PHYSICAL AND SOCIO-ECONOMIC IMPACT OF FARM-TO-MARKET ROADS (FMR) IN SURIGAO DEL SUR, PHILIPPINES

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PHYSICAL AND SOCIO-ECONOMIC IMPACT OF FARM-TO-MARKET ROADS (FMR) IN SURIGAO DEL SUR, PHILIPPINES

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Abstract: *This study assessed the physical and socio-economic effects of three (3) Farm-to-Market Roads (FMRs) built from 2016 to 2021 in the municipalities of Cagwait, Cortes, and Tandag in Surigao del Sur. Utilizing the quantitative and qualitative approaches, through surveys, focused group discussions, and in situ observations. Results demonstrated that FMR has resulted in enhanced rural accessibility, reduced travel time, and increased household income, with around 74.7% of participants indicating modest income increases of less than PHP 1,000 monthly. Physically, road conditions exhibited considerable variation among municipalities after 5 to 10 years of use. The FMR in three municipalities has exhibited considerable deterioration, with the surface affected by cracks, potholes, insufficient drainage systems, and sediment buildup, indicating the need for preventive maintenance and infrastructure improvements.*

Keywords: Farm-to-market roads; roadside infrastructure; Socio-economic.

1. INTRODUCTION

Infrastructure, particularly rural roads, is crucial for agricultural development and poverty alleviation. In the Philippines, Farm-to-Market Roads (FMRs) connect remote agricultural communities to economic hubs, facilitating the effective transport of goods, services, and people [1].

Agricultural roads link production areas to national highways and other routes, including feeder roads. FMRs facilitate the transportation of agricultural inputs and products to markets. [2]. Efficient road connectivity in rural regions facilitates market access, enabling rural inhabitants to forge connections with various economic partners [3]. Moreover, farm roads exert significant social effects by facilitating access to services, including healthcare, education, agricultural extension, and information. Despite these advantages, the construction of farm roads may also lead to detrimental environmental consequences, such as heightened land conversion driven by immigration and intensified resource extraction to satisfy urban needs [4].

The economic drivers of Surigao del Sur encompass agriculture, which includes crops, livestock, and fisheries. Despite support from governmental and private sectors, significant challenges, including infrastructure deficiencies, continue to hinder the cultivation of high-value crops, the expansion of aquaculture, and the advancement of integrated farming systems[1]. Surigao del Sur exhibits considerable agricultural potential, characterized by rising commercialization and sustainable development efforts; thus, strong infrastructure, particularly farm-to-market roads, is essential.

Between 2016 and 2021, several farm-to-market roads (FMRs) were constructed through the programs instituted by the Department of Public Works and Highways (DPWH) and the Department of Agriculture (DA). Nonetheless, despite significant investments, the tangible impacts remain insufficiently assessed, especially concerning physical sustainability and socio-economic outcomes. This study investigates the deficiencies in Surigao del Sur to evaluate the current state of farm-to-market roads, assess their socio-economic impacts on local agricultural communities, and analyze their physical consequences for agricultural sustainability. Moreover, it seeks to identify the challenges to the maintenance and improvement of these roads. The study aims to provide insights and recommendations to enhance the effectiveness of farm-to-market roads in promoting sustainable rural development by tackling these issues.

2. METHODOLOGY

2.1 Study Area

This study was focused on Surigao del Sur, Caraga, Philippines, with completed farm-to-market road (FMR) projects based on the data acquired from the Department of Agriculture - Caraga Region from 2016 to 2021, specifically, FMR projects within <0.5 km to ≥0.9 km road length. Figure 1 shows the three FMR projects identified as small-scale (<0.5 km), medium-scale (≥0.5 km - <0.9 km), and large-scale (≥0.9 km) that were in Brgy. San Isidro, Tandag City, Brgy. Poblacion,Cortes, and Brgy.Aras-asan, Cagwait, Surigao del Sur, respectively.

2.2 Research Methodology

Physical and socio-economic assessment in Surigao del Sur comprises a series of activities undertaken, as shown in Figure 2. The research commenced by identifying an appropriate design that integrated the quantitative and qualitative approaches and utilized household surveys, focus group discussions (FGDs), and in-situ physical impact assessments. Additionally, QGIS mapping techniques were employed to ascertain the exact

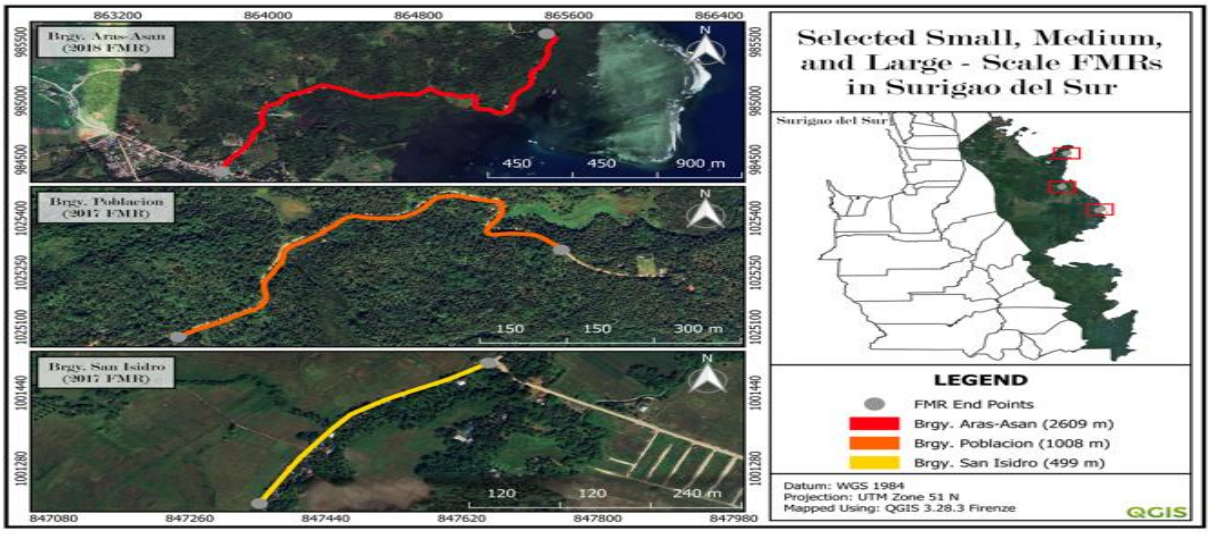

Figure 1. Research area identified as small, medium, and large-scale based projects

locations and classifications of the FMRs, categorized as small, medium, and large-scale projects. The collected data were examined, analyzed, and recommendations were developed for current and ongoing FMR projects to inform decision-making and policy formulation, ensuring the efficient use and sustainable upkeep of FMRs.

2.2 Data Collection

2.2.1 Development of Survey Questionnaire

The design and creation of a questionnaire are essential for collecting precise and pertinent data, which underpins effective analysis and significant conclusions; therefore, the survey questionnaires utilized in this study were constructed to meet its objectives. Three (3) questionnaires were developed to encompass a household survey, a focus group discussion (FGD), and a physical assessment survey. The questions were meticulously designed to elicit information from diverse respondents, including farmers, residents, and project-affiliated personnel. The respondents of this research are exclusively from the provinces located in Mindanao; therefore, the questionnaires were translated into two languages: English and Visayan, to guarantee clarity and comprehension.

Prior to deployment, a pilot test was executed in a similar rural environment to identify and rectify potential issues, including ambiguous phrasing, improper question sequencing, or technical deficiencies. The administered questionnaires were refined and enhanced according to the feedback obtained during the pilot test.

2.2.2 Household Survey

The household survey questionnaire was employed to evaluate the perceived social and economic impacts of the Farm-to-Market Road (FMR) project on the local community. It included factors such as income, service accessibility, transportation costs, agricultural productivity, market participation, quality of life, demographics, mobility patterns, and development perceptions. Pre-testing, however, revealed several issues that were subsequently addressed, particularly concerning unfamiliar terminology and discomfort in responding to sensitive financial inquiries.

2.2.3 Focus Group Discussion (FGD)

The Focus Group Discussion (FGD) aimed to investigate community experiences and perceptions concerning the Farm-to-Market Road (FMR) project in greater detail. This qualitative methodology facilitated the acquisition of comprehensive insights regarding information such as agricultural practices, community engagement, road conditions, and deficiencies in infrastructure or services in the area.

2.2.4 Physical Assessment Survey Questionnaire

The Physical Assessment survey was created as a perception-based instrument in accordance with established road condition protocols. It assessed the physical condition of the Farm-to-Market Road, encompassing surface roughness, structural integrity, and environmental characteristics, while documenting field observations regarding usability and sustainability.

2.2.5 Research Respondents/Participants

The research classified participants into four categories according to their roles concerning the FMR projects. Residents in proximity to the designated FMRs were surveyed to evaluate social and physical effects, corroborated by researchers' observations. Farmers supplied information regarding economic effects, encompassing transportation efficiency and market accessibility.

interviews were conducted with public officials involved in agricultural development to evaluate the contributions of FMRs to economic and rural progress. Focus Group Discussions (FGDs) were held with at least seven to ten participants from farmers' associations, barangay officials, and other agriculture-related sectors to gather qualitative insights.

Informed consent was obtained in conjunction with local government agencies, while municipal agriculturalists aided in the identification and engagement of participants. Interviews were conducted with prior consent, utilizing audio recordings and written notes for accuracy. Participants were deliberately and conveniently selected based on their profession and proximity to the FMRs established in Surigao del Sur from 2016 to 2021. The study faced limitations such as respondent availability, time constraints, and health issues.

2.3 Data Analysis

Information gathered from face-to-face interviews and in situ observations was analyzed to evaluate the physical and socio-economic impacts of farm-to-market roads

(FMRs) on agricultural sustainability and local farming activities in certain barangays in Surigao del Sur.
The study employed a mixed-methods research design, integrating quantitative and qualitative analysis approaches to provide a comprehensive evaluation. Visual data representations, such as tables and figures, were developed to support the findings. Quantitative data were examined through descriptive statistics, whereas qualitative insights enhanced the contextual comprehension of the impacts.

2.4 Ethical Considerations

The researchers strictly adhered to a set of ethical guidelines to ensure the proper conduct, management, and integrity of the study. These measures were implemented to safeguard the well-being of participants and ensure that they would not be harmed throughout their involvement in the research process.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Impact of Farm-to-Market Roads

3.1.1 Business impact on local enterprises after FMR construction

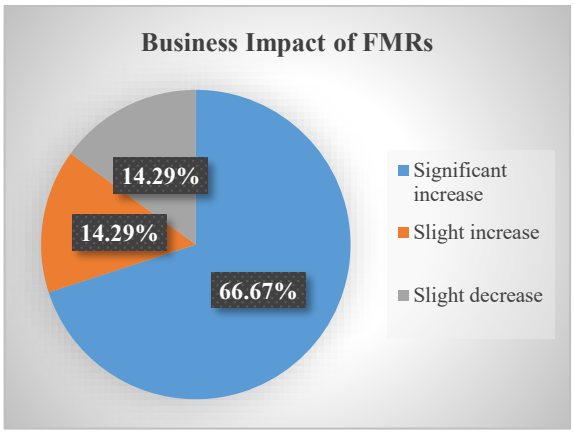

Figure 2. Economic Impact on Local Enterprises After FMR Construction

From a business performance perspective, Figure 2 illustrates that 66.67% of respondents reported increased business activity following the completion of the FMR, indicating the positive impact of road infrastructure on rural economic growth, with 14.29% experiencing a slight increase, confirming the FMR's contribution to improved income, productivity, and trade in rural areas [6]. Nevertheless, the 14.29% of respondents indicating a decrease in business activity may signify localized difficulties, including inadequate road conditions in remote barangays, susceptibility to natural disasters, and restricted access to the capital. These disparate outcomes underscore the inequitable nature of rural development and the necessity for targeted interventions to facilitate inclusive growth. On the other note, all respondents (100%) acknowledge the emergence of new business opportunities with the construction of FMRs.

3.1.2 Social Access through Farm-to-Market Roads

Restricted transportation access or the elimination of public transit options diminished social connections and decreased the availability of social support. Conversely, dependable, cost-effective, and efficient transportation systems yielded beneficial social outcomes. Accessibility was influenced not only by the availability or proximity of transit services but also by factors including cost, information access, safety, and crime rates. When these elements were insufficient, individuals experienced transport disadvantages, which contributed to social exclusion by limiting access to essential services, opportunities, and community engagement. This dynamic exacerbated pre-existing socio-economic disparities [8]. In addition to exclusion, access to transportation was linked to the development of social capital. Shared public transportation experiences, including direct interactions during transit, reinforced social connections, whereas dependence on private vehicles and solitary travel generally diminished them [9]. Table 1 shows the perceived transportation impact of FMR to the respondent.

Table 1. Perceived transportation impact of FMR of the respondents

Variable	Category	Cagwait (n=9)		Cortes (n=9)		Tandag (n=9)	
		F	%	F	%	F	%
Improved Accessibility due to FMR establishment	Market	9	100	9	100	9	100
	Hospital	9	100	9	100	9	100
	School	9	100	9	100	9	100
	Opportunity work	9	100	9	100	9	100
	Social Services	9	100	9	100	9	100
Ease of travel after the FMR	Significant improvement	9	100	9	100	9	100
	Slight improvement	0	-	0	-	0	-
	No change	0	-	0	-	0	-
	Worsened	0	-	0	-	0	-
Time of travel before FMR in minutes (Mean ± SD)	Market	21.4 ± 10.3		66.7 ± 20.0		37.2 ± 14.8	
	Hospital	24.4 ± 5.8		66.8 ± 19.8		21.7 ± 5.0	
	School	16.7 ± 8.7		53.3 ± 20.0		33.9 ± 15.8	
	Government Offices	22.2 ± 9.7		53.3 ± 20.1		21.7 ± 5.0	
Time of travel after FMR in minutes (Mean ± SD)	Market	11.1 ± 5.5		27.8 ± 4.4		23.3 ± 7.1	
	Hospital	10.1 ± 5.4		27.8 ± 4.5		12.2 ± 3.6	
	School	10.2 ± 4.1		23.3 ± 6.6		16.7 ± 8.7	
	Government Offices	13.0 ± 6.6		23.3 ± 8.3		12.2 ± 3.6	
Acces to Public transportation	Significant improvement	9	100	9	100	9	100
	Slight improvement	0	-	0	-	0	-
	No change	0	-	0	-	0	-
	Worsened	0	-	0	-	0	-

After the Farm-to-Market Road (FMR) was built in every study area, every respondent indicated that their access to social services, hospitals, schools, and employment possibilities improved. Travel convenience improved generally as well. In Cagwait, the average travel time to the market dropped by 48.1%, from 21.4 minutes prior to the building of the farm-to-market road. Traveling to the government offices, school, and hospital required 58.6%, 38.9%, and 41.4% less time, respectively. Through the focused group discussion (FGD), transportation in Cagwait transitioned from carabao over challenging terrain to vehicles such as tricycles and four-wheel drives, thereby enhancing delivery speed and product quality.
FMR significantly reduced the average travel time to notable Cortes by more than fifty percent. Before the FMR, visiting these sites took an average of fifty-three to sixty-seven minutes. Prior to the implementation of the FMR, travel durations in Tandag varied from 21.7 minutes to 37.2 minutes; however, these durations decreased by 37 to 51 percent following the road's construction. Moreover, all participants indicated that upon the completion of road construction, public transportation became significantly more accessible. This improved accessibility led to significant social impacts, such as better access to essential services, increased livelihood opportunities, and greater population mobility. Access to education, healthcare, and government services became more efficient, fostering social inclusion and contributing to community development.
The perceived social impact of the Farm-to-Market Road (FMR), Table 2, yielded significantly positive outcomes for the municipalities of Cagwait, Cortes, and Tandag

collectively. After the construction of FMR, 89% of participants reported a significant enhancement in their overall quality of life; 7% indicated a slight improvement, while merely 4% stated there had been no change whatsoever. No one asserted any exacerbation. Concerning community social interaction, 89% exhibited a significant positive change; 11% reported a slight improvement; once again, there were no documented instances of negative change.

Table 2. Perceived social impact of FMRs from the respondents.

Variable	Category	Cagwait (n=9)		Cortes (n=9)		Tandag (n=9)	
		F	%	F	%	F	%
Overall Quality of Life After the FMR	Significantly improved	6	66.7	9	100	9	100
	Slightly improved	2	22.2	0	-	0	-
	No change	1	11.1	0	-	0	-
	Worsened	0	-	0	-	0	-
Changes in social interaction within the community	Significant positive change	7	77.8	8	88.9	9	100
	Slight positive change	2	22.2	1	11.1	0	-
	No change	0	-	0	-	0	-
	Worsened	0	-	0	-	0	-
Changes in population or movement of people	Increased	7	77.8	9	100	9	100
	Decreased	0	-	0	-	0	-
	No change	2	22.2	0	-	0	-
Easier access to education for children	Yes	9	100	9	100	9	100
	No	0	-	0	-	0	-
	Not applicable	0	-	0	-	0	-
Improved access to public services (e.g., free check-ups, assistance)	Yes	9	100	9	100	9	100
	No	0	-	0	-	0	-
	Not applicable	0	-	0	-	0	-
Safety and security while using the FMR	Very safe	8	88.9	9	100	9	100
	Somewhat safe	1	11.1	0	-	0	-
	Unsafe	0	-	0	-	0	-
Opportunities for education and livelihood training	Greatly increased	6	66.7	2	22.2	9	100
	Slightly increased	2	22.2	1	11.1	0	-
	No change	1	11.1	6	66.7	0	-
	Decreased	0	-	0	-	0	-

Ninety-three percent of respondents indicated that they observed an increase in population movement, likely attributable to enhanced access and mobility. All respondents indicated that access to education for children has been enhanced, thereby highlighting the FMR's role in eliminating barriers to learning. All respondents, constituting 100%, indicated that they experienced enhanced access to public services, including complimentary health inspections and government assistance programs.

Regarding security and safety in relation to FMR, 96% of participants expressed feeling very safe, whereas 4% reported feeling somewhat safe. No one explicitly indicated a sense of insecurity. Regarding opportunities for vocational training and education, 63% of respondents observed a substantial increase, 11% noted a slight increase, and 26% reported no change. Not once more was a decline noted.

Figure 3 shows the Farm-to-Market Road (FMR) in Sitio Sabang, Poblacion, Cortes, Surigao del Sur, and its links to several social access. The existing FMR showed improvements that led to an overall enhancement in quality of life, as reflected in Table 2.

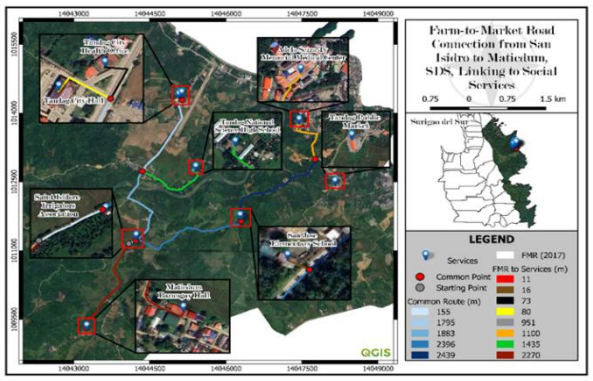

Figure 3. Farm-to-Market Road Access to Social Services (San Isidro to Maticdum, Tandag City).

Nonetheless, regarding livelihood opportunities, respondents indicated no substantial changes. This may be attributed to the prevailing livelihood reliance on traditional farming as the primary source of income.

Access to services, Figure 4, in Cortes, has improved, demonstrated by a reduction in travel time to social services, from 21.4 ± 10.3 minutes before the FMR to 11.1 ± 5.5 minutes after. It was noted that the road only extended to the area near the Poblacion center, while the middle section remained unpaved, causing transportation delays. This finding indicates that incomplete or poorly planned road infrastructure can significantly contribute to such delays and inefficiencies [10] .

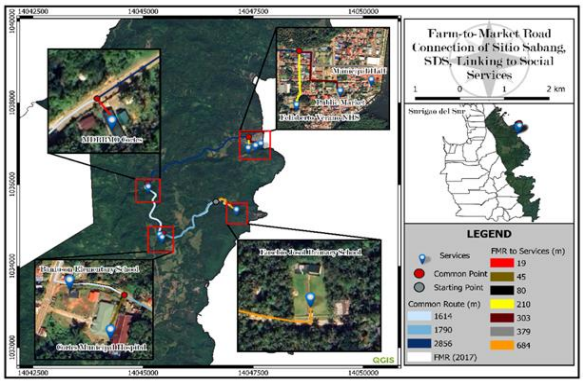

Figure 4. Farm-to-Market Road Access to Social Services (Sitio Sabang, Poblacion, Cortes, Surigao del Sur).

Social services in Aras-asan, Cagwait, Surigao del Sur were accessible prior to the construction of the farm-to-market road (FMR). By reducing travel time, the FMR, Figure 5, significantly enhanced access to these services. Prior to the FMR, the average commute from residences to the market was 24.4 minutes. Participants reported a 48.1% reduction in travel time after its establishment. Prior to the FMR, the mean travel durations from residences to the hospital, school, and government offices were 24.4, 16.7, and 22.2 minutes, respectively.

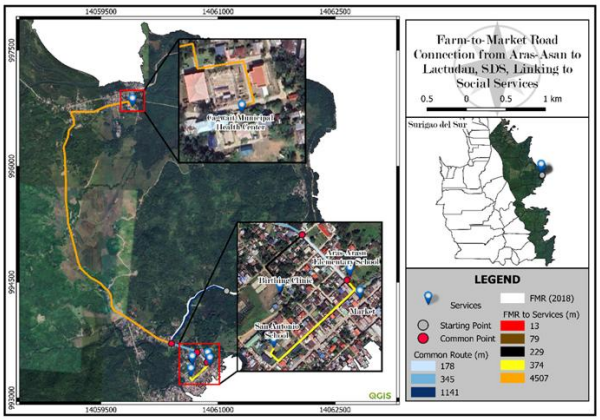

Figure 5. Farm-to-Market Road Access to Social Services (Aras-asan to Lactudan, Cagwait, Surigao del Sur).

3.1.3 Agricultural Impact of Farm-to-Market Roads

In Surigao del Sur, merely 7% of farms spanned 4 hectares or more, with the majority being small; 50% ranged from 1 to 3 hectares, and 43% were under 1 hectare. Primarily, coconut was cultivated on the land, followed by rice and corn, as presented in Table 3.

Figure 5 presents that none reported exceptionally high production; 71.4% of farmers indicated low production,

14% very low, 7.1% moderate, and 7.1% low prior to the FMR. Following the introduction of the FMR, low and extremely low production rates decreased to 21% and 7%, respectively, while 64% of farmers reported high production levels. At 7%, moderate production remained unchanged; no farmers reported exceptionally high output. Enhanced access to markets, transportation, and inputs—each contributing to heightened productivity—characterized these transformations.

Table 3. Agricultural Output and Land Size of Surigao del Sur

Agricultural information	Values
Farm Size	< 1 ha (43%) 1-3 ha (50%) >4 ha (7%)
Frequency of Selling Product	Occasionally (7%) Trimester (80%) Quarterly (13%)
Type of Crop	Corn (24%) Rice (35%) Coconut (41%)

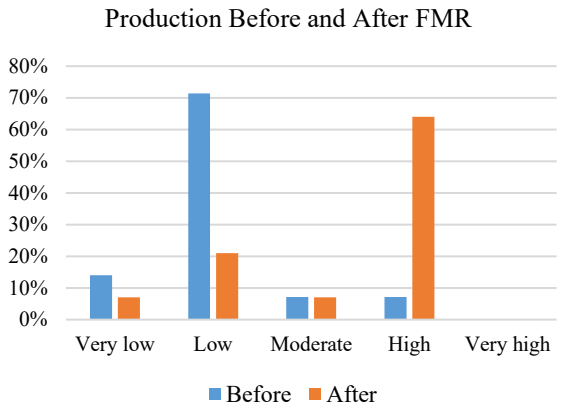

Figure 6. Perceived production before and after the FMR construction

3.1.4 Economic Impact

The data indicates that the Farm-to-Market Road (FMR) project enhanced market accessibility and increased household income, thereby benefiting the towns surveyed. A unanimous consensus among the residents of Tandag revealed that a substantial majority (88.9%) of respondents indicated that the FMR had augmented their household income. Individuals from Cagwait and Cortes did not experience increases in income. While 44.44%, all from Tandag, reported between PHP 1,000 and 5,000, most beneficiaries, 88.89 % and 77.78% from Cagwait and Cortes, respectively, reported extra monthly income of less than PHP 1,000. Eleven percent of respondents reported no change, indicating that income increases were predominantly modest; none of the respondents reported gains exceeding PHP 5,000.

Regarding business opportunities and employment, 41% of respondents indicated that the FMR facilitated such prospects, with Tandag (66.7%), Cortes (44.4%), and Cagwait (11.1%) following in order of impact. Enhanced market access was the most frequently cited benefit, as every respondent from the three municipalities indicated an improved ability to sell their products. The results validated the notion that FMRs are crucial for enhancing local economies through improved connectivity; however, disparities in benefits suggested the potential for increased inequality, as noted by [12].

Table 4. Perceived Economic Impact with FMR

Variable	Category	Cagwait	Cortes	Tanda
FMR helped increase household income	Yes	88.89%	77.78%	100%
	No	11.11%	22.22%	0.00%
Estimated Additional Income per Month	< 1,000	88.89%	77.78%	55.56%
	1,000–5,000			44.44%
	> 5,000			0.00%
	No Change	11.11%	22.22%	0.00%
New Job or Business Opportunity	Yes	11.11%	44.44%	66.67%
	No	88.89%	55.56%	33.33%

3.2 Physical Impact

3.2.1 Physical Condition of the FMR

The physical condition of the Farm-to-Market Roads (FMRs) in Cagwait, Cortes, and Tandag was influenced by usage levels, maintenance practices, and environmental stressors. Minimal damage (0–20%) suggests recent construction or low traffic in Cagwait; initial signs of edge and longitudinal cracking, coupled with obstructed drainage, underscore the necessity for preventative maintenance. Despite minimal erosion and only moderately adequate drainage (41%–60%), vulnerable areas require attention. Increased traffic and environmental exposure resulted in a slight decline in Cortes (21%–40%). Erosion and insufficient drainage coverage pose enduring risks, even with relatively effective drainage systems. The FMR of Tandag indicated significant deterioration (61%–80%), characterized by cracks, potholes, insufficient joint sealing, minimal maintenance, and ineffective drainage systems. Despite minimal erosion, significant water accumulation (21%–40%) highlighted the necessity for prompt intervention.

Figure 7. Sample photos of physical damage in the surveyed FMR

Through the focused group discussion (FGD), it was reported that FMR in Cagwait, constructed adjacent to an unpaved road, has minimized environmental disruption and mitigated flooding since its inception. As the road avoided flood-prone regions, Sitio Sabang reported no environmental alterations or damage. A typhoon induced minor flooding in San Isidro, underscoring the necessity for enhanced drainage and resilience planning. Access to markets has notably improved.

3.3 Policy Recommendation

With the conduct of this study, the author suggests that regular monitoring and maintenance be strictly observed

by local government units (LGUs) in collaboration with the Department of Public Works and Highways (DPWH) and the Department of Agriculture (DA) to keep Farm-to-Market Roads (FMRs) in excellent condition. To slow infrastructure deterioration, especially in high-traffic areas like Tandag, there should be an established standardized maintenance. To maintain road accessibility and quality, the FMR project budget must fund long-term maintenance and drainage system management. Inclusive planning and prioritization must also consider community feedback and socioeconomic data to target underserved and high-demand areas. FMR development should include climate-resilient design elements like flood and erosion control, especially in coastal barangays and ecologically sensitive areas. These initiatives need robust monitoring and assessment systems. This requires geospatial tools and local participation in participatory monitoring to assess road performance and ensure application responsibility[16,17].

4. CONCLUSION

The development and pilot testing of the survey questionnaires were essential and effective in evaluating the physical and socio-economic conditions of the study area. Despite restricted access to fundamental social services, the Farm-to-Market Road (FMR) mitigated urbanization as communities developed. FGDs indicated that FMRs enhanced agricultural transportation, thereby augmenting output and income. Farm profitability is impeded by declining farmgate prices and inflation. The FMRs in Tandag facilitated agriculture, Cagwait enhanced tourism via resort affiliations, and coastal Cortes advanced fish trade and transportation. The FMR of Cagwait was properly maintained, with minor drainage problems and cracks rectified. Cortes exhibited fissures, speed bumps, and erosion attributable to adjacent residences. The road in Tandag was susceptible to flooding and fissures, necessitating safety signage and waiting shelters. The enhancements to the city's FMR, vegetation, and central concrete culvert have ameliorated drainage and accessibility in Tandag. Load and environmental factors resulted in minor damage to the roads, which were typically in good condition.

5. REFERENCES

[1] P. Pinstrup-Andersen, Rural Infrastructure and Agricultural Development, (2006).

[2] K. Andraw and T. Reeder, How do highway influnce snake movement? Behavioral response to roads and vechicles., (2005).

[3] A. N. Bansal and B. R. Patil, Socio Economic Impact of Roads on Village Developments., (1979).

[4] P. P. Chapagai and U. Tashi, Social Benefits And Environmental Impacts Of Phobjikha Farm Roads In Wangduephodrang Dzongkhag, (2016).

[5] D. S. &. M. F. Callanta, The socioeconomic implications of farm-to-market road infrastructure on rural development in Zamboanga Sibugay Province, Philippines: An analysis of policy and community outcomes., DA - PRDP, (2024).

[6] D. A., The Sampling Issues in Quantitative Research. Educational Sciences: Theory & Practice, (2010).

[7] W. Bank, Rural Roads and Market Access: A Development Perspective., (2019).

[8] D. o. Agriculture, Department of Agriculture Special Order No. 530, Series of 2018, (2018).

[9] S. S. R. Boniface, S. J. Watkins and J. S. Mindell, Health implications of transport: Evidence of effects of transport on social interactions., (2015).

[10] G. Currie and J. Stanley, Investigating Links between Social Capital and Public Transport., (2008).

[11] L. Rivera, H. J. Baguec and C. & Yeom, A study on causes of delay in road construction projects across 25 developing countries., (2020).

[12] A. Iimi, E. R. Lancelot, I. Manelici and S. & Ogita, Social and economic impacts of rural road improvements in the state of Tocantins, Brazil, World Bank, (2015).

[13] M. J. T. E. G. Teves, Assessing a Japanese-Funded Farm-to-Market Road Project in Agdangan, Quezon: Exacerbating Divides and Deepening Inequalities., (2025).

[14] S. Engel, M. B. Regmi and P. & O'Neill, Achieving poverty eradication through improved, inclusive and equitable transport systems, (2017).

[15] I. Mohseni, A. R. Khalim and E. Nikbakht, Effectiveness of skewness on dynamic impact factor of concrete multicell Box-Girder bridges subjected to truck loads., (2014).

[16] Dalman AM, Jimena DML, Soliman CM, Bocobo AE. Impact Assessment of the Government-installed Solar-Powered Irrigation Systems in Agusan del Sur. Int Exch Innov Conf Eng Sci 2024;10:672–9. https://doi.org/10.5109/7323334.

[17] Bocobo AE, Salte CMM, Tagaro MB. Modeling Carbon Storage and Sequestration in Taguibo Watershed, Butuan City, Philippines using GIS and InVEST Technology. Int Exch Innov Conf Eng Sci 2024;10:399–405. https://doi.org/10.5109/7323292.