



## **Impact of Road Infrastructure to Market Access and Income Generating Opportunities of Rural Area in Mahottari District of Nepal**

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### **Abstract**

**Background:** Road infrastructure is the backbone of rural as well as urban transport systems. The road infrastructure plays a critical impact in the rural areas for market access and improving their livelihoods. In Mahottari district of Nepal, more rural road infrastructure is upgraded from different agency between 2016 and 2024.

**Objective:** The objective of this study is to examine the impact of road infrastructure in market access and income-generating opportunities for rural households in Mahottari District.

**Methodology:** The overall strategy is pragmatic combining deductive (QUAN) and inductive (QUAL). The study follows a mixed method approach to understand the impact of road infrastructure in rural livelihoods. Questionnaire survey of two hundred forty households for three rural municipalities is for quantitative data collection. FGD with users as well as KIIs with rural municipality's president are the qualitative data collection.

**Findings:** Improvements in the road infrastructure have facilitated market access by decreasing travel duration and transportation expenses. The households have reported receiving better prices for their goods and have gained improved access to inputs and services, resulting in increased incomes. The research indicated that rural roads allowed households to transition



from exclusively subsistence farming to a variety of income-generating type activities, including small enterprises, wage employment, and transport services.

**Conclusion:** Road infrastructure has improved access to both local and regional markets, allowing the farmers and entrepreneurs to enhance their incomes by lowering transaction costs and time. The research findings regarding the impact of road infrastructure on the livelihoods of rural people in the Mahottari district clearly indicate that the development of rural roads has positively influenced livelihood better in rural area. The households have reported an increase in occupational diversity, which includes participation in non-farm employment, small-scale trade as well as transport services.

**Keywords:** Road Infrastructure, market access, income

## **Introduction**

Road Infrastructure is a basic enabler for development (Singh, 2009). Road infrastructure is the backbone of rural as well as urban transport systems. Well managed road infrastructure reduces travel time and transport costs, improves access to markets and creates economic opportunities by connecting producers, consumers and workers (Pandey & Pathak, 2025). In Nepal where a large of the population depends on agriculture and rural livelihoods. Investments in road infrastructure are widely assumed to be a key pathway to poverty reduction as well as structural transformation.

The people of the rural communities in Mahottari District, Nepal face problems such as limited access to the markets, inadequate access to education and healthcare center, difficulties in business, limited job opportunity and low socioeconomic development. Government as well as development agencies have planned to improve road infrastructure (Government of Nepal, Department of Roads, 2007). Road infrastructure of some rural area has improved and other under construction. Many rural areas still experience poor connectivity, seasonal inaccessibility and limited transportation facility. This problem hinders the households and farmers from improvements in livelihoods.

Despite road infrastructure construction projects have been started in various rural parts of the district, there is limited knowledge of research on whether the improvements have translated into sustained changes in rural livelihoods of rural areas of the district (Manandhar & Singh, 2019). There is a lack of understanding about how the road infrastructure influences income generating opportunities, access to the market (Government of Nepal, Ministry of Industries, 2017). This will be supportive in planning of road infrastructure investments. The objective of this study is to examine the impact of road infrastructure in market access and income-generating opportunities for rural households in Mahottari District.

In Mahottari district of Nepal, more rural road infrastructure is upgraded from different agency such as government and donor supported type program between 2016 and 2024. Rural municipalities Sonama, Samsi and Pipara are distant from the district administration office than Ekadara rural municipality and Mahottari rural municipality. Sonama, Samsi and Pipara rural municipalities are less developed than Ekadara and Mahottari rural municipalities. The study includes Sonama, Samsi and Pipara rural municipalities where more number of road

infrastructure are upgraded than other rural municipality and connected to the main road or highway during 2016 to 2024. In Pipara rural municipality, the roads of the villages upgraded to concrete road which connects to the Dhirapur-Pipara road. And Dirapur-Pipara road upgraded to the blacktopped standard which connects Matihani municipality and Janakpur-Jaleshwor road. Janakpur-Jaleshwor road connects to Janakpur and Jaleshwor city. In Samsi rural municipality, the roads of the villages upgraded concrete road which connects to the samsi road. And samsi road connects to the Mahindra highway. Jaleshwor road connects samsi rural municipality to the Bardibas-Jaleshwor highway. In Sonama rural municipality, the roads of the villages upgraded concrete road which connects samsi rural municipality and samsi road. The study area location is shown in Figure 1

**Figure 1**

*Location Map*



*Source:* Google Map of Mahottari District, Nepal

In Mahottari district of Nepal, agriculture is the main source of income of the farmers for many households. The goods, people and ideas are moved from one place to another place through



the road infrastructure which plays an important impact in economic development. The government programs have expanded some rural road infrastructure to connect market. Some rural road infrastructures are under construction (Koirala, 2023). Proper planned network connection to the fast track will be better effective for rural area for this district (Chaudhary, Pokharel, & Adhikari, 2024).

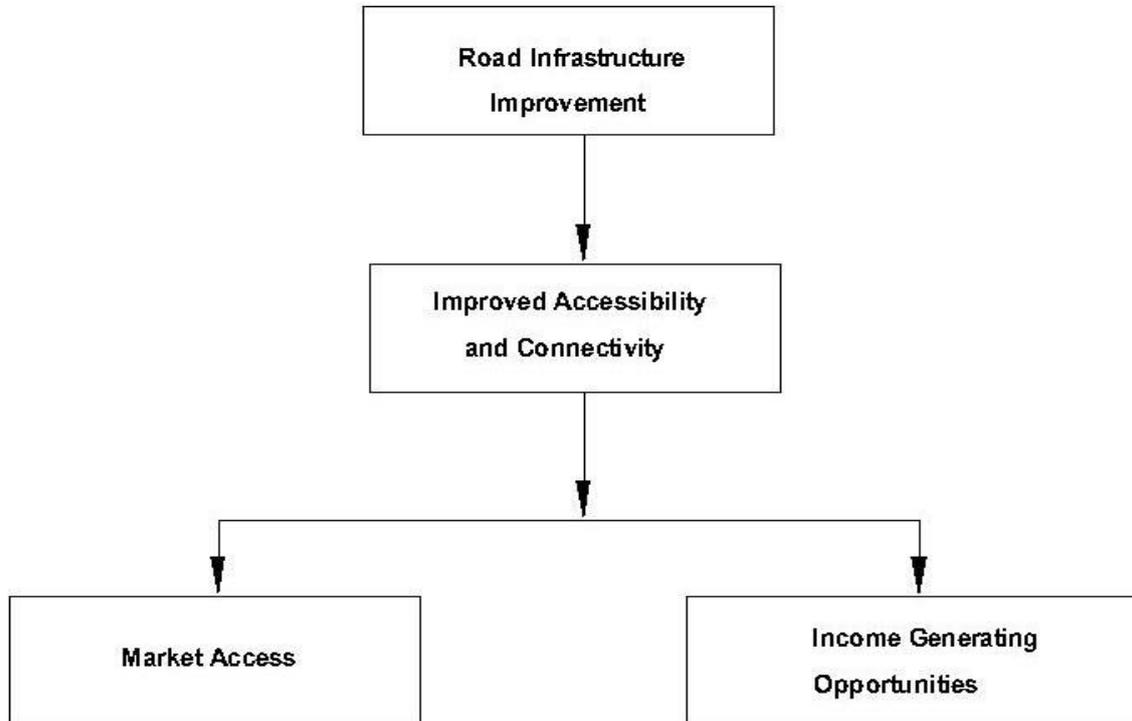
### **Literature review**

Growth Pole Theory (Perroux, 1950; Par, 1999; Hansea, 1967) explains how the development often occurs around central point or “pole” (e.g., infrastructure, industry town), and positive effects spread on surrounding areas. The theory is relevant to this study because roads in rural Mahottari may act as growth poles, stimulating economic and social development in nearby communities through improved access and mobility.

Road Infrastructure is a key to increase the growth and development of the economy. The simple logic is that economic development first needs to have access to the markets (Singh, 2009). The belief is supported by the observation that the historical construction of road infrastructure coincided with the periods of rapid economic growth in Western Europe, Japan and the United States. The richer countries have better transportation infrastructure than poorer ones (Kim, 2006). The policymakers considering the trade-offs of investing in road infrastructure must consider several related arguments (Majid, Malik, & Vyborny, 2018). They must consider the question is road infrastructure development object of policy is the natural forces of the market competition between local and others. The policymakers are typically concerned about the distributional effects of road infrastructure. On the other hand, the increased access to markets and ideas should benefit all regions. The historical context of the United States, it has been argued that the road infrastructure gives rise to more cities, which then turns into “engines” of growth for the country. The conceptual framework for the study is developed by considering the theoretical and empirical review. The conceptual Framework captures the relationship between road infrastructure and changes in rural livelihoods, focusing on across to market and income opportunities Conceptual framework is outlined in Figure 2.

**Figure 2**

*Conceptual Framework*



*Source:* Researcher's self-designed

Road infrastructure acts as a key enabler of rural transformation. By improving physical connectivity, it reduces isolation, lowers transaction costs, and opens up access to market and economic opportunities.

[Khumya and Kusakabe \(2015\)](#) examined the socio-economic transformations driven by road infrastructure improvement in Savannakhet, a province in Lao PDR. The study examines the effect of the road infrastructure on livelihoods, gendered mobility, and the dynamics of economic activities. It utilizes qualitative data for analysis. The authors engaged in interviews and focus group discussions with local community people to collect insights regarding the effect of road improvement on livelihoods and mobility. These qualitative techniques allowed to collect the nuances and lived experiences of the individuals impacted by road infrastructure changes, including gender-specific effects and the perceptions of the economic and social connectivity for rural area. The qualitative methodology enabled the study to prioritize subjective experiences and socio-cultural dynamics over statistical results. The analysis was supplemented with secondary information concerning regional road development initiatives and their overarching socio-economic goals in Lao PDR. The study's findings can be categorized into four main areas: (i) The development of roads enhances access to markets, which in turn promotes livelihood diversification, as improved transportation enables farmers to efficiently move their goods, thereby increasing their market engagement and income potential. (ii) Women face both empowerment and obstacles as a result of enhanced mobility.



While roads grant them improved access to resources and opportunities, cultural norms regarding travel and societal expectations can sometimes restrict their involvement in economic activities. (iii) The presence of roads affects migration and mobility, as better road infrastructure encourages migration, allowing individuals to pursue job opportunities in urban centers. Nevertheless, this migration poses challenges for rural communities, including labor shortages and social disintegration. (iv) Roads improve economic and social connectivity by lowering travel costs and time, which facilitates better access to healthcare, education, and other vital services. The strengths of this study lie in its effective use of qualitative methods, such as interviews and focus groups, to gain a comprehensive understanding of local perceptions concerning road development; additionally, the inclusion of gender perspectives enriches the discourse on infrastructure development and its societal implications. The findings are specific to the context of Savannakhet and may not be entirely applicable to other regions with varying socio-economic or cultural contexts. The study could be enhanced by the integration of quantitative data to offer a more balanced and measurable evaluation of the effects of road improvement. Despite these limitations, the article remains highly pertinent to discussions surrounding rural development and the impact of road infrastructure on transforming livelihoods in rural areas of developing nations like Nepal.

[Lokshin and Yemtsov \(2005\)](#) investigated the effects of rural infrastructure rehabilitation in Georgia on poverty reduction. This study is a part of a larger initiative to assess the effectiveness of infrastructure investments in developing nations, particularly in post-Soviet economies such as Georgia. The focus of the research is on rural infrastructure rehabilitation projects conducted from 1999 to 2004, which include enhancing rural access to markets, services, and other areas. Expanding and upgrading electricity grids to guarantee reliable access. Ensuring clean water availability for rural communities to enhance health and sanitation. The objectives of the research paper are: To evaluate the degree to which rural infrastructure rehabilitation projects in Georgia have improved the living standards of impoverished populations. To identify the specific mechanisms through which infrastructure enhancements have aided in poverty alleviation. To analyze the distributional effects, such as taking into account how the benefits of infrastructure rehabilitation have been fairly distributed among different socio-economic groups. The econometric methodology employed to assess the impact of rural infrastructure improvements on poverty. The findings indicate that enhancements in roads and transportation are essential for improving rural households' access to markets. Access to electricity and clean water has had a substantial impact on lowering household expenses, enhancing health outcomes, and improving educational opportunities. The study concludes that the rehabilitation of rural infrastructure in Georgia has a positive effect on poverty.

[Kaiser and Barstow \(2022\)](#) investigated the significant impact of rural transportation infrastructure in fostering socio-economic development in low- and middle-income countries (LMICs). This research assesses the challenges as well as effects related to transportation infrastructure in these areas, emphasizing its crucial role in enhancing access to services, markets, and economic opportunities for rural communities. It examines various strategies



aimed at improving transportation networks in rural regions. The rural road infrastructure is frequently insufficient, which can obstruct access to vital services such as education, healthcare as well as markets. The rural populations, who depend on agriculture for their livelihoods, encounter difficulties in reaching markets to sell their products. Inadequate transportation can also exacerbate regional inequalities in economic development, leaving rural areas disconnected from urban centers. This study addresses the challenges in rural transportation, including: Insufficient road networks, geographical and environmental limitations, financial constraints, and political and social obstacles. The main research objectives are: To investigate the effects of rural transportation infrastructure on the socio-economic outcomes of rural communities. To identify the challenges and obstacles in developing rural transportation infrastructure. This study is a literature review based on existing research, reports, and data from various sources, including academic studies, case analyses, and policy documents. The review primarily concentrates on studies conducted in low- and middle-income countries. The relationship between rural transportation and various socio-economic indicators is examined, including market access, income generation.

[Wagale, Singh, and Sarkar \(2019\)](#) examined the effects of rural road development under the Pradhan Mantri Gram Sadak Yojana (PMGSY) program on livelihood diversification in rural area of India. The study specifically focuses on the Jhunjhunu district in the state of Rajasthan, where the rural road construction has been a critical component of poverty alleviation and rural area development. The mixed-methods approach, the combination of both quantitative and qualitative research methods are applied to assess the impact of rural the road construction on livelihood diversification. The study areas are: Road-connected villages (where PMGSY roads have been constructed or upgraded). Non-road-connected villages (where infrastructure improvements have not been made). The data collection methods include: Household surveys, Key informant interviews, and Focus group discussions. The research also employs comparative analysis. The results of the research indicate: a) rural road construction significantly enhances livelihood diversification in the Jhunjhunu district. This includes increased access to non-farm activities, expansion of employment opportunities, and heightened investment in rural enterprises. b) Economic advantages include market integration, improved access to resources, availability of healthcare and education, and cost reduction. c) The social and demographic effects are: gendered impact, decreased migration, and a reduction in migration. d) Challenges and limitations include uneven benefits, sustainability of road maintenance, long-term sustainability, road upkeep, and financial constraints. The research concludes that the rural road construction under the PMGSY program has had a considerable positive effect on livelihood diversification in the Jhunjhunu district. Enhanced roads have allowed rural households to lessen their reliance on agriculture and venture into non-farm income-generating activities, resulting in improved economic stability and poverty alleviation. The recommendations include targeted interventions, suggesting that policymakers should ensure road construction projects are tailored to benefit the most vulnerable groups, including women and marginalized populations, by addressing mobility barriers and facilitating access to markets, healthcare as well as education.



Tiwari and Shukla (2024) investigated the effect of the road infrastructure development on the livelihoods of rural area in the Raisen district of Madhya Pradesh, India. The rural areas in India encounter considerable challenges regarding the infrastructure, especially in transportation. In numerous rural areas, inadequate road networks lead to isolation, hindering access to the markets, and income generating opportunities. Government initiatives, such as the Pradhan Mantri Gram Sadak Yojana (PMGSY) and other rural development project, have emphasized both the road construction and improvements. The study employs a mixed-methods approach, integrating both quantitative and qualitative research methods to evaluate the effects of road infrastructure development. It incorporates household surveys, key informant interviews (KII), and focus group discussions (FGD), applying comparative analysis. The findings are: a) enhanced access to markets and resources. A primary conclusion of the study is that road infrastructure development has significantly enhanced access to the markets. In villages with road connectivity, the farmers could transport their agricultural products to larger markets more effectively, resulting in increasement incomes, lower transportation costs, and improved access to agricultural inputs. b) livelihood diversification, including non-farm activities, greater access to employment opportunities, and improved mobility for women. c) economic growth and resilience. d) social benefits, such as better access to services and reduced social isolation. e) challenges, including uneven benefits and maintenance issues. This study concludes that road development in the Raisen district has positively influenced the livelihoods of rural households, and economic growth.

**Research methodology**

This research uses a sequential explanatory strategy in which quantitative method is first phase for identification patterns of change associated with road infrastructure. For qualitative method to explore the mechanisms and contextual factors underlying the patterns is second phase. Data collection includes household survey, focus group discussions and key informant interviews. The overall strategy is pragmatic combining deductive (QUAN) and inductive (QUAL). The study follows a mixed method approach to understand the impact of road infrastructure in rural livelihoods. As per design for the collection of data using tools and technique from the rural area of the Mahottari district of Nepal as per sampling procedure and sample size

For sampling procedure, Sample size formula (Cochran, 1977) for large population:

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{E^2} \quad \text{----- (a)}$$

$$n_{adjusted} = \frac{n}{1 + \frac{(n-1)}{N}} \quad \text{----- (b)}$$

Where

n: Initial sample size

n<sub>adjusted</sub>: Final sample size accounting for finite population



Z: Z-score corresponding to the confidence level (1.96 for 95%)

p: Proportion (default 0.5 if unknown)

E: Margin of error (e.g., 0.05)

N: Total population size

The universe of this study is the population living in the sampled three rural municipalities Pipara, Samsi, and Sonama of Mahottari district of Nepal.

Table 1

Sample Size Determination

Rural Municipality of Mahottari District	Total Population (Universe)	Sample Population (Adjusted Population)	Average Shape of Family	Sample Number (Households Number)	Sample Number (Households Number) Add 5% more	Total Sample Number (Households Number)
Pipara Rural Municipality	40535	380	5	76	4	80
Samsi Rural Municipality	38585	380	5	76	4	80
Sonama Rural Municipality	38747	380	5	76	4	80
Total	117867	1140	15	228	12	240

Source: NSO, 2021

The data were collected from primary sources using questionnaire survey and deploying the questionnaire to the purposefully selected sample participants as per Table 1. In 2025, questionnaire survey for households of the rural municipality was used to gather data. The number of two hundred forty respondents from three rural municipalities as per sample size was involved in questionnaire survey. Key Informant Interviews (KIIs) were conducted with the rural municipality’s president for three rural municipalities separately. Then Focus Group Discussions (FGDs) were held for triangulating the information. The user team of Pipara Rural Municipality, Samsi Rural Municipality and Sonama Rural Municipality were participated in FGD separately. Six representatives from each group were participated during the FGD. Furthermore, the selected sites were logistically accessible for data collection, and initial assessments indicated that they had not been extensively studied there by justifying their inclusion in this research.

Quantitative data is analysed in SPSS. And thematic analysis is done for qualitative data.



**Ethical Considerations**

All the participants such as survey respondents informed about the study's purpose and their right to confidentiality and voluntary participation. The personal information and data were kept confidential, with the results presented in aggregate form. The study does not cause any harm to the participants and all the findings are for constructive purposes.

**Findings and Discussion**

The modes of transportation of goods before improvement in road is summarized in Table 2.

**Table 2**

*Modes of transportation of Goods before Road Improvement*

	Frequency	Percent
On foot	73	30.5
Animal cart	153	64.0
Local transport	10	4.2
Did not transport goods	4	1.3
Total	240	100.0

Source: Field Survey, 2025

The transportation of goods to market was very difficult before due to difficult and poor condition of road. Doing livelihood activities in the society was difficult. Around 30.5 percent of the respondents said that they used physical human labour to transport goods up to the selling point (market). Out of the total respondents, majority of them (64 percent) used animal cart to transport goods. Near about 4.2 percent (10 out of total 240) used local transportation to carry goods up to the market place. There were few respondents (1.3 percent) who did not transport goods. Thus, it appears there was difficulty to transport goods to market before the construction of improved roads in the rural area.

Modes of Transportation of Goods after Road Improvement in road is summarized in Table 3.

**Table 3**

*Modes of Transportation of Goods after Road Improvement*

	Frequency	Percent
On foot	16	6.7
Bicycle	56	23.3
Motorcycle	53	22.1
Public transport	100	41.7
Private transport	15	6.3
Total	240	100.0

Source: Field Survey, 2025

The information summarized in Table 3 reveals that improved road transportation has helped people to transport goods to market. So, 6.7 percent transportation of goods has managed by using on foot. While 23.3 percent transportation of goods is managed by using bicycle. Around 22.1 percent respondents said transportation of goods was managed by using motorcycle. Around 41.7 percent respondents that they did transformation by using public transport. Similarly, 6.3 percent responded that transportation of goods was managed by using private transportation vehicles.

The number of people transporting goods upto the market place. On foot has now reduced to 6.7 percent from 30.5 percent that happened before the improvement in road transportation. Impact of Road Infrastructure on income generating activities before improved rural road is highlighted in Table 4.

**Table 4**

*Livelihood Activities before Improved Rural Road Infrastructure*

	Frequency	Percent
Agriculture	186	78.2
Livestock Farming	23	9.7
Small business/trade	26	10.9
Wage labour	5	1.3
Total	240	100.0

*Source: Field Survey, 2025*

As transportation was very difficult before upgraded road at that time. It appears that around 78.2 percent farmer that involved in agriculture, 9.7 percent were involved in livestock farming. Around 10.9 percent were involved in small business/ trade. Similarly, 1.3 percent were involved in wage labour.

**Impact of Road Infrastructure on Income generating activities after improved road**

The study explored whether the livelihood activities changed after the road upgraded and transportation passing through the villages. The obtained responses are summarized in Table 5.

**Table 5**

*Livelihood Activities after Improved Rural Road Infrastructure*

	Frequency	Percent
Agriculture	62	25.8
Livestock Farming	43	17.9
Small business/trade	31	12.9
Shop	39	16.3



Sugarcane farming	26	10.8
Fishery	19	7.9
Job	16	6.7
Agency for selling agricultural goods	4	1.7
<b>Total</b>	<b>240</b>	<b>100.0</b>

Source: Field Survey, 2025

There is diversification in livelihood activities after the provision of transportation. Improved road infrastructure has made movement of people and goods easier. After improved rural road infrastructure, 25.8 percent farmer are involved in agriculture. The percent of farmer involved in agriculture is decreased due to involve in new other activities. Before it was 78.2 percent. Around 17.9 percent are involved in livestock farming. Whereas 12.9 percent are involved in small business/ trade. Similarly, 16.3 percent are involved in shop. Followed by 10.8 percent involved in sugarcane farming. Out of the 240 respondents, 19 of them (7.9percent) are found involved in fishery activities while 6.7 are involved in job. Similarly, 1.7 percent are involved in agency for selling agricultural goods.

The descriptive statistics of the variables related to impact of road infrastructure are given in table 6 and 7.

**Table 6**  
*Descriptive Statistics*

	Mean	Std. Deviation	Skewness
Improved Road access to the markets	3.18	0.695	0.203
Improved Road reduced travel time to markets	1	0	0
Transport currently use to take goods to market	2.57	1.134	0.042
Trading with larger markets after road improvement	1.03	0.16	6.12
Income generating	2.77	0.681	0.41
Involvement in income generating activities changed compared to before road development	3.24	0.662	-0.226
New sources of income added	4.65	1.881	0.042

Source: Researcher's Calculation Using SPSS, 2025



The mean value of the improved road access to the market is about 3.18, means that on average, people perceive the market to have a moderate level of influence or importance in the context being studied. The Standard Deviation is 0.695: This indicates that the responses vary moderately with some people having differing views on the importance or role of markets. Skewness is 0.203, slightly positive skew indicates the tendency toward more favorable perceptions of the market, with a few responses on the lower end.

The mean value of road development reduced travel time to markets is 1.00. The Std. Deviation is 0.000 means everyone answered the same. Skewness approximately symmetric distribution. The mean value of what mode of transportation is currently used to take goods to market is about 2.57. It means that shift in transport modes. The Std. Deviation is 1.134 means moderate variation. Skewness is 0.042 means symmetrical distribution in both cases.

The mean value of have started trading with larger markets after road improvement is 1.03 means everyone reported yes. The Std. Deviation is 0.156 very low variation. Skewness is 6.123 highly positively skewed.

The mean value of Income Generating is 2.77, the average score means that the income-generating activities or opportunities are somewhat lacking or are seen as not very effective, with responses falling just below the neutral midpoint. The Standard Deviation is 0.681, the standard deviation indicates moderate variability, meaning people have differing views on how successful or available income-generating opportunities. Skewness is 0.410, the positive skew means that while the majority of the respondents might view income generation somewhat negatively, a small number report more positive view.

The mean value of involvement in income-generating activities changed compared to before road development is 3.24. On average, respondents indicate that their involvement in income-generating activities has moderately increased. The Standard Deviation is 0.662: The responses show moderate variation. Skewness is -0.226: A small negative skew suggests a tendency for responses slightly to the left.

The main value of new sources of income added is 4.65. This indicates that, on average, a high number of new sources of income were added. Standard Deviation is 1.881. The higher standard deviation suggests that the number of new income sources added varies significantly across respondents. Skewness is 0.042. The distribution is nearly symmetrical, indicating no significant skewness, with a balance of respondents reporting both low and high new sources of income.

**Table 7**  
*Descriptive Statistics*

	Mean	Std. Deviation	Skewness
Road development impacted household income	3.72	0.815	-2.116
Average monthly income before road development	2.21	0.847	-0.162



Current average monthly income after road development	3.4	1.039	-1.437
New employment opportunities available after transportation improvement	3.17	1.431	-0.314

Source: Researcher's Calculation Using SPSS, 2025

Impact of Road Development on Household Income the computed statistics are: Mean is 3.72, SD is 0.815, Skewness is -2.116. The negative skew indicates that most responses were toward the higher end, showing a strong positive impact on household income from road development. Income before road development the computed statistics before are: Mean is 2.21, SD is 0.847, Skewness is -0.162. There is a slightly negative skew, indicating that majority of respondents expresses the income relatively low before road development.

The computed statistics after are: Mean is 3.40, SD is 1.039, Skewness is -1.437. After road development, there is an increase in income, with responses skewed to the left, showing a generally positive impact on income, though some responses are still spread out.

New Employment Opportunities the computed statistics are: Mean is 3.17, SD is 1.431, Skewness is -0.314. The respondents report moderate improvements in employment opportunities, with a negative skew indicating a higher concentration of responses towards the more favorable end.

### **Analysis of Information from KII and FGD Responses**

#### **Analysis of Information from KII**

The objective of the study were discussed with the participants of Pipara Rural Municipality, Samsi Rural Municipality, and Sonama Rural Municipality in details as a key informant interview (KII). After thematic analysis, the summary is expressed.

Regarding the perception about impact of road infrastructure to market access and income generating opportunities of rural area in Mahottari district of Nepal, rural municipality's president of Pipara Rural Municipality expresses the view as:

*Market access was difficult. There was difficult to bring the agricultural tools, seed, and fertilizer etc due to absence of improved road. The people feel easy for market access and transporting their agricultural good to the market to sell. The economic condition of the people is changed in positive direction. The people have established shop, business, livestock farming, fishery etc. Job opportunity is seen easy as compared before road improvement.*

Rural municipality's president of Samsi Rural Municipality expresses the view as:

*Business progress such as milk business, livestock farming, sugarcane farming etc are in progress due to good market access. Income generating opportunity is more as compare before road improvement.*

Rural municipality's president of Sonama Rural Municipality expresses the view as:



*Livestock farming, sugarcane farming, and fishery are the main business of the farmer after improved road. The development of road infrastructure is seen essential for livelihood change in rural area and market access.*

### **Analysis of Information from FGD**

Focus Group Discussion (FGD) with the participants of Pipara Rural municipality, Samsi Rural Municipality, and Sonama Rural Municipality were done to collect the qualitative data in two thematic area such as access to the market and income generating opportunities in rural area of Mahottari district.

Focus Group Discussion (FGD) of Pipara Rural Municipality is summarized. There was difficult accessibility and connectivity with the market. Only agriculture was the main income source. Due to improved road, livelihood activities and access to the market are easy for rural community people.

Focus Group Discussion (FGD) of Samsi Rural Municipality is summarized. The difficulties in accessibility to market is removed for rural community people. The small business is progressed for rural community people.

Focus Group Discussion (FGD) of Sonama Rural Municipality is summarized. diversification of increasement of income source and access to the market are progressed from the improved road connectivity.

### **Discussion of Finding**

Based on survey data from 240 households, KIIs and FGD in Mahottari District, the results confirm a positive impact of road infrastructure in improving market access and income generating opportunities.

Improvements in the road infrastructure have facilitated market access by decreasing travel duration and transportation expenses. The households have reported receiving better prices for their goods and have gained improved access to inputs and services, resulting in increased incomes. The research indicated that rural roads allowed households to transition from exclusively subsistence farming to a variety of income-generating type activities, including small enterprises, wage employment, and transport services. The observation is consistent with the Growth Pole Theory (Perroux, 1950; Par, 1999; Hansea, 1967), as roads served as centers of development that drew in new ventures.

### **Conclusion and recommendation**

#### **Conclusion**

The road infrastructure have improved access to both local and regional markets, allowing the farmers and entrepreneurs to enhance their incomes by lowering transaction costs and time. Furthermore, the research findings regarding the impact of road infrastructure on the livelihoods of rural people in the Mahottari district clearly indicate that the development of rural roads has positively influenced livelihood changes in rural area. The households have reported an increase in occupational diversity, which includes participation in non-farm employment, small-scale trade as well as transport services. The analysis confirms the significance of the theory. The Growth Pole Theory provide insights into how the road infrastructure has served as catalysts for market access and local economic activities.



### Recommendations

Based on the findings, the following recommendations are proposed:

- i. **Expand and Maintain Rural Road Infrastructure:** In light of the positive effects on livelihood diversification and market access, it is essential to prioritize ongoing investment in the expansion and maintenance of rural road infrastructure, particularly in remote as well as underdeveloped regions.
- ii. **Integrate Road Development with Local Economic Planning:** Road infrastructure initiatives should be paired with the programs that bolster small enterprises, enhance value chain development (such as for sugarcane or livestock), and promote market access initiatives to fully realize the economic advantages of road infrastructure connectivity.

**Transparency Statement:** The authors confirm that this study has been conducted with honesty and in full adherence to ethical guidelines.

**Data Availability Statement:** Authors can provide data.

**Conflict of Interest:** The authors declare there is no conflicts of interest.

**Authors' Contributions:** The authors jointly conducted all research activities i.e., concept, data collecting, drafting and final review of manuscript.

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