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Socio-Economic and Physical Impact Assessment of Farm-to-Market Roads in the Province of Dinagat Islands, Philippines

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Abstract: *This study evaluated the socio-economic and physical impacts of Farm-to-Market Roads (FMRs) constructed in the Province of Dinagat Islands from 2016 to 2021. Data was gathered through geospatial mapping, field observations, and surveys from communities served by three representative FMR projects. Findings indicate that 78% of respondents experienced improvements in quality of life and income, while 33.3% reported new employment opportunities. All respondents noted cost savings from reduced transportation expenses and improved access to education and public services. Furthermore, 56% observed the rise of new local establishments, and 89% indicated that community participation and social connectivity became more accessible. However, the inclusion of marginalized groups remained unchanged. In terms of physical impact, all respondents reported a significant reduction in travel time. These results demonstrate that FMRs contribute substantially to rural development by enhancing mobility, economic activity, and social integration, underscoring the importance of continued investment in resilient and inclusive rural infrastructure.*

Keywords: Farm-to-Market Road, Dinagat Islands, Socio-Economic Impact, Physical Impact, Agricultural Sustainability, Rural Infrastructure, Geospatial Mapping, Road Accessibility

I. INTRODUCTION

Farm-to-Market Roads (FMRs) are crucial to modern agricultural infrastructure, facilitating the efficient transport of goods from farms to markets and enhancing supply chains. As outlined in the Department of Agriculture's FMR Network Plan [1], these roads are fundamental for agricultural connectivity in rural regions. In remote island provinces of the Philippines, FMRs significantly boost productivity, lower transportation costs, and improve the socio-economic conditions of farmers [2].

The Province of Dinagat Islands (PDI), situated in the Caraga Region, has an agriculture-based economy reliant on crops like cassava, coconut, and rice. However, economic development has been limited due to its geographic isolation and inadequate infrastructure [3]. In response, both national and local governments have prioritized the construction and enhancement of FMRs in the area. A recent Php 341.4 million project aims to link cassava farmers to wider markets, impacting around 3,659 households in Libjo and Basilisa [4].

Studies indicate that improved rural road infrastructure can increase agricultural productivity, market access, and farmer incomes [5], as well as improve QGIS software was used to map completed FMRs in Dinagat Islands from 2016 to 2021. This visual approach helped identify target areas affected by FMRs and select representative respondents based on proximity to socio-economic infrastructures to education, healthcare, and basic services [6]. Nevertheless, the effects of FMRs in isolated island economies like PDI warrant further investigation.

II. MATERIALS AND METHODS

2.1 Research Design

The study used a mixed methods approach, combining quantitative (descriptive surveys) and qualitative (focus group discussions) methods to assess the socio-economic

and physical impacts of FMRs in Dinagat Islands. Quantitative data provided measurable trends, while qualitative insights helped explain the underlying reasons behind these trends.

2.2 Formulation of Survey Questionnaire

Three tailored questionnaires were developed for farmers, residents, and project personnel, aligned with the study's objectives. These were translated into English and Bisaya – a local dialect to ensure clarity and understanding for Mindanao-based respondents.

2.3 Pilot Testing of Survey Questionnaire

A pilot test was conducted in Barangay Pigdaulan, Butuan City to verify the clarity and relevance of questionnaire items. Adjustments were made based on findings to improve data collection effectiveness.

2.4 Mapping out the Completed FMR Projects (2016–2021)

QGIS software was used to map completed FMRs in Dinagat Islands from 2016 to 2021. This visual approach helped identify target areas affected by FMRs and select representative respondents based on proximity to socio-economic infrastructures.

2.5 Selection of Survey Site

Survey sites were chosen using Department of Agriculture data, categorizing FMR projects by scale (small, medium, large) based on road length. One project from each category was selected to ensure diverse representation in the study.

2.6 Mapping Selected FMR Projects

Using QGIS, researchers mapped the three selected FMRs and measured their distance to essential services (markets, schools, health centers). This helped determine the level of accessibility provided by each project.

2.7 Research Respondents/Participants

Respondents were categorized into residents, farmers, public officials, and FGD (Focus Group Discussion) participants. Each group provided different perspectives on the impacts of FMRs. Over 30 individuals were engaged, meeting the criteria for descriptive research.

2.7.1 Sample and Sampling Techniques

The study used purposive and convenience sampling in specific areas of Dinagat Islands, selecting participants based on relevance (e.g., farmers along the FMR traverse). These respondents were key informants for the study's goals.

2.8 Data Gathering Methods and Procedure

Primary data were gathered through face-to-face interviews using self-constructed questionnaires. The researchers coordinated with local officials, secured informed consent, and recorded responses. Challenges included respondent availability, time constraints, and health-related delays.

2.9 Physical Impact Evaluation

Researchers assessed FMRs' physical condition through field observations, focusing on road durability, safety features, weather usability, and connectivity. These observations helped determine how road quality influenced agricultural operations.

2.9.1 Social Impact Evaluation

The study explored FMRs' effects on access to services, community engagement, and social cohesion. It evaluated improvements in education, healthcare, employment, and infrastructure brought by enhanced road access.

2.9.2 Economic Impact Evaluation

The economic evaluation focused on changes in agricultural productivity, household income, and cost efficiency before and after FMR development. It also assessed the impact on business growth and employment.

2.10 Research Instrument

Three types of questionnaires were used: one for physical assessment, another for social and economic impacts, and a third for FGDs. These tools enabled the study to gather both quantitative data and qualitative insights from diverse stakeholders.

2.11 Data Analysis

The study employed mixed data analysis using JASP software to identify trends, outliers, and variability. Data

was analyzed through statistical summaries and visualizations like tables and graphs.

2.12 Ethical Considerations

Researchers ensured ethical compliance by safeguarding anonymity, confidentiality, and voluntary participation. Respondents were informed of their rights, consent was secured, and all activities followed Data Privacy Act guidelines and APA citation standards.

III. RESULTS AND DISCUSSIONS

3.1 Geospatial Mapping of Farm-to-Market Roads Implemented in the Province Dinagat Islands (FY 2016–2021)

This section summarizes 13 FMRs from FY 2016–2021, then analyzes three case studies (small-, medium-, and large-scale) to assess service coverage, connectivity, and socio-economic impact, concluding with a comparative evaluation of how scale and location influence rural development outcomes.

3.1.1 Overview of Spatial Distribution of FMR Projects

The implementation of 13 Farm-to-Market Road (FMR) projects in the Province of Dinagat Islands from FY 2016–2021 was assessed using geospatial data from QGIS and the Department of Agriculture – Caraga Region. The study examined project distribution, scale classification, and service coverage.

Georeferencing was done by mapping project titles, locations, implementation years, and budget allocations to visualize infrastructure connectivity across municipalities and barangays. Projects were ranked by road length and budget size, and classified into:

Small-scale: <0.5 km or ≤ PHP 10 million,

Medium-scale: 0.5–0.9 km or PHP 11–20 million,

Large-scale: >0.9 km or ≥ PHP 21 million.

Based on this classification, three representative projects were selected:

Small-scale: Sta. Rita–Nueva Estrella FMR (PHP 10M),

Medium-scale: Sitio Pagtabanan–Sitio Linao FMR, Brgy. Esperanza (PHP 12.5M),

Large-scale: Sta. Cruz–Lauban–Bujon FMR (PHP 30M).

Although over one kilometer long, the Sta. Rita FMR was classified as small-scale due to its relatively low budget. This enabled a more holistic comparison of physical and financial aspects. Budget was used as the main classification criterion, aligning with literature linking it to project complexity, scope, and logistics [7], [8].

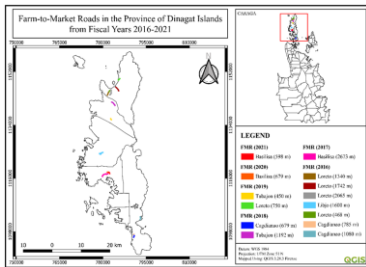


Figure 1. Map of All 13 FMR Projects in the Province of Dinagat Islands (FY 2016–2021)

Figure 1 maps all 13 FMRs, showing uneven spatial distribution with Loreto as a key investment area due to intensive agriculture [12], [13]. San Jose and Dinagat lack projects, possibly due to existing infrastructure or overlooked needs [14], [15]. FMRs cluster in northern and central PDI, especially Loreto and Cagdianao, aligning with major agricultural zones for strategic economic support [16], [17]. The 13 projects include three small-, five medium-, and five large-scale FMRs, reflecting varied investments for balanced development [18], [19]. The three representative FMRs were selected via descending DA-Caraga budget ranking, ensuring fair representation across scales and locations.

3.1.2 Sta. Rita–Nueva Estrella Farm-to-Market Road (Small Scale Project)

The Sta. Rita–Nueva Estrella Farm-to-Market Road (FMR) in Cagdianao, with a budget of PHP 10 million, represents the study’s small-scale project. Despite its modest funding, it significantly improved accessibility for upland communities by connecting Brgy. Sta. Rita to Brgy. Nueva Estrella. The FMR traverses key agricultural zones, particularly coconut and rice fields, previously isolated due to limited transport routes. As shown in spatial maps (Figures 2 and 3), the road not only links production areas to lowland settlements but also enhances household mobility, promoting both economic and social integration [20].



Figure 2. Service Area of Sta. Rita-Nueva Estrella FMR

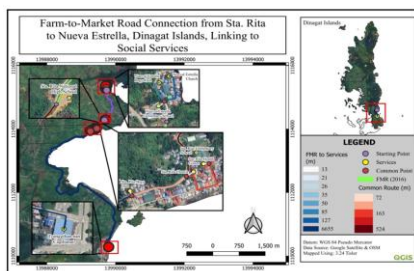


Figure 3. FMR Connection from Sta. Rita to Nueva Estrella Linking to Social Services

The FMR lies within short distances (13–127 meters) from vital services like schools, health centers, and barangay halls, facilitating access to education,

healthcare, and governance. This aligns with findings that strategic road investments reduce travel time, transport costs, and support human development [21], [22]. Though small in scale, this FMR demonstrates how cost-effective, well-placed infrastructure can yield disproportionately large benefits, especially in geographically fragmented regions [9], [23]. It highlights how rural roads serve as conduits for institutional access, disaster resilience, and livelihood support [11], [23]. The project exemplifies that even limited investments, when strategically implemented, can bridge infrastructure gaps and reinforce socio-economic resilience in rural areas [9], [22], [23].

3.1.3 Sitio Pagtabanan–Sitio Linao, Brgy. Esperanza Farm-to-Market Road (Medium Scale Project)

The Sitio Pagtabanan–Sitio Linao Farm-to-Market Road (FMR) in Barangay Esperanza, Loreto represents a medium-scale infrastructure project with a budget of PHP 12.5 million. Strategically aligned through rice field zones and leading to Sitio Linao, the road connects agriculturally active lands with residential clusters and essential barangay facilities. QGIS mapping (Figures 4 and 5) shows that the FMR’s endpoints were placed to optimize accessibility within a coastal-upland corridor, supporting both agricultural transport and daily community mobility.



Figure 4. Service Area of Sitio Pagtabanan–Sitio Linao, Brgy. Esperanza Farm-to-Market Road



Figure 5. FMR Connection from Sitio Pagtabanan–Sitio Linao, Brgy. Esperanza Linking to Social Services

The road’s green alignment traverses productive farmland and links directly to households, highlighting its role in facilitating farm-to-market logistics and local livelihood activities. Spatial overlays in Figure 18 confirm its short-distance connectivity (8–38 meters) to the Esperanza Elementary School, Barangay Hall, and health center, ensuring timely access to basic services. These connections are vital during emergencies and peak farming periods.

Overall, this FMR demonstrates how mid-range investments can address both economic and social needs, enhancing transport efficiency and institutional access. It reinforces the notion that medium-scale infrastructure supports rural development through spatial integration, consistent with the findings of Rahman et al. [24] and

Acharya [25], who assert that such projects significantly impact rural mobility and community cohesion.

3.1.4 Sta. Cruz–Lauban–Bujo Farm-to-Market Road (Large Scale Project)

The Sta. Cruz–Lauban–Bujo Farm-to-Market Road (FMR), a large-scale project in Loreto, was completed in 2016 with a PHP 30 million budget. Selected as the high-investment representative among 13 FMRs in Dinagat Islands, it demonstrates how expansive road infrastructure fosters inter-barangay connectivity, regional mobility, and access to socio-economic services. QGIS mapping (Figure 6) shows the road traverses coconut and rice production zones, consolidating fragmented farmlands and linking settlements, with endpoints strategically placed near densely cultivated areas.

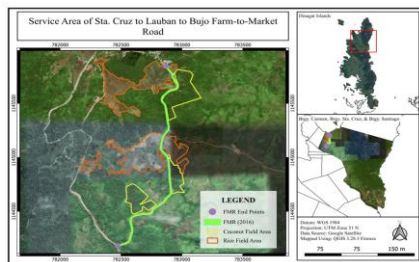


Figure 6. Service Area of Sta. Cruz to Lauban to Bujo Farm-to-Market Road

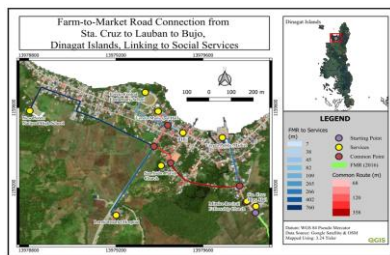


Figure 7. FMR Connection from Sta. Cruz to Lauban to Bujo Linking to Social Services

Figure 7 shows the FMR linking key institutions—Loreto Municipal Hall, District Hospital, and Public Market—with distances from 7 to 265 meters and shared routes up to 402 meters, enhancing service delivery and economic exchange.

The project demonstrates how high-budget FMRs achieve economies of scale by broadening service coverage and maximizing development returns. Research confirms that larger rural infrastructure investments improve mobility, institutional access, and welfare [26], [27], [28], supporting the view that strategic, large-scale FMRs transform regional development by boosting economic and social connectivity.

3.1.5 Synthesis of Analysis

The analysis of three representative FMRs highlights varied yet significant impacts on rural development. The large-scale Sta. Cruz–Lauban–Bujo FMR enhanced regional connectivity, while the medium-scale Brgy. Esperanza FMR demonstrated the socio-economic benefits of moderate investments [29], [30] QGIS-based overlays confirm reduced travel distances to schools, health centers, and markets (Figs. 15–20). These findings align with literature affirming that rural roads improve

market access, agricultural productivity, and social inclusion [9], [12], [27], [31]. As supported by [32], [33], [34] strategic infrastructure investments are essential for achieving sustainable development, fostering equity, poverty reduction, and overall quality of life in underserved rural communities.

a. Impacts of Farm-to-Market Roads on Agricultural Sustainability and Local Farming Communities

This section examines the impacts of FMRs on local farming communities. It highlights how these roads influence agricultural sustainability through social, economic, and physical aspects. Understanding these impacts is crucial for planning and implementing effective rural development strategies

3.2.1 Economic Impact

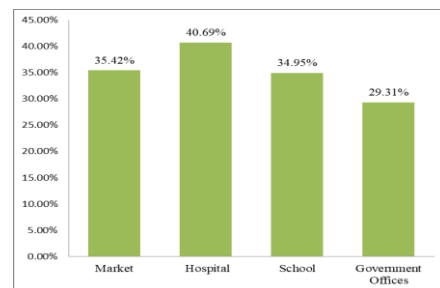


Figure 8. Percentage Decrease in Travel Time after FMR

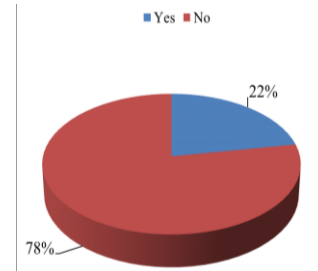


Figure 9. Perceived Household Income Increase Post-FMR

The economic impact of Farm-to-Market Roads (FMRs) in the Province of Dinagat Islands shows mixed results. While all respondents reported improved market access and reduced transportation time, as shown in Figure 8—with travel to hospitals and markets decreasing by 40.7% and 35.4%, respectively—only 22.2% experienced any increase in household income, and 77.8% reported no income change post-FMR implementation, as shown in Figure 9. These findings align with Samuel & Michael [35], who emphasize that FMRs lower transport costs but do not guarantee higher incomes without support for agricultural productivity, credit access, and climate resilience.

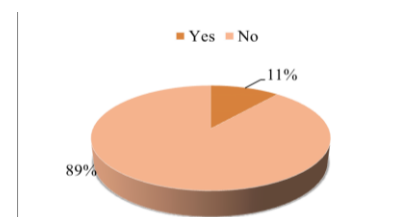


Figure 10. Improved Access to Financial Services Post-FMR

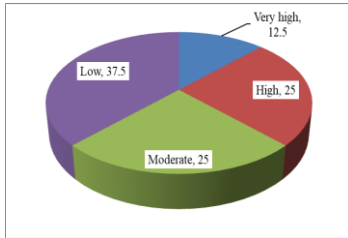


Figure 11. Production Status of Crops after the FMR

Financial inclusion remains limited, with only 11.1% reporting improved access to services and none experiencing better savings or loan access (Figure 10), supporting Eli et al. [7] and ADB [36] on the need for financial sector development alongside infrastructure. Similarly, just 12.5% noted notable farm productivity gains (Figure 11), echoing Vila and Montalbo [37] and Daphney et al. [38].

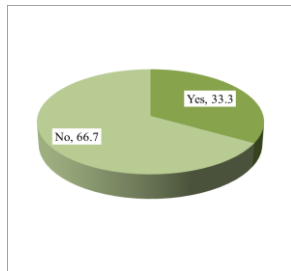


Figure 12. New Job or Business Opportunities Post-FMR

Focus Group Discussions identified climate variability and land constraints as key barriers. Farmers cited limited motivation to expand or diversify due to uncertain yields and land use restrictions. While 33.3% observed job opportunities (Figure 12), these were mainly mobility-related, not tied to sustained employment. As Patinio [39] and ILO [40] highlight, lasting job creation depends on integrating rural enterprise development—not just building roads.

Thus, while FMRs ease physical access and reduce transport burdens, their economic benefits are limited by structural challenges, underscoring the need for integrated rural development to turn mobility into sustained livelihood gains.

3.2.2 Social Impact

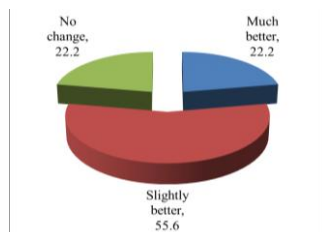


Figure 13. Overall Quality of Life Post-FMR

The social impact of Farm-to-Market Roads (FMRs) in Dinagat Islands shows significant improvements in community well-being, access to services, and social cohesion. As Figure 13 shows, 77.8% of respondents reported better quality of life due to improved access to education, healthcare, and public services, aligning with findings by Daphney et al. [38] in Zamboanga Sibugay. Moreover, 100% noted easier access to schools and medical facilities (Figure 14), consistent with the Asian

Development Bank [41] and the Farm to Market Roads for All Act emphasizing rural roads' role in enhancing education and healthcare access.

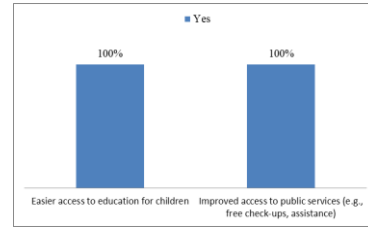


Figure 14. Improved Access to Education and Public Services

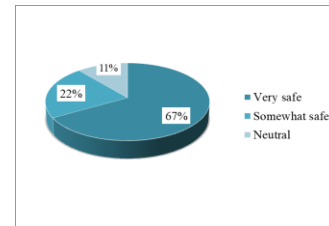


Figure 15. Safety and Security while Using the FMR

Improved safety was also a key outcome, with 66.7% feeling very safe using the roads, as shown in Figure 15, particularly during adverse weather—reflecting adherence to national FMR standards focused on reliable and safe infrastructure [42].

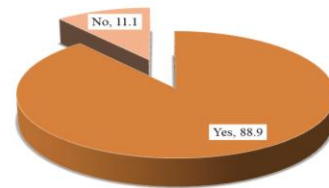


Figure 16. Community Participation

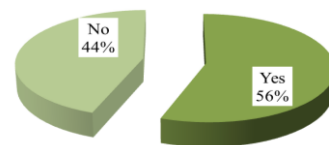


Figure 17. New Establishment after the FMR

Figures 16 and Figure 17 highlights increased community participation (88.9%) and establishment of new local enterprises (55.6%), affirming that FMRs foster social inclusion and mobility. However, 100% of respondents noted no change in the inclusion of marginalized groups, echoing Choudhary et al. [43], who argue that systemic barriers still hinder integration of disadvantaged populations in rural economies. Thus, while FMRs enhance social connectivity, inclusive development remains a challenge.

3.2.2 Physical Impact

The physical impact of Farm-to-Market Roads (FMRs) in Dinagat Islands includes reduced travel time, better accessibility, environmental management, and more reliable infrastructure, despite ongoing maintenance and design issues. Survey data (Figure 8) show average travel time to markets dropped by 35.4%, with similar gains for

hospitals, schools, and government offices—confirming FMRs boost rural mobility and service access. These results support Nakamura et al. [44] and Van de Walle and Cratty [45], who highlight rural roads' role in development by shrinking spatial divides.

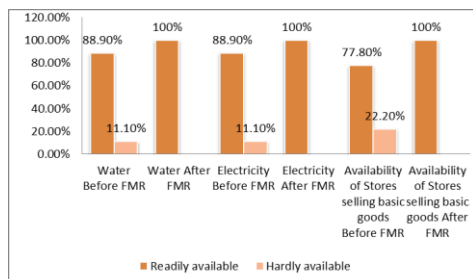


Figure 18. The perceived impact of FMR of the respondents in terms of access to basic needs.

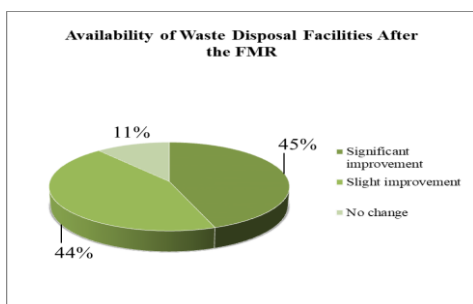


Figure 19. The perceived impact of FMR of the respondents in terms of access to basic needs.

Environmental and service access improvements were noted, with Figures 18 and 19 showing increased water, electricity, and waste facilities post-FMR. As Knox et al. [46] and DAWN.COM [47] highlight, road infrastructure facilitates utility delivery and rural commerce. Loreto LEED adds that FMRs promote environmental stability through organized waste collection and erosion reduction.

However, field assessments reveal widespread road deterioration, missing drainage, and absent safety features across the three FMRs. Only Sta. Cruz–Lauban–Bujo FMR had partial drainage; others lacked key protective infrastructure, risking sustainability. These findings align with World Bank (2023) and PABES 289:2019, which stress integrating drainage, erosion control, and safety in rural road design [42].

The synthesis reveals that while FMRs effectively enhance connectivity and catalyze economic activity, their long-term impact depends on robust design, regular maintenance, and environmental safeguards. Without these, physical deterioration could reverse the mobility gains achieved, especially in upland and weather-vulnerable areas.

IV. Policy Implications and Recommendations

Policy recommendations to improve Farm-to-Market Roads (FMRs) in Dinagat Islands focus on sustainability, safety, agricultural integration, social inclusion, and climate resilience, aligned with Philippine policies.

1. **Maintenance & Sustainability:** Early wear and erosion call for periodic upkeep per DILG Memorandum Circular No. 2020-06-19. Basic drainage and community-based maintenance extend

road life cost-effectively.

2. **Safety & Utility:** Gradual addition of safety features like signs and reflectors is advised (PABES 289:2019). Selective wider roads should prioritize high-traffic areas (DPWH DO No. 11 s.2014).
3. **Agricultural & Economic Integration:** FMRs should link with programs under RA 8435 and RA 10601 (seed distribution, mechanization), expand financial access via cooperatives (RA 9520), and promote livelihood diversification (DOLE's National Livelihood Development Program).
4. **Social Inclusion & Services:** Access must reach marginalized groups through DSWD coordination and align with RA 8371, RA 7160, the 1987 Constitution, and Local Government Code to ensure participatory planning.
5. **Environmental & Climate Resilience:** Incorporate slope stabilization, vegetative buffers, and zoning per PABES 289:2019, DPWH guidelines, and the National Physical Framework Plan. Designs must consider typhoon vulnerability per DPWH DO No. 11 s.2014 and DA's FMRNP 2023–2027.

These recommendations align legal mandates with local conditions, ensuring FMRs deliver sustained benefits across economic, social, and environmental dimensions.

4.0 Conclusion

This study assessed the physical and socio-economic impacts of Farm-to-Market Roads (FMRs) in Dinagat Islands (FY 2016–2021) through geospatial mapping, field assessments, and descriptive analysis. Results showed uneven FMR distribution, concentrated in Loreto and Cagdianao, indicating strategic yet imbalanced planning. Three selected FMRs demonstrated how both small- and large-scale projects enhanced connectivity, service access, and development.

Economically, FMRs lowered transport costs and travel time, but income gains were modest due to low productivity, an aging farmer population, and limited capital. Socially, access to education, healthcare, and services improved, though some marginalized sectors remained underserved. Physically, roads improved mobility but faced maintenance challenges like poor drainage and missing safety features.

The study concludes that while FMRs boost rural connectivity, maximizing their benefits requires support in agriculture, finance, and environmental sectors. Sustainable outcomes demand institutional monitoring, inclusive planning, and cross-sector collaboration. FMRs serve as vital enablers of rural resilience, beyond mere infrastructure.

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