastructure inequality. The research aims to evaluate the potential of hybrid fiber-wireless broadband architecture as a solution to accelerate broadband expansion, particularly in rural, remote, and underserved areas. The research employed a qualitative-descriptive approach combined with techno-economic analysis and policy studies, along with a comparative analysis between Fiber to the Home (FTTH) and 5G FWA based on deployment flexibility, scalability, implementation speed, and suitability to archipelagic geographical conditions. The findings indicate that 5G FWA offers significant advantages in accelerating broadband deployment in areas with high geographical barriers through more flexible infrastructure compared to full FTTH deployment. The hybrid fiber-wireless architecture enables the integration of the national fiber optic backbone with last-mile wireless connectivity to improve broadband access in rural and island regions. The success of broadband equity is influenced not only by technological capabilities but also by spectrum policy support, infrastructure sharing, investment incentives, and digital literacy programs, with the integration of Massive MIMO and beamforming technologies contributing to improved coverage efficiency and capacity. This study concludes that 5G FWA should be positioned as a complementary broadband solution rather than a complete replacement for fiber optic infrastructure, with the hybrid approach offering a more realistic, flexible, and scalable implementation pathway to reduce the digital divide and support national digital transformation in Indonesia.

Introduction

Digital transformation has become one of the main strategic agendas in global economic and social development (Dąbrowska et al., 2022; George & Schillebeeckx, 2022; Kaggwa et al., 2023; Qadri et al., 2025; Yoo & Yi, 2022). The availability of fast, stable, and equitable broadband access is now seen as the basic infrastructure that supports the growth of the digital economy, online education services, telemedicine, e-government, and various other information technology-based activities. The Organisation for Economic Co-operation and Development (OECD) emphasizes that the development of future broadband is a fundamental element in building an inclusive and sustainable digital society (OECD, 2022). In this context, developing countries face major challenges in realizing broadband equity due to limited infrastructure, high fixed network deployment costs, and inequality in the distribution of internet access between regions. These problems are becoming increasingly complex in archipelagic countries such as Indonesia which have extensive geographical characteristics, diverse topography, and uneven population distribution (Astari et al., 2024; Mau et al., 2025; Narotama, 2022).

The unequal distribution of broadband in developing island countries is generally influenced by geographical factors, infrastructure development costs, and low economic viability in low-density areas. Brewer et al. (2022) and Curwen and Whalley (2023) explain that the construction of fixed broadband in rural and remote areas requires a large investment as operators must build backbones and last-mile networks with extensive geographical coverage. This condition causes telecommunication operators to prioritize network development in urban areas with a higher rate of return on investment. As a result, rural areas and frontier, outermost, and disadvantaged (3T) areas often experience limited access to high-quality internet. The OECD (2022) also emphasizes that broadband gaps are not only related to technology access, but also increase social and economic inequalities in society due to limited participation in digital services.

In the Indonesian context, the challenge of broadband equity is influenced by the geographical conditions of the archipelago consisting of thousands of islands with different levels of population density. Fiber optic infrastructure as the backbone of fixed broadband requires high construction and maintenance costs, especially in mountainous areas, small islands, and remote areas. Brewer et al. (2022) stated that the cost of installing fixed broadband networks in rural areas can increase significantly due to the complexity of physical infrastructure development and low market potential. This condition causes broadband penetration in rural Indonesia to develop more slowly than urban areas. In addition, limited broadband access also affects the development of the digital economy of rural communities due to limited access to online education services, telemedicine, e-commerce, and internet-based government services (OECD, 2022; Zhu et al., 2022).

The digital divide between urban and rural areas is not only a technological issue, but also a challenge for national development. Unequal access to the internet has the potential to increase socio-economic inequality because people in remote areas have limited access to digital economy opportunities and information technology-based public services. Curwen and Whalley (2023) explain that uneven broadband development can slow down regional economic growth and hinder national digital transformation. In the context of developing countries, inclusive broadband access is one of the important factors in supporting knowledge-based economic development and strengthening the capacity of human resources. Therefore, a more flexible and efficient alternative approach is needed to accelerate the equitable distribution of national broadband.

The development of fifth-generation communication technology presents new opportunities in the provision of broadband services through the implementation of Fixed Wireless Access. This technology leverages mobile networks to provide fixed broadband connectivity without full reliance on cable networks all the way to the customer side. Alimi et al. (2021) explained that 5G Fixed Wireless Access has great potential in supporting enhanced mobile broadband because it is able to provide high capacity, low latency, and more flexible deployment than conventional fixed broadband. In addition, the development of Massive Multiple Input Multiple Output technology, beamforming, and modern network architectures allow for improved spectral efficiency and quality of wireless-based broadband services (Erunkulu et al., 2021; Hong et al., 2022).

The implementation of Fixed Wireless Access is increasingly seen as a strategic solution for rural and suburban areas that are difficult to reach by fiber optic networks. Brewer et al. (2022) emphasized that wireless broadband technology can be a more economical last-mile connectivity solution in low-density areas. Casetti (2023) also explained that the hybrid fiber–wireless approach is an important trend in the development of modern broadband networks because it combines fiber backbone capacity with the flexibility of wireless access. In the context of island countries, the hybrid approach is considered more realistic than the development of Fiber to the Home as a whole because it is able to adapt network deployment to geographical conditions and user needs.

A number of previous studies have discussed the implementation of 5G and wireless broadband in developing countries. Goggin and Mansilla (2023) examine the challenges of 5G implementation in Indonesia and Peru and show that the development of broadband infrastructure in developing economies is influenced by regulatory readiness, operator investment, and socio-economic conditions of the community. Oughton and Jha (2021) also emphasized the importance of supporting infrastructure policies to support the equitable distribution of next-generation networks. In addition, Kumar and Oughton (2023) explain that infrastructure sharing strategies can improve the efficiency of broadband network development by reducing deployment costs and accelerating the expansion of service coverage.

Although various studies have discussed the potential of wireless broadband and the implementation of 5G, most studies still focus on technical aspects of the network such as throughput, latency, spectral efficiency, and communication architecture design. Studies that integrate technological, economic, geographical, and policy aspects in the context of broadband equity in island countries are still relatively limited. The OECD (2019) emphasizes that the success of future broadband implementation depends not only on technological innovation, but also on the readiness of policies, spectrum regulation, and national infrastructure development strategies. In addition, most international research has not specifically evaluated how Fixed Wireless Access can support broadband equality in the context of Indonesia as an archipelagic country with complex geographical challenges and distribution of infrastructure.

The research gap is also seen in the limited study on the implementation of hybrid fiber-wireless architecture as a national broadband strategy in Indonesia. Most studies still position Fixed Wireless Access as a technical alternative to fixed broadband, rather than as part of an integrated national broadband development framework. In fact, the literature suggests that Fixed Wireless Access is more appropriately positioned as a complementary technology to the fiber optic backbone, rather than as a full replacement for fixed broadband networks (Brewer et al., 2022; Casetti, 2023; OECD, 2022; Singh et al., 2024). In this context, research is needed that is able to connect the implementation of broadband technology with issues of digital equity, economic development, and national digital transformation.

Based on these problems, this research aims to analyze the role of 5G Fixed Wireless Access in supporting broadband equity in Indonesia through a strategic approach that integrates technological, economic, and telecommunication policy aspects. This study examines how the hybrid fiber-wireless approach can be a more adaptive solution to Indonesia's geographical characteristics than the full development of conventional fixed broadband. In addition, this study also evaluates the socio-economic implications of broadband equity on the development of the digital economy, internet-based public services, and digital inclusion of the community.

The novelty of the research lies in the development of an integrative perspective on broadband implementation in developing island countries by placing Fixed Wireless Access as a complementary broadband solution to support national digital transformation. This research provides theoretical benefits by enriching the study of broadband equality in developing island countries through the integration of technological, economic, geographical, and policy perspectives in one analytical framework, while also contributing to the development of hybrid broadband architecture studies in archipelagic contexts. Practically, this research serves as evaluative material for policymakers in formulating national broadband strategies, a reference for telecommunication operators in designing network deployment plans, input for regulators in developing spectrum policies and infrastructure sharing frameworks, and a foundation for future researchers. Ultimately, this research supports inclusive and sustainable digital transformation in Indonesia by identifying more adaptive and efficient broadband implementation pathways to reduce the digital divide and advance national development.

Method

This study used a descriptive qualitative approach with a techno-economic analysis framework to evaluate the role of 5G Fixed Wireless Access (FWA) technology in supporting broadband equity in Indonesia. This approach was chosen because the development of national broadband is not only influenced by the technical aspects of the network, but also by geographical, economic, and readiness factors of telecommunications infrastructure. In the context of archipelagic countries such as Indonesia, broadband implementation faces challenges in the form of high fiber optic deployment costs, limited backbone infrastructure, and low investment feasibility in rural and remote areas (Brewer et al., 2022; OECD, 2022). Therefore, this study positions FWA as a complementary broadband solution that can expand internet access more flexibly than full Fiber to the Home (FTTH) deployment. The research framework was developed based on the relationship between broadband equity challenges, FWA technological capabilities, and socio-economic implications for national digital transformation. In addition, the study adopts the concept of hybrid fiber–wireless architecture that combines a fiber optic backbone with last-mile wireless broadband to improve network deployment efficiency in areas with high geographical barriers (Casetti, 2023; Singh et al., 2024).

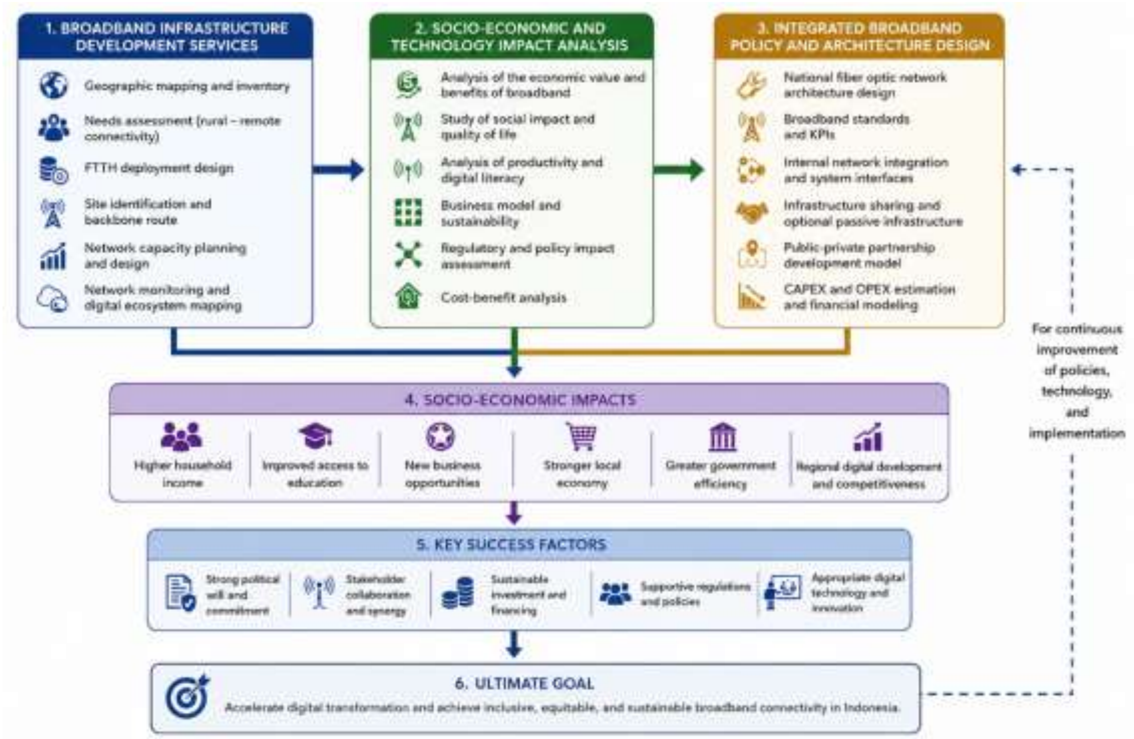

Figure 1. A research framework evaluating the role of 5G Fixed Wireless Access in supporting broadband equity in Indonesia

Source: Developed by the Author, 2024

The study also conducted a comparative broadband analysis between FTTH and 5G FWA based on the parameters of deployment flexibility, infrastructure scalability, implementation cost, deployment speed, and suitability to Indonesia's geographical conditions. FTTH is used as a baseline comparison because it has high bandwidth capacity and good connection stability, but its implementation requires a large investment in physical infrastructure, especially in rural and island areas (Brewer et al., 2022). In contrast, FWAs offer greater deployment flexibility by leveraging the existing mobile network infrastructure. The hybrid fiber-wireless approach is considered to be able to optimize the capacity of the fiber backbone while expanding broadband access through wireless last-mile deployment (Casetti, 2023). The comparative analysis also considers aspects of investment efficiency and network scalability. Kumar and Oughton (2023) stated that infrastructure sharing strategies can improve the efficiency of broadband development by reducing the need for new infrastructure investment. In addition, 5G supporting technologies such as Massive Multiple Input Multiple Output and beamforming allow for more efficient increase in the capacity of wireless-based broadband networks (Alimi et al., 2021; Erunkulu et al., 2021).

Table 1. Comparison of Deployment Characteristics of Fiber to The Home (Ftth) and 5G Fixed Wireless Access (FWA)

Parameter	Fiber to the Home (FTTH)	5G Fixed Wireless Access (FWA)
Deployment Speed	It is relatively slow because it requires the construction of fiber cables to the customer side and	Relatively fast because it utilizes the existing BTS infrastructure and mobile network

	complex physical construction processes	
Infrastructure Costs	High, especially in backbone and last-mile construction in rural and archipelagic areas	Lower than FTTH because it reduces the need for last-mile cable construction
Network Scalability	Scalability is limited because customer additions require physical network expansion	High scalability and more flexibility for increased coverage and network capacity
Maintenance Complexity	High due to the maintenance needs of physical cables and fiber network devices	Relatively lower as most of the infrastructure is wireless-based and centralized on base stations
Broadband Flexibility	Less flexible in areas with difficult geographical conditions	Highly flexible and adaptive to rural, suburban, and archipelago areas
Suitability for Rural Areas	Less economical in areas with low customer density	More suitable for rural areas because it is faster deployment and more cost-efficient
Suitability for the Archipelago Region	Limited due to the high cost of inter-regional and island cable construction	It is ideal because it utilizes a wireless broadband approach for last-mile connectivity
Physical Infrastructure Needs	Very high because it requires trenching, ducting, and fiber cable pulling	Lower because it uses existing mobile infrastructure
Investment Efficiency	Longer return on investment in rural and 3T areas	More efficient for broadband expansion in underserved and unserved areas
Role in the National Broadband Architecture	Serves as the main backbone with high capacity and network stability	Serves as a complementary broadband solution to expand last-mile broadband access

Source: Developed by the Author based on Literature Synthesis

Data analysis was carried out using a qualitative content analysis approach and thematic synthesise of various scientific literature, industry reports, and policy documents related to broadband and the implementation of 5G technology. The literature is obtained from peer-reviewed publications, international organization reports, and telecommunications policy documents relevant to the topic of broadband equity and wireless broadband deployment. The analysis process was carried out by identifying the main themes related to the broadband gap, economic-technological analysis in broadband deployment, hybrid fiber-wireless architecture, and digital inclusion. Furthermore, the research conducted a thematic synthesis to establish an argumentative relationship between FWA's technological capabilities and national broadband equity needs. Contextual analysis approaches are also used to adjust global research results to the geographical, infrastructural, and socio-economic characteristics of Indonesia. Thus, the research resulted in a more contextual analytical framework in evaluating the implementation of FWA as a strategy to support national broadband equity.

Results and Discussion

Broadband Inequality in Indonesia and Archipelagic Connectivity Challenges

The results of the analysis show that broadband inequality is still one of the main challenges in Indonesia's digital transformation. As an archipelagic country with more than 17,000 islands and an uneven distribution of population, Indonesia faces significant obstacles in the development of fixed network-based broadband infrastructure. The literature shows that urban areas have a much higher broadband penetration rate than rural areas and frontier, outermost, and disadvantaged (3T) areas, mainly due to the limitations of backbone infrastructure and the high cost of fiber optic network deployment (Brewer et al., 2022; Curwen & Whalley, 2023; OECD, 2022).

The results of the literature synthesis show that the main challenges in broadband development in island countries come from a combination of geographical, economic, and regulatory factors. Brewer et al. (2022) emphasized that the construction of fixed broadband in rural areas requires a large investment as operators must build backbone and last-mile infrastructure with wide geographical coverage but relatively low number of subscribers. This condition causes telecommunication operators to prioritize urban areas that have a higher rate of return on investment. In the Indonesian context, geographical conditions in the form of mountains, small islands, and remote areas further increase the complexity of fixed broadband network deployment.

Broadband inequality is also affected by the limitations of supporting infrastructure and the physical deployment process of fiber optic networks. The OECD (2022) explains that the development of future broadband requires the integration of infrastructure that is adaptive to the geographical and socioeconomic conditions of the community. However, the full deployment of Fiber to the Home in the island nation requires very high construction and maintenance costs. As a result, broadband development in many regions of Indonesia is still lagging behind the needs of national digital transformation.

Further analysis shows that broadband inequality not only impacts limited internet access, but also affects the socio-economic development of society. Areas with broadband limitations tend to have lower access to digital education, internet-based healthcare, e-government, and digital economy opportunities. The OECD (2022) and Zhu et al. (2022) emphasized that broadband access gaps can widen the digital divide and slow down the improvement of the quality of life of rural communities.

In this context, the results of the study show that the wireless-based broadband approach is becoming increasingly relevant to support equitable distribution of internet access. Wireless broadband technology allows operators to expand internet services without being fully dependent on the construction of fiber optic cables as a whole. Therefore, the implementation of 5G Fixed Wireless Access is seen as having strategic potential in accelerating the equitable distribution of national broadband.

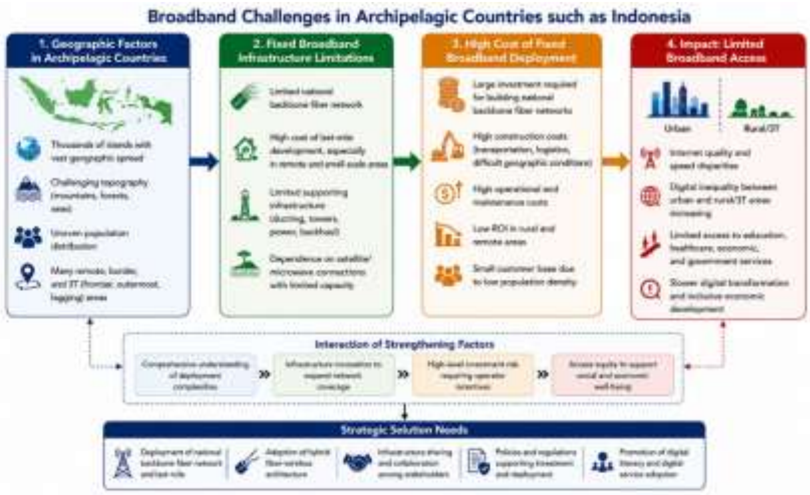

Figure 2. Challenges of Broadband Equity in Archipelagic Countries such as Indonesia.
Source: Developed by the Author based on Literature Synthesis, 2024

The Strategic Potential of 5G Fixed Wireless Access

The results of the study show that 5G Fixed Wireless Access (FWA) has significant potential as a complementary broadband solution to support equitable distribution of internet access in Indonesia. FWA technology allows the provision of fixed broadband services through a cellular network without the need for the construction of fiber cables to the customer side. Alimi et al. (2021) explained that the implementation of fifth-generation network-based FWA provides higher deployment flexibility than conventional fixed broadband because it utilizes the available wireless infrastructure and Base Transceiver Stations.

The development of Massive Multiple Input Multiple Output and beamforming technology in 5G networks increases spectral efficiency as well as wireless-based broadband capacity (Erunkulu et al., 2021; Hong et al., 2022). The results of the study show that the integration of this technology allows wireless broadband networks to provide service quality that is close to fixed broadband under various implementation conditions. In the context of Indonesia, faster broadband deployment capabilities are a strategic factor because many rural areas and islands are still experiencing limited fixed broadband access.

An analysis of the international literature shows that the implementation of FWA is increasingly seen as a last-mile broadband solution in underserved and unserved areas. Casetti (2023) explained that the hybrid fiber-wireless approach is one of the main strategies in the development of modern broadband networks because it is able to integrate fiber backbone capacity with the flexibility of wireless broadband. Such an approach is particularly relevant for island nations because the construction of full fixed broadband across the region is often uneconomical.

The results of the study also show that FWA implementation has higher deployment flexibility than FTTH. Wireless infrastructure allows operators to gradually expand their networks according to the growth of user needs without having to build a comprehensive physical infrastructure. Kumar and Oughton (2023) emphasized that the infrastructure sharing approach to wireless networks can increase investment efficiency and accelerate the expansion of national broadband coverage.

In addition, the implementation of FWA supports the reduction of deployment complexity in areas with high geographical barriers. Wireless-based broadband infrastructure allows operators to reach island and rural areas at a lower cost than full fiber optic deployments. Singh et al. (2024) show that wireless broadband technology has great potential in supporting socio-economic development in island countries and rural areas through increased access to digital connectivity.

Comparative Evaluation Between FTTH and FWA Deployment

The results of the comparative analysis show that there is a fundamental difference between the implementation of FTTH and FWA in the context of national broadband development. FTTH still has advantages in bandwidth capacity and connection stability, especially in urban areas with high user density. However, full fiber optic deployment requires huge development and maintenance costs, especially in rural and archipelagic areas (Brewer et al., 2022; OECD, 2022).

In contrast, FWAs offer more flexible and efficient broadband deployments because they take advantage of the cellular network infrastructure that is already available. The results show that operators can significantly reduce the need for last-mile cable construction through the implementation of wireless broadband. Casetti (2023) explained that the hybrid fiber–wireless approach allows operators to maintain fiber backbone capacity while expanding broadband access using wireless technology.

The analysis shows that FWA has a major advantage in network deployment speed and scalability. Wireless-based broadband infrastructure allows operators to expand the coverage of internet services faster than full FTTH construction. In addition, wireless broadband has greater flexibility in adjusting network capacity to the growth of user needs.

The results of the study also show that the implementation of FWA is more appropriate for areas with low to medium customer density. In these regions, FTTH deployments are often uneconomical due to the high investment cost compared to the number of potential customers. In contrast, FWAs allow operators to expand broadband access with lower investment risks and shorter deployment times.

Nonetheless, research confirms that FWA is not a full replacement for fiber optic backbones. Fiber infrastructure is still needed to support the capacity of the national broadband backbone and inter-regional connectivity. Therefore, the relationship between FTTH and FWA is more appropriately positioned as a complementary broadband architecture rather than a competing technology.

Table 2. Comparative Evaluation of FTTH and FWA Implementation

Evaluation Aspects	Fiber to the Home (FTTH)	5G Fixed Wireless Access (FWA)	Implications for Indonesia
Deployment Flexibility	Deployment is limited because it requires the construction of physical cables to the customer side	Deployment is more flexible because it utilizes existing wireless networks and base stations	FWA is more adaptive for rural, suburban, and island areas

Scalability Infrastructure	Scalability requires physical expansion of fiber networks and distribution devices	Higher scalability through increased wireless network capacity and base station optimization	FWA supports faster and more gradual broadband expansion
Deployment Costs	High due to trenching, ducting, backbone, and last-mile fiber needs	Relatively lower because it reduces the need for last-mile cable construction	FWA is more economical for areas with low population density
Maintenance Complexity	High due to maintenance of physical cables and fiber network devices	Lower because most of the infrastructure is wireless-based	FWA maintenance is more efficient in difficult geographical areas
Implementation Speed	Relatively slow due to complex physical construction and installation processes	Relatively fast through the optimization of existing mobile infrastructure	FWA accelerates expansion of national broadband access
Suitability for Rural Areas	Less than optimal due to high deployment costs and low ROI	It is suitable because the deployment is more flexible and cost efficient	FWA supports broadband equity in underserved areas
Suitability for the Archipelago Region	Limited because inter-regional cable construction requires high costs	Ideal for the archipelago through a last-mile wireless approach	FWA is more realistic for archipelagic countries like Indonesia
Reliance on Physical Infrastructure	Very high against cable networks and physical distribution lines	Lower because it takes advantage of wireless broadband connectivity	FWA reduces the complexity of network building
Operator Investment Efficiency	Slower return on investment in low-density areas	Investment is more efficient because deployment can be done in stages	FWA boosts rural broadband economic viability
Role in the National Broadband Architecture	Serves as a high-capacity primary broadband backbone	Serves as a complementary broadband for last-mile connectivity	FTTH and FWA integration forms hybrid broadband architecture

Source: Developed by the Author based on Literature Synthesis

Hybrid Fiber–Wireless Broadband Architecture

One of the main results of this study is the identification of the hybrid fiber-wireless architecture approach as the most realistic broadband model for Indonesia. The hybrid approach combines high-capacity fiber optic backbone with wireless-based last-mile broadband distribution through FWA technology. The literature shows that this approach is increasingly used in the development of modern broadband because it can improve deployment efficiency and network flexibility (Casetti, 2023; OECD, 2022).

The results of the analysis show that the hybrid model allows broadband development to be carried out more adaptively to Indonesia's geographical conditions. The fiber optic backbone can be focused on regional centers and areas with high capacity needs, while the distribution of internet access to the community is carried out through wireless broadband networks. This approach reduces the need to build fiber cables throughout the region so that broadband deployment becomes more efficient.

In addition, the implementation of hybrid architecture supports the reduction of capital expenditure and operational expenditure of telecommunication operators. Wireless infrastructure allows operators to leverage available mobile network assets so that additional investments can be reduced. Lörincz et al. (2023) explain that the integration of fiber–wireless access networks can improve energy efficiency and the sustainability of future broadband development.

The results of the study also show that the hybrid approach improves the scalability of national broadband. Operators can gradually expand the network according to user needs without making large investments simultaneously. This approach is important in supporting the development of sustainable and more inclusive long-term broadband.

Socioeconomic Impact of Broadband Equality

The results of the study show that broadband equity has significant implications for the social and economic development of the community. The availability of more equitable internet access allows for increased digital inclusion, technology-based economic development, and expansion of digital public services. The OECD (2022) emphasizes that broadband is a fundamental infrastructure in supporting national digital transformation and increasing economic productivity.

In the education sector, broadband access allows the implementation of online learning and the distribution of digital learning resources more widely. This is important in rural areas that have limited access to conventional education. In addition, broadband connectivity also supports digital health services and telemedicine that allows people to obtain remote health services more effectively.

From an economic perspective, the implementation of wireless-based broadband has the potential to increase public participation in the digital economy. Internet access allows micro, small, and medium enterprises to leverage e-commerce, digital payments, and internet-based marketing platforms to expand the market and increase productivity. Brewer et al. (2022) show that the expansion of broadband access in underserved areas has a direct relationship with increased economic inclusion and the reduction of social inequality.

The results of the study also show that broadband equality supports the strengthening of digital governance and internet-based public services. Broadband infrastructure allows governments to develop more efficient digital administrative services, public information systems, and smart services. In the context of national digital transformation, broadband equity is an important foundation in building a more inclusive and sustainable digital society.

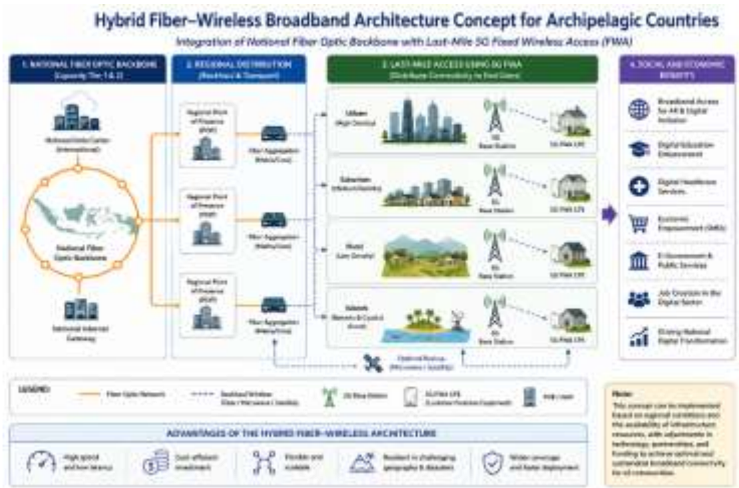

Figure 3. Socioeconomic Impacts of Broadband Equality in Indonesia
Source: Developed by the Author based on Literature Synthesis

Regulatory and Infrastructure Challenges

Although the implementation of FWA has great potential, the results show that there are a number of regulatory and infrastructure challenges that need to be addressed. One of the main challenges is the readiness of mobile network infrastructure in rural areas and islands. Without adequate backbone support and network capacity, it is difficult for wireless-based broadband service to achieve optimal performance.

In addition, spectrum policies and telecommunications regulations are important factors in supporting the implementation of next-generation broadband. Fanfalone (2022) asserts that flexible spectrum management and supportive investment policies are needed to accelerate the deployment of wireless-based broadband. The OECD (2019) also shows that the successful implementation of modern broadband networks is influenced by the synchronization of infrastructure, investment, and telecommunications regulations.

The results of the study show that the infrastructure sharing approach can be a solution to improve the efficiency of national broadband development. Kumar and Oughton (2023) explain that telecom infrastructure sharing allows operators to reduce deployment costs and accelerate the expansion of broadband networks. This approach is especially important in rural areas and islands that have limited basic infrastructure.

In addition to regulatory factors, the readiness of the community to adopt digital services is also an important challenge. Low digital literacy can hinder the optimization of broadband benefits for rural communities. Therefore, broadband equity needs to be accompanied by a program to increase the digital capacity of the community so that digital transformation can run more effectively and inclusively.

Conclusion

This study shows that Fifth Generation Fixed Wireless Access has significant strategic potential in supporting the equitable distribution of national broadband in Indonesia through the implementation of hybrid fiber-wireless broadband architecture. The findings of the study confirm that Indonesia's geographical characteristics as an archipelagic country create great challenges to the development of Fiber to the Home nationally, especially in rural, remote, and underserved areas. High infrastructure costs, deployment complexity, low population density, and logistical limitations make it difficult for conventional fixed broadband approaches to be the only solution for equitable distribution of digital connectivity. The results show that Fifth Generation Fixed Wireless Access offers major advantages in terms of deployment flexibility, implementation speed, network scalability, and infrastructure efficiency. By leveraging existing wireless infrastructure and technology integration such as Massive Multiple-Input Multiple-Output and beamforming, broadband deployments can be done faster without the need for comprehensive last-mile fiber construction. In this context, the hybrid fiber-wireless model allows fiber optic infrastructure to continue to function as a national backbone, while wireless broadband serves as a complementary broadband solution for rural and island areas. The discussion of the research also shows that broadband equity is not only determined by technological factors, but is greatly influenced by regulatory readiness, spectrum policies, infrastructure sharing, investment incentives, and increasing people's digital literacy. This research emphasizes that national digital transformation requires integration between technological, economic, and policy governance aspects so that the benefits of broadband can be felt more inclusively through increased access to digital education, health services, digital economy, and internet-based public services.

The main contribution of this research lies in the development of an integrative analytical framework that links techno-economic evaluation, hybrid broadband architecture, and policy perspectives in the context of developing island countries. In contrast to most previous studies that focused more on network technical performance, this study places broadband equality as part of the national socio-economic transformation. Thus, this study expands the study of the role of Fifth Generation Fixed Wireless Access as a complementary broadband solution in supporting the equitable distribution of digital connectivity. However, this study still has some limitations. This literature-based research has not involved field measurements or quantitative simulations of broadband deployment in Indonesia. In addition, techno-economic analysis is still conceptual and has not been validated through empirical implementation studies in certain regions. Therefore, further research needs to be directed at the empirical evaluation of wireless broadband deployment in rural and island areas, including service quality measurement, investment modeling, policy evaluation, and socio-economic impact analysis of communities. Future research can also explore the integration of Open Radio Access Networks, artificial intelligence-based network optimization, and green broadband infrastructure to support a more sustainable national digital transformation.

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