ROAD CONNECTIVITY FOR RURAL DEVELOPMENT IN MIZORAM

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BY
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CERTIFICATE

This is to certify that the thesis entitled ***"Road Connectivity for Rural Development in Mizoram"*** submitted to the Mizoram University for the degree of Doctor of Philosophy in Economics, is a record of research work carried out by Lianhmingthanga, Registration No. MZU/Ph.D/607 dated 29.10.2013, under my supervision and guidance.

The thesis is the result of his own investigation into the subject and to the best of my knowledge, the work as a whole or part has not been submitted elsewhere to confer any degree.

DECLARATION

I, Lianhmingthanga, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form base of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

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Date__________ (LIANHMINGTHANGA)

To My Parents

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LIST OF ABBREVIATIONS

ADB	–	Asian Development Bank
ANOCOVA	–	Analysis of Covariance
AWR	–	All-Weather Roads
BMS	–	Basic Minimum Services
CAGR	–	Compound Annual Growth Rate
CHC	–	Community Health Centre
CI	–	Condition Index
CRF	–	Central Road Fund
CSS	–	Centrally Sponsored Scheme
DiD	–	Difference-in-Difference
EAS	–	Employment Assurance Scheme
FRDD	–	Fuzzy Regression Discontinuity Design
GDP	–	Gross Domestic Product
GIS	–	Geographic Information System
GoI	–	Government of India
HDI	–	Human Development Index
HMV	–	Heavy Motor Vehicle
IMR	–	Infant Mortality Rate
JNNURM	–	Jawaharlal Nehru National Urban Renewal Mission
JRY	–	Jawahar Rozgar Yojana
LDCs	–	Less Developed Countries
LMV	–	Light Motor Vehicle
LPCD	–	Litres Per Capita Per Day
MIRSAC	–	Mizoram Remote Sensing Application Centre
MNP	–	Minimum Needs Programme

MoRD	–	Ministry of Rural Development
NABARD	–	National Bank for Agriculture and Rural Development
NEC	–	North Eastern Council
NESRIP	–	North Eastern State Roads Investment Programme
NH	–	National Highway
NITI	–	National Institution for Transforming India
NLCPR	–	Non-Lapsable Central Pool of Resources
NREP	–	National Rural Employment Programme
OBC	–	Other Backward Class
PCI	–	Per Capita Income
PHC	–	Primary Health Centre
PMGSY	–	Pradhan Mantri Gram Sadak Yojana
PRA	–	Participatory Rural Assessment
PWD	–	Public Works Department
RePEAT	–	Research on Poverty, Environment and Agricultural Technology
RLEGP	–	Rural Landless Employment Guarantee Programme
PQLI	–	Physical Quality of Life Index
SARDP	–	Special Accelerated Road Development Programme for North Eastern Region
SC	–	Scheduled Caste
ST	–	Scheduled Tribe
VLW	–	Village Level Worker

CHAPTER 1

INTRODUCTION

1.1 Background

It is rightly stated that the development level of different economies varies immensely (Diener and Suh, 1997) and that an individual's chances of getting educated, finding a job and escaping poverty largely depends upon the economy they are born in (Hull, 2009). These definitely hold true when the view is made across countries, but there are also significant variations within countries. Although various factors are at play, one of the most important catalysts credited to this markedly spatial pattern of development is connectivity (Farole, 2012). Connectivity is considered to be the most important pre-requisite for human sustenance (Oraboune, 2008), and includes communication networks through telephony, internet and postal services, electric connections, health infrastructure, educational infrastructure, and transport facilities through road networks (Sum, 2008). Among them, road connectivity is the most fundamental and sought-after connectivity, particularly for rural areas, due to its flexibility and affordability within the community.

The importance of roads and road transport has been recognised since the early times dating back to the Indus Valley Civilization where streets were paved and the roads in the towns were straight and long, intersecting one another at right angles. With the advent of the Roman Empire, there was a need for armies to be able to travel quickly from one area to another and so, they built great roads using deep roadbeds of crushed stone. Many roads were built throughout the Arab Empire as well. However, the first sophisticated roads paved with tar came to light in the 8th century in Baghdad, Iraq (Ajram, 1992). The nature and construction of roads gradually developed with the growth of the glamour of incessant struggle for mastery over the trade routes of the world. Contemporary asphalt roads capable of supporting vehicles emerged in the 20th century and have changed dramatically; going from large gangs of workers with picks and shovels to enormous specialised machines (Abrams, 2013). Roads now have proved to yield a profound social significance. It is stated that if a community is primitive and stagnant, the inadequacy of their roads will indicate this fact and that economically advanced communities will necessarily possess an efficient and sufficient road system (Verma, 1980). As such, road connectivity has been viewed as one of the key components of national development, especially for a developing country in its drive for rural development.

1.1.1 Rural Development

The increasing interest in rural development is a result of the realisation that a systematic effort is necessary to create better living conditions in the rural areas where the vast majority of populations of developing countries reside. The term ‘rural development’ connotes overall development of rural areas to improve the quality of life of rural people (Chauhan, 2014). In this sense, it is a comprehensive and multidimensional concept, encompassing the development of agriculture and allied activities, village and cottage industries and crafts, socio-economic infrastructure, community services and facilities and, above all, human resources in rural areas. It has been defined in different ways. As a phenomenon, rural development is the end-result of interactions between various physical, technological, economic, social, cultural, and institutional factors. As a strategy, it is designed to improve the economic and social wellbeing of a specific group of people – the rural poor. As a discipline, it is multi-disciplinary in nature, representing an intersection of agriculture, social, behavioural, engineering, and management sciences (Singh, 2009).

Rural development is also defined as a process of change, by which the efforts of the people themselves are united with those of government authorities to improve their economic, social, and cultural conditions of communities to enable them to contribute fully to national programmes. Thus, it is a process of bringing change among rural community from the traditional way of living to a progressive way of living. It is also expressed as a movement for progress. Whatever be the differences in conceptualising the notion of rural development, there is a widely shared view that its essence should be poverty alleviation and distributive, justice-oriented economic transformation. So, the primary objectives of rural development includes – to improve the living standards by providing food, shelter, clothing, employment, and education; to increase productivity in rural areas and reduce poverty; to involve people in planning and development through their participation in decision making and through decentralisation of administration; and to ensure distributive justice and equalisation of opportunities in the society.

Therefore, rural development is a continuous process, which means that it is developmental and progressive and is primarily concerned with the optimum utilisation of resources – human, economic, social, and physical – in a given area through a systematic manner (Fajardo, 1994). This implies that rural development programmes should be well-planned, coordinated, and integrated in which the approach must be multi-sectored, and that planning should start from below. The target population should directly and actively participate in planning and in the implementation of development programmes. Moreover, although non-farm activities are also developed, the emphasis of rural development programmes has been agriculture development since most of rural population live and works in agriculture communities. It is concerned with not only the economic improvement of rural conditions but also other aspects that contribute to development of people and their quality of life. As such, rural development promotes a balanced development of all sectors in the rural areas.

Over the years, especially from the post-war era, rural development has become a matter of growing urgency. This is mainly for considerations of social justice, national integration, economic uplift, and inclusive growth (Chaudhary, 2012). It was found that rural development needs to complement urban development so that a balanced growth would be ensured and growth in each sector be mutually reinforcing. However, development of rural areas is constrained by a slew of factors such as lack of adequate employment opportunities and consequential rural-to-urban migration, frequent occurrence of drought and resultant loss of agricultural output and income, growing erosion of cropped area due to faster pace of urbanisation and industrialisation, dwindling water resources and asymmetries, and disparities in terms of economic and social indicators. Solutions to these issues lie in the reinvigoration of the agricultural sector, generation of gainful employment, creation of sufficient infrastructure in rural areas, thrust on a broad-based manufacturing sector, and strengthening of social services in rural areas.

Progress in rural development has also been hampered by structural and institutional biases against the rural poor. Emulating the relationship between the notions of ‘core’ and ‘periphery’ given by the dependency theory, there is a problem of ‘urban bias’ (Lipton, 2005) which, reduced to its bare essentials, puts forth the propositions that the development process in the developing countries is systematically biased against the rural areas and that this bias is deeply embedded in the political structure of these countries, dominated as they are by the urban groups (Varshney, 1998). So, there seems to be a systematic tendency for a country’s resources to be unfairly and inefficiently distributed in favour of urban areas, to the detriment of people living in rural areas. At the same time, rural roads represent the link between the urban 'core' and the rural 'periphery' (Windle and Cramb, 1997) and have the potential to counter some of the disadvantages of remoteness and provide benefits to all groups within a community.

1.1.2 Rural Road Connectivity

Rural infrastructure is a *sine qua non* for significantly improving the quality of human life and phenomenally accelerating the process of development; of which, the construction and improvement of rural roads increasingly show potential for creating opportunities of economic growth and poverty reduction in developing countries (Vargas, 2007). Rural roads may be defined as pure public goods (Ellis, 1997) as they have the characteristics of non-excludability and non-rivalry (Mankiw, 2014). This means that individuals cannot be effectively excluded from using the good and that an individual's use does not reduce the availability for others. In other words, the addition of an extra user does not reduce the supply for other users and there is no way to exclude others from using the good. Like that of other public goods, the market cannot play a significant role and thus, it has fallen on the government's shoulder to build and maintain rural roads. However, although private investment may not be suitable, there are a number of measures that can make provision of rural roads more responsive to the needs of the people. For example, if funds are diverted to the rural areas, local institutions may be more likely to be in tune with the demands of people and therefore prioritise infrastructural investment more efficiently and with less wastage (World Bank, 1994). Local level involvement at all levels of planning would increase commitment to the day-to-day maintenance required, the lack of which is probably the most common source of failure in infrastructural projects (Ellis, 1997).

The emphasis on farm marketing and procurement of farm supplies emerged with the commercialisation of farms and so, the productivity of agriculture hinges largely on the efficiency of transportation. This in turn is dependent on the level of road improvement which creates vehicular operating benefits, transit benefits and access benefits (Singh, 1962). Moreover, the provision of rural roads positively affects the demand of labour for men and women in farm and non-farm activities as well as larger investments in health and education for rural households in most remote areas (Llanto, 2012). In villages with all-weather roads (AWR), not only do new and additional employment and business opportunities tend to increase (Golmohammadi, 2012) but also female wage employment (Lokshin and Yemtsov, 2005). Rural roads also provide an important connectivity with growing markets adjacent to rural areas and also lessen input costs and transaction costs of rural producers and consumers (Llanto, 2012) and are often a key spatial determinant of land use conversion (Ahmed et al., 2013).

Better accessibility to agricultural land or markets as a consequence of road connectivity can encourage people to convert lands (Munroe et al., 2004) while at the same time allowing farmers to reduce travel time and transportation costs to market towns (Dorosh et al., 2009). This confers substantial benefits on average, much of it going to poor households (Jacoby, 2000). On the flipside, a deplorable state of rural roads affects the quality of farm produce and reduces cost of the product while at the same time reducing the quality of life and well being of farmers (Ikejiofor and Ali, 2014). Additionally, an intense increase in road density creates favourable changes in land use and occupation (Freitas et al., 2009). With the development of roads, agricultural productivity tend to increase through expansion of crop production (Soares-Filho et al., 2004), and greater access to markets through rural roads may promote expansion of production into forest area and other fragile lands (Angelsen, 1999). In a nutshell, rural road improvements lead to substantial reduction in freight charges, increase in household income, more employment opportunities, and expansion of cultivated land.

In addition to these, connecting villages with an all-weather road increases preventive health care usage by the residents of the village and in these villages, women are more likely to seek antenatal care, to have delivery being conducted by trained health personnel, and are more likely to use modern contraceptive methods (Banerjee and Sachdeva, 2015). It also leads to improvement in the accessibility to education facilities which results in increased school enrolment and school attendance, especially in the number of girls going to schools (Parida, 2014). It also bridges the gap between young men and women in enrolment in secondary education, especially in rural areas (Bravo, 2002). Roads not only create physical pathways but also improve the informational connectivity between regions because increase in health care usage comes not only from increase in income or reduction in travel cost but also from increase in the awareness amongst households and individuals, improvement in health care supply, and increase in social interaction within and between villages, all of which have positive linkages with better road connectivity (Banerjee and Sachdeva, 2015).

The above arguments point to the notion that rural roads are an important factor that can bring about development especially for rural areas. They do not inherently favour the rural elite, satisfying the requirement of rural development strategies that benefit women, the most remote, and the most poor (Windle and Cramb, 1997). In that sense, this intervention has the potential to effectively reach a sector of the population that has been persistently marginalised from the benefits of aggregate economic growth. While the availability and quality of rural infrastructure are never substitutes to efficient macroeconomic and agriculture-specific policies and the effective implementation of such policies, inadequate infrastructure can be a significant constraint to growth and productivity (Llanto, 2012). Therefore, rural road connectivity is viewed as a key component of rural development and a key ingredient in ensuring poverty reduction because it promotes access to economic and social services, thereby generating increased agricultural incomes and productive employment opportunities.

1.2 Current Situation of Road Connectivity in India

With a total road network of over 46,89,842 km, India has the second largest road network in the world. Moreover, the quantitative density of India's road network, represented by roads per square kilometer of land, is 0.66 km which is similar to that of the United States of America at 0.65 (CIA, 2014). However, the quality of India's roads is a mix of modern highways and narrow, unpaved roads. Paved roads constitute only 54 percent (NHDP, 2013). Roads in India are classified as Expressways, National Highways, State Highways and rural and urban roads. Expressways, also known as Express Highways, are controlled-access highways, mostly 6-lane or above, where entrance and exit is controlled by the use of slip roads (ramps) that are incorporated into the design of the highway. On the other hand, National Highways are at-grade roads that connect various regions of one state to the other and are managed and maintained by agencies of the Government of India, while State Highways are usually roads that link important cities, towns, and district headquarters within the state and connect them with National Highways or highways of neighbouring states. State-wise, the national highway length per square kilometer ranges from 0.006 km for Jammu and Kashmir to 0.073 km for Goa, while the national average is 0.023 km. Moreover, the overall average of state highways per square kilometer is 0.05 with the highest being the state of Kerala at 0.112 km while Arunachal Pradesh does not have any state highway within its state (NITI Aayog, 2015).

Construction of rural roads is not a new phenomenon in India. Earlier, rural roads were seen as a means for revenue officials to reach the people for collecting land revenue, rather than for the benefit of the community. However, the construction of village roads was included under the Minimum Needs Programme (MNP) for the first time in the 5th Five Year Plan (1974-79), which envisaged providing connectivity to population groups of 1500 persons or more with all-weather roads (All-weather roads, as its name suggests, are roads that are usable or operative in all kinds of weather). A definite outlay for this programme was made in each year for the Fifth Plan, though it decreased in the subsequent Five Year Plans. Further, the Government of India (GoI) initiated a number of programmes such as the National Rural Employment Programme (NREP) in 1980, the Rural Landless Employment Guarantee Programme (RLEGP) in 1983, the Jawahar Rozgar Yojana (JRY) in 1989, the Basic Minimum Services (BMS) in 1997, the Employment Assurance Scheme (EAS) in 1993, and other similar schemes under which rural roads were constructed year after year and plan after plan.

Notwithstanding the efforts made over the years at the state and central levels through different programmes, many habitations in the country are still not connected by all-weather roads. Even where connectivity has been provided, the roads constructed are of such quality (due to poor construction or maintenance) that they cannot always be categorised as all-weather roads. Moreover, the rural roads sector is a state subject which lacks adequate planning and management due to poor coordination between multiple funding streams and agencies. Investing in rural roads was given low priority and viewed in isolation from the need for State and National Highways (World Bank, 2014). With a view to redressing the situation, the Government of India on 15th December, 2000 launched Pradhan Mantri Gram Sadak Yojana (PMGSY) under the Ministry of Rural Development (MoRD) so as to provide all-weather access roads to unconnected habitations. The PMGSY is a 100% Centrally Sponsored Scheme (CSS) with the primary objective of providing connectivity, by way of all-weather road to the eligible unconnected habitations in rural areas.

PMGSY initially envisaged the provision of new connectivity to about 180,000 habitations through the construction of about 372,000 km of roads, and upgrading about 370,000 km of the existing core rural network to provide full farm-to-market connectivity. This includes necessary culverts and cross-drainage structures that are operable throughout the year. The scheme aimed to cover all unconnected habitations with a population of 1000 persons and above within three years (2000-2003) and all unconnected habitations with a population of 500 persons and above by the end of the Tenth Plan Period (2007). In respect of the Hill States (North-East, Sikkim, Himachal Pradesh, Jammu & Kashmir, Uttaranchal) and the Desert Areas (as identified in the Desert Development Programme) as well as the Tribal (Schedule V) areas, the objective was to connect habitations with a population of 250 persons and above. According to the latest figures made available by the State Governments under a survey to identify core network as part of the PMGSY programme, about 1.67 lakh unconnected habitations are eligible for coverage under the programme. This involves construction of about 3.71 lakh km. of roads for new connectivity and 3.68 lakh km. under upgradation.

The programme has greatly enhanced the capacity of states to plan and manage rural roads by creating State Rural Roads Development Agencies in each state. These agencies monitor PMGSY works, which are implemented by Public Works Departments (PWD), Rural Development Departments, and similar agencies. This CSS, along with some State-run schemes, have had favourable effects on the life of Mizoram rural inhabitants as well.

1.3 Rural Roads in Mizoram

The provision of rural roads in Mizoram is mostly undertaken by the State PWD and Rural Development Department. Although there has been a thrust of initiatives taken for the provision of rural roads in Mizoram, the situation is still at a distressing stage. The percentage of surfaced and unsurfaced roads in the state is given in Table 1.1.

Table 1.1 Category-Wise Length of Roads: Mizoram (2013-14)

Sl. No.	Type of Roads	In Km			In Percent		
		Surfaced	Un-surfaced	Total	Surfaced	Un-surfaced	Total
1	National Highways	986.530	0	986.530	100	0	100
2	State Highways	310.450	0	310.450	100	0	100
3	District Roads	1400.600	250.200	1650.800	84.84	15.16	100
4	Town Roads	253.202	44.204	297.406	85.14	14.86	100
5	Village Roads	948.061	1677.492	2625.553	36.11	63.89	100
6	Misc. Roads	877.980	799.310	1677.290	52.35	47.65	100
	Total	4776.823	2771.206	7548.029	63.29	36.71	100

Source: Mizoram Statistical Handbook, 2014

The table shows that the total length of village roads in Mizoram, according to the latest data (Mizoram Statistical Handbook, 2014), is 2625.55 km, which constitutes 34.78 percent of the total length of roads i.e. 7548.03 km. However, only

36.11 percent of rural roads are surfaced while the remaining 63.89 percent are fair weather roads. Moreover, at the time of the study, the percentage of villages connected with all-weather roads is 52.22 percent. This means that 47.78 percent of villages in Mizoram still have a deplorable status of connecting routes, let alone the internal roads. In the district-wise analysis, it can be seen that while at least half of the villages in the districts of Mamit, Kolasib, Aizawl, Champhai, and Lunglei are AWR-connected, Serchhip, Lawngtlai, and Saiha districts have less than 50 percent of their villages connected with all-weather roads. The district with highest percentage is Kolasib at 75.86 percent while Saiha district has the lowest with only 28.57 percent of its villages connected with AWR. This is shown in Table 1.2.

Table 1.2 Villages Connected with AWR

Sl. No.	Districts	Number of Villages			Percentage of Villages		
		Connected with AWR	Not Connected with AWR	Total	Connected with AWR	Not Connected with AWR	Total
1	Mamit	38	23	61	62.30	37.70	100
2	Kolasib	22	7	29	75.86	24.14	100
3	Aizawl	49	30	79	62.03	37.97	100
4	Champhai	38	38	76	50	50	100
5	Serchhip	12	19	31	38.71	61.29	100
6	Lunglei	55	52	107	51.40	48.60	100
7	Lawngtlai	46	53	99	46.46	53.54	100
8	Saiha	10	25	35	28.57	71.43	100
	Total	270	247	517	52.22	47.78	100

Source: Field Survey, 2015

On the other hand, more than half of the state’s population lives in urban areas. Mizoram’s population, according to the 2011 Population Census, is 10,91,014, of which 5,29,037 (48.49 per cent) are living in rural areas and 5,61,977 (51.52 per cent) are living in urban areas. This higher percentage of urban population is a distinguishing feature of Mizoram population making it one of the two states of India that possess a lower rural population relative to the total number of persons in the state, the other being Goa. Moreover, during the past ten years (2001-2011), the rural population increased by 81,470 and the urban population by 1,20,971 thus making the decadal growth rates in rural and urban areas 18.20 percent and 27.43 percent, respectively. The higher percentage of people currently living in urban areas may be cited as the effect of rural-urban migration, which is caused by multiple factors ranging from marriage and employment to lack of education and health facilities and lack of security in the rural areas (Essang and Mabawonku, 1975).

Therefore, looking at the status of village roads in Mizoram which is sub-standard and because it had been established by various researchers that rural roads bring about increased opportunities for employment and multiple socio-economic infrastructures, the construction and upgradation of rural roads is highly needed in the state to remove rural-urban dichotomy which would bring forth balanced development.

1.4 Statement of the Problem

Road connectivity is a key component of rural development since it promotes access to economic and social services (MoRD, 2000), thereby generating increased agricultural productivity, non-agriculture employment, and non-agricultural productivity, which in turn expands rural growth opportunities and real income through which poverty can be reduced (Golmohammadi, 2012). The importance of rural roads is also recognised in Mizoram. However, the state being land-locked, road transport is the principal means of communication for most community, business and personal purposes. With slopes of hills ranging from 20° to 80° and an average elevation of 900 metres above sea level (Sawmliana and Roy, 2003), the terrain of Mizoram does not permit easy accessibility to roads, and since road infrastructure is but a public good, there is no private investment in its provision in the state.

At the same time, the state of Mizoram has a high performance in some demographic and socio-economic development variables like total literacy and female literacy rates, child sex ratio and number of households with piped water supply, etc. However, its performance on key development parameters like employment rate and per capita income is comparatively low (NITI Aayog, 2015). Moreover, agricultural productivity is very low in the state and the market infrastructure is below par (Thanga, 2014).

It is thus an academic interest to study how road connectivity influences the development of the economy, and what the pattern of relationship is between rural road connectivity and development in the villages of Mizoram. It is believed that the findings and suggestions of the study would bear substantial policy implications and assist policy makers in the production of blueprints for future programmes, particularly for those in relation to the goals of sustainability, universal coverage, and equity.

1.5 Objectives of the Study

The primary objective of the study is to examine the differences between the well connected and poorly connected villages in terms of different indicators of economic development. Attempt was also made to examine the pattern of relationship between the development and connectivity parameters. The specific objectives are as under:

1. To examine the existing status of road connectivity of villages in Mizoram.
2. To study the existing condition of economic development of the villages.
3. To analyse the differences in the demographic profiles of the rural areas.
4. To examine the impact of connectivity on land use change.
5. To study the existing state and availability of basic social infrastructures across the villages of Mizoram.

In addition to these specific objectives, other development parameters found to be relevant for the study were taken into account in the field research. All these parameters were studied along the line of the primary objective in that the existing status and performances of the well connected and poorly connected villages were separately examined; and the differences between these villages, if any, were identified and interpreted.

1.6 Hypotheses

To form specific and firm conclusion in our study, the following hypotheses were proposed and tested:

1. Agriculture plantation area is positively related to improvement in road connectivity, while the intensity of *jhum* practice is negatively related to it.
2. Rural road connectivity has a direct relationship with literacy.
3. While the proportion of main workers is significantly higher in the well connected villages, the proportion of persons working as agriculture labourers is also significantly higher in these villages.

1.7 Methodology

The study adopted a village level design; while the parameters and indicators assessed were road connectivity and economic development, which are further composed of a number of variables. So, the sampling unit of the study is a village, rather than individuals. It may be mentioned that different variables having diversified sources were used and as such, an explanation of the data variables is necessary while describing their sources. Detailed framework of data collection is enumerated in the following:

1.7.1 Study Area and Size

It is important to note that the study accounts for only the rural parts of the state and as such, the urban areas – the state capital and the 23 notified towns – were excluded. The focus of the study is therefore on the 704 inhabited villages identified by the Population Census 2011. However, following the data of Geographic Information System (GIS) obtained from Mizoram Remote Sensing Application Centre (MIRSAC), some of the villages hypothesised to be having the same characteristics as they are located relatively closer to each other and the villages smaller in comparison were merged with other villages, which make the total number of villages amount to 517.

At the same time, it is important to note that the total population accounted for in the study is 5,25,435 which is the same as the total rural population of the 2011 Population Census. To explain this further, an example may be made of the Mamit district villages of Chilui, N. Sabual, N. Tlangkhang, Vawngawnzo, and Damdiai with respective populations of 102, 233, 80, 304 and 404, were merged and denoted in the study as Chilui with total population of 1,123. Another example is the merging of 12 villages of Lunglei District namely, Diplibagh, Serhuan, Nunsuri, Muriskata, Bindiasora, Thekaduar, Balungsuri, Zohmun, Silkur, Tiperaghat I, II, and III with populations of 1651, 551, 1,263, 206, 474, 316, 317 433, 278, 834, 554, 427 respectively, were represented by Diplibagh with total population of 7,304.

1.7.2 Connectivity Variables

Four sets of road connectivity variables were introduced in the study – whether the village is connected with AWR or not (in short, AWR Connectivity); whether it lies along or outside the main transport route of the state (Main Transport Route); distance of the unconnected village from the nearest AWR (Distance from AWR); and road density of the village (Road Density).

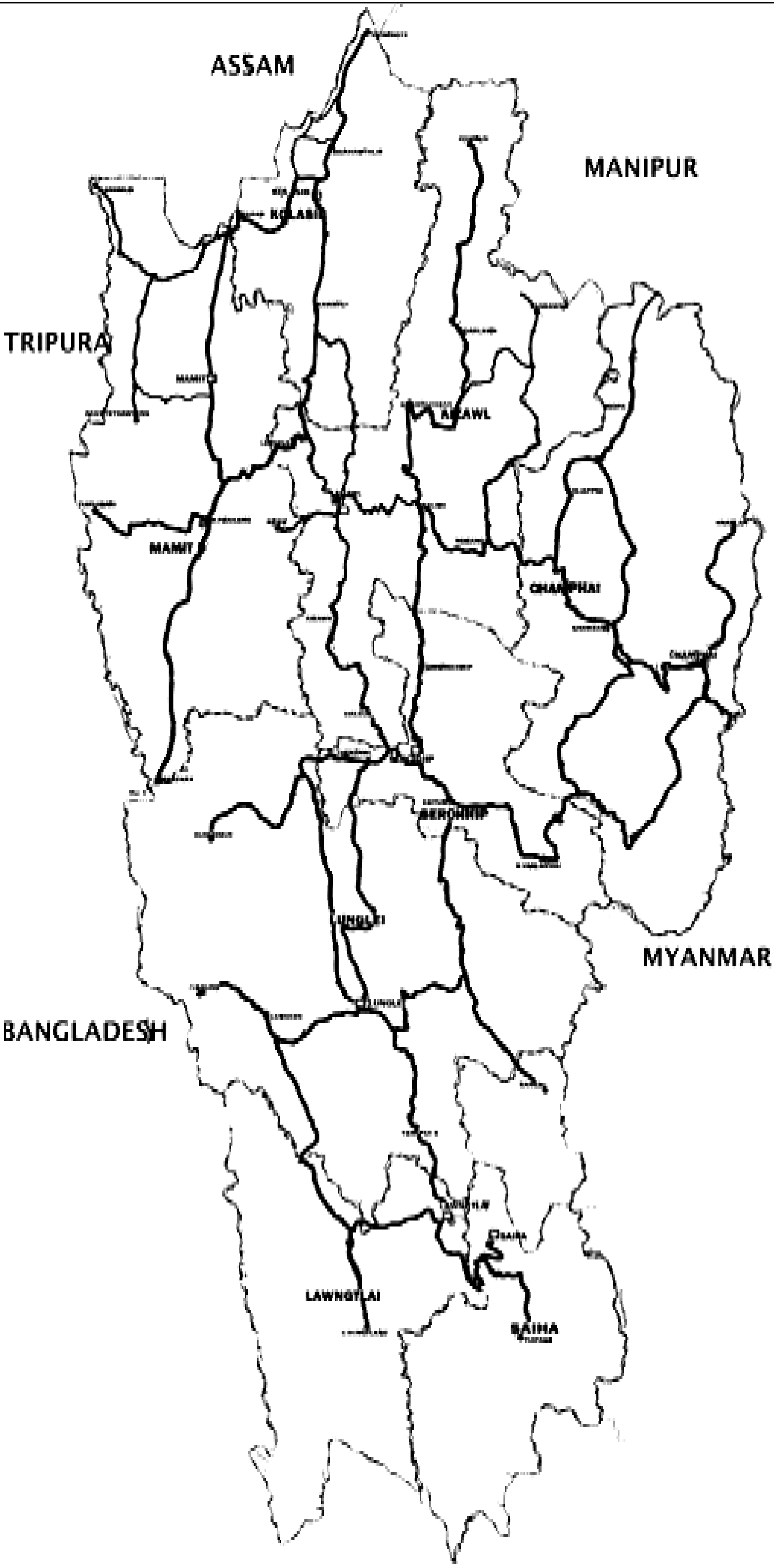
a) *AWR Connectivity*: The Mizoram State Public Works Department was queried on the status of the 517 villages whether they are connected with AWR or not. However, for the information that could not be obtained from the same, the Village Councils were contacted telephonically and through letters regarding their status of connectivity. The data so obtained was then fitted to the respective villages thus showing qualitatively the connectivity status of the villages – those connected with AWR and those that are not. The study found the total number of connected villages to be 270 while 247 villages are not connected with AWR.

b) *Main Transport Route*: As it was felt that the status of the villages on AWR connectivity might fall short if not backed by regular road transport to that village, the parameter on whether it lies along the state's main transport route was earmarked as a connectivity variable as well. Here, the 'main transport route' includes the national highways, state highways, and roads connecting major transport destinations. The data for this variable was determined through interview of various stakeholders, particularly vehicle owners, transport operators and knowledgeable persons. This again was vetted with the Department of Transport, Government of Mizoram for confidence. Thus, the key determinants on whether the villages are located along the main transport route are national highway, state highway, and the frequency of vehicles passing through the village. The study identified 112 villages to be along the main transport route while the remaining 405 villages lie outside the route. A map displaying the roads identified as main transport routes in the study is given in Fig. 1.1.

c) *Distance from AWR*: As noted, the third parameter of road connectivity is the distance from the nearest AWR for those that are not connected with it. The data for this variable was obtained from two sources – the Public Works Department, Government of Mizoram and the Village Council of the villages, from which the bulk of it was procured from the latter. Here, the village councils that could be communicated through telephone were asked of the distance of their village from nearest AWR while those that could not were contacted using letters. The reported distances were then apportioned to the respective villages and thus accounted as a connectivity variable to check if distance of the village from AWR plays a role in development.

d) *Road Density*: The data for the fourth variable adopted as a parameter of road connectivity i.e., the road density of the village was determined through the estimated area of the village within 1 km from motorable road obtained from the GIS data of MIRSAC. To work this variable out, technical assistance from a GIS expert was sought. The data obtained from this source was later on allied with the data sets of the other connectivity variables to complete the road connectivity parameters of the study.

Fig. 1.1 Map showing the Main Transport Route of the State as identified in the Study



1.7.3 Development Indicators

The development indicators considered in the study can be broadly classified into four groups as well – population development, structure of employment, agriculture development, and basic social infrastructures. The variables used in each major development indicator and their respective sources are given as follows:

a) *Population Development*: The key variables used in the study under this head are mostly an indicator of population quality. They are sex ratio, child-population ratio, child sex ratio, family size, literacy rate, female literacy rate, and number of households. The data source for this indicator is the untabulated Primary Abstract of the 2011 Population Census obtained from the Directorate of Census Operations, Mizoram.

b) *Structure of Employment*: For studying the structure of employment, the variables taken into account are the percentage of workers to total village population, workers' sex ratio, percentage of main workers and marginal workers to total workers and the percentage of cultivators, agricultural labourers and household industry workers in both the main and marginal workers. These are also obtained from the Primary Abstract of Population Census 2011 through the Directorate of Census Operations, Mizoram.

c) *Agricultural Land Use*: Lack of detailed village data about land use precludes analysis of the impact of road connectivity on agricultural land use. Instead, this study used the GIS data derived through satellite map as given by MIRSAC to represent the different statuses of land use of the villages. Here, the variables of interest are area of wet rice cultivation (WRC), agricultural plantation area, forest area—all represented as ratios to total area of the village—and average area under jhum cultivation per household denoted in hectares.

d) *Basic Social Infrastructures*: Under the social infrastructures are schools, water supply and medical institutions. The number of schools, students, and teachers present in each of the villages of Mizoram was obtained from the 22 (twenty-two) Sub-Divisional Education Officers and 8 (eight) District Education Officers of the state. The number of schools was then added up for each merged village while the teacher-student ratio was calculated through the total number of students and teachers present in each village.

At the same time, the amount of piped drinking water supplied to each village was obtained from the Public Health Engineering Department, Government of Mizoram. Here, the primary data of litres per capita per day (LPCD) was computed and affixed for the villages. Lastly, for the number of health care institutions and the number of qualified medical personnel present in the villages, data was collected from offices of the 9 (nine) Chief Medical Officers across the state, which again was columned with the other development variables.

1.7.4 Analytical Tools

The primary and secondary data collected were analysed using suitable statistical tools. First, for testing the general trend of differences between the respective categories of the four connectivity variables, the study used descriptive statistics, namely, averages and percentages. Second, t-test and chi-square tests were employed to test the significance of difference across villages of different road connectivity conditions i.e. to check whether there are significant differences in the development indicators of the study across the respective categories of the connectivity variables. The third statistical tool adopted is the Dummy Variable Regression Model which was done so as to examine the pattern of relationship of differences across the road connectivity variables. The details of the second and third statistical tests are given in Chapter 5.

1.8 Chapterisation Scheme

The thesis is organised into 6 (six) chapters. They are:

Chapter 1 *(Introduction)*: The chapter gives the theoretical framework of the study – that of rural development and rural roads and infrastructure – while at the same time giving a brief highlight of the current situation of rural roads in Mizoram.

Chapter 2 *(Review of Literature)*: This chapter presents an outline of various related literature of the relationship between road connectivity and rural development.

Chapter 3 *(Situational Profile of Connectivity in India)*: In this chapter, a simple analysis of the secondary data of connectivity infrastructures and economic development statuses of different states of India is shown while at the same time presenting the scenario of Mizoram's road connectivity and road transport and the public expenditures allocated for them by the state government.

Chapter 4 *(Existing Status of Rural Road Connectivity and Economic Development in Mizoram)*: This chapter presents the analysis of the status of socio-economic development of study area through the adoption of the four variables of road connectivity.

Chapter 5 *(Impact of Road Connectivity on Rural Development: An Empirical Analysis)*: The chapter shows the empirical analysis of performance of study area through statistical analyses.

Chapter 6 *(Summary of Findings and Recommendations)*: A summary of findings, recommendations and the conclusion of the study are given in this chapter.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

The present study is an inquiry into the impact of road connectivity on rural development. But first, it was felt necessary to survey literatures of the study's relevant areas in order to explicate the value of the research and its contribution. Many studies have presented the nature, status and conditions of road and road transport and its impacts on the life of the rural sector. However, it is important to point out that while there is a wide range of information, it is not within the realm of this study to present an exhaustive account of it. Nonetheless, this review is comprehensive insofar as it provides a solid knowledge base of the work that has been done in the relevant areas. The available literature and documentary sources helped us to achieve a clear idea of the extent of research that had been carried out for the particular field in the past. As such, this chapter attempts to present a clear view of the research gaps and the areas that are required to be filled.

The literatures reviewed are divided into three broad sections, viz. the impact of road connectivity on development, on the agricultural sector, and on basic social infrastructures.

2.2 Roads and Rural Development

Among various literature reviewed in the study, the first set presented in the following are studies that have been undertaken by researchers whose due emphasis, through varied methodologies, was on the impact of rural roads on overall economic development.

An analytical study was undertaken by World Bank which assessed the benefits of Pradhan Mantri Gram Sadak Yojana (PMGSY) – the centrally sponsored scheme of India whose aim is to provide all-weather access roads to unconnected habitations. This study by World Bank's South Asia Sustainable Development Unit (2014) focused on two aspects of the PMGSY programme. First was an emphasis on new/additional gainful employment and economic opportunities, as opposed to other forms of benefits. Second, the distributional concern related to whether women and members of scheduled castes (SC), tribes (ST), and other backward classes (OBC) have been able to exploit such opportunities. Among the numerous findings, mention may be made of the result that villages connected with all-weather roads saw new and additional employment and business opportunities while in the unconnected villages, only one quarter felt any such developments in their villages. Moreover, the new road was reported as an enabling factor for villagers to save time in performing their tasks productively. Interestingly, although it was professed that PMGSY roads influenced the cropping patterns to shift towards commercial crops, it found that there is a movement towards 'specialisation' in economic activities in both connected and unconnected villages. On the other hand, women and weaker groups were found to be able to scale up their micro-enterprises and get involved in commerce and trade with the construction of new roads. In the PMGSY villages, new roads increased the mobility of women thus enhancing their work participation and contribution to the household economy.

However, the study came up with a finding that the impact of PMGSY on the states and the different groups it touched, particularly the weaker sections of society such as women and lower castes, was not uniform. While men benefited in terms of seizing opportunities outside the village, the women, less educated, or lower castes did not gain equally and have possibly been forced to engage more heavily in the village economy. Another finding from the study was the low level of community participation in planning and building of roads. Given that one of the end objectives of the programme is to achieve 'sustainable and inclusive' growth of the country thus enabling reduction in poverty, this aim cannot be met without ensuring that the roads constructed are properly maintained, which requires that the community has 'ownership' right from road design to construction and maintenance. The findings of the study suggested that the rural road connectivity programme needs to rely on a set of complementary policies and programmes, some state specific, others national, to provide the much needed catalyst for the relatively excluded groups to share in the benefits equally. Moreover, it was felt that there is a strong need for a much more integrated approach to rural development by exploiting the synergies between various programmes running independent of each other.

Ibok and Daniel (2013) studied the impact of rural roads on socio-economic development of Akwa Ibom state of Nigeria. It stated that rural roads constitute the most critical infrastructure in the rural areas. Through various data, the study showcased the government of Akwa Ibom acknowledging roads not only in quantitative terms, but also in qualitative terms. Interestingly, the government's efforts in transforming Akwa Ibom through rural roads had positive impacts on the socio-economic development in the state. It stated that the availability of a good road network that transcend rural areas made it easy to navigate many parts of the state in a matter of hours and consequently, it made it possible for rural farmers to transport their farm produce with ease to the urban centres with less cost; while at the same time reducing the cost of porterage and time loss in trekking long distances thereby facilitating more efficient distribution of goods and services in the state. Other benefits – commercial agriculture, industrialisation and employment opportunities were enhanced as well.

However, it reported that these government efforts through rural roads were not without some hindrances. Inadequate funding occasioned by low budgetary allocation hindered the effective provision in terms of a wider coverage. The study then suggested that the state government should allocate more funds in their annual budget for rural infrastructure considering its importance. Also, it felt that such funds should be released on time considering the seasonal nature of road construction and maintenance. It further stated that the government should put in place monitoring and evaluation units to ensure standard performance and accountability in its project implementation. Most importantly, it said that the government should ensure sustainability of its road projects in the rural areas which could be accomplished by establishing a village or community development and maintenance board to oversee road maintenance of any kind. Lastly, it recommended that there be political will on the part of the successive governments to see rural roads as a propelling force for rural transformation.

A study titled 'Rural Road, Sustainable Development and Maintenance of People in Desert Regions' by Golmohammadi (2012) stated that the perception of many scientists and experts that investment in rural roads is a solution to economic and social development problems in rural areas is indeed true as there is a link between transport and sustainable development that is not always acknowledged. The study found an improvement in the employment situation in terms of more job opportunities, avenues for self-employment, etc. after the construction of rural roads. On-farm employment opportunities were also found to be increased due to shift from grains to cash crops and also multiple cropping. At the same time, it encouraged more people to go to nearby towns and villages for odd jobs like selling woods, vegetables, dairy products and locally made items due to expansion of local industries, which in turn generated employment opportunities. Positive impact was also observed on accessibility to preventive and curative health care facilities, better management of infectious diseases, and attending to emergencies by health workers. Improvement in antenatal and post-natal care was enjoyed by the beneficiaries, thereby decreasing obstetrics emergencies. It also found that there is an improvement in the accessibility to education facilities which resulted in increased school enrolment and school attendance in all the villages, especially in the number of girls going to schools.

On another note, it was found that road connectivity had increased the frequency of visits by government officials and grass root level functionaries like Village Level Workers (VLWs) and that there had been an improvement in accessibility to banks, and post offices, and quicker access to the police. In addition, an increase in ownership of bicycles, pickup trucks, motorcycle, and scooters by rural people was observed. Also, the connectivity led to sudden escalation of prices of land adjacent to the roads; and also led to an increase in the sale of land for commercial purposes. The roads, directly or indirectly, provided opportunities for on-farm and off-farm employments as well as self-employment. With the improvement in on-farm and non-farm employment opportunities, an increase in their average household income and thus, reduction in poverty was reported. Another important point given by the study is that well-off households with better resource endowments, capabilities, and skill sets generally derived more benefits from the improved access in comparison to poor households. This would call for prior in-depth analysis of the potential input from the major stakeholders with a view to devising appropriate mitigation measures to make road connectivity schemes 'inclusive' in terms of its benefits.

Along the same line, Olagunju et al. (2012) analysed the effect of rural roads on income of farming households of Osun State, Nigeria. It noted that agricultural development is essential for economic growth, rural development, and poverty alleviation in low-income developing countries and that such development depends on good rural infrastructures, well functioning domestic markets, appropriate institutions, and access to appropriate technology. It stated that the weak rural infrastructures of the study area affected both the corporate and informal private sector more adversely in various ways. This key constraint limits the integration of the rural with the urban markets which in turn seriously hinders accessibility to inputs and services and increases costs. It also made the cost of business in urban cities expensive which in turn encouraged over-concentration of industries and firms in urban cities, leading to over-congestion, too much pressure on existing infrastructure, and other social vices. Moreover, the study stated that poor roads and transport had equally held back industrial distribution in different rural areas which again affected the ability of many small industries to be sited in those areas.

Using multiple regression analysis to find the relationship between the farmers' income and their access to road and market infrastructures, it was confirmed that bad roads are clearly an obstacle to attaining the potential benefits from a market-based economic reform. In addition, from the paired sample correlation test, it was deduced that availability of tarred road, occupation, and distance from market and condition of road to the market are correlated with annual income. They were all statistically significant which indicates that if there is availability/non-availability of tarred road it will either increase or decrease the annual income. Also, the condition of the road leading to the market and the distance of the farm from the market can affect the annual income positively or negatively. It was therefore recommended for the study area that for combating food crisis and food insecurity, rural-urban migration and to achieve sustainable development, policies targeted towards rural infrastructural development most especially rural roads should be formulated because the bulk of farm produce comes from the rural areas.

Dorosh et al. (2012) adopted a cross-sectional spatial approach to examine the relationship between transport infrastructure, population, and agricultural production in Sub-Saharan Africa. It uses geographic information system data sets on agro ecological zones and crop production potentials, actual crop production, and road infrastructure. Examining the relationship between connectivity/remoteness and population, it was found that population is spatially concentrated near large cities which had better road networks on average. Thus, the average travel times is inversely related to population size. Total crop production showed the same pattern, meaning that the areas with larger populations and better road networks experienced higher crop production. In other words, road-connectivity measures has significant effects on total crop production as the elasticity of crop production increases (in absolute magnitude) when travel time to 'larger' cities was taken into account. Moreover, it stated that longer travel time discourages the adoption of high-input/high yield crop-production technology more than other production systems, and as such, better road connectivity was deemed to make high-input production more profitable, and therefore, increased its share of production.

It was noted that a large supply response to road connectivity and travel time would require that road investments be directly translated into reducing travel time and transport prices, that reductions in transport costs would significantly reduce marketing margins, that the structure of supply and demand of agricultural goods is such that producers reap substantial benefits from reductions in marketing costs, and that the own-price elasticity of supply is relatively large. Nevertheless, the study found correlations between the location of population centres and road infrastructure (reflected as travel time) and the location of crop production. This suggests a long-run relationship in which land is typically not a binding constraint on aggregate production but in which demand constraints that vary over space are important. It further stressed that remoteness and demand constraints may not be the only factor limiting production and that improved roads will not reduce transport and marketing costs significantly in the short run if transport and trade services are not competitive or volumes of marketed products are small. It also recognised that production increases may not be forthcoming in the absence of availability of credit, land tenure arrangements that encourage investment, and insecurity and frequent changes in government policies that increase risk.

Rasmussen and Broegaard (2011) studied the impact of rural transport infrastructure in Nicaragua. Characterised by labour-based methods and community involvement in planning, execution, and maintenance in close coordination with the municipalities concerned, the study established clear positive economic and social impacts at community level flowing from investments in rural transport infrastructure. The evaluation used a quantitative double-difference approach, based on existing national data sets, covering households in similar communities with and without investments in improved transport access. This was combined with qualitative investigations to further explore the quantitative results, as well as additional issues. The study's analysis demonstrated statistically significant impacts on important economic indicators – such as travel time, paid employment, connection to electricity grid, and size of homes – as a proxy indicator for economic opportunities.

The communities were found to show a significant increase in the number of household heads in paid employment. New entrance to the labour market occurred mainly in agriculture, but employment gains were also observed in the construction sector. The qualitative analysis strongly supported these findings. Other benefits included more frequent, timely, and less expensive contacts with markets and buyers for agricultural products, resulting in improved prices and changes in production patterns. Moreover, the investigation highlighted that a key social impact for beneficiary communities was improved access to health services, especially for emergency cases. It also found that greater transport access made a positive impact on the frequency of care visits from health personnel while parallel improvements were not reported in the comparison communities. Similar positive impacts were also identified in the field of education, with improvements in teacher attendance, more materials, new or rehabilitated schools, and easier access to secondary schools outside the community. The evaluation stated that the combination of improved access with increased capability of the communities reveals a significantly higher inflow of other development projects.

Umoren et al. (2009) in their study ‘Development of Road Infrastructure as a Tool of Transforming Ibino Ibom Local Government Area’ gave a statement that the need for rural roads and their resultant effect on the rural communities’ economy cannot be overstressed because an extensive, adequate, and efficient rural feeder road network serves as one of the channels for the collection and movement of goods and services, movement of people and dissemination of information; and that it helps in the exchange of rural productivity as well as strengthening the socio-economic, cultural, and political fabrics and processes of the rural communities. The study is analytical in nature in which the fieldwork constituted primary sources of data collected through oral interviews, distribution of questionnaire, field enumeration of road infrastructure, social amenities, and observation in the field. Development indices such as markets, health centres, schools, etc. and their quality point were sampled and measured in the designated zones in the study area.

The analysis of the primary data showed that there is a strong, positive relationship between road infrastructure development and socio-economic activity in the study area. In other words as the road infrastructural development increases, development in socioeconomic activity in the area also increases. Squaring the value of the correlation coefficient, the coefficient of determination obtained shows that over 75.69% of the variation in socio-economic activity is influenced by road infrastructure development. Thus, it was found that transport infrastructure is an overwhelming factor for transforming the rural environment. In addition, a *t-test* gave a result which enabled the researchers to confidently and statistically conclude that there is a significant relationship between road infrastructural development and socio-economic activity in the study area. Therefore, it was concluded that the development of road infrastructure is a crucial factor which influences the development of a region and so, a good transportation network has to be considered in every stage of development planning especially now that modern development planning is geared towards the transformation of rural areas.

Oraboune (2008) in 'Infrastructure (Rural Road) Development and Poverty Alleviation in Loa PR' illustrated the significance of rural roads and also demonstrated the approach through which rural farmers can improve their income earning, develop their farming system, and living standard, and reduce poverty. Through various analyses, it was shown that an important linkage does exist between road connectivity and income of rural people. It was observed that improvements of all-weather road significantly contribute to poverty reduction as the consumption expenditure increases. It illustrated that there is a close link between village-connecting roads and poverty reduction through increase in income opportunities for rural people. Roads provide market access opportunities to rural farmers/people which helps them develop market linkage with other stakeholders in the economy. The network development also enabled them to diversify their income sources as they have links with more variety and functional livelihood value chain systems. On the other hand, it was also stated that provision of village link road alone is not enough to ensure that rural people gain as much benefit as they can. Provision of agriculture extension works including other relevant issues like agricultural market information together with raising awareness of rural farmers of the benefits they could gain from the roads was felt as a need. Therefore, it recommended that a strategy to connect rural people to the main roads should be considered and developed in conjunction with the national strategy of the sector development.

Mohapatra and Chandrasekhar (2007) stressed the importance of road connectivity as a key component of rural development. The study stated that roads promote access to economic and social services, thereby generating increased agricultural productivity, non-agriculture employment as well as non-agricultural productivity, which in turn expands rural growth opportunities and real income through which poverty can be reduced. Presenting major findings of the impact assessment of PMGSY conducted by different agencies commissioned by India's Ministry of Rural Development, it stated that road connectivity leads to better transport systems during all seasons and made it easier to transport agricultural inputs to villages which has led some farmers to switch from food to cash crops. A rural road was also professed to lead to an increase in the number of families rearing animals for commercial purposes. Moreover, after the construction of PMGSY roads, an improvement in the employment situation in terms of more job opportunities, avenues for self-employment, and so on were observed. On-farm employment opportunities also increased due to shift from grains to cash crops. In addition to the positive impact observed on accessibility to preventive and curative health care facilities, the study also observed a better management of infectious diseases, an improvement in attending to emergencies, and an increase in the frequency of visits by health workers. An immediate and direct impact of providing rural road connectivity was observed in the quality of life as cooking gas became available in villages. All in all, it stated that providing all weather connectivity helps in promoting economic growth and alleviates poverty because PMGSY has accelerated works in connecting habitations all over the country. The impact of PMGSY on rural economy was found to be perceptible not only in the economic life of people but in the social life as well. It, therefore, concluded that there is little doubt that rural roads are vital to agro-based industry and rural development, to create jobs, and to make the country's growth more broad based.

A study titled 'The Poverty Impact of Rural Roads: Evidence from Bangladesh' by Khandker et al. (2006) examined the impacts of rural road projects and estimated the income-consumption benefits of road investment by controlling both household- and community-level heterogeneity using household-level panel data from Bangladesh. The findings of the study suggested that road improvement has a significant impact on men's agricultural wage, fertiliser price, and aggregate crop indices. The road effects were found to be substantial for adult labour supply in the project villages, and schooling of both boys and girls. Moreover, improvements in roads favourably affected household per capita consumption although the distribution of benefits was found to be independent of household resource endowments and location specific factors. Thus, the study stated that rural road projects do benefit the poor, but disproportionately.

However, the overall poverty effect of road improvement projects was found to be significant as it observed an approximate 5 percent poverty reduction in the villages under study. Thus, it was estimated that if the duration of road pavement took about 5 years, in each year, poverty fell by about 1 percent solely due to rural road improvements. This analysis of the data through an econometric framework thus shows that rural road investments reduce poverty significantly through higher agricultural production, higher wages, lower input and transportation costs, and higher output prices. The study goes so far as to say that road investments are pro-poor, meaning the gains are proportionately higher for the poor than for the rich.

Lombard and Coetzer (2006) studied the impact of rural road investment on socio-economic development of Africa. The study stated that although roads are the primary mode of transport in the area for both freight and passengers, the road network was found to be characterised by several constraints of which funding is among the major ones. This constraint was credited to result in lack of capital funds to develop and expand road network and also lack of funds for routine or periodic maintenance of existing roads. The consequence, it was professed, is deterioration of the road network which not only limits accessibility, mobility, and regional connectivity of a country, but also results in increased production costs and transport costs. Deterioration of a road network therefore causes significant ripple effects, ultimately creating a negative impact on the overall macro-economy, and subsequently impeding on poverty alleviation, socio-economic development, and overall macro-economic growth and development.

The study stated that continuous road investment should form the basis of any country's actions in place to address road infrastructure deterioration, development and maintenance. Stressing its importance, it stated that since rural households, and in particular women, spend a large amount of time and effort on transport activities to fulfil their basic needs, they are often severely hampered by the lack of an adequate rural road network. The researchers felt that significant limitations of growth and development of rural communities were experienced in the past, and are also being experienced today as a result of this. They went on to say that poverty is very often far worse in rural areas than in urban centres, as a result of lack of integration with urban centres due to lack of adequate accessibility and mobility. Moreover, local roads and tracks are often impassable, thereby proving it very difficult and in some cases nearly impossible for rural families to have access to the local rural economy. The study also stated that road infrastructure provides accessibility and mobility, leading in turn to increased transport operations, economic activity, subsequent economic growth, and ultimately a healthy and sound economy. It also claimed that an adequate road infrastructure network provides an advantage to a country in terms of improved regional integration, which helps to promote regional and international trade, and significantly enhances the economic growth and development of a country, thus alleviating poverty.

Using data from a household and community survey, Lokshin and Yemstov (2005) studied whether rural infrastructure rehabilitation help the poor. The empirical approach of the study applied propensity score-matched difference-in-difference (DiD) comparison between project (connected) beneficiaries and a control (unconnected) group to purge biases arising from time-invariant unobservable community characteristics that might affect project outcomes. Focusing on the road infrastructure, the study stated that rehabilitation of roads reduces commuting time and improves access to markets and is likely to generate new income opportunities for agricultural households, with impacts far beyond the site at which the rehabilitation project is implemented. It was found that the most immediate outcome indicators of a road rehabilitation project shows reduction in time spent for commuting to the district centre. Moreover, the share of villages with active non-agricultural small and medium-size enterprises was found to be increased significantly in the project villages along with a drop in the share of villages reporting barter exchange among the main channels for marketing agricultural products. In addition to these, it was found that off-farm employment and female wage employment rates increased in villages affected by road rehabilitation but declined in the villages in which projects were not undertaken.

However, indicators reflecting changes in the per capita market sales of agriculture products did not show any improvement, while the time for an ambulance to arrive in times of medical emergencies was found to be improved for some project villages. The outcome indicators adopted in the study were also assessed to show whether infrastructure rehabilitation projects had different impacts on the living standards of poor and non-poor households in the study area. It was found that the distributional impact of road rehabilitation projects varied for different outcome indicators. The study stated that the non-poor clearly benefited more in improved access to emergency medical assistance and in opportunities for non-agricultural employment. At the same time, female off-farm employment rates were found to show a greater positive change among the poor. The agricultural product sales indicator, however, was more complex to interpret because the sales of agricultural products plummeted in the whole country during the time of study and the decline was particularly strong for rich households. The impact analysis for this, therefore, showed that road quality is not the main driver of the process.

A case study based analysis was presented by Asian Development Bank (ADB in 2002 to study the impact of rural road on reduction of poverty. The focus is on key impact indicators using available secondary statistics, and relied on classical road impact assessment tools such as traffic and passenger surveys and changes in vehicle operating costs. In addition, it collected data from household surveys, key informant interviews, participatory rural assessments (PRAs), and feedback workshops. It was found that rural roads are an important enabling condition for livelihood development for people in the connected sites. This is evident from the finding that improved roads guarantee rural access throughout the year which enables the villagers to invest time and resources in outside endeavours.

Although the study confirmed that better rural roads are a necessity, it was found that this is not a sufficient condition for graduating from poverty as there was little evidence that roads have a direct impact in terms of reducing poverty on those groups in each community identified explicitly as being very poor. The ability of the poor and very poor to make significant economic use of the road was found to be dependent on their asset base and the entitlements to resources and opportunities that they can command, as well as the passage of time. In few instances, the poor who have invested savings in a small business or used their skills experienced graduation from poverty, using the benefits from the road. However, it recognised that the poor and very poor primarily benefited through the indirect impacts of road improvements, of better access to state services and improved provision of services to the village, and of opportunities in alternative livelihood income streams where the preconditions for their development are right. It was thus argued that the poor could also benefit broadly from improvements to the rural economy through increased opportunities for agricultural wage labour, but again these impacts are contingent on favourable preconditions being in place.

Windle and Cramb (1997) in their paper ‘Remoteness and Rural Development: Economic Impacts of Rural Roads…’ focused on three economic impacts of roads – agricultural production, employment and household income. For the study, data was collected with the use of questionnaire survey, supplemented by interviews with key informants and participant observation. Although some impacts were quantified in the study, more emphasis was placed on comprehensive reasoning and plausible inferences. The study showed that rural road provision has some economic impact on all communities in the area of influence. It was found, however, that impacts were not evenly distributed and this was believed to be influenced by two factors which are both related to accessibility. Access to a large urban centre was found to provide a market for both food and labour, which gives households more opportunities of earning cash income. Second, more remote communities benefit to a lesser extent than those with direct road access, and cash incomes and total incomes are higher at roadside communities. Communities without road access were found to be continuing to rely on hill paddy cultivation to ensure their subsistence needs. It was also stated in the study that rural road provision reduced some of the disadvantages associated with living in a rural area.

Highlighting their importance, the paper stated that roads are essential for economic development of an area, for speedy transportation of commodities and quick movement. Consequently considering the importance of road infrastructure in the socio-economic development of the people, it suggested that major road rehabilitation, maintenance, and upgrade efforts are required in the study area. This undoubtedly would require significant increase in road funding commitment by the government at all levels particularly at the local government. An alternative to this was given by suggesting that the existing maintenance strategies and practices be upgraded to aid effective and efficient movement and accessibility. The improvement in road quality, it was stated, reduces travel time and reduce vehicle and maintenance costs which in turn lowers the actual cost of marketing produce and thus reduce the costs of delivering inputs. Hence, it was felt that there is an urgent need to improve the existing network connectivity and density levels of road to achieve all these.

2.3 Roads and Agriculture Development

While the former studies assessed the overall economic impacts of roads, there are many that focused solely on the agricultural sector. It is of general knowledge that the mainstay of developing countries, especially for the rural parts, is agriculture and allied activities. So, it was felt that a literature review of the impact that rural road connectivity has on the sector is needed. As such, the following studies were reviewed to find what effect provision of rural roads have on agriculture and its development.

Ikejiofor and Ali (2014) analysed the characteristics of road transport and its effect on marketing of agricultural produce in Nsukka Local Government Area, South Eastern Nigeria. Data was collected from documentary materials, questionnaire, in-depth interview, and field observation. The variables considered were nature and conditions of roads, means of transportation used, and distance travelled. The field observation showed that the roads in the study area are in a deplorable state which made the roads seasonal, being nearly impassable during the rainy season. Thus, the quality of roads was believed to affect the quality/freshness of farm produce, leading to a reduction in the cost of farm products, and the quality of life and well being of farmers. It was further explained that this arises from the fact that farmers spend their meagre income on buying drugs and treating themselves for sprains, pains, headaches and overall body ache due to long hour of trekking heavy loads through roads of poor quality. It was found that this affected in loss of man/hour time as the journey to farm and market takes a long time. It also found that majority of farmers use head poterage in their journey to farm and in the journey to market which confirms that head poterage is still the most used means of transporting agricultural produce. This, further, is mainly because of the nature of roads which makes it difficult for other means of transportation to be used. Therefore, the non-usage of buses, cars, pickups stems from the fact that roads are generally poor and seasonally accessible.

One of the suggested measures is the construction of more rural feeder roads to link farmlands to the markets and where roads are in a deplorable state of despair so as to enhance easy evacuation of agricultural produce. Another measure suggested was that the government should make efforts to improve upon the nature of the roads by concession of rural roads to private firms that will constantly maintain the roads. This is in line with the inaccessibility caused by poor state of roads which reduces productivity. Moreover, having established the fact that transportation cost increases the price of agricultural products, it was recommended that the government with the collective will of the people should establish food collecting points in the various rural areas where the government can collect and transport the produce to urban markets. It was believed that these recommendations if followed would help in increasing production and distribution of agricultural products to feed both the urban and rural dwellers.

A study by Adedeji et al. (2014) assessed the impact of roads on rural development in Obokun local government area of Nigeria. Selecting communities through a randomised systematic stratified sampling technique, it adopted survey approach in which data was collected through primary sources, consisting of personal observations and questionnaire administration. Using indices such as surface condition, road width, number of lanes, and reliability in all seasons, it was found that the condition of road in the study area varies from one community to another; some enjoy good roads while some do not which shows disparities in the levels of development and hence, no uniform development in rural areas. It was also presented that farm trip has the highest percentage of trip in the communities surveyed which implies that majority of the people in the area are farmers and thus the condition of roads in the area has a significant effect on their farming activities. It stated that most farmers in the rural areas found it difficult to transport perishable produce from farm to urban areas, where they have better patronage to boost their economic ability. It was felt that efficient and effective road facility would enhance the transportation of these produce to urban areas where they would be processed, distributed locally, and exported.

The analysis also showed a low level of interaction between the rural areas and neighbouring urban centres through the assessment of their trip frequency to urban centres. This was found to be a result of transportation problem which ranges from high cost of transportation to bad road conditions, especially during monsoon. To correct such anomalies caused by a low level of development in rural communities and also to ensure sustainable development, it was felt that there is need for integrated development strategy which seeks to develop all sectors of the rural economy and link them up effectively with their urban counterpart without a sense of backwardness. To improve the level of development in the area, it was suggested that there is a need for adequate provision of rural transportation and other infrastructural facilities. Also, the need to empower the grassroots government was felt to be of paramount importance owing to the fact that the construction and rehabilitation of most rural roads fall within the jurisdiction of the local government.

Kiprono and Matsumoto (2014) studied the effect of infrastructure improvement on the agricultural sector of Kenya. The study examined the impact of improving road accessibility on the change in technology adoption, usage of fertilisers, maize productivity, and market participation by smallholder farmers. It used geo-referenced panel data from Research on Poverty, Environment and Agricultural Technology (RePEAT), merged with Roads Network data. The two independent datasets collected were merged to provide a balanced panel, enabling the use of a technique called difference-in-difference (DiD). This makes it possible to control both the biases due to omitted variables as a result of non-random placement of roads as well as reverse causality, providing a substantial degree of explanatory power. The results showed that the use of maize hybrid seeds, chemical fertilisers, maize productivity, and milk market participation increased more in areas with better road access improvement. However, there was no evidence to support that improvement of road infrastructure could lead to an increase in maize market participation. The results showed that even though there was wide-spread improvement of roads, the impact was experienced more in areas with poorer road access in the initial period. Therefore, it was found that the recent infrastructure investment contributed to productivity enhancement, especially in remote areas.

Overall, the study shed light on the importance of improving infrastructure, especially in the remote areas, where impact can have far reaching benefits. As the study was based in rural areas, it is postulated that the results of the study are lower bound. More exploration is needed to ascertain the importance of the study to enable generalisation to other settings such as urban areas. Moreover, the findings imply that roads improvement is a key factor towards alleviating poverty in the country. However, there could be more benefits to the improvement of road infrastructure in rural areas, for example, in land use alteration and human capital investment.

Eze (2012) determined impact of rural infrastructures, particularly feeder roads and provision of water supply on farmers' agricultural practices and socio economic status. The findings of this study indicated that farmers transported farm inputs such as fertilisers, cassava stems, and seed yams easily to their farms because of good roads which previously were found to be difficult. It also revealed that farmers found it easy to convey agricultural produce from rural areas to urban areas and sell them at profitable market rates because of accessible rural roads. In addition, movement of farmers and their families to health centres for treatment was found to be easy and comfortable. Before, lack of good roads prevented farmers from these operations. It was also found that the provision of rural water supply had positive impact on the socio economic status of farmers in the study area. It also revealed that farmers' agricultural practices are positively affected by the provision of water supply and low cost irrigation scheme. The findings showed that the provision of water supply impacted the farmers' good health because they have access to good drinking water all year round which reduce disease infection among farmers. Diseases which hitherto ravaged rural farmers and prevented them from active participation in farm work had been eradicated by the provision of clean water supply.

The findings also showed that farmers produce large quantities of crops all year round for their families and for markets. All in all, the provisions of rural infrastructures to farmers has far reaching positive effects on their agricultural activities and socio-economic status as it was found that there were significant positive changes on the socio economic status of farmers. Hence, rural farmers who would not have been able to enjoy good health now have access to health facilities because of the provision of roads in the state. Farmers were found to produce crops in large quantities, sell and make good profit, and have enough money to meet other social demands and commitments. Thus, the study proved that the intervention and the implementation of rural infrastructural development such as the provision of water supply and construction of feeder roads have caused some positive changes not only in the agricultural activities of farmers and their socio-economic status, especially on farmers that had contacts with the project but also on the life of other farmers in the area. Therefore, it can be derived from the study that roads along with water supply are central to agricultural activities/operations, productivity, and welfare of farmers in any agrarian society.

A study by Llanto (2012) titled 'The Impact of Infrastructure on Agriculture Productivity' provided an empirical basis for the perceived link between rural infrastructure and agricultural productivity. It uses the standard production function approach with agricultural productivity as the dependent variable and rural infrastructure and other variables as independent variables. Results of the empirical estimation showed that infrastructure has a significant impact on regional Gross Domestic Product (GDP) growth and that inadequate infrastructure acts as a binding constraint to economic growth. It noted that paved roads contribute to the physical integration of rural areas with urban areas, which result in access to faster growing urban markets. Looking at it from another angle, the study argued that easier access contributes to greater mobility of productive labour that move to better paying non-agricultural sectors as the phenomenon of young rural and agricultural workers leaving the countryside in search of better opportunities in the urban areas and even outside the country was experienced. Good-quality roads also enabled rural households to generate off-farm incomes from economic opportunities that present themselves to those households.

Despite data constraints, the study's overall empirical results indicate a significant link between rural infrastructure and agricultural productivity. It was found that rural roads in particular provide the important connectivity with growing markets adjacent to rural areas and also lessen input costs and transaction costs of rural producers and consumers. It showed that rural areas that have good road infrastructure experienced higher rates of growth of agricultural productivity than those areas with inadequate roads. It was also found that regions with high infrastructure investments tend to have higher economic growth, while regions with low infrastructure investments tend to have lower economic growth. However, it was found that there is an imbalance in the availability and quality of infrastructure at the regional, provincial, municipal, and city levels. Richer and more advanced regions have better infrastructure while lagging regions are weighed down by inadequate infrastructure. The linkage of the primary road network with secondary roads is critical for reducing high transport and logistics costs, which were found to have contributed to low productivity and lack of competitiveness of domestic producers.

A somewhat different approach can be found in the study undertaken by Freitas et al. (2009) which studied the relationship between roads and land use. It stated that roads, along with topography can determine patterns of land use and distribution of forest cover. Employing Pearson's Correlation between road connectivity and density and chi-square tests for testing the hypothesis of independence between road parameters and land use and coverage, it was found that an intense increase in road density leads to changes in land use and occupation.

Moreover, the study associated the increase in road density and connectivity with the expansion of urban development, favoured by the installation and broadening of the power grid and by improvements in the highway connecting the study area to the nearest city.

The study also found that density and connectivity of roads do not present a significant relationship to altimetrical variance. In other words, road distribution did not seem to be the most relevant factor to explain greater forest coverage in areas of higher altitude. On the other hand, the relationships found between forest coverage and distance from roads showed that the areas closer to the roads possessed less forest coverage than expected and more distant areas presented greater forest coverage than expected. Besides, farmland areas and those with rural and urban facilities were greater than expected near roads, and smaller than expected in more distant areas from the roads. Thus, it may be stated that forest areas were found to be concentrated in areas distant from roads, while the farming areas and rural and urban facilities concentrated near roads. However, it was found that road proximity positively influence farmlands and human occupation and, conversely, negatively influence forest coverage. The increase in road density was credited as one of the factors that led to loss of forest coverage, since it was smaller near roads. Therefore, it was suggested that roads should be taken into consideration as facilitators of deforestation agents and as a relevant additional factor to define conservation strategies and the restoration of rainforests and their biodiversity.

Ulimwengu et al. (2009) in their study 'Paving the Way for Development: The Impact of Road Infrastructure on Agricultural Production and Household Wealth in the Democratic Republic of Congo' stated that rural roads are somewhat unique in terms of their capacity to literally pave the way for other investments, such as schools, health services, and security services. The results provided preliminary evidence on the question of what type of infrastructure is important for agricultural production and trade. Given the strong prior of the researchers about the importance of agriculture in the country, the study unsurprisingly found highly significant and negative elasticities between travel times to sizeable cities. Another finding is that the road and rail investment proposed by various donors had quite a limited impact on market access for the agricultural sector as the dispersion of the rural population means that feeder roads also have to be improved. One of the reasons given why road transport was relatively unattractive compared to river transport is that the road network as a whole is very weak, and to a great extent the road chain is only as strong as its weakest link.

Many of the areas with the highest agricultural potential are ignored by the proposed investments, even though these regions are a potential breadbasket. It was felt that if adequate political stability could be achieved in these areas, road infrastructure could open up new opportunities for agricultural trade. The researchers acknowledged that they had probably underestimated the potential impacts that improved infrastructure could have on agricultural and rural development in the country. Unlike many other African countries, the Democratic Republic of Congo uses virtually no modern inputs, such as fertilisers or seeds. For this reason, it was believed that the estimated elasticities between production and market access only capture demand-side effects. However, it can be stated through all of these factors that, although roads and other infrastructures do indeed 'pave the way' for future developments, the returns to roads still heavily depend upon how they are used.

Mu and van de Walle (2007) assessed the impacts of rural road rehabilitation on market development at the commune level in rural Vietnam and examined the variance of those impacts and the geographic, community, and household factors that explain it. Double difference and matching methods were used to address sources of selection bias in identifying impacts. The results of the study show indications of significant average impacts on the development of local markets and related indicators. However, it was found that few outcomes responded rapidly to the new and improved roads as most impacts are not apparent in more than two years (on an average) after road rehabilitation. Significant average impacts on the presence and frequency of markets and on the availability of various services were observed. Also, it was found that the rehabilitation of rural roads resulted in households switching from agriculture to non-agricultural, mostly service-related activities, with tailoring and hairdressing services becoming more commonly available. These impacts were not sharp and short-lived but took time to emerge, and were found to be rising over time. It also noted that there were quicker, sustained, and robust impacts on primary school completion rates.

At the same time, the study argued that the circumstances of a project's location influence its impacts. It was found that, on the whole, poor communes tend to experience higher impacts on many indicators of market development which is the outcome of two broad sets of attributes of poor areas that tend to work in opposite directions to influence the impacts on local markets of road improvements. On one hand, the poor areas were less likely to have markets and market-related institutions and services, and this alone means more scope for road improvements to help develop those same institutions and services. On the other hand, poor areas were found to possess various other attributes that tend to discourage transport-induced local-market development. They were found to be more likely to have a high share of ethnic minorities and high illiteracy rates, were more isolated and had lower population densities, and were less likely to initially have a local market – which again impedes development of other market-related institutions and services in response to road improvements. In a nutshell, the results of the study suggest that, on balance, the road project tends to have larger impacts on market development in poorer communes due largely to the initially lower market development in these places. It was felt that this is strong enough to outweigh the fact that poorer communes have other attributes (besides low initial market development) that reduce impacts of road improvements.

In the study titled ‘Access to Markets and the Benefits of Rural Roads,’ Jacoby (2000) stated that roads definitely play a central role in rural development but that little is known about the size and distribution of benefits from such investments. The paper developed a method for estimating household-level benefits from road projects using the relationship between the value of farmland and its distance to agricultural markets. Using data from Nepal, a country with a largely agrarian economy, a sparse highway network, and extremely difficult terrain, the paper examined the distributional consequences of rural roads. An empirical methodology was developed for estimating the household-specific benefits from hypothetical road projects using information on the value of farmland and distance to agricultural markets. The study stated that if a farmland behaves like an asset, which is a testable assumption, then its value equals the discounted stream of maximal profits from cultivation. Hence, the higher farm profits due to lower transport costs was capitalised in farmland values, and benefits to consumers from lower transport costs will also be reflected in wages. Thus, using estimates of the land value-distance and the wage-distance relationship, each household's benefit was calculated from a hypothetical road project and compared with the household's income.

Summarising the findings, the study suggested that providing extensive road access to markets would confer substantial benefits on an average, much of these going to poor households. However, it was stated that the benefits would not be large enough or targeted efficiently enough to greatly reduce income inequality in the population unless there is an exceptionally high degree of inequality aversion. Thus, rural road construction is certainly not the magic bullet for poverty alleviation. Another lesson that can be learned from the study is that plot-level data on land values and characteristics, rarely collected in household surveys, can be extremely useful in measuring the benefits of infrastructure investments in less developed countries (LDCs), and not only of rural roads. Land may not always behave like a typical asset, so benefit capitalisation may be imperfect, but the asset-pricing model can be tested to determine whether the methodology developed is appropriate in a particular context. The research also emphasised other benefits of rural roads besides cheaper transport to and from agricultural markets, such as better access to schools and health facilities and, more generally, to a greater variety of consumer goods.

2.4 Roads and Social Infrastructures

Although already incorporated in the studies by various researchers of road connectivity's impact on rural development presented before, there are some who focused mainly on its impact on social infrastructures. A few of them are discussed here.

Banerjee and Sachdeva (2015) studied the impact of a massive nationwide road construction programme on the usage, provision, and awareness of preventive health care. The study use village population and matched the household survey data with the programme placement data at the village (treatment) level. It adopted a Fuzzy Regression Discontinuity Design (FRDD) to estimate the causal effect of the road-building programme. The findings of the study suggest that connecting villages with an all-weather road increases preventive health care usage by the residents of the village. Women were found to be more likely to seek antenatal care, to have delivery conducted by trained health personnel, and were more likely to use modern contraceptive methods. Moreover, households were found to be more likely to treat water and more likely to be covered by health insurance.

It was observed that households in the connected villages were more likely to be aware of the various government-run health care programmes, and the provision of roads was found to increase the likelihood of various health care workers being present in the village, health camps being organised, and improvement in the health centre. In the treatment villages, an increase in social interaction was found and these villages were more likely to have a women's assembly, a welfare committee for the sick, a self-help group, and a youth club. It was deemed that roads not only create physical pathways but also improve the informational connectivity between regions because increase in health care usage comes not only from increase in income or reduction in travel cost but also from increase in the awareness amongst households and individual, improvement in health care supply, and increase in social interaction within and between villages, which all had positive linkages with better road connectivity as proved by the study.

The study titled ‘Role of Rural Road Connectivity in Accelerating Development & Improving Quality of Life’ by Parida (2014) also focused on the impact that PMGSY has on rural development of the state of Orissa. It was found that construction of PMGSY roads led to an improvement in the accessibility to education facilities which resulted in increased school enrolment and school attendance, especially in the number of girls going to schools. Moreover, regular attendance of the teachers throughout the year was observed and greater willingness was found evident among parents to send their children for higher studies and college education outside their village. In addition to education, it was found that road connectivity increases the frequency of visits by government officials and grass root level functionaries like health workers/auxiliary nurse and midwives, village level workers and village anganwadi workers, and that there had been an improvement in accessibility to banks, and post and telegraph offices. The study also mentioned that in villages where roads had been developed to varying degrees, the social impacts are not as massive as from opening a new road, but are still significant as socio-economic development parameters adopted were generally positively correlated with the type and condition of the roads.

All in all, it stated that areas with poor accessibility are worse off compared to areas with better road access, while the highest social and economic progress occurred in areas with established paved roads for a long time. At the same time, the study recognised the fact that road connectivity is often only one of many factors that influence change in the state of development, social and economic, of a community and that there are several other factors which are at work simultaneously. It stressed that a causal relationship between the road and the social and economic changes in its area of influence is often not possible to establish and that very often what a study can establish is simply that the road connectivity, along with other factors, are positively correlated with a given change.

Empirical evidence was given by Castaing (2011) of the effect of education on per capita consumption growth and its relationship with road connectivity through the query of whether a change in road connectivity affects the distribution of earnings according to the level of education. The study found that over the study period, post-primary education represented an advantage over primary education in determining per capita consumption growth in the study area where road connectivity improved or did not deteriorate. On the contrary, no similar benefit was found for primary education compared to receiving no instruction. The distribution of earnings shifted in favour of post-primary educated people in communities that experienced zero change or an improvement in road connectivity, but was not affected where connectivity deteriorated. Coupled with the lack of a significant advantage of primary education over non education, it was concluded that basic knowledge and skills acquired in primary school are certainly not sufficient to enable villagers to enjoy new employment and activity opportunities opened up by the improvement in road connectivity.

Thus, it may be stated that the results of the study called for a hand-in-hand design of roads and education investments. Integrating the effect highlighted in the development policies could help to achieve a poverty reduction more efficiently than if roads and education were taken separately. Furthermore, the study stated that the expected impact of road connectivity improvement on consumption may be overestimated in very low education attainment regions while it could be underestimated if road connectivity improvements occur in high education attainment areas. A simple recommendation, it was stated, would be to invest for roads only in regions where post-primary education is spread. But to reach post-primary grades, one has to first achieve primary education cycle. So, primary and post-primary education investments, it was stated, should not be separated because they belong to the same investment package. From the study, it appears that road connectivity could also help at this stage, as it facilitates access to education facilities.

A host of studies also analysed the impact that rural connectivity has on women population. One such study is done by Atagher and Atagher (2014) which assessed the availability of rural roads among project and non-project women farmers in Benue State, Nigeria. It stated that efficient economic infrastructure is central to raising productivity and increasing growth. Using simple descriptive statistics to analyse the questionnaires collected, it was found that most of the rural roads in the study area are not accessible all year round, resulting in high transport costs with attendant inability to procure and transport inputs to areas of need, and in the inability to evacuate and distribute produce to areas of high demand and need, with a resultant negative effect on respondents' income, poverty reduction, and national development. Moreover, the study also assessed the sources of domestic water available to respondents of the study area. It was found that a negligible percentage of respondents get their water supply from sources close to them and therefore, would have to spend time and other resources looking for water. It stated that the time wasted in searching for water by the women and children could be saved and devoted to other uses.

Another implication of this finding is that since only a small amount of the women farmers had access to clean water supply, getting water from sources other than hygienic sources (such as boreholes and pipe borne water). This was deemed to have implication for respondents' (their families and communities) health as an impure water supply can lead to ill health constraining productivity, income and welfare. In both the cases, it was found that there were stark differences between the villages in which development project was undertaken and where it was not. Henceforth, it recommended for more provision of road infrastructures to improve their productivity and improve welfare of the people, especially the women in the study area.

Another study is the one by Bravo (2002) titled 'The Impact of Improved Rural Roads on Gender Relations in Peru.' The paper discussed that roads alone do not have a great impact on poverty alleviation and that an efficient and equitable strategy of poverty reduction must be based on a full understanding of the gendered nature of poverty. Giving various avenues of impacts, the study stated that improved roads reduce traveling time related to marketing tasks and in accessing health services. It was found that the gap between young men and women in enrolment in secondary education had been reduced to some extent, especially in rural areas. Improved roads made it easier and faster to reach school. In terms of access to technical and undergraduate education, however, the study found no change in the gap between males and females after the rural roads programme. In the highlands where economic resources are scarce, only men were found to have an opportunity to continue education. The study also gave the impact of improved road on access to market. It was found that road rehabilitation had led to an increase in the number of women visiting markets, either to sell their produce or buy other products. It had also increased productive roles among women because the number of women stockpiling their produce was now comparable to that of men after the provision of improved roads.

It was also noted that improved roads facilitated transport services and, as a consequence, seasonal migration among young people was experienced. It was further discussed that increased travel by women also meant improved access to information. Access to markets brings contact with people from other regions, along with a chance to learn about and from them. It was recognised that improved roads can also have an effect on women's participation in community organizations. However, the study found that greater participation by women in general community meetings were still far from noticeable in all the study areas. This reduced participation prevents women from letting their voices be heard and thus, planning meetings failed to take account of women's needs. Although the rehabilitation of roads and paths was found to improve mobility and access to services, livelihood improvement was not uniform for all groups in the study. In fact, improvement was found to be greater for men than for women. Social customs, unavoidable household burdens, lack of control over cash resources, and minimal transport services limit travel by women.

Nevertheless, the study made some commendable recommendations. It stated that transport intervention programmes need to pursue a more clearly defined gender strategy to ensure participation by women in transport resource management and decision making. Road users, especially women and children, should be among those consulted during the planning stage before any decisions are taken about transport improvement. Moreover, it was also suggested that women's productive and family life tasks should be considered if they are to be included in maintenance work on paths, so as not to add to their existing workload. Finally, it stated that affordable transport services and appropriate intermediate means of transport should be considered and encouraged in transport intervention programmes.

2.5 Concluding Remarks

Although the reviewed studies vary greatly in methodology, in research objectives, and in temporal and spatial coverage, in most cases they support the hypothesis that rural road connectivity has favourable impacts on livelihood, production and productivity, poverty alleviation and economic development in general.

The studies of Parida (2014), Ibok and Daniel (2013), Olagunju et al. (2012), Dorosh et al. (2011), Umoren et al. (2009), Mohapatra and Chandrasekhar (2007), Lombard and Coetzer (2006), and Windle and Cramb (1997) found a positive and significant relationship between road connectivity and economic development. Specifically, economic activities and employment opportunities increased with the provision of rural roads, thus leading to a reduction in poverty, according to the findings of Llanto (2012), Rasmussen and Broegaard (2011), Orabourne (2008), Khandker et al. (2006), and Lokshin and Yemstov (2005). Moreover, it was found in the works of Adedeji et al. (2014), Ikejoifor and Ali (2014), Kiprono and Matsumoto (2014), Eze (2012), Ulimwengu et al. (2009), and Mu and van de Walle (2007) that road connectivity does lead to agriculture development – its productivity and marketing; while Freitas et al. (2009) and Jacoby (2000) in particular found favourable changes in pattern of land utilisation as a result of the same.

In addition to these, reviewing of existing literature like the studies of Banerjee and Sachdeva (2015), Parida (2014), Golmohammadi (2012), and Castaing (2011) shed light on the fact that road connectivity does have significant impacts on the development of basic social infrastructures, specifically that of health and education. At the same time, the works of World Bank (2014), Atagher and Atagher (2014), and Bravo (2002) showed that improved rural roads have beneficial impacts on the women population. On the other hand, what has come to light from the review of various studies (World Bank, 2014; Golmohammadi 2012; Llanto, 2012; Khandker et al., 2006; Bravo, 2002; Windle and Cramb, 1997) is that road investments can contribute to spatial inequities across and within regions of better and poor connectivity statuses.

Some of the points that need to be addressed, but are scarce in the existing literature, are discussed in the following. Firstly, in their assessment, most studies took into account only the connectivity parameter of whether the study areas are connected with all weather roads. They did not focus on road traffic. This means there is lack of analysis on if being frequented by vehicles on a daily basis plays a significant role in the development of that area. Moreover, in the majority of the literature, assessment was made by simply demarcating their study areas into connected and unconnected areas. No attempts were made to find out whether distance plays a distinctive role. Lastly, although deemed as a useful indicator of road infrastructure, only a handful of the reviewed considered density of road as a connectivity measure. It is important to account for the different levels of road density as this facilitates marketing and transport, thus having different economic returns and different impacts on economic development.

CHAPTER 3

SITUATIONAL PROFILE OF CONNECTIVITY IN INDIA

3.1 Introduction

It is an academic interest to undertake an analysis of the status of road connectivity in the country as a whole so as to learn the present scenario which will guide us in the study of road connectivity and economic development for the study areas. As such, this chapter presents an overview of connectivity infrastructure and the level of socio-economic development of India and of Mizoram, in particular. The status of connectivity infrastructures and socio-economic development of India is obtained mainly from the data of National Institution for Transforming India (NITI) Aayog. While for Mizoram, the annual reports of the state Public Works Department (PWD), the Statistical Abstract and various issues of Economic Survey of Mizoram are being utilised.

The chapter is thus broadly divided into two parts. The first section shows the connectivity infrastructure of various states of India and their status of demographic and other socio-economic indicators of development. The second section focuses on the situational profile of road infrastructure in the state of Mizoram, while at the same time highlighting the measures undertaken by the government for the provision of the public good.

3.2 Connectivity Infrastructure and Socio-Economic Development across the Indian States

India has one of the largest road networks of over 48.65 lakh km, comprising expressways, national highways, state highways, major district roads, other district roads, and village roads. The national highways with a total length of 96,214 km serve as the arterial network of the country (Economic Survey, 2014-15). The NITI Aayog's paper titled ‘Comprehensive Roadmap for Development of North Eastern States…..’ identified 6 connectivity infrastructures which are highway length per sq km, state highways per sq km, per capita consumption of electricity presented in kWh, total rail route (km) per sq km of area, percentage of rural tele-density, percentage of urban tele-density, and percentage of households electrified. On the other hand, the indicators of socio-economic development are varied and comprise of literacy rate, infant mortality rate, child sex ratio, per capita income, households with improved drinking water, households availing banking services, among others. It would be important to note that the interpretation of the data of the following section covers just the extremes of each parameter while at the same time focusing on the North-Eastern States and Mizoram in particular.

3.2.1 Connectivity Infrastructures

The performance of the 28 states on the mentioned connectivity infrastructures is presented in Table 3.1. It can be seen that the highway length per square kilometer of the states ranges between 0.073 km and 0.006 km with an all India average of 0.023 km. In relation to the total geographical area of the state, Goa has the highest network of highways at 0.073 km while the national highway of Jammu and Kashmir is the lowest at 0.006 km. There are 17 states above the national average and 10 states below it, while Karnataka stands at the average. Of the 17 states above the national average, 6 of the eight North-East states are included. Mizoram with a length of 0.049 km has the fourth highest national highway network among the states of India.

At the same time, the state with the highest network of state highways per sq km is Kerala at 0.112 km while Arunachal Pradesh has 0 state highways. With the all-India average being 0.05, there are 13 states above this average of which 5 of the

North-Eastern states falls short. Among them is Mizoram with road network of 0.033 km which makes it the nineteenth state in terms of this connectivity infrastructure.

Table 3.1. Indian States in terms of Connectivity Infrastructure

Sl. No.	States	Highway Length per sq. km.	State Highways per sq. km.	Total Rail Route (km) per sq. km. of area	Rural Tele Density (%)	Urban Tele Density (%)	Household Electrified	Per capita consumption of electricity (kWh)
	All India	0.023	0.05	0.02	44	145.5	67.2	914.4
1	Andhra Pradesh	0.016	0.039	0.018	45.4	167.6	92.2	1134.9
2	Arunachal Pradesh	0.024	0	0.00001	42.7	153	65.7	718.6
3	Assam	0.037	0.04	0.064	34.4	126.3	37	240.3
4	Bihar	0.044	0.052	0.026	29.4	151	16.4	145.4
5	Chhatisgarh	0.017	0.039	0.027	33.7	116.3	75.3	1495.4
6	Goa	0.073	0.075	0.049	72	154.3	96.9	2044.9
7	Gujarat	0.021	0.094	0.0004	57.4	137.6	90.4	1796.3
8	Haryana	0.037	0.057	0.119	59.8	121.4	90.5	1722.3
9	Himachal Pradesh	0.027	0.029	0.029	77.1	325.9	96.8	1379.8
10	Jammu and Kashmir	0.006	0.0003	0.001	42.6	130.7	85.1	1043.4
11	Jharkhand	0.027	0.024	0.003	29.4	151	45.8	846.8
12	Karnataka	0.023	0.108	0.011	46.2	167.2	90.6	1129.1
13	Kerala	0.037	0.112	0.083	64.3	189.7	94.4	630.1
14	Madhya Pradesh	0.016	0.034	0.003	33.7	116.3	67.1	752.7
15	Maharashtra	0.014	0.106	0.019	55.8	116.3	83.9	1239.3
16	Manipur	0.059	0.051	0.00004	42.7	153	68.3	352.9
17	Meghalaya	0.052	0.038	0	42.7	153	60.9	690.2
18	Mizoram	0.049	0.033	0.0001	42.7	153	84.2	469.4
19	Nagaland	0.03	0.06	0.001	42.7	153	81.6	268.5
20	Odisha	0.024	0.023	0.016	39.9	161.1	43	1209.2
21	Punjab	0.031	0.029	0.044	72	154.3	96.6	1761.1
22	Rajasthan	0.021	0.031	0.017	48.6	160	67	981.9
23	Sikkim	0.021	0.025	0	42.7	153	92.5	861.8
24	Tamil Nadu	0.038	0.083	0.031	74	138.2	93.4	1226.3
25	Tripura	0.038	0.066	0.014	42.7	153	68.4	861.8
26	Uttar Pradesh	0.032	0.033	0.037	35.6	131.5	36.8	450
27	Uttarakhand	0.038	0.071	0.006	35.6	131.5	87	1297.3
28	West Bengal	0.03	0.051	0.045	41.7	135.3	54.5	593.9

Source: NITI Aayog, 2015

Table 3.1 also shows that the all-India average of total rail route per sq. km. of area is 0.02 km. There are 11 states which have rail route above the national average where Haryana stands first at 0.119 and Meghalaya and Sikkim at the bottom as the state is not connected with rail route. At the same time, Mizoram's rail route per sq km of total geographical area is 0.0001 km which is the fifth lowest in the country.

In terms of percent of rural tele-density, the highest percentage is of Himachal Pradesh with 77.1 percent and the lowest are Jharkhand and Bihar at 29.4 percent. With an all-India average of 44 percent, there are 11 states that have rural tele-density above this average. Mizoram has 42.7 percent tele-density which is the twelfth highest in the country. The scenario is slightly better for urban tele-density. With the all-India average at 145.5 percent, there are 17 states above this average, including seven of the north east states. The highest position is occupied by Himachal Pradesh with 325.9 percent while Maharashtra is at the lowest with 116.3 percent. Mizoram is the ninth highest with 153 percent which is the same percentage of urban tele-density of Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, and Tripura.

Moreover, the all-India average of electrified households stands at 67.2 percent. There are 18 states with more electrified households than this average, including the north east states of Manipur, Mizoram, Nagaland, Sikkim and Tripura. Goa has the highest number of its households electrified at 96.9 percent and Bihar is at the bottom with 16.4 percent. Mizoram has the thirteenth highest percentage in India at 84.2 percent. Consumption of electricity is also presented in the table. Per capita consumption of electricity is lowest in Bihar at 145.4 kWh while it is highest in Goa with 2044.9 kWh. The number of states above the national average of 914.4 kWh is 14 – which is half of the total number of states in the country. With 469.4 kWh, Mizoram is among the states of low per capita consumption of electricity.

3.2.2 Socio-Economic Development

Table 3.2 shows the performance of the states on percentages of birth rate (2014), death rate (2014), unemployment rate (2011-12), and the total literacy rate (2011). Moreover, it also presents the infant mortality rate (per 1000 live births), percentage of underweight children under 5 years (2005-06), and child sex ratio (2011) denoted as number of females per 1000 males.

Table 3.2 States on the Basis of Various Demographic and Socio-Economic Indicators

Sl. No.	States	Birth Rate (%) 2014	Death Rate (%) 2014	Unemployment Rate (per 1000) 2011-12	Total Literacy Rate (%) 2011	Gender Gap in Literacy (%) 2011	Infant Mortality Rate (per 1000 live births)	% of underweight children under 5 years (2005-06)	Child Sex Ratio (0-6 yrs) 2011
	All India	21.4	7	27	74	16.7	40	40.9	919
1	Andhra Pradesh	17.4	7.3	24	67.7	15.8	39	29.8	939
2	Arunachal Pradesh	19.3	5.8	21	67	14.1	32	29.7	972
3	Assam	22.8	7.8	50	73.2	11.5	54	35.8	962
4	Bihar	27.6	6.6	37	63.8	20.1	42	54.9	935
5	Chhatisgarh	24.4	7.9	20	71	20.9	46	47.8	969
6	Goa	13	6.6	48	87.4	11	9	21.3	942
7	Gujarat	20.8	6.5	7	79.3	16.5	36	41.1	890
8	Haryana	21.3	6.3	31	76.6	18.6	41	38.8	834
9	Himachal Pradesh	16	6.7	20	83.8	14.2	35	31.1	909
10	Jammu and Kashmir	17.5	5.3	48	68.7	20.3	37	24	862
11	Jharkhand	24.6	6.8	32	67.6	22.2	37	54.6	948
12	Karnataka	18.3	7	19	75.6	14.7	31	33.3	948
13	Kerala	14.7	6.9	91	93.9	4	12	21.2	964
14	Madhya Pradesh	26.3	8	11	70.6	20.5	54	57.9	918
15	Maharashtra	16.5	6.2	15	82.9	14.3	24	32.7	894
16	Manipur	14.7	4	47	79.9	13.3	10	19.5	936
17	Meghalaya	23.9	7.6	9	75.5	3.4	47	42.9	970
18	Mizoram	16.1	4.3	37	91.6	4.3	35	14.2	970
19	Nagaland	15.4	3.1	256	80.1	6.6	18	23.7	943
20	Odisha	19.6	8.4	29	73.5	18	51	39.5	941
21	Punjab	15.7	6.7	27	76.7	10.1	26	23.6	846
22	Rajasthan	25.6	6.5	17	67.1	27.9	47	36.8	888
23	Sikkim	17.1	5.2	11	82.2	10.9	22	17.3	957
24	Tamil Nadu	15.6	7.3	30	80.3	13	21	25.9	943
25	Tripura	13.7	4.7	146	87.8	9	26	35.2	957
26	Uttar Pradesh	27.2	7.7	24	69.7	20	50	41.6	902
27	Uttarakhand	18.2	6.1	42	79.6	17.6	32	31.7	890
28	West Bengal	16	6.4	44	77.1	11.5	31	37.6	956

Source: NITI Aayog, 2015

The all-India average birth rate is 21.4 percent. There are 8 states that have rates higher than this average among which the north-eastern states of Assam and Meghalaya are included. Goa has the lowest birth rate at 13 percent while the state with the highest birth rate is Bihar at 27.6 percent. With 16.1 percent, Mizoram is among the top ten states that have a low birth rate. The table also shows the death rate across the states of the country. It can be seen that there are 8 states which have death rates equal to or greater than the all-India average of 7 percent. Here also, the state with the lowest death rate is Nagaland at 3.1 percent while Odisha has the highest death rate at 8.4 percent. Mizoram with 4.3 percent has the third lowest death rate among the states of India.

The unemployment rate (2011-12) for India is 27 per 1000 population. There are 16 states having unemployment rates higher than this average including the north east states of Assam, Manipur, Mizoram, Nagaland and Tripura. The state with the lowest unemployment rate is Gujarat in which 7 percent of the population is unemployed. The highest rate is suffered by Nagaland at 256 persons while the unemployment rate of Mizoram is 37 per 1000 which is the eighteenth lowest in India.

The all-India average for total literacy (2011) is 74 percent. This rate is the highest in Kerala at 93.9 percent while Bihar has the lowest literacy rate at 63.8 percent. Mizoram comes a close second to Kerala at 91.6 percent. Specifically, male literacy ranges between 96 percent for Kerala and 73.4 percent for Bihar. The national average is 82.1 percent and Mizoram stands second with 93.7 percent. On the other hand, female literacy rate ranges between 92 percent for Kerala and 52.7 percent for Rajasthan. The national average is 65.5 percent and Mizoram proudly stands at the second place with 89.4 percent. Therefore, it is evident that there is still a gender gap in literacy in the country which ranges from 3.4 percent in Meghalaya to 27.9 percent in Rajasthan. The literacy gender gap for Mizoram is 4.3 percent while the all-India average stands at 16.7 percent.

The national average for infant mortality rate (IMR) expressed as number of deaths per 1000 live births is 40. A close look at the table shows that there are 9 states with infant mortality rate greater than this average, among which the states of Assam and Meghalaya are included. Goa has the lowest rate of infant mortality at 9 while Madhya Pradesh and Assam have the highest rate of 54 per 1000 live births. For Mizoram, the infant mortality rate is 35 which is the fourteenth lowest in India. It can also be seen from the table that the child sex-ratio (0-6 years) ranges from 972 for Arunachal Pradesh to 834 for Haryana. Mizoram shares its position with Meghalaya and is the second highest in the country with 970. Moreover, with a national average of 919, there are 19 states with child sex ratio above this average, including all the 8 north eastern states.

In addition to the above, it was felt that the analysis and interpretation should include data of per capita income (PCI), households with improved drinking water, households availing banking services, households with latrine, households with piped water supply, and percentage of rural population with piped water supply.

Table 3.3 shows that the percentage of rural household with access to improved source of drinking water is highest in Punjab at 99.5 percent while it is lowest in Kerala at 29.5 percent. Mizoram with 86.8 percent is the sixteenth highest in India. Moreover, the data of urban households with access to improved source of drinking water shows that Himachal Pradesh has the highest percentage at 100 percent while Kerala is the lowest at 56.8 percent. Mizoram is the eighth highest at 99.1 percent.

Table 3.3 States in terms of improved source of drinking water, banking, latrine facilities, piped water supply and PCI

Sl. No.	States	% of HH with improved drinking water (Rural)	% of HH with improved drinking water (Urban)	HH availing Banking services	HH with latrine within premises	% of HH with piped water supply (2014)	% of rural population with piped water supply	Per Capita Income (2012-13) at 2004-05 prices
1	Andhra Pradesh	91.9	97.5	53.1	49.6	14.64	67.09	44526
2	Arunachal Pradesh	96.2	98.4	53	62	2.21	55.08	35845
3	Assam	85.1	92.8	44.1	64.9	1.77	41.28	23448
4	Bihar	97.6	99.7	44.4	23.1	0.23	5.84	14362
5	Chhatisgarh	94.8	93.6	48.8	24.6	5.76	48.97	27421
6	Goa	83.9	99.6	86.8	79.7	0	0	132121
7	Gujarat	89.2	95.6	57.9	57.4	63.79	91.26	61220
8	Haryana	92.6	92.3	68.1	68.6	44.67	96.87	64136
9	Himachal Pradesh	95.8	100	89.1	69.1	23.3	92.91	51730
10	Jammu and Kashmir	80.6	97.9	70	51.2	48.35	84.46	29754
11	Jharkhand	64.4	88.3	54	22	1.01	21.41	27010
12	Karnataka	95.1	96	61.1	51.2	24.18	94.85	42976
13	Kerala	29.5	56.8	74.2	95.2	9.78	99.36	56115
14	Madhya Pradesh	83.2	97.1	46.6	28.8	8.03	28.74	25463
15	Maharashtra	85.5	98.7	68.9	53.1	33.43	82.32	64218
16	Manipur	57	69.8	29.6	89.3	2.79	93.47	22395
17	Meghalaya	70.4	94.5	37.5	62.9	0.72	76.35	34004
18	Mizoram	86.8	99.1	54.9	91.9	3.66	97.02	39347
19	Nagaland	91.9	90.6	34.9	76.5	5.13	92.63	48111
20	Odisha	82.4	95.5	45	22	1.47	40.23	25415
21	Punjab	99.5	99.7	65.2	79.3	31.51	96.16	47834
22	Rajasthan	79.1	92.3	68	35	9.59	51.28	29244
23	Sikkim	85.2	98.8	67.5	87.2	42.86	100	78427
24	Tamil Nadu	94	95	52.5	48.3	20.08	93.96	58360
25	Tripura	87.3	99.7	79.2	86	1.37	80.44	42315
26	Uttar Pradesh	92.8	99.9	72	35.7	0	0.73	18595
27	Uttarakhand	96.6	99.2	80.7	65.8	13.36	68.98	54462
28	West Bengal	95	94.7	48.8	58.9	0.77	44.77	33889

Source: NITI Aayog, 2015

The table also shows that the percentage of households availing banking services is highest in Himachal Pradesh with 89.1 percent and lowest in Manipur with 29.6 percent while Mizoram is the fifteenth highest with 54.9 percent. At the same time, the percentage of households with latrine facility within the premises is highest in Kerala with 95.2 percent and lowest in Jharkhand and Odisha at 22 percent. Mizoram has the second highest percentage at 91.9 percent.

It can be computed that the national average for total households connected with piped water supply is 12.75 percent, of which 10 states possess percentages higher than the average. The state with the highest percentage is Gujarat at 63.79 percent while Goa and Uttar Pradesh have zero or negligible households connected with piped water supply. At the same time, Mizoram is the seventeenth highest with 3.66 percent. Moreover, the national average for total rural population of states having access to piped water supply is 46.77 percent. 20 of the 28 states have percentages higher than this average, including the north east states of Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. On the all-India scene, Sikkim has the highest percentage with all of its households possessing piped water supply while Goa has no, or an insignificant number of, households with water supply. Mizoram is the third highest at 97.02 percent.

States on the basis of per capita income (2012-13) at 2004-05 prices are also given in the table. Goa has the highest PCI at ₹ 1,32,121 while the state of Bihar has the lowest at ₹ 14,363. At the same time, Mizoram has the fifteenth highest PCI among the states with ₹ 39,347.

3.2.3 Road Connectivity versus Socio-Economic Development

From the analysis of the connectivity infrastructures and the socio-economic development of the 28 states of India presented in the previous two sections, the following points can be derived:

First, accounting for the different levels of connectivity infrastructures present in the states, those that have infrastructures higher than the national average are also the ones that have higher than average performances in the various demographic and socio-economic development indicators. For example, among the 17 states that have literacy rates higher than the national average, 13 of the states have national highway lengths greater than the national average while 12 of the states have higher than average length of state highways. Here, it can be seen that Kerala, which has the highest network of state highways has the highest literacy rate in India. Moreover, 13 states and 11 states respectively of the 19 states that have lower than average IMR possess national and state highways higher than the national averages. It may be cited that Goa with the highest network of national highways has the lowest IMR in the country. In addition, 15 of the 18 states having child sex ratio higher than the national average have a higher than average highway length per sq km while the number of states that have state highway higher than the overall average among these is 9.

Second, the analysis of states on the basis of improved source of drinking water, banking, latrine facilities, and per capita income shows that majority of the states with higher than average performance in these indicators have connectivity infrastructures which are higher than the national average. An example may be cited of the states which have a percentage of rural households with improved drinking water that is higher than the national average. Here, 13 of the 18 states have total length of highways higher than the all-India average while 10 of these states have state highway infrastructure higher than the average. At the same time, in the analysis of the percentage of households with latrine facility within the premises, 14 of the 15 states that have percentages higher than the overall average possess a highway length that is longer than the national average while 8 of them have state highway which is higher than the overall average. Moreover, among the 12 states that have the highest per capita income in the country, the percentage of states that have higher than all-India average lengths of both national and state highways is 66.67 percent. Among them are Goa, which has the highest PCI and also the highest network of national highways, and Kerala, which has the highest network of state highways among the states of India.

In summary, it can be stated that states with developed connectivity infrastructures enjoy higher levels of development. This is evident by the analysis presented above where the majority of the states with better connectivity status have better performances on the socio-economic indicators of development. Therefore, it is safe to conclude that there is a close relationship between road connectivity and socio-economic development.

3.3 Road Connectivity Scenario in Mizoram

Being a hilly state with difficult terrain and climatic conditions, transport infrastructure in Mizoram is essentially road based. While there is a small metre-gauge rail link at Bairabi (about 130 km from Aizawl), an airport at Lengpui (44 km from Aizawl), for most community, business, and personal purposes, road transport is the only principal means of communication. However, the terrain of Mizoram does not permit easy accessibility to roads as the slopes of hills ranges from 20° to 80° and the average elevation is 900 metres above sea level. In clearer terms, the area within 1 km (say) from a motorable road does not necessarily mean that all the area within the perimeter is easily accessible because of its slope and elevation and the deep gorges between the hills. Therefore, it may be stated that construction and maintenance of roads should be and is a high priority in Mizoram, maybe even more so than the other parts of the country.

The roads of Mizoram are normally divided into five broad categories. They are:

i) *National Highway*s (NH) which consists of NH-154 with a total length of 58 km connecting Bairabi to Bilkhawthlir; NH-150 of length 140 km which connects Seling to Manipur border; NH-44A of 130 km starting from Aizawl to Mamit to Tripura; NH-54A of 9 km connecting Hrangchalkawn and Lunglei; NH-54B of length 27 km which connects Zero Point and Saiha; NH-54 of 522 km starting from Lailapur to Tuipang; and NH-502A with a total length of 100 km which is a multi modal road, i.e. NH-54 at Lawngtlai to Myanmar border.
ii) *State Highways* which connect the other district capitals not connected by the national highways.
iii) *Town roads* within the 23 notified towns of the state.
iv) *Village roads* which consist of both approach and internal link roads of the villages.
v) *Miscellaneous roads* which are the other roads of the state that do not fall under the previous four categories.

3.3.1 Total Length of Roads in Mizoram

As per the Mizoram State Road Statistics 2014, the total length of all types of roads in Mizoram as on 2014 is 7548.03 km and road density is 35.50 km/100 sq km. The road density in Mizoram is still relatively low when compared to the average national level road density at 129.00 km/100 sq km.

The category-wise length of roads in Mizoram is shown in Table 3.4 where 4776.82 km out of the total length of roads in Mizoram is surfaced while the remaining is not. It would be important to note that the national and state highways of the state are represented as surfaced although some of the national highways are being reported as 'unsurfaced.' It is hypothesised that this is because of wear and tear after being initially surfaced and so, the present study considered all of the highways to be surfaced.

Table 3.4 Total Length of Surfaced and Unsurfaced Roads in Mizoram

(in km)

Sl. No.	Type of Roads	Surfaced	Unsurfaced	Total	Density
1	National Highways	986.530	0	986.530	4.68
2	State Highways	310.450	0	310.450	1.47
3	District Roads	1400.600	250.200	1650.800	7.83
4	Town Roads	253.202	44.204	297.406	1.50
5	Village Roads	948.061	1677.492	2625.553	12.45
6	Misc. Roads	877.980	799.310	1677.290	7.57
	Total	4776.823	2771.206	7548.029	35.50

Source: Mizoram Statistical Handbook, 2014

Table 3.4 further shows that 1400.6 km out of the total district roads of 1650.8 km is surfaced while for the town roads, the length of surfaced roads total to 253.202 km. The worst situation is suffered by village roads where the total length is 2625.55 km of which only 984.06 are surfaced.

In order to present the length of surfaced roads in clearer terms, the district-wise breakup of the various types of roads is presented in percentages in Table 3.5. It must be noted that since a more recent one is not available, the data given in the Statistical Abstract of Mizoram: 2013 is being used and so, the data is subject to change within the past years. However, it is believed that it would represent the existing status to a great extent. Moreover, the national highways and state highways are being presented here as 'surfaced.' The reasoning of which has already been given.

Table 3.5 Percentage of Surfaced Roads in Mizoram: District-Wise

in percentages

Sl. No.	District	National Highway	State Highway	District Road	Village Road	Town Road	Total
1	Mamit	100	100	69.40	15.09	64.15	75.87
2	Kolasib	100	100	58.64	25.27	57.42	72.67
3	Aizawl	100	100	60.14	23.85	80.58	74.17
4	Champhai	NA	100	69.30	20.57	67.80	66.88
5	Serchhip	100	100	54.60	13.41	62.41	71.35
6	Lunglei	100	100	50.80	-	75.60	65.88
7	Lawngtlai	100	100	44.46	11.31	26.16	56.50
8	Saiha	100	100	9.88	-	92.02	50.63
	Total	100	100	54.19	15.75	71.73	67.38

— Data not available

Source: Statistical Abstract of Mizoram: 2013

The total percentage of surfaced roads in the state is 54.19 percent for district roads and 15.75 percent for village roads. The town roads show a relatively favourable situation as 71.73 percent are surfaced. Saiha district has the worst situation for districts roads with only 9.88 percent of them being surfaced while Mamit has the highest percentage at 69.40. It can also be seen from the table that the percentages of village roads that are surfaced are very low, ranging from 11.31 percent for Lawngtlai to 25.27 percent for Kolasib. At the same time, the roads of the 23 towns of the states are much better than these two types of roads although there are stark differences among the districts. Saiha district has surfaced town roads of 92.02 percent but for Lawngtlai, the percentage is only 26.16.

3.3.2 Progressive Number of Vehicles on Road

As the provision of roads is synonymous with transport, it was considered necessary to analyse the increasing rate of vehicles in the state. The year-wise data for the number of different types of vehicles on road is given in Table 3.6. It should be noted here that light motor vehicles (LMVs) consist of motor cab, maxi cab, motor car, gypsy and the like while heavy motor vehicles (HMVs) are trucks, tractor, trailers, etc. Under the 'Others' category are ambulances, fire fighters and recovery vans, among others.

Table 3.6 Number of Vehicles on Road

Sl. No.	Types	2010-11	2011-12	2012-13	2013-14	CAGR (%)
1	Two Wheeler	50898	60278	70449	80729	16.53
2	Three Wheeler	2544	3029	3669	4425	20.32
3	LMV	32475	36126	40021	44318	10.85
4	HMV	5285	5796	6199	6596	7.57
5	Others	721	876	992	1157	16.65
	Total	91923	106105	121330	137225	14.22

Source: Statistical Handbook (various issues), Govt. of Mizoram

It can be seen from the table that the number of registered vehicles keeps on increasing with the passage of time. It can be derived that there were 14,182 additional vehicles during the years 2010-11 and 2011-12 while for the next year, i.e. 2012-13, the number of registered vehicles increased to 1,21,330. In 2013-14, there were a total of 1,37,225 registered vehicles which is an increase by 15,895 vehicles from the previous year (2012-13). The table also shows that the computed compound annual growth rate (CAGR) of all types of vehicles is 14.22 percent where the highest growth rate was experienced in the number of three-wheelers which grew at the rate of 20.32 percent annually while the number of two-wheelers grew at 16.53 percent per annum over the period of four years.

3.3.3 Public Expenditure on Roads and Road Transport

The funding of road upgradation and maintenance programmes of the Public Works Department (PWD) depend mainly on State and Central Government allocations. Table 3.7 presents the analysis of the annual expenditure for roads and transport under plan scheme in Mizoram during the past ten years.

Table 3.7 Annual Expenditure for Roads and Transport under Plan Scheme

Rs. in crore unless specified otherwise

Sl	Heads	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
1	Transport										
	a) Aviation	0.00	0.07	0.29	0.82	2.27	0.67	1.25	0.86	1.43	3.71
	b) Roads and Bridges	89.74	126.47	112.61	138.62	47.26	66.49	125.34	85.85	70.00	78.38
	c) Road Transport	4.00	4.71	4.95	4.30	3.97	6.01	5.00	4.99	4.33	4.64
	d) Inland Water Trans.	0.05	0.05	0.32	0.04	0.04	0.05	0.04	0.05	0.05	0.05
	e) M.V. Wing	0.77	0.82	1.01	1.15	1.01	0.93	1.06	1.09	0.84	1.01
2	Total Road (b + c)	93.74	131.18	117.56	142.92	51.23	72.50	130.34	90.84	74.33	83.02
3	Total Transport (a to e)	98.56	132.12	119.18	144.93	54.55	74.15	132.69	92.84	76.65	87.79
4	Total Plan Budget	550.40	692.64	745.32	777.13	839.29	1152.75	1288.69	1534.82	1741.74	1762.62
5	% of Total Road in Total Transport	95.11	99.29	98.64	98.61	93.91	97.77	98.23	97.85	96.97	94.57
6	% of Total Road in Total Budget	17.03	18.94	15.77	18.39	6.10	6.29	10.11	5.92	4.27	4.71

CAGR: a) Total Road = - 3.73%, b) Total Transport: - 3.53%, c) Total Plan Budget: 14.45%
Source: Economic Survey (various issues) Govt. of Mizoram

It is shown in the table that the sub-heads of 'Roads and Bridges' and 'Road Transport' taken together constitute almost all of the annual expenditure allocated for the head 'Transport' in every year of the presented ten years. The percentages range from 93.61 percent in 2007-08 to 99.29 percent in 2005-06; while for 2013-14, it is 94.57 percent of the total amount allocated for transport. This dedication of the budget expenditure shows that road and its transport are considered the most important means of transport communication in the state. In absolute terms, the amount of expenditure for the two sub-heads is ₹ 142.92 crore in 2007-08 and ₹ 51.23 crore 2008-09; while in 2013-14, it is ₹ 83.03 crore which is higher than the amount in 2012-13 at ₹ 74.33 crore. Taking the total plan budget of the state into account, the percentage of total road and road transport taken together accounted for 4.71 percent in 2013-14. It was as high as 18.94 percent in 2005-06 and 18.39 percent in 2007-08, and sank to 4.27 percent in 2012-13.

The calculated CAGR of expenditures on total road and bridges summed with total transport turned out to be –3.73 percent while that of the transport head is –3.53 percent. On the other hand, the total plan budget increased at the rate of 14.45 percent per annum during the last ten years. This means that while the amount of expenditure of the total plan budget has been on the rise, the amount allocated and spent for the 'Transport' head as a whole and total of 'Road and Bridges' and 'Road Transport' in particular experienced a falling trend.

Since road transport is the major mode of transport within the state, improvement of road network is believed to be the major key to achieve development in the state as better connectivity enhances the environment for development and growth by reducing freight and passenger transport costs, and by providing quicker and safer access to all parts of the state and to neighbouring state and countries thereby promoting tourism in the state. Moreover, as the major occupation of the people is agriculture, easy access to remote, hilly, mountainous regions and low lying areas would cause increased agricultural produce in the state. Therefore, it is a priority of the state government and the Mizoram PWD in particular to spurge up the status of roads. This is evident from the recent projects taken up by the Department.

3.3.4 Existing Road Projects Undertaken by the State PWD

The Mizoram PWD is responsible for construction and maintenance of roads in the state. To have a better understanding on the role of the State PWD for the development of road connectivity, it is considered pertinent to look into some of the major projects recently undertaken by this Department. The data for this is obtained from the Mizoram Economic Survey, 2014-15. The following points enumerate the various funding agencies and the amounts and/or number of projects allocated for the provision of roads in the state which are under the purview of the department:

a) Under the State plan are the improvement of roads within Aizawl City, within district capitals, within town and villages and the improvement and rehabilitation of district roads. For improving the existing roads within Aizawl City, an amount of ₹ 1000 lakh is allocated for 2014-15 because it is viewed that development of the city and its surrounding towns is generally caused by the development of internal roads. Moreover, an amount of ₹ 400 lakh is allocated for improvement of the other district capitals in the state while ₹ 300 lakh is allocated for improvement of roads in towns and villages. Another ₹ 300 lakh is allocated through the plan for improvement and rehabilitation of district roads in the State.

b) In addition to the state plan, ₹ 900 lakh is allocated for construction of roads under National Bank for Agriculture and Rural Development (NABARD) while under Central Road Fund (CRF), ₹ 1268 lakh is allocated.

c) ₹ 5600 lakh is allocated for construction of roads under PMGSY scheme for various works in the state. The scheme is a nationwide plan in India to provide good all-weather road connectivity to unconnected villages and as such, is the main provider of all weather roads for villages in the state as well. A significant amount of plan expenditure has been allocated and achieved under this scheme in the past. In 2007-08, an amount of ₹ 61.05 crore was achieved under the scheme and in 2009-10, it was ₹ 66.85 crore. Moreover, while the achievement of the FY 2010-11 was ₹ 82.24 crore, ₹ 62.38 crore was used up for the provision of all-weather roads to Mizoram villages in 2011-12.

d) Mizoram PWD is also presently looking after and maintaining the National Highways having a total length of 986 km within the state. Here, work is in progress under Special Accelerated Road Development Programme for North Eastern Region (SARDP) with an amount of ₹ 147956 lakh while under National Highway (Others), the amount allocated is ₹ 15776.16 lakh. Three works amounting to ₹ 2561.13 lakh are under tender process at the time of the report.

e) There are three projects taken up under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) scheme by the state PWD in Mizoram. They are: a) improvement and widening of Aizawl City Road Phase–I; b) widening and improvement of Vaivakawn locality to Mizoram University road; and c) Sihhmui to Mizoram University as spur of Aizawl City ring road. The total sanctioned amount under the scheme is ₹ 11090.36 lakh and the fund released from the Central Government is ₹ 3382.26, with ₹ 554.54 lakh to be afforded by the state as its matching share.

e) ₹ 9670 lakh is allocated under the World Bank Phase–II during 2014-15. This project, called the Mizoram State Roads II Regional Transport Connectivity Project, aims to provide better intra-state and regional connectivity for the residents of landlocked Mizoram with Myanmar, Bangladesh and the rest of north east India.

f) The North Eastern State Roads Investment Programme (NESRIP) is a part of the Ministry of Development of North Eastern Region's (DoNER) initiative to bring the north eastern region into the mainstream of development. This programme is assisted by the Asian Development Bank (ADB). ₹ 259.20 crores is estimated for the Serchhip-Thenzawl-Buarpui road which will be financed through DoNER with Central's share of ₹ 161.43 crores and State's share of ₹ 97.76 crore. Moreover, ₹ 1800 lakh is allocated for upgradation of the road under ADB during 2014-15.

g) The North Eastern Council (NEC) is one of the main funding sources of major road works in Mizoram. At present, there are 10 (ten) road projects and 4 (four) other projects undertaken by the PWD under NEC scheme.

h) There are 35 projects being implemented through PWD under Non-Lapsable Central Pool of Resources (NLCPR) Scheme in Mizoram. The projects are mostly on-going and few projects are in a stage of completion while some are yet to be started. The total approved sanctioned amount for the project is ₹ 24087.43 lakhs and the total fund released from the Ministry of DoNER is ₹ 10524.11 lakh and the state matching share already released is ₹ 677.68 lakh. The balance amount yet to be released as the state's matching share calculated from the amount DoNER already released is ₹ 491.67 lakh.

i) The Kaladan Multi Modal project was initiated by Ministry of External Affairs, GoI, to build transport communication to link Kolkata port with North eastern region via Mizoram and through Myanmar. The route consists of sea route (720 km) from Kolkata-Sittwe (Akyab) in Myanmar, river route along Kolodyne river from Sittwe-Kaletwa (222km) in Myanmar up to which 500 tons capacity of vessel can ply. It also includes inland road from Kaletwa-Indo Myanmar border (62 km) and then from the

Myanmar border to NH-54 at Lawngtlai (100 km) in Mizoram. Kaladan Multi Modal Transit Transport Project within Mizoram from 100 km of Double Lane Highway to connect Kolkata port via Myanmar and sea route has been sanctioned for an amount of ₹ 575.69 crore. This was declared as National Highway NH-502A and the work was physically started on February 2011. In October 15, 2015, the Union cabinet gave its approval for the revised cost estimate of ₹ 2904.04 crore for this project.

The preceding points advocate that connectivity is among the top priorities of the state government. Through this dedication, roads and highways within the state are improved and upgraded, which consequently improves the riding quality of district roads, towns, and villages. The improvement of road communication networks in the state is professed to have resulted in economic and social development, better access to health and education services for a large portion of the state‘s population especially women and girls, lower costs for goods and services, and improved market access for Mizoram‘s agricultural and industrial products. As such, the contribution of PWD could not be over-emphasized and it may be reiterated that Mizoram PWD plays an indispensable part in boosting development initiatives and picking up economic development across the state.

3.4 Concluding Remarks

An overview of the scenario of connectivity and socio-economic development across the country shows a positive relationship between the availability of connectivity infrastructure and socio-economic development. This is evident from the fact that most of the states above the national average in terms of connectivity infrastructure are also above the national average in socio-economic development status. The state of Mizoram has commendable achievements in terms of connectivity for being above the national average and at the same time, having higher than average achievements in human development like literacy, child sex ratio, etc. However, it shows comparatively poor performance on unemployment rate and per capita income.

Though the state of Mizoram is among the top five in the country with regard to the measure of National Highway density, it still shows a relatively low road density within the state. This may be construed as the poor performance of the state in constructing road connectivity infrastructure on its own. Of the 8 districts, those in the northern parts of the state are showing better road conditions as they have higher percentages of surfaced roads. However, the percentages for southern districts are well below the northern districts, which indicate unequal regional development of the state on road infrastructure. Another notable feature on the status of road connectivity in the state is the extremely poor status of village roads – the main transport infrastructure for the rural population. Moreover, the condition of town roads is no better. Taking into account the high increasing rate of vehicles plying on the road side by side with the high unsurfaced roads, it means that a large number of vehicles are regularly plying on the poor unsurfaced village and town roads. This would cause the vehicles owners as well as commuters to exhaust huge expenses in their movement from one place to another, the reason for which may be social or political, but mostly economic.

CHAPTER 4

EXISTING STATUS OF RURAL ROAD CONNECTIVITY AND ECONOMIC DEVELOPMENT IN MIZORAM

4.1 Introduction

The provision of road connectivity has a positive relation with economic development of both urban and rural areas. For rural areas in particular, it brings forth multiple socio-economic benefits which form a strong base for the economy and is a powerful instrument for the socio-economic transformation (Lombard and Coetzer, 2006). Therefore, roads are among the most important public assets because they bring immediate benefits to road users through improved access to hospitals, schools, and markets, thereby enhancing comfort, speed, and safety. In communities where there is access to extended networks of transport infrastructure, markets are more likely to be developed (Mu and van de Walle, 2007) and benefits from improving access to basic education depend on such investments in infrastructure (Deininger and Okidi, 2003).

Moreover, road improvements lead to lower input and transportation costs, higher production, higher wages and higher output prices (Khandker et al., 2006) while raising the productive capacity of poor households as well (Jacoby, 2000). Road connectivity not only affects the agricultural sector but also increases opportunities for off-farm and female wage employment (Lokshin and Yemtsov, 2005).

This chapter presents the analysis of the impact of rural road connectivity on economic development of the villages of Mizoram. This has been done by checking whether there are differences in levels of development when their status of connectivity is being accounted for. In other words, this chapter attempts to demonstrate the effect that the status of village road connectivity has on the level of development by identifying performance variations in selected parameters of development across different connectivity measures. It may again be mentioned that the study focuses only on the rural parts of the state.

The chapter is divided into two broad sub-chapters. First, it discusses in detail the various measures of road connectivity used in the study and second, it shows the tests of relationship between the connectivity measures and development variables. The connectivity parameters employed were:

1) whether the village is connected with all-weather road (AWR);
2) whether it lies along the main transport route;
3) the locational distance of the village from the nearest all-weather road; and
4) the village's road density measured by the area of village within 1 km from motorable road.

As stated, the latter part of the chapter shows the analysis of the study area using these road connectivity measures to determine the development status of the villages through different parameters and to check whether there are distinctions between the categories of each set of classifications. The development parameters used were basic population characteristics, economic activities of the population, agriculture land use and basic socio-economic parameters like education and health care, etc.

4.2 Classification of Villages

The selected 517 villages were classified according to the mentioned connectivity measures. The first classification was done by taking into account whether the village is connected with an all weather road or not. The primary data for this classification was obtained from the Public Works Department, Government of

Mizoram in raw form. However, for the information that cannot be obtained from the same, the Village Councils were contacted using letters and through telephonic enquiry of their status of connectivity. The villages were then fitted their respective connectivity status and then grouped into those connected with AWR and those that are not. This is presented in Table 4.1.

Table 4.1 Villages with AWR Connectivity

Sl. No.	Districts	Number of Villages			Percentage of Villages		
		Connected with AWR	Not Connected with AWR	Total	Connected with AWR	Not Connected with AWR	Total
1	Mamit	38	23	61	62.30	37.70	100
2	Kolasib	22	7	29	75.86	24.14	100
3	Aizawl	49	30	79	62.03	37.97	100
4	Champhai	38	38	76	50	50	100
5	Serchhip	12	19	31	38.71	61.29	100
6	Lunglei	55	52	107	51.40	48.60	100
7	Lawngtlai	46	53	99	46.46	53.54	100
8	Saiha	10	25	35	28.57	71.43	100
	Total	270	247	517	52.22	47.78	100

Source: Field Survey, 2015

Table 4.1 shows that in total, more than half (52.22 percent) of the villages in Mizoram are connected with all-weather roads (AWR). In the district-wise analysis, it can be seen that while at least half of the villages in the districts of Mamit, Kolasib, Aizawl, Champhai, and Lunglei are AWR-connected, Serchhip, Lawngtlai, and Saiha districts have less than 50 percent of their villages connected with all-weather roads. It can also be seen that the district with the highest percentage of connectivity is Kolasib at 75.86 percent while Saiha district has the lowest, with only 28.57 percent of its villages are connected with AWR.

The second classification was determined through an examination of whether the village lies along the main transport route on which vehicles ply on a daily basis. The data for it was acquired through an interview with various stakeholders, particularly vehicle owners, transport operators and knowledgeable persons. This again was cross-checked with the Department of Transport, Government of Mizoram for confirmation. The 'main transport route' in the study includes the national highways, state highways, and roads connecting major transport destinations. This classification may be justified as mere connectivity like that of the first classification may not translate into development if transport to that village is irregular and uncertain. The district-wise scenario is given in Table 4.2.

Table 4.2: Villages along Main Transport Route

Sl. No.	Districts	Number of Villages			Percentage of Villages		
		Along Main Route	Outside Main Route	Total	Along Main Route	Outside Main Route	Total
1	Mamit	20	41	61	32.79	67.21	100
2	Kolasib	7	22	29	24.14	75.86	100
3	Aizawl	35	44	79	44.30	55.70	100
4	Champhai	8	68	76	10.53	89.47	100
5	Serchhip	5	26	31	16.13	83.87	100
6	Lunglei	27	80	107	25.23	74.77	100
7	Lawngtlai	6	93	99	6.06	93.94	100
8	Saiha	4	31	35	11.43	88.57	100
	Total	112	405	517	21.66	78.34	100

Source: Field Survey, 2015

It can be seen from the table that 21.66 percent of Mizoram villages are being passed through by the main transport routes. Here, Aizawl district ranks the highest as 44.30 percent of its total villages are lying along the main route. While 4 districts (Mamit, Kolasib, Aizawl, and Lunglei) have percentages above the state average, Lawngtlai district has the lowest with only 6.06 percent of its total villages lying along the major transport route of the state. Moreover, the table also shows that districts of Saiha (11.43 percent), Champhai (10.53 percent) and Serchhip (16.13 percent) have percentages lower than the state average.

To check if distance of the village from AWR plays a role in development, data was obtained from the Village Council of the villages and Public Works Department, Government of Mizoram. Therefore, the third classification focused upon the villages that fall under 'not connected with AWR' of the first classification. Here, the bulk of the information was acquired from the village councils through telephones and through letters. They were asked the distance of their village from the nearest AWR and the reported distances were then apportioned to the respective villages. The villages were grouped into those that are within 15 km and outside 15 km of the nearest AWR.

Thus this classification divides the study area into three categories – those connected with AWR, those within 15 km of AWR and those farther than 15 km from the nearest AWR. Simply put, the first category of the classification would automatically be made up of the 270 villages connected with AWR, while the remaining 248 are divided into villages within and outside 15 km of the nearest AWR. As already stated, the villages of the second and third categories (i.e. those not connected with AWR) will be the focus in the immediate and subsequent interpretation. Table 4.3 shows the classification of the study area according to their distance from the nearest AWR.

Table 4.3 Distance of Villages from Nearest AWR

Sl. No.	Districts	Number of Villages				Percentage of Villages			
		AWR	Within 15 km	Outside 15 km	Total	AWR	Within 15 km	Outside 15 km	Total
1	Mamit	38	19	4	61	62.30	31.15	6.56	100
2	Kolasib	22	7	0	29	75.86	24.14	0	100
3	Aizawl	49	15	15	79	62.03	18.99	18.99	100
4	Champhai	38	22	16	76	50	28.95	21.05	100
5	Serchhip	12	6	13	31	38.71	19.35	41.94	100
6	Lunglei	55	26	26	107	51.40	24.30	24.30	100
7	Lawngtlai	46	32	21	99	46.46	32.32	21.21	100
8	Saiha	10	5	20	35	28.57	14.29	57.14	100
	Total	270	132	115	517	52.22	25.53	22.24	100

Source: Field Survey, 2015

As is already shown under Classification I, the percentage of villages connected with all-weather road is 52.22 percent. Among those that are not, 25.53 percent are within 15 km of the nearest AWR while 22.24 percent are outside i.e. farther than 15 km. Here, the situation is worst in Saiha district as 57.14 percent of its villages are more than 15 km away from the nearest AWR. The situation is also acute in Serchhip district at 41.94 percent, while Lunglei district with 24.30 percent is also higher than the state average.

The table also shows that in the district of Kolasib, all of its villages are within 15 km of the nearest AWR, if not connected with it. Mamit district also shows a heartening situation as only 6.56 percent of its villages are more than 15 km away from the nearest AWR while 31.15 are within 15 km. It can also be seen that in Aizawl district, the percentage of villages ‘within’ and ‘outside’ are the same at 18.99 percent. In Lawngtlai district, the percentage of villages within 15 km is 32.32 while 21.21 percent are farther than 15 km from AWR. Moreover, the percentages are 28.95

and 21.05 for villages within and outside 15 km of nearest AWR for Champhai district.

Lastly, the fourth classification accounted the total road network present in each village. This was done by determining the area of the villages within 1000m from motorable road; which was generated from the road network data of Mizoram Remote Sensing Application Centre (MIRSAC). The motorable road here encompasses a wide denotation as it includes National Highways, State Highways, District Roads, and Village Roads. The villages are then divided into two categories – those with road density 'below' and 'above' 7.5 km. This is presented in the following table.

Table 4.4: Road Density of Villages

Sl. No.	Districts	Number of Villages			Percentage of Villages		
		Below 7.5 km	Above 7.5 km	Total	Below 7.5 km	Above 7.5 km	Total
1	Mamit	21	40	61	34.43	65.57	100
2	Kolasib	8	21	29	27.59	72.41	100
3	Aizawl	48	31	79	60.76	39.24	100
4	Champhai	36	40	76	47.37	52.63	100
5	Serchhip	19	12	31	61.29	38.71	100
6	Lunglei	58	49	107	54.21	45.79	100
7	Lawngtlai	86	13	99	86.87	13.13	100
8	Saiha	28	7	35	80.00	20.00	100
	Total	304	213	517	58.80	41.20	100

Source: Mizoram Remote Sensing Application Centre, 2014

Table 4.4 shows that in Mizoram, 41.20 percent of villages have road density above 7.5 km while 58.80 percent are with road density below 7.5 km. This means that road density is still low in spite of the fact that more than half of the villages are connected with all-weather roads.

The district with the highest percentage of its villages falling under 'Above 7.5 km' is Kolasib with 72.41 percent followed by Mamit district with 65.57 percent. The other two districts with percentages higher than the state average are Champhai (52.63 percent) and Lunglei (45.79 percent). It can also be seen that the overall percentage is being pulled down by the low densities of road in villages of Lawngtlai (13.13 percent) and Saiha (20 percent) districts while Serchhip (38.71 percent) and Aizawl (38.24 percent) districts are also below the state average.

4.3 Road Connectivity and Rural Development in Mizoram

As mentioned in the introductory part of this chapter, the previously enumerated classifications of road connectivity were used as independent variables for analysing the development status of the study areas. Although varied and numbered development parameters had been specified by different studies, the present study selected and focused on certain parameters available in the state.

First, it was tested whether the different classifications of road connectivity had impacts on the population characteristics like sex ratio, child sex ratio, literacy rate, and the density of population, among others.

Second, it was analysed whether there were differences within the categories of the four classifications when the workers' details such as number of workers, main workers and marginal workers of the villages were taken into account.

Third, the land-use data like area of wet rice cultivation, plantation, forest cover and jhum cultivation were determined and it was checked if the villages' status of road connectivity had any impact on them.

Last, the four classifications of road connectivity were tested on the basis of social infrastructures namely, educational institutions, health care facilities and water supply.

4.3.1 Population Status

One of the simplest ways in which the development of an economy can be judged is by its demography because it is acknowledged as the single most important supply-side determinant of economic activity and employment trends especially in rural areas (Copus et al., 2006). Moreover, the current view of development is that the variables—development and population—are inseparable, and that the explanation of trends for one of these cannot be sought in isolation from the other (Mostert, 1985). Therefore, it is an interest to examine whether road connectivity have impacts on the population structure of the study area. The selected variables under this parameter includes total population, sex ratio, population of children below 6 years, child sex ratio, male and female literacy rates, number of households, family size, and population density – all taken in averages and checked using the four classifications discussed at length in section 4.2.

The following tables shows the selected population characteristics of the study areas with the mentioned classifications viz. connectivity status and whether they are along main transport route (Table 4.5), and distance from nearest AWR and the density of road in the villages (Table 4.6).

Table 4.5 Classification I & II: Basic Population Characteristics

Figures in average unless specified otherwise

Sl. No.	Characteristics	Classification I		Classification II		Total
		Connected with AWR	Not Connected with AWR	Along Main Route	Outside Main Route	
1	Population	1250	761	1499	883	1016
	Males	638	392	766	453	521
	Females	611	369	733	430	496
2	Sex Ratio	952	944	952	947	952
3	Population below 6 years	210	149	241	164	181
	Males	107	76	122	83	92
	Females	103	73	119	80	89
4	Child - Population Ratio (%)	17.13	19.40	16.28	18.75	18.22
5	Child Sex Ratio	995	996	1008	992	966
6	Number of households	255	150	313	175	205
7	Family Size	4.90	5.06	4.75	5.04	4.97
8	Literacy Rate (percentage)	72.98	64.85	77.16	66.87	69.10
	Male	75.68	69.09	78.95	70.76	72.53
	Female	70.08	60.31	75.27	62.69	65.41
9	Population Density (per sq. km)	94	34	55	68	65

Source: Census, 2011

Table 4.6 Classification III & IV: Basic Population Characteristics

Figures in average unless specified otherwise

Sl. No.	Characteristics	Classification III			Classification IV		Total
		AWR	Within 15 km	Outside 15 km	Below 7.5 km	Above 7.5 km	
1	Population	1250	798	719	759	1383	1016
	Males	638	411	369	391	706	521
	Females	611	386	350	369	677	496
2	Sex Ratio	952	937	951	942	956	948
3	Population below 6 years	210	157	140	144	233	181
	Males	107	80	71	74	118	92
	Females	103	77	69	70	115	89

contd.

4	Child - Population Ratio (%)	17.13	19.33	19.49	19.12	16.93	18.22
5	Child Sex Ratio	995	989	1004	986	1008	995
6	Number of households	255	157	141	150	282	205
7	Family Size	4.90	5.05	5.07	5.05	4.87	4.97
8	Literacy Rate (percentage)	72.98	63.71	66.15	64.49	75.67	69.10
	Male (percentage)	75.68	68.41	69.87	68.86	77.77	72.53
	Female (percentage)	70.08	58.67	62.18	59.77	73.46	65.41
9	Population Density (per sq. km)	94	40	26	86	34	65

Source: Census, 2011

First is the total population of the villages. This is important because population modifies the man-land ratio, facilitates specialisation, and communication, and provides other economies of scale (Boserup, 1976). The study of the impact of road connectivity on population has been done by Dorosh et al. (2012) and is also accounted for in the various impact assessments of Pradhan Mantri Gram Sadak Yojana (PMGSY) in the different states of India.

As can be seen in the table, the classification of villages into those that are connected and not connected with AWR shows that the number of people living in villages connected with AWR is significantly higher than in those that are not. Here, the average person per village is 1,250 for the first category and only 761 for the second. This difference can clearly be seen in the number of males and females per village as well. In the second classification, with average number of males and females being relatively larger in villages along the main route than in those that are not, the average population per village turns out to be 1,499 for the former and 883 for the latter. Moreover, as can be seen in Table 4.6, the number of both males and females is also higher in villages within 15 km of nearest AWR than in villages farther than 15 km from AWR. As such, the average number of persons living in villages within 15 km (798) is higher than in villages outside 15 km (719). The fourth classification shows that the average number of males and females in villages with road density greater than 7.5 km is significantly higher than those below it. The average population per village is 1383 for the high road density villages and 759 for villages with lower road density.

The above analysis of total population shows that the average number of people residing in villages with better road connectivity is higher than the average for villages with poor road connectivity. On one hand, it can be hypothesised that people tend to reside in areas where there is better road connectivity as it brings with it numerous amenities. On the other hand, it may mean that provision of infrastructure is greatly influenced by the quantity of population considering the fact, among other factors, that the study area is a democratic state. At the same time, it is important to note that the areas where population is high are usually common service centres in which various facilities are available thus making the road network higher. In addition, villages with better road connectivity are usually engaged in settled cultivation more than others which make density of road higher through agricultural link roads and the like.

The second argument is sex ratio, defined here as the number of females per 1000 males in the population. It is an important social indicator to measure the extent of prevailing equity between males and females in a society at a given point of time. It is also often supposed that higher the human sex ratio, the higher is the development of that economy (South and Trent, 1988). Moreover, this type of study could be found in the works of Aggarwal (2013) and Ryhal and Punam (2009).

Table 4.5 and Table 4.6 shows that sex ratio is higher in villages connected with AWR at 952 while it is 944 for the unconnected villages. Moreover, for every

1000 males, there are 952 females in villages along the main route, while the average is 947 for those lying outside the route. However, the sex ratio is 937 for villages within 15 km which is lower than in villages farther than 15 km from AWR at 951. Lastly, the number of females per 1000 males is 956 and 942 for villages with road density above and below 7.5 respectively. This denotes that the sex ratio is higher in villages with better road connectivity except for the third classification i.e., distance from AWR. Nevertheless, it may be concluded that road connectivity does have an impact on the sex ratio of the population since it was found to be higher in most of the classifications.

The next analysis is child population of the age group of 0-6 years which allows us to broadly analyse possible linkages with growth of population, particularly providing leads on fertility (Census of India, 2011).

For villages connected with AWR, the average number of children below 6 years is 210 while the same is 149 for unconnected ones. However, in terms of its ratio to total population, those not connected with AWR have a higher percentage at 19.40 while it is 17.13 percent for connected villages. At the same time, the number of children below 6 years is 241 for villages along the main route and 164 outside main route. Here also, the number of males and females is significantly higher in the former than in the latter. A similar scenario like that of the first classification can be seen in the child ratio to population as the ratio is higher in villages outside main transport routes (18.75 percent for outside main route; 16.28 percent for along main route). For the third classification, the average number of children below the age of 6 is 157 for those within 15 km of the nearest AWR while it is 140 outside this area, with respective Child-Total Population Ratio of 19.33 percent and 19.49 percent. The road density classification also shows similar character as the number is significantly higher in villages above 7.5 km (233) than those below it (144). The child ratio to total population is 19.12 percent for ‘below 7.5 km’ which is higher than the ratio for ‘above 7.5 km’ with 16.93 percent.

Thus, it may be noted that in most cases, there are more children in villages with better road connectivity. This is in line with the analysis of total population where the number of people is higher in these areas. However, a distinct feature that came to light is the ratio of children to the total population being higher in villages with poor road connectivity, which may be translated as higher dependency ratio in these villages. In other words, in villages with poor road connectivity, there are more people, particularly children in this case, who are dependent on others.

Sex ratio (females per 1000 males) for the population of 0-6 years is the most important sex ratio because an adverse sex ratio would mean that fewer girls are being born compared to boys, thereby indicating discrimination against the female foetus (MacPherson, 2007). Although the state of Mizoram prides itself of no such discrimination, it is still a point of interest to check whether there are any differences between the various categories because of the importance attributed to it especially at the national level.

It can be seen from the same tables (Table 4.5 and 4.6) that the child sex ratio (females per 100 males) for connected villages (995) is slightly lower than for those not connected (966). In contrast, it is higher in villages along main route at 1008 while it is 992 in villages outside the main transport route. While the averages for the third classification are 989 and 1004 for those within of and farther than 15 km from AWR, the child sex ratios are 986 and 1008 respectively for those ‘below’ and ‘above’ 7.5 km. These observations show that although the differences are not greatly significant, the child sex ratio is indeed higher for villages with better road connectivity.

The study also accounted the number of households from which average family size is derived. For the classification of AWR-connection, the average number of households for connected villages is 255 while it is only 150 for the unconnected ones. This incident is in line with the average number of persons residing in the areas. On the other hand, the average family size is higher in the latter than the former at 5.06 and 4.90, respectively. For the second classification, the average number of households is higher along the main transport route at 313, while it is 175 for those outside the transport route. The average family size, however, is 4.75 for along main route and 5.04 for outside main route which means that there are more persons living under one roof in the villages outside of the main transport route. It is also shown in the third classification that the number of households descends as we go farther from AWR availability as their averages are 255, 157 and 141 for villages with AWR, within 15 km and outside 15 km of AWR, respectively. Alternately, it ascends in family size with average of 4.90, 5.05 and 5.07 persons per family. Furthermore, it can be seen that the average number of households in villages with road density above 7.5 km is 282 which is higher than number of households per village with road density below 7.5 km whose average is 150. The average family size, however, is larger in ‘below 7.5 km’ (5.05) than in the ‘above 7.5 km’ (4.87) category.

The above examination shows that the average number of households is higher in villages with better road connectivity. This, again, is in consonance with the total number of population given in the earlier analysis. It also shows that the average family size is smaller in these villages than in villages with poor road connectivity. This may translate into better social and economic life in villages with better road connectivity as households with small family sizes would be able to educate their children well, provide better medical care as well as give them better housing and welfare services (Arthur, 2005).

The next characteristic taken under study is the literacy level. This is a vital indicator of development in a society as it greatly contributes to improving quality of life, particularly with regard to life expectancy, infant mortality, learning levels, and nutritional levels of children (Shah, 2013). Moreover, it may be added that literacy level and educational attainment are key variables in the Physical Quality of Life Index (PQLI) of Overseas Development Council and United Nations Development Programme's Human Development Index (HDI). As such, literacy rate of the people is considered an important variable in the study.

In the classification of whether or not the village is connected with AWR, literates occupy 72.98 percent of the total population in the connected villages and 64.85 percent in unconnected villages. Moreover, the male literacy rate for the first category is 75.68 percent while the same is 69.09 percent for the second. Female literacy rate is also higher in AWR-connected villages as 70.08 percent are literates while for the unconnected, the average percentage is 60.31. Literacy rate with respect to the second classification also shows a higher number of literates in villages along the main transport route than those outside the main transport route. The percentages are 77.16 and 66.87 respectively. It is also higher for both the sexes in villages along the main route (78.95 for males; 75.27 for females) than in villages outside the main route (70.76 for males; 62.69 for females). In the third classification, it can be observed that the percentage of literates is slightly lower in villages within 15 km (63.71 percent) than in villages outside 15 km (66.15 percent) though both are lower than the literacy rate of AWR-connected villages. Moreover, the male literacy rate for villages within 15 km is 68.41 percent which is lower than for villages outside 15 km of AWR at 69.87 percent. Also, in villages within 15 km, the female literacy rate is 58.67 percent which is again lower than the percentage for villages 15 km away from the nearest AWR at 62.18 percent. The fourth classification shows that both male and female literacy rates are higher in villages with higher road density. In percentages, the literacy rates of males and females in villages with road density above 7.5 km are respectively 77.77 and 73.46 while the same are 68.86 and 59.77, respectively for males and females in villages with road density below 7.5 km. As such, the overall literacy rate for villages above 7.5 km is 75.67 percent while it is 64.49 percent for those below 7.5 km. Thus, in most of the classifications, the overall literacy rate and male and females rates are significantly higher in villages with better road connectivity. Since higher level of literacy leads to greater awareness and help people in acquiring new skills, it may be concluded that road connectivity does have a favourable impact on economic development.

Next is population density. Population density is simply the average number of people per square kilometer and is a way of measuring population distribution. It can be seen that the density of population per square kilometer is significantly higher in connected villages at 94 while it is only 34 for villages not connected with AWR. It is however higher in villages outside the main route with an average of 68 persons per square kilometer while the same is 55 for those along the state's main transport route. At the same time, population density was found to be higher in villages within 15 km of AWR with the average being 40 persons; while it is 26 persons per sq km for villages outside 15 km. However, it is higher in the villages with road density below 7.5 km at 86 persons per sq km than in villages above 7.5 km road density which has an average number of 34 persons per sq km.

The above analysis of population density provided mixed results. While it is higher in the AWR-connected villages (Classification I) and in villages within 15 km (Classification III), the density of population is lower in villages along the main road (Classification II) and villages with road density above 7.5 km (Classification IV). However, it may also be stated that while high population density has been commonly portrayed as the main spanner in economic development, the 2011 World Population data showed that many nations with higher population density fare better on development counts.

4.3.2 Composition of Workers

Another approach in which the growth and development level of an area can be studied is through its employment status. Full, productive and decent employment is the most important source of income security as it paves the way for broader social and economic advancement, strengthening individuals, their families and communities (United Nations, 2012). Studies of the impact of road connectivity on employment level can be seen in the works of Parida (2014), Mohapatra and Chandrasekhar (2007) and in other impact assessments of schemes promoting rural road connectivity undertaken by various agencies. As such, it is an interest to present workers' detail of the study areas and use it to check whether there are divergences in the economic activities of the population across the four connectivity classifications.

Table 4.7 shows the different ratios in our first (connectivity status) and second (main transport route) classifications and Table 4.8 presents the data with respect to their distance from the nearest AWR and in terms of road density.

Table 4.7 Classification I & II: Population by Economic Activity

Figures in average unless specified otherwise

Sl. No.	Activity	Classification I		Classification II		Total
		Connected with AWR	Not Connected with AWR	Along Main Route	Outside Main Route	
1	Total Workers (%)	49.64	48.48	51.19	48.50	49.09
	Males	59.22	58.88	58.69	59.15	59.05
	Females	40.78	41.12	41.31	40.85	40.95
	Workers' Sex Ratio	725	747	727	738	735
2	Main Workers (%)	89.13	85.60	88.38	87.18	87.44
	Males	63.40	65.51	62.88	64.83	64.41
	Females	36.60	34.49	37.12	35.17	35.59
	Cultivators	68.46	72.79	62.81	72.66	4.58
	Agriculture Labourers	6.28	2.73	9.30	3.28	0.51
	Household Industry Workers	0.55	0.47	0.63	0.48	6.49
3	Marginal Workers (%)	5.83	7.21	6.20	6.57	30.89
	Males	31.37	30.37	31.60	30.69	54.60
	Females	57.15	51.81	60.36	53.01	46.68
	Cultivators	44.58	48.97	42.58	47.81	2.91
	Agriculture Labourers	18.34	8.24	23.93	10.64	13.52
	Household Industry Workers	3.07	2.74	3.71	2.69	2.91

Source: Census, 2011

Table 4.8 Classification III & IV: Population by Economic Activity

Figures in average unless specified otherwise

Sl. No.	Activity	Classification III			Classification IV		Total
		AWR	Within 15 km	Outside 15 km	Below 7.5 km	Above 7.5 km	
1	Total Workers (%)	49.64	48.85	48.05	47.78	50.95	49.09
	Males	59.22	60.03	57.55	59.58	58.31	59.05
	Females	40.78	39.97	42.45	40.42	41.69	40.95
	Workers' Sex Ratio	725	721	776	729	745	735
2	Main Workers (%)	89.13	87.95	82.89	86.41	88.92	87.44
	Males	63.40	65.62	65.39	65.62	62.69	64.41
	Females	36.60	34.38	34.61	34.38	37.31	35.59

contd.

	Cultivators	68.46	75.22	70.00	70.80	70.14	4.58
	Agriculture Labourers	6.28	2.86	2.58	4.25	5.05	0.51
	Household Industry Workers	0.55	0.35	0.61	0.39	0.69	6.49
3	Marginal Workers (%)	5.83	6.25	8.31	6.77	6.08	30.89
	Males	31.37	29.65	31.20	31.72	29.71	54.60
	Females	57.15	49.90	54.01	51.50	59.02	46.68
	Cultivators	44.58	46.18	52.18	47.45	45.57	2.91
	Agriculture Labourers	18.34	8.27	8.21	11.53	16.35	13.52
	Household Industry Workers	3.07	2.22	3.33	2.35	3.72	2.91

Source: Census, 2011

Table 4.7 shows that the number of workers relative to their respective total population is higher in villages with better road connectivity. Elaborately, the ratio of total workers to total population in villages with AWR is 49.64 percent while it is 48.48 percent for the case of villages without AWR, which means that the working population is higher in the former than in the latter. It can also be seen in the second classification that there are more workers in the villages along the main route than in those outside the main transport route as 51.19 percent in villages along the main route are workers while the same is 48.50 percent for villages outside main route. Table 4.8 shows that the number of workers is higher in the villages nearer to the AWR as 48.85 percent of the population in villages within 15 km of the nearest AWR are workers while it is 48.05 percent for villages farther than 15 km. The fourth classification also shows higher work participation in the villages with higher road density. This is evident because the percentage of total workers to total population for villages with road density of more than 7.5 km is 50.95 percent, while for villages below the same measure it is 47.78 percent. Therefore, the above analysis showing the number of workers being higher in villages with better road connectivity may be translated as higher development level since employment is the source of income and a powerful tool of development through removal of poverty.

Moreover, the ratio of males to total workers in Classification I is 59.22 percent for the AWR-connected villages while the same is 58.88 percent for unconnected villages. The connected villages have a lower ratio of female workers to total workers (40.78 percent) than the unconnected ones (41.12 percent). This means that there are more female workers in villages not connected with AWR when measured in relation to the total population of workers. In Classification II, the percentage of male workers to total workers is slightly lower in villages along transport route (58.69 percent) than in villages outside the route (59.15 percent). The ratio of female workers to total workers, on the other hand, is higher in villages along the main routes (41.31 percent) than in the villages outside the main routes (40.85 percent). This means that female work participation is higher in the villages along the main routes. For Classification III, the data show that the ratio of males to total workers is higher in villages within 15 km (60.03 percent) than in villages outside 15 km of AWR (57.55 percent). Females–Total Workers Ratio, on the other hand, shows that in villages farther than 15 km, the ratio is 42.45 percent which is higher than the ratio for villages within 15 km at 39.97 percent. It is also shown that the ratio of male workers to total workers is higher in villages with ‘below 7.5 km’ road density (59.58 percent) than in villages with road density ‘above 7.5 km’ (58.31 percent). On the other hand, percentage of female workers with respect to total workers is higher in villages with greater road density as the ratio is 41.69 percent while the percentage of the same is 40.42 for villages with lower road density. This confirms that female work participation is higher in villages having greater network of roads.

The above analysis of the percentage of male workers to total workers shows mixed results. While the ratio is higher in villages along the main route (Classification II) and those within 15 km of AWR (Classification III) than their respective counterparts, it is lower in villages connected with AWR (Classification I) and those with road density above 7.5 km (Classification IV). The opposite is evidently true for the female ratio to total workers in the classifications. Therefore, the study cannot give a clear cut conclusion about the male and female percentages of total workers. This would obviously result in the same effect on the workers' sex ratio.

In Table 4.7, the workers' sex ratio (females per 1000 males) is higher in unconnected villages than in villages connected with AWR as their averages per village are 747 and 725 females per 1000 males, respectively. Also, the ratio is higher in villages lying outside of the main transport route at 738 while it is 727 for villages along the main route. Table 4.8 shows that female workers per 1000 male workers is highest in villages that are farther than 15 km from AWR (776) followed by AWR-connected villages (725) while villages within 15 km has the lowest ratio (721). Moreover, the ratio for villages with road density above 7.5 km is 745 females per 100 males which is higher than its counterpart i.e., below 7.5 km whose ratio is 729. Therefore, it may be stated that an AWR connection and distance from it may not translate into higher sex ratio of workers, but if the focus is on such, then the village has to have daily transport facilities connecting it with other villages and also a high density of road.

The population of total workers was further broken down into 'main workers' and 'marginal workers.' It is important to add here that the Census of India defines main workers as workers who had worked for the major part of the reference period (i.e. 6 months or more) while marginal workers are those workers who had worked for less than 6 months during the reference period.

The number of main workers was found to be higher in villages with better road connectivity as its percentage to total workers is higher in all the classifications. It can be seen from the table that the ratio of main workers to total workers for AWR-connected villages is 89.13 percent, which is higher than its counterpart at 85.60 percent. This ratio is also higher for the case of ‘along main road’ at 88.38 percent while it is 87.18 percent for ‘outside main road’ in the second classification. It can also be seen that among the total number of workers, there are more workers who fall into the ‘main workers’ category in villages within 15 km as the ratio is 87.95 percent while it is 82.89 percent for villages farther than 15 km. There are also larger numbers of main workers in villages with higher road density as the ratio is higher in villages with road density above 7.5 km (88.92 percent) than in villages with road density below 7.5 km (86.41 percent).

It can also be deduced from Table 4.7 that the number of main workers who are males is higher in villages not connected with AWR as their percentages are 65.51 and 63.40 percent respectively. On the other hand, the share of females in main workers is higher in villages with AWR at 36.60 percent while it is 34.49 percent in villages without AWR. This means that the number of female workers categorised as main workers is higher in AWR-connected villages. It is also shown that the male population who are main workers is higher in villages outside the main route at 64.83 percent while the same is 62.88 percent in villages along the main transport route. The data for the female population, however, shows that the percentage of female main workers is higher in villages along the main route at 37.12 percent than in villages outside the main route at 35.17 percent. Through Table 4.8, it may be noted that the ratio of males to the number of main workers is slightly higher in villages within 15 km of AWR than in villages outside 15 km. Their shares are 65.62 and 65.39 percent, respectively. At the same time, the number of females is higher in villages outside 15 km (34.61 percent) than in villages within 15 km (34.38 percent). It is also shown that for villages below 7.5 km of road density, the percentage of males among main workers is 65.62 percent which is higher than the percentage for villages above 7.5 km at 62.69 percent. The opposite is true for the female population. 37.31 percent of the main workers in villages with road density above 7.5 km are female workers while for villages with road density below 7.5 km, it is 34.38 percent. This denotes that, in respect of the total main workers, there are more female workers in villages with higher road density.

Consequently, what can be derived from the particular examination is – the percentage male main workers is higher in villages lying outside the main route and within 15 km of AWR while they are lower in villages connected with AWR and in villages that possess above 7.5 km road density than their respective adversaries. However, in most of the cases, the percentage of female main workers among total main workers was found to be higher in villages with better road connectivity.

The ratio of cultivators to the total main workers was also analysed. In its simplest form, a cultivator is a person engaged in cultivation of land owned or held and has effective supervision or direction in cultivation. The analysis shows that the percentage of cultivators is higher for unconnected villages (72.79 percent) than the connected ones (68.46 percent). This means that in relation of total main workers, the number of cultivators is higher in the unconnected villages than in the connected villages. It is also higher in villages outside of the main route at 72.66 percent while for villages along main route, it is 62.81 percent. Moreover, computation of the ratio with respect to distance from AWR shows that it is higher in the villages within 15 km than in villages outside 15 km of AWR as their percentages are respectively 75.22 and 70. On the other hand, the average is higher in the villages below 7.5 km road density at 70.80 percent, while it is 70.14 percent for villages above 7.5 km. Thus, in most cases, the percentage share of cultivators in the total main workers is higher in villages with poor road connectivity.

It was also an interest to check the percentage of agricultural labourers. An agricultural labourer may be defined as a person who works on another person's land for wages in money or kind or share. The analysis shows that the ratio of agricultural labourers in relation to the total number of main workers is higher in AWR-connected villages as the ratio of the same is 6.28 percent while it is 2.73 percent for unconnected villages. It can also be seen that the percentage is higher in villages along the main route as the ratio of main agriculture labourers to main workers is significantly higher at 9.30 percent while the same is only 3.28 percent for villages outside the main route. At the same time, it is also higher in villages within 15 km as their ratio to the total number of main workers is 2.86 percent while the same is 2.58 percent for villages farther than 15 km from the nearest AWR. The road density classification also shows that the ratio is higher in villages above 7.5 km road density at 5.05 percent while it is 4.25 percent for villages below 7.5 km. It can be consequently stated that the number of agricultural labourers i.e. persons working on other people’s land for wages is higher in villages with better road connectivity.

It was also found that there are more household industry workers in villages with better road connectivity than in villages with relatively inferior connectivity. From the tables, it can be derived that the average of household industry workers as a ratio of main workers is 0.55 percent for AWR-connected villages which is higher than its counterpart at 0.47 percent. The same can be observed in the second classification as the ratio for villages along transport route is 0.63 percent which is higher than the percentage for villages outside transport route at 0.48 percent. However, villages lying farther than 15 km from the nearest AWR have higher number of industrial main workers. While it is 0.61 percent for this category, the percentage for villages within 15 km of AWR is 0.35. The ratio for villages with higher road density above 7.5 km is 0.69 percent which is significantly greater than the ratio for villages with lower road density at 0.39 percent.

The case of marginal workers was also taken into account in the study. As already stated, marginal workers are workers who worked for less than 6 months within a reference year. The ratio of marginal workers to total workers is lower in the villages connected with AWR at 5.83 percent while it is 7.21 percent for the villages not connected with AWR. The same is higher in the case of villages outside the main route as its ratio is 6.57 percent while it is 6.20 percent for villages lying along the main route. This percentage of marginal workers out of total workers is also higher in villages outside 15 km of AWR at 8.31 while the same is 6.25 percent for villages within 15 km. The percentage for villages where road density is below 7.5 km is higher than its counterpart as the share of marginal workers to total workers is 6.77 percent for villages with lower road density and 6.08 percent for villages with higher road density. Thus, it can be seen that the percentage of marginal workers is higher in villages with poor road connectivity. In other words, out of the total workers in the village, there are more marginal workers in villages with poor road connectivity than in villages with better road connectivity.

In spite of the fact that the percentage of marginal workers is lower in villages with AWR connection, the ratio of male marginal worker to total marginal worker for connected villages is 31.37 percent, which is higher than 30.37 percent for unconnected villages. The ratio of female worker to marginal worker is 57.15 percent for connected villages and 51.81 percent for unconnected villages. Classification II shows that the percentage is higher in both the sexes in villages along the main route although the percentage of the female marginal workers (60.36 percent for 'along main route' and 53.01 percent for 'outside main route') is more significant in both the cases than their male counterpart (31.60 percent for 'along main route' and 30.69 percent for 'outside main route').

In contrast, percentage of males and females among total marginal workers shows that villages farther from AWR are higher (31.20 percent for males, 54.01 percent for females) than the percentages for villages nearer to AWR (29.65 percent for males, 49.90 percent for females). This implies that the number of marginal workers becomes higher as we go farther from AWR. Lastly, in the classification of villages by their road density, the number of male workers is higher in villages of lesser road density than in villages with road density above 7.5 km as the ratios show 31.72 percent and 29.71 percent, respectively. On the other hand, the percentage for female workers is higher in the 'below 7.5 km' category at 59.02 percent while it is 51.50 percent for 'above 7.5 km'. As such, a clear-cut conclusion regarding male marginal workers cannot be derived from the above interpretation as it shows mixed results across the four classifications. However, it may be noted that in most cases, the participation of the female population is higher in villages with better road connectivity than in villages with poor road connectivity.

Like that of main cultivators, there are more marginal cultivators in villages with poor road connectivity when the same is taken as a percentage of total marginal workers. Here, the average number of marginal cultivators is higher in the case of villages not connected with AWR as its percentage to marginal workers is 48.97 percent while the same is 44.58 percent for the villages connected with AWR. Also, the percentage of marginal cultivators to total marginal ratio is higher at 47.81 percent for villages outside the main route and 42.58 percent for villages along the main route. Moreover, the percentage is higher in villages outside 15 km of AWR as it is 52.18 percent in these villages while in villages within 15 km, it is 46.18 percent. The table also shows that the percentage is higher in villages with road density below 7.5 km at 47.45 percent while the same is 45.57 percent for villages with road density above 7.5 km.

Again in Table 4.7, it is shown that the percentage of marginal agricultural labourers to marginal workers is significantly higher in the connected villages at 18.34 percent while the same is only 8.24 percent for unconnected villages. The percentage of the same is also higher in villages along the main route (23.93 percent) than in villages outside the main route (10.64 percent). Table 4.8 shows that the percentage of agricultural labourers is higher in villages within 15 km at 8.27 percent than in villages farther than 15 km from AWR whose share in total marginal workers is 8.21 percent. Moreover, it is higher in villages with greater road density at 16.35 percent while for villages with lower road density, it is 11.53 percent. Thus, like that of main agricultural labourers, the ratio of agricultural labourers who are marginal workers is higher in villages with better road connectivity.

The data for the ratio of household industry workers to total marginal workers shows that AWR-connected villages have a higher percentage at 3.07 percent while the same is 2.74 percent for the villages not connected with AWR. At the same time, it is also higher in villages along the main transport route at 3.71 percent than in villages outside the route whose share amounts to 2.69 percent. It can also be seen that the percentage is the highest in villages that are more than 15 km away from the nearest AWR with 3.33 percent while in villages nearer to AWR, the percentage is 2.22. However, it can be also be seen that villages with road density greater than 7.5 km has a higher percentage at 3.72 percent while its counterpart, villages with road density under 7.5 km, is at 2.35 percent. Therefore, except for the 'distance from AWR' classification, it can be seen that there are more industrial workers in villages with better road connectivity than in villages with inferior road connectivity.

The entire analysis of the population according to their economic activities can be summarised in the following notable points –

First, total workers' ratio is higher in villages with better road connectivity. A reasonable assumption may be the availability of more livelihood options and the possibility of shifting from agriculture to service sector in these villages. At the same time, the percentage is low in villages with poor road connectivity probably because of the high child ratio to population in these villages which consequently translates into high dependency ratio.

Second, even though the total workers' ratio is lower in villages with poor road connectivity, a notable feature is the contribution of female workers. The reason for this situation may be the extensive practice of shifting cultivation in these areas. In a traditional set up, male and female work forces have equal contribution in jhumming cultivation in most of the cases and as such, female work participation was found to be high in these villages.

Third, there are more marginal workers in villages with poor road connectivity. The definition of 'marginal workers' as given in Census of India as those who worked for less than 6 months would support the assumed reason for this feature of high marginal workers to being a result of the seasonal nature of the state's agriculture, jhumming to be exact. On the other hand, a distinctive trait found in the analysis of marginal workers is that while the overall percentage is higher in poorly connected villages, the female marginal workers' percentage is higher in villages with better road connectivity.

Fourth, the percentage of industrial workers is higher in the villages with better road connectivity. At the same time, there are a higher percentage of agricultural labourers in these villages as well. It may be hypothesized that the problem of land availability has emerged as a result of road connectivity, especially in the areas along the main transport route. The lands in the villages with better road connectivity attract wealthy investors (Golmohammadi, 2012). At the same time, the price of such lands rises up (Chambers, 2006). So, the workers are required to work in other people's farms and become agricultural labourers. Meanwhile, with the development of communication, households belonging to the villages with better road connectivity may have a better chance of adopting industrial livelihood occupations like trade and transport services, among others, thus resulting in the higher percentage of household industry workers in these villages.

4.3.3 Land Use Pattern

Having major impacts not only on the livelihood of rural population but also on natural resources, proper land use practices have been rightly viewed to have effects on the economy and environment. As the main occupation of the people in developing countries is agriculture and with the growing attention towards sustainable development, land use is an integral part of development processes that cannot be viewed in isolation from other critical elements of that process, namely social and economic planning (Thomas, 2001). Different literatures regarding the relationship between road connectivity and land use can be found in the works of Huang and Hsieh (2014), Freitas et al. (2009), and Alba and Beimborn (2004). Therefore, it is an academic interest to study the land use patterns of the areas using the same set of classifications.

Here, the cases considered are percentage area of wet rice cultivation, agriculture plantation, forest cover, and jhum size per household. In addition to these, the total area of the village and its area within 1 kilometer from motorable road are presented as well. Table 4.9 and 4.10 shows the land use data with respect to the four classifications.

Table 4.9 Classification I & II: Land Use Data

Figures in average unless specified otherwise

Sl. No.	Cases	Classification I		Classification II		Total
		Connected with AWR	Not Connected with AWR	Along Main Route	Outside Main Route	
1	WRC Area (%)	0.85	0.83	0.69	0.89	0.84
2	Agriculture Plantation Area (%)	0.31	0.09	0.45	0.14	0.20
3	Forest Area (%)	73.88	76.27	75.57	74.88	75.03
4	Jhum Size per Household (Hectare)	3.44	4.36	2.81	4.17	3.88
5	Average Area of the Village (sq km)	37.86	36.43	40.34	36.30	37.18
6	Area within 1km from motorable road (sq km)	11.73	2.98	14.17	5.72	7.55

Source: Mizoram Remote Sensing Application Centre, 2014

Table 4.10 Classification III & IV: Land Use Data

Figures in average unless specified otherwise

Sl. No.	Cases	Classification III			Classification IV		Total
		AWR	Within 15 km	Outside 15 km	Below 7.5 km	Above 7.5 km	
1	WRC Area (%)	0.85	1.05	0.58	1.01	0.60	0.84
2	Agriculture Plantation Area (%)	0.31	0.08	0.10	0.11	0.34	0.20
3	Forest Area (%)	73.88	75.19	77.52	74.75	75.42	75.03
4	Jhum Size per Household (Hectare)	3.44	4.27	4.45	3.85	3.91	3.88
5	Average Area of the Village (sq km)	37.86	33.37	39.94	30.65	46.50	37.18
6	Area within 1km from motorable road (sq km)	11.73	4.03	1.79	1.31	16.46	7.55

Source: Mizoram Remote Sensing Application Centre, 2014

Like the former analyses, Classification I is based on whether the village is connected with AWR or not and Classification II on whether they are along the main transport route of the state. These are given in Table 4.9. At the same time, Table 7.10 shows Classification III, in which the land use data is analysed according to the distance of villages from the nearest AWR, and Classification IV, which is based on the density of road network in the village.

The area of wet rice cultivation (WRC) to village area is higher in the AWR-connected villages with the percentage being 0.85 percent while it is 0.83 percent for villages not connected with AWR. In the second classification, it can be seen that the percentage of WRC area is higher for villages outside main road (0.89 percent) than for villages along main road (0.69 percent). At the same time, the percentage of WRC area is higher in villages nearer to AWR than those far from it. For villages within 15 km, it is 1.05 percent while it is 0.58 percent for those outside 15 km of AWR. However, the percentage of land under WRC is larger in villages with lower road density. Their percentages are 1.01 and 0.60 for villages below and above 7.5 km respectively. Thus, the data presents mixed results where the percentage of WRC area is higher in villages connected with AWR and in villages within 15 km of the nearest AWR than their respective opponents while it is higher in villages outside main route and villages with road density below 7.5 km.

In the case of agriculture plantation area, there is a significant difference between villages connected with AWR and those that are not, the percentage being 0.31 for the former and only 0.09 percent for the latter. Moreover, it can be seen that plantation is being undertaken more extensively in villages lying along the main transport route as the percentage of agriculture plantation area is higher in these villages at 0.45 percent while it is 0.14 percent for villages outside the main route. The percentage, however, is higher in villages farther than 15 km as it is 0.10 percent while it is 0.08 percent for villages within 15 km. At the same time, agriculture plantation area is greater in villages with higher road density at 0.34 percent for villages with road density above 7.5 km and 0.11 percent for those below it. Consequently, what can be seen is that in most of the cases, agriculture plantation area is higher in villages with better road connectivity than in villages with poor road connectivity.

Percentage of forest cover area to average village area is higher in villages not connected with AWR as it stands at 76.27 percent while it is 73.88 percent for the connected ones. However, the percentage is higher in villages along the main transport route at 75.57 percent while the same is 74.88 percent for villages outside the main route. It can also be observed that percentage of forest cover area becomes denser as we move farther away from AWR. It is 73.88 percent, 75.19 percent and 77.52 percent for villages with AWR, within 15 km and outside 15 km of AWR, respectively. At the same time, the percentage area of villages under forest cover is slightly higher in villages with road density above 7.5 with 75.42 percent while it is 74.75 percent for villages below 7.5 road density. Therefore, the data for percentage of forest cover area in village area show that it is lower in villages with AWR connection and in villages within 15 km of AWR, while it is slightly higher both in villages along main route and villages with road density above 7.5 km.

The average jhum area per household was found to be higher in villages not connected with AWR at 4.36 hectares while the same is 3.44 hectares for AWR-connected villages. Moreover, it is higher in villages outside the main transport route at 4.17 hectares than in villages along the route with an average percentage of 2.81. The percentage is higher in villages farther than 15 km from AWR (4.45 hectares) than in villages within 15 km (4.27 hectares). On the other hand, the average area under jhum cultivation for a household is higher in villages with greater road density at 3.91 hectare while its counterpart is at 3.85 hectare percent. It should however be noted that the area of jhum cover for the study areas as a whole turned out to be 3.88 hectares per household per village which is larger than anticipated. The reason may be because of the fact that the data was derived through geographic information system which included both the current jhum and current fallow areas. However, the current fallow is considered here as operational holding if the entire area of operational holding is under current fallow during the reference year but was cultivated in the preceding year.

The average area of villages is slightly higher for the case of AWR-connected villages at 37.86 sq km, while for the unconnected ones, it is 36.43 sq km. At the same time, it is larger for the villages along main route as the average for it is 40.34 sq km while it is 36.30 for villages outside the main route. This average village area, however, shows a contrasting feature in the third classification as it is lowest in villages within 15 km of the nearest AWR (33.37 sq km) while it is the highest in villages with a distance of more than 15 km from AWR (39.94 sq km). On the other hand, villages with higher road density have larger area (46.50 sq km) than villages with low road density (30.65 sq km). Therefore, the area of the village in most of the classifications is larger in villages with better road connectivity.

The area of the village within 1 km from the motorable road (National Highway, State Highway, District Road, and Village Road) is significantly higher in AWR-connected area as the average turned out to be 11.73 sq km while the same is 2.98 sq km for the villages without AWR. Moreover, for villages along the main transport route, the average is 14.17 sq km which is significantly higher than its counterpart whose average area is 5.72 sq km. This measure is higher in villages within 15 km of AWR (4.03 sq km) than in villages outside 15 km of AWR (1.79 sq km). However, it should be noted that both these averages are well below the state average. Lastly, villages with higher road density have a significantly higher area of their village within 1 km from motorable road as the average for these villages is 16.64 sq km while for villages with lower road density, the average is 1.31 sq km. It can thus be concluded that the villages with better road connectivity unsurprisingly have more area of their village within 1 km from motorable road.

Some of the notable observations of the analysis of the various cases of land use are given in the following:-

First, the percentage of WRC area to total village area is higher in villages connected with AWR and in villages that are within 15 km of the nearest AWR. However, it is lower in villages with high road density and those along the main transport route than their respective adversaries. This is due to the fact there are villages that are connected with AWR but do not lie along the main route having large tracts of land under WRC. The cases of Buhchangphai, Meidum and Bukvannei villages of Kolasib districts may be cited. Possessing WRC areas of 22.69 percent, 19.48 percent and 14.72 percent respectively, they are among the villages having the highest area under WRC in the whole study area. As such, the percentage is higher for villages outside the main route since these percentages shoot up the average percentage of the category.

Second, it can be stated that agricultural plantation area is highly correlated with road connectivity because the percentages for the villages with better road connectivity are significantly higher. Considering the topography of Mizoram, WRC might not be a possible option for the agricultural sector because the area for such cultivation would be limited by the state's terrain. An alternative practice to move the people away from the unsustainable practice of jhumming to sustainable cultivation would be agricultural plantation/settled cultivation like horticultural crops, rubber, etc. As such, the prevalence of agricultural plantation area may be viewed as one of the development indicators, especially for the agricultural sector. The percentage area being higher in villages with better road connectivity suggests that agriculture development is greater in these villages.

Third, percentage of forest cover area is higher in villages not connected with AWR and villages outside 15 km of nearest AWR than their counterparts while it is lower for villages with road density below 7.5 km and for villages outside the main route. This, again, may be due to the presence of high percentages in villages that are along the main route as a result of sanctuaries like Ngengpui Wildlife Sanctuary and Blue Mountain Sanctuary. The possibility of these sanctuaries raising the average percentage of forest area for these villages cannot be ruled out.

Fourth, the average jhum area per household per village is lower in villages with better road connectivity. In other words, the practice of jhumming is being undertaken more extensively in villages with poor road connectivity.

Lastly, in most cases, the average area of the village is larger in villages with better road connectivity. Moreover, the area of the village within 1 km from motorable land also shows a favourable situation for villages with better road connectivity. Therefore, it may be concluded the village road network is influenced by its connectivity status while the reverse would also hold true to that effect.

4.3.4 Basic Social Infrastructures

Social infrastructures, like economic infrastructures, are deemed to possess enormous externalities in which social marginal productivity exceeds private marginal productivity (Kularatne, 2006) and as such, it is of interest to identify and analyse certain basic social infrastructures in order to know whether road connectivity has effect on the availability of these infrastructures which are crucial for creating sustainable communities. The social infrastructures identified for the study are educational facilities, amount of piped water supplied which is measured in litres per capita per day (LPCD), and the health care institutions and health care providers present in the villages.

a) Educational Facilities

The study analysed the educational institutions present in the villages because education in every sense is one of the fundamental factors of development. Various studies have shown that well-educated societies have lower rates of violence and crime, and societies that emphasise accessible, effective education see their economies improve as well. Moreover, one of the indicators of educational development is the number of teachers available per student because a high teacher-student ratio (or low student-teacher ratio) can increase student achievement and provide lasting academic benefits by closing the achievement gap, promoting individualized achievement and encouraging greater participation in class. This test of the effect of road connectivity on the educational sector has been done at length by various authors like Golmohammadi (2012), Castaing (2011) and Umoren et al. (2009) who, among many others, have found a close relation between the status of road connectivity and education. Here in the present study, the number of schools, students and teachers in each village were collected and are presented in averages in the following tables, Table 4.11 and Table 4.12.

Table 4.11 Classification I & II: Educational Institutions and Enrolment Details

Figures in average unless specified otherwise

Sl. No.	Details	Classification I		Classification II		Total
		Connected with AWR	Not Connected with AWR	Along Main Route	Outside Main Route	
1	No. of Primary Schools	2.71	1.76	3.19	2.00	2.26
	Teacher-Student Ratio (%)	6.42	5.76	6.52	5.99	6.11
2	No. of Middle Schools	1.88	1.27	2.26	1.40	1.59
	Teacher-Student Ratio (%)	14.24	14.32	14.12	14.32	14.28
3	No. of High Schools	0.80	0.38	0.96	0.49	0.59
	Teacher-Student Ratio (%)	12.10	7.02	13.25	8.69	9.68
4	No. of Higher Secondary Schools	0.10	0.01	0.13	0.03	0.06
	Teacher-Student Ratio (%)	1.30	0.06	1.84	0.40	0.71
5	Total No. of Schools (1+2+3+4)	5.48	3.42	6.54	3.93	4.50
	Teacher-Student Ratio (%)	10.11	9.49	10.30	9.68	9.81

Source: Field Survey, 2014

Table 4.12 Classification III & IV: Educational Institutions and Enrolment Details

Figures in average unless specified otherwise

Sl. No.	Details	Classification III			Classification IV		Total
		AWR	Within 15 km	Outside 15 km	Below 7.5 km	Above 7.5 km	
1	No. of Primary Schools	2.71	1.70	1.83	1.75	2.99	2.26
	Teacher-Student Ratio (%)	6.42	5.57	5.99	5.94	6.34	6.11
2	No. of Middle Schools	1.88	1.33	1.20	1.26	2.07	1.59
	Teacher-Student Ratio (%)	14.24	14.19	14.46	13.78	14.99	14.28
3	No. of High Schools	0.80	0.39	0.36	0.42	0.84	0.59
	Teacher-Student Ratio (%)	12.10	7.14	6.89	7.63	12.59	9.68
4	No. of Higher Secondary Schools	0.10	0.02	0.01	0.01	0.12	0.06
	Teacher-Student Ratio (%)	1.30	0.04	0.09	0.08	1.61	0.71
5	Total No. of Schools (1+2+3+4)	5.48	3.45	3.39	3.44	6.01	4.50
	Teacher-Student Ratio (%)	10.11	9.17	9.84	9.48	10.28	9.81

Source: Field Survey, 2014

Starting from the total number of schools, it can be seen in Table 4.11 that the average number of schools in villages connected with AWR is 5.48 which is higher than in villages not connected with AWR whose average is 3.42. The ratio of teachers to students is also higher for the AWR-connected villages at 10.11 teachers per 100 students while it is 9.49 for the unconnected ones. Another conclusion that can be drawn from the table is that there are more schools in villages along main transport route than in villages outside the route. A significant difference between the two categories of villages can be observed as the average for the former is 6.54 while it is 3.93 for the latter. The teacher-student ratio is also higher in villages along the main transport route at 10.30 while the same is 9.68 for villages lying outside the main route of the state. In the third classification (Table 4.12), the number of schools decreases as we move farther from AWR. As is shown, the average is 5.48 for villages with AWR while it is 3.45 for villages within 15 km of AWR and 3.39 for villages outside 15 km. The average number of teachers per 100 students, however, shows a different picture as it is highest in ‘AWR’ (10.11), followed by ‘Outside 15 km’ (9.84) and then by ‘Within 15 km’ (9.17). In the ‘Road Density’ classification shown in the same table, it can be seen that villages with road density equal to or higher than 7.5 km has larger number of schools at 6.01 per village while it is only 3.44 for villages with road density lower than 7.5 km. Moreover, the teacher-student ratio is also higher in villages with road density 7.5 km or higher, as the average is 10.28 while the same is 9.48 in villages with road density lower than 7.5 km.

Therefore, the above analysis shows that the number of schools per village is higher in villages with better road connectivity than in villages with poor road connectivity. Moreover, the teacher-student ratio measured here as the number of teachers per 100 students is higher in most of the classifications of villages with better road connectivity. As such, it may be concluded that the existence of schools and availability of educators are related to the connectivity status of the rural areas.

The study also identified and analysed these educational facilities at the different standards – primary, middle, high, and higher secondary schools. This has been done to identify the standards in which there are significant differences between each category of the different classifications.

In the first classification, the number of primary schools is significantly higher in villages connected with AWR as its average is 2.71 while the same is 1.76 for villages not connected with AWR. The teacher-student ratio is also higher in the former case as the average number of teachers per 100 students in primary schools is 6.42 for the connected villages and 5.76 for the unconnected ones. The same can also be seen in the second classification as the average number of primary schools is 3.19 for villages along main transport route while it is 2.00 for the other villages. The teacher-student ratio is also higher in villages along the route (6.52) than in villages lying outside main transport route (5.99). At the same time, Table 4.12 shows that while the average number of primary schools is highest in villages with AWR, it is lowest in villages within 15 km of AWR at 1.70 and its counterpart is slightly higher at 1.83 primary schools per village. The same pattern can also be observed in the number of teachers per 100 students in primary schools as the average for villages within 15 km of AWR is 5.57, which is lower than the average for villages farther than 15 km at 5.99. Again, they both are lower than the number of teachers in villages with AWR. The fourth classification shows that villages with road density above 7.5 km have more number of primary schools as the average for these villages is 2.99 while it is 1.75 for villages with lower road density. At the same time, the average number of primary school teachers per 100 students is 6.34 for villages having road density above 7.5 km while the same is 5.94 for villages with road density lower than 7.5 km. Therefore, the study of primary schools shows that in most of the classifications, there are more primary schools and more teachers per 100 students in villages with better road connectivity.

The average number of middle schools is higher in villages connected with AWR at 1.88 while the same is 1.27 in villages not connected with AWR. However, the average number of middle school teachers per 100 students is lower in the former (14.24) than in the latter (14.32). The classification of villages into ‘along main route’ and ‘outside main route’ also shows that the number of middle schools is higher in the former category than in the latter as their averages are respectively 2.26 and 1.40. The teacher-student ratio, however, is higher in villages outside the main route as the average is 14.32 while it is 14.12 for villages along the main route. It can also be seen from Table 4.12 that the number of middle schools is lower as we move farther from AWR. While the average for villages with AWR is 1.88, it is 1.33 and 1.20 for villages within 15 km and outside 15 km of AWR, respectively. On the other hand, the teacher per 100 student average is highest in villages farther than 15 km from the nearest AWR (14.46) followed by villages with AWR (14.24) and villages within 15 km (14.19). The classification according to their density of road shows that villages with higher road network have a greater number of middle schools and teacher-student ratio. The average number of middle schools for villages with road density above 7.5 km is 2.07, which is higher than its counterpart at 1.26. At the same time, the average number of middle school teachers per 100 students is 14.99 for villages with higher road density while the same is 13.78 for villages with lower road density.

It can be seen from the above analysis that there are more middle schools in villages that possess better road connectivity. However, the teacher-student ratio of middle schools gives a mixed result. The number of teachers per 100 students of middle school standard is higher in villages with AWR and in villages with road density above 7.5 km while it is lower in villages along main route and those within 15 km of AWR. Therefore, it may be concluded that while the establishment of middle schools is related to their road connectivity status, the presence of teachers for middle school standard is not affected by the village being along the main transport route or its distance from AWR, but is affected by the village's road network and its AWR connectivity status.

The data for high school level of education shows that the average number of high schools in villages connected with AWR is 0.80 which is higher than the number for villages not connected with AWR whose average is 0.38. At the same time, the average number of high school teachers per 100 students in villages connected with AWR is 12.10, which is again higher than the average number of teachers per students in villages not connected with AWR at 7.02. The second classification also shows that more high schools are established in villages along the main route as the average for it is 0.96 while it is 0.49 per village for those lying outside the main transport route. In addition, the number of teachers per 100 students is higher along main route at 13.25 while for those outside the main route, the average is 8.69. It can also be seen that the average is higher in villages within 15 km (0.39) than in villages outside 15 km (0.36) of AWR. The teacher-student ratio for this classification is also higher in villages within 15 km as the average for it stands at 7.14 while for the outside 15 km category, it is 6.89 per village. Lastly, the number of high schools in villages with road density above 7.5 km is 0.84 per village which is higher than the average for villages below 7.5 km road density at 0.42. Moreover, the average number of teachers per 100 students is higher for villages that have road density above 7.5 km than for villages below 7.5 km road density. Their averages are 12.59 and 7.63, respectively. Thus, it may be stated that the establishment of high schools is related to the connectivity status as the averages of number of high schools and teachers per 100 students are higher in villages with better road connectivity.

Lastly, the average number of higher secondary schools for villages connected with AWR stands at 0.10 which is higher than the average for villages without AWR connection at only 0.01. The average teacher-student ratio is also higher in the former (1.30) than in the latter (0.06). At the same time, the average number of higher secondary schools is greater in villages along the main route at 0.13 than in villages outside the main route whose average is 0.03. The teacher-student ratio is also higher in the former at 1.84 while in the latter, it is 0.40. Classification according to the distance from AWR shows that the average number of higher secondary schools is slightly higher in villages within 15 km (0.02) than in villages outside 15 km (0.01). However, the teacher-student ratio for villages within 15 km is lower at 0.04 than for villages farther than 15 km, the ratio of which is 0.09. In addition, the number of higher secondary schools is higher in villages with road density above 7.5 km as the average for it is 0.12 while the same is 0.01 for villages with road density below 7.5 km. The teacher-student ratio is also higher in the former (1.61) than in the latter (0.08). Conclusively, it can be stated that the number of higher secondary schools available and teacher-pupil ratio is more favourable in villages with better road connectivity as their averages are higher for these villages in almost all the cases.

Therefore, the analysis of the number of schools present in each village and the number of teachers available for the total number of students shows that villages with better road connectivity enjoy better educational facilities. The average number of schools was found to be higher in villages with superior road connectivity than in villages with poor road connectivity in most of the cases. Moreover, the teacher-student ratio was also found to be higher in almost all the cases in favour of better connected villages. Therefore, it may be concluded that the promotion of education is taken up more extensively in villages that have a high level of road connectivity.

b) Drinking Water Supply

Another important component of social infrastructure is water supply and so, the study included the quantity of drinking water supply as one of the development variables. Though access to drinking water is not a major problem for the state, piped water supply is quite poor. But since unpolluted and treated piped water is regarded as the single most important determinant of public health, the litres per capita per day for each village was collected and analysed to the tune of the four classifications. The analysis of supply of drinking water in tandem with rural roads can be found in studies of Atagher and Atagher (2014), Eze (2012), and Olagunju et al. (2012).

Table 4.13 shows the litres per capita per day (LPCD) of the villages tabulated according to the four classifications of connectivity status, main transport route, distance from AWR and road density.

Table 4.13: Piped Water Supply

Figures in average

Classification	Cases	Litres per Capita per Day
I Connectivity Status	Connected with AWR	33.79
	Not Connected with AWR	31.27
II Main Transport Route	Along Main Route	39.58
	Outside Main Route	30.51
III Distance from AWR	AWR	33.79
	Within 15 km	29.02
	Outside 15 km	33.86
IV Road Density	Below 7.5 km	31.05
	Above 7.5 km	34.77
	Total	32.58

Source: Public Health Engineering Dept, Mizoram 2015

In Classification I, it can be seen that villages with AWR have higher LPCD than villages not connected with it. The average for the former is 33.79 litres while it is 31.27 litres for the latter. It can also be seen that villages lying along the main transport route have higher LPCD than those that are not - their respective averages being 39.58 litres and 30.51 litres. However, distance from AWR shows a contrasting feature as villages outside 15 km of AWR has the highest average of LPCD at 33.86 litres while those within 15 km have 29.02 litres. On the other hand, villages with higher density of road network have higher LPCD at 34.77 litres while those with lower network have an average of 31.05 litres per capita per day.

From the above interpretation, it can be seen that the amount of piped water supplied to the study areas was found to be greater in almost all of the cases in favour of the villages with better road connectivity. This can be assumed to have positive impacts on the economy as the supply of clean drinking water contributes to sustainable improvements in peoples' lives regarding their health and education situation, which are the preconditions for productive employment (Hesselbarth, 2005).

c) Health Care Facilities

The next set of investigation is of health care institutions. It is often stated that economic development contributes to better health care and vice versa (Cypher and Dietz, 2004). More elaborately, health improvement contributes to economic development by improving productivity and learning, reducing family size and even increasing availability of land for productive use. At the same time, access to health care facilities may be severely limited by the road connectivity status and transport services. Extensive research work regarding road connectivity and its impact on health care has been done by various authors like Banerjee and Sachdeva (2015), Ibrahim (2013), Bhatt and Joshi (2013), Bhandari and Dutta (2014), to name a few. As such, the inclusion of analysis of health care facilities present in villages for the present study may be justified.

The following tables (Table 4.14, Table 4.15, Table 4.16, and Table 4.17) show the number of health care facilities available in the rural areas which are again tabulated according to the four classifications.

Table 4.14 Classification I: Health Care Facilities

Sl. No.	Health Facilities	Number of Villages			Percentage of Villages		
		Connected with AWR	Not Connected with AWR	Total	Connected with AWR	Not Connected with AWR	Total
1	Community Health Centre	6	0	6	100	0	100
2	Primary Health Centre	36	5	41	87.80	12.20	100
3	Sub-Centre	117	95	212	55.19	44.81	100
4	Sub-Centre Clinic	27	29	56	48.21	51.79	100
6	No Health Facilities	84	118	202	41.58	58.42	100
	Total	270	247	517	52.22	47.78	100

Source: Field Survey, 2015

Table 4.15 Classification II: Health Care Facilities

Sl. No.	Health Facilities	Number of Villages			Percentage of Villages		
		Along Main Route	Outside Main Route	Total	Along Main Route	Outside Main Route	Total
1	Community Health Centre	5	1	6	83.33	16.67	100
2	Primary Health Centre	18	23	41	43.90	56.10	100
3	Sub-Centre	58	154	212	27.36	72.64	100
4	Sub-Centre Clinic	9	47	56	16.07	83.93	100
6	No Health Facilities	22	180	202	10.89	89.11	100
	Total	112	405	517	21.66	78.34	100

Source: Field Survey, 2015

Table 4.16 Classification III: Health Care Facilities

Sl. No.	Health Facilities	Number of Villages				Percentage of Villages			
		AWR	Within 15 km	Outside 15 km	Total	AWR	Within 15 km	Outside 15 km	Total
1	Community Health Centre	6	0	0	6	100	0	0	100
2	Primary Health Centre	36	1	4	41	87.80	2.44	9.76	100
3	Sub-Centre	117	45	50	212	55.19	21.23	23.58	100
4	Sub-Centre Clinic	27	14	15	56	48.21	25	26.79	100
5	No Health Facilities	84	72	46	202	41.58	35.64	22.77	100
	Total	270	132	115	517	52.22	25.53	22.24	100

Source: Field Survey, 2015

Table 4.17 Classification IV: Health Care Facilities

Sl. No.	Health Facilities	Number of Villages			Percentage of Villages		
		Below 7.5 km	Above 7.5 km	Total	Below 7.5 km	Above 7.5 km	Total
1	Community Health Centre	3	3	6	50	50	100
2	Primary Health Centre	6	35	41	14.63	85.37	100
3	Sub-Centre	118	94	212	55.66	44.34	100
4	Sub-Centre Clinic	33	23	56	58.93	41.07	100
5	No Health Facilities	144	58	202	71.29	28.71	100
	Total	304	213	517	58.80	41.20	100

Source: Field Survey, 2015

In Table 4.14, it can be seen that all of the Community Health Centres (CHCs) of the rural areas are in villages connected with AWR while in Table 4.15, 83.33 percent are in villages along the main transport route and 16.67 percent are in villages outside the route. As is already stated, CHCs are concentrated in villages with AWR, so there are no such facilities in villages within and outside 15 km of AWR (Table 4.16). However, in Table 4.17 when classification is done accounting for road density, the CHCs of the state are evenly distributed in villages with road density below and above 7.5 km. Therefore, it may be concluded that Community Health Centres are typically located in villages with better road connectivity showing a significant relation between the availability of Community Health Centres and road connectivity.

It can also be seen that 87.80 percent of Primary Health Centres (PHCs) are in the connected villages while 12.20 percent are in villages not connected with AWR. However, the number of PHCs is higher in villages lying outside of the main transport route as 56.10 percent are in these villages while the remaining 43.90 percent are in villages along main route. Again, as 87.80 percent of PHCs are in villages with AWR, the remaining are distributed among the other villages of which 9.76 percent are in villages outside 15 km of AWR which is higher than in villages within 15 km of AWR at 2.44 percent. According to the road density measure, 85.37 percent are in villages with density above 7.5 km while 14.63 percent are in villages with road density below 7.5 km. The data for Primary Health Centres thus give us a mixed result where the number is higher in villages with AWR connection and those with higher road density, while at the same time it is lower in villages along main route and villages within 15 km of AWR than their respective counterparts.

The study also found that there are more Sub-Centres in villages connected with AWR than in villages that are not connected as their percentages are 55.19 and 44.81 respectively. On the other hand, in the second classification, 72.64 percent of sub-centres are in villages outside the main transport route while the same is 27.36 percent for villages along the transport route. For villages farther than 15 km from AWR, the percentage is 23.58 which are slightly higher than for villages within 15 km at 21.23 percent. It can also be seen that 55.66 percent of Sub-Centres are in villages below 7.5 km road density while the remaining 44.34 percent are in villages with road density above 7.5 km. Thus, it may be stated that Sub-Centres are concentrated in villages with poor road connectivity as it is true for almost all of the classifications.

The tables also show that 51.79 percent of Sub-Centre Clinics are in villages not connected with AWR and 83.93 percent in villages outside main transport route, which means that these Clinics are usually established in far-flung villages. Table 4.16 also shows that 26.79 percent of Sub-Centre Clinics are in villages lying farther than 15 km from the nearest AWR while 25 percent are in villages within 15 km. Along the same line, 58.93 percent are in villages with road density below 7.5 km while the remaining 41.07 percent are in villages with road density above 7.5 km, which means that there are more Sub-Centre Clinics in villages of lower road network. In a nutshell, it can be concluded that the number Sub-Centre Clinics is higher in villages with inferior road connectivity than in villages with better road connectivity.

There are more villages with no health care facility in the 'not connected with AWR' category of Classification I. These villages compose 58.42 percent of the total number of villages without any health care facility while the rest are in the AWR-connected villages. At the same time, of the total number of villages in which there are no health care facilities, 89.11 percent are villages outside the main transport route while 10.89 percent are villages along the main route. For villages that are not connected with AWR, Classification III shows that villages within 15 km compose 35.64 percent of the same measure and villages outside 15 km compose 22.77 percent. It can also be seen from the table that out of the total, absence of health care facilities is more acute in lower road density villages as they compose 71.29 percent while the remaining 28.71 percent are in villages with road density above 7.5 km. Therefore, it can be seen that although the number of Sub-Centres and Sub-Centre Clinics is higher in villages with poor road connectivity, the total number of villages without any health care facility is still higher in this broad classification than the number of villages classified as villages with better road connectivity.

In line with the number of health facilities in villages, the number of trained personnel and health care providers available was determined and then fitted for each village. Table 4.18 shows the average number of medical officers, nurses and health workers present in the study area according to the four classifications.

Table 4.18: Number of Health Care Personnel Available

Figures in average

Classification	Cases	Doctors per 1000	Nurses per 1000	Health Workers per 1000
I Connectivity Status	Connected with AWR	0.09	0.26	1.51
	Not Connected with AWR	0.02	0.06	1.55
II Main Transport Route	Along Main Route	0.1	0.3	2.03
	Outside Main Route	0.04	0.12	1.39
III Distance from AWR	AWR	0.09	0.26	1.51
	Within 15 km	0.01	0.02	1.2
	Outside 15 km	0.03	0.1	1.94
IV Road Density	Below 7.5 km	0.03	0.09	1.47
	Above 7.5 km	0.09	0.26	1.6
	Total	0.06	0.16	1.53

Source: Field Survey, 2015

First, with an overall average of 0.06 per village, the average number of doctors (per 1000 population) available in the AWR-connected villages is 0.09 which is significantly higher than villages not connected with AWR whose average is 0.02. The same can be observed in villages along the main transport route as the average is 0.10 while it is only 0.04 for those lying outside the route. However, although significantly lower than those connected with AWR, villages within 15 km of nearest AWR have lesser number of doctors than villages outside 15 km. Their averages are 0.01 and 0.03, respectively. In the classification according to density of road, villages with density of road above 7.5 km have a higher average (0.09) than villages with density below 7.5 km (0.03). As such, it may be concluded that villages with better road connectivity houses a larger number of doctors as the average for it is higher in most of the cases than the average for villages with poor road connectivity.

Second, it can be seen that the average number of nurses is higher in almost all the cases for villages with better road connectivity. While the state average is 0.16, the number of nurses per 1000 population in connected villages is 0.26 which is significantly higher than the average for villages not connected with AWR at 0.06. Likewise, the average number of nurses in villages along the main route (0.30) is higher than villages outside the main route (0.12). For villages not connected and are farther than 15 km from the nearest AWR, the average number of nurses is 0.10 while the same is 0.02 for villages within 15 km. It can also be seen that villages that possess road density higher than or equal to 7.5 km have a significantly higher number of nurses (0.26) per village than those with a road network below 7.5 km (0.09).

Lastly, the average number of health workers available in the study area for 1000 persons is 1.53. It can be seen from the table that AWR-connected villages have a lower number of health workers than those not connected with it, their respective averages being 1.51 and 1.55. In contrast, for villages along the main route, the number is 2.03 which is higher than the average for villages outside the main route at 1.39. For the third classification, villages outside 15 km have the highest average at 1.94 followed by those that are connected whose average, as already mentioned, is 1.51, and is the lowest in villages within 15 km of the nearest AWR with 1.20 health workers per village. Like that of the former two averages, the number of health workers is higher in villages with road density above 7.5 km as the average of it is 1.60 while it is 1.47 for villages with 7.5 km density of road. This data for the number of health care workers shows varied results across the classifications. While the average is higher in villages along the main road and villages with road density above

7.5 km, it is lower in villages with AWR connection and in villages within 15 km of AWR than their respective counterparts.

4.4 Concluding Remarks

The chapter shows the analysis of the study area through the adoption of various measures of road connectivity namely, all weather road connection, location along the main transport route, distance from the nearest all weather road and the density of road. These classifications are applied to check if there are significant differences in selected development parameters. The parameters selected for the study are demography, depicted through basic population characteristics; employment, as indicated by workers' details; agriculture development, as represented by land use; and availability of basic social infrastructures. The main conclusions based on these observations may be summarised as follows -

In the study of the population characteristics, villages having better road connectivity have better achievement with respect to population development in most of the cases. This is indicated by higher sex ratio and literacy rates. At the same time, although the average of the total number of population is higher in these villages, the size of the family is larger in villages with poor road connectivity.

With respect to employment as indicated by workers' detail, villages with better road connectivity can be identified as more developed because the percentage of workers to population and the percentage of main workers in particular are higher in these villages when taken in aggregate. It may however be noted that the percentage of agriculture labourers is significantly higher which may be due to unavailability of land in the areas. Another important point that needs to be acknowledged is the greater contribution of industrial activities among both the main and marginal workers of villages with better road connectivity. Meanwhile, in villages with poor road connectivity, the percentage of females in total workers is high in most of the classifications. Also higher in these villages is the percentage of cultivators in both the cases of main and marginal workers. In addition, the percentage of marginal workers is also higher in villages with poor road connectivity. This denotes the undeveloped state of agriculture through the mirror of mass practice of unsustainable shifting cultivation which is seasonal in nature.

Examination of the existing state of land utilisation for determining the status of agriculture development shows, firstly, that the area of wet rice cultivation is higher in villages with better road connectivity. Secondly, the fact that agriculture plantation area is higher in these villages denotes a favourable state of agriculture because it is a viable option when the topography of the state is taken into consideration. Thirdly, the area under forest cover is higher in villages with poor road connectivity, which is not surprising. Fourthly, the jhum size per family is higher in the villages with poor road connectivity. This points to the fact that jhumming is practiced at a more extensive level in these villages which is again in line with the low intensity of agricultural plantation area.

Moreover, the villages with better and poorer road connectivity show distinct performances in the analysis of basic social infrastructure as well. First, in most of the cases, the connected villages show better educational development which is measured through the number of schools per village and teacher-pupil ratio. Secondly, in provision of health service, analysis of the average number of health care facilities like CHCs, PHCs, Sub-Centres and Clinics and the average number of doctors, nurses and health workers per 1000 population shows a higher performance in villages with better road connectivity. Thirdly, in the measure of the availability of drinking water supply, these villages also show better performance.

However, it may be included that the analysis of socio-economic development through the four classifications shows mixed results in some of the parameters used in the study. Mention may be made of the countering results in population density, male workers' ratio to total workers, and the number of primary health centres.

At the same time, it was found in most of the cases that village with better road connectivity status outperform their adversaries in the different development parameters identified in the study. Thus, it may be concluded that rural road connectivity is directly associated with development.

CHAPTER 5

IMPACT OF ROAD CONNECTIVITY ON RURAL DEVELOPMENT:

AN EMPIRICAL ANALYSIS

5.1 Introduction

Provision of adequate and quality infrastructure in rural areas is considered a *sine qua non* because it is crucial for agricultural, industrial, and overall economic development and incidentally provides basic amenities, which improve the quality of life (NABARD, 2004). Moreover, an extensive, adequate, and efficient rural feeder road network serves as one of the channels for the collection and movement of goods and services, movement of people, and dissemination of information. It helps in the exchange of rural productivity as well as strengthening the socio-economic, cultural, and political fabrics and processes of the rural communities (Umoren et al., 2009).

The aim of the study is to examine the effect that road connectivity has on rural development in the villages of Mizoram. The exercise in the previous chapter gave us basic information about the assertion that connectivity is a determinant of development. In addition to these findings, it was felt necessary to undertake further empirical investigation so that a firm conclusion could be drawn. This chapter therefore attempts to study the relationship between road connectivity and rural development using a regression model.

But first, to have a clearer view on the differential performance of villages that have different connectivity status, t-test is adopted to test for significance of difference in the identified development parameters. It is important to note that the terminologies used in this chapter for the connectivity classifications are AWR Connectivity, Main Route, Distance and Road Density. Like that of the previous chapter, here, 'AWR Connectivity' is the classification of villages on whether or not they are connected with all-weather roads and the 'Main Route' classification is of the villages on whether they lie along the main transport route of the state or not. The

‘Distance’ classification covers the distance of unconnected villages from the nearest AWR and categorised the villages into those within 15 km and those outside 15 km of the nearest AWR. Lastly, the ‘Road Density’ classification groups the villages according to their road density – villages with road density below and above 7.5 km.

Testing the significance of differences can be found in the literature of various researchers in their study of rural road’s impact on development. While Huang and Hsieh (2014) used correlation analysis to test the level of significance of their observations, t-test was applied by Umoren et al. (2009) and Mu and van de Walle (2007) for examining differences of means in their respective studies. At the same time, difference-in-difference method was adopted by Lokshin and Yemtsov (2005) and Kiprono and Matsumoto (2014), while Dorosh et al. (2012), Olagunju et al. (2012), and Freitas et al. (2009) tested the relationships of variables using regression analysis.

The rest of the chapter is divided into three parts. The first one shows the t-test of difference in performance, the second presents the estimation of the regression model and the third gives the concluding observations.

5.2 Testing the Difference in Performances

The main thrust of the analysis is to examine whether there are significant differences in the development parameters between the villages that have different connectivity status. This can primarily be taken as the impact of road connectivity on their economic condition. To come to this, t-test for difference of means has been appropriated to examine the average performance of villages across the different classifications presented in the last chapter.

The statistic adopted in the study may be defined as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s^2(1/n_1 + 1/n_2)}}$$

where $\bar{x}_1$ and $\bar{x}_2$ are mean in area 1 and area 2 respectively, and

$s^2 = \frac{1}{n_1+n_{2-2}} \left[\sum(x_{1i} - \bar{x}_1)^2 + \sum(x_{2j} - \bar{x}_2)^2\right]$ which follows students' t-distribution with $n_1 + n_2 - 2$ degrees of freedom.

The results and observations of the t-test for difference of performance are presented in the following sub-sections:

5.2.1 Population Development

The first set of parameters of economic development adopted in the study is the population structure of the rural areas as obtained from the Population Census 2011. This may be interpreted as the 'quality' of the population. Table 5.1 presents the structure of population of the study area.

Table 5.1 Testing of Difference in Population Quality

Sl. No.	Variable	t-value for difference of means			
		AWR Connectivity	Main Route	Distance	Road Density
1	Total Population	6.20***	6.48***	0.82	7.99***
2	Population Density	1.44	-0.25	2.44*	-1.22
3	Sex Ratio	1.20	0.61	-1.16	1.90
4	Child - Population Ratio	-7.26***	-6.46***	-0.36	-6.85***
5	Child Sex Ratio	-0.06	0.65	-0.47	1.04
6	Number of households	6.62***	7.24***	0.86	8.41***
7	Family Size	-3.56***	-5.14***	-0.33	-3.77***
8	Literacy Rate	5.23***	5.47***	-0.95	7.24***
9	Female Literacy Rate	5.10***	5.43***	-1.12	7.20***

*** - significant at all levels, ** - significant at 1%, * - significant at 5%

The table shows that the t-statistic is significant for the classification of 'AWR Connectivity' in most of the cases except Population Density, Sex Ratio, and Child Sex Ratio. A similar trend can be seen in the 'Main Route' classification and 'Road Density' classification. This means that there are significantly different population structures between the respective categories of these classifications i.e., between the villages connected and not connected with AWR (AWR Connectivity classification), between the villages along main transport route and outside main route (Main Route classification) and between villages with higher and lower road density (Road Density classification). In other words, villages having different connectivity statuses have shown significantly different structures of population. This can be construed as the impact of road connectivity.

It was observed in the previous chapter that villages connected with AWR, villages along the main road and villages with higher road density (villages with better road connectivity, for short) showed favourable situations. Therefore, we may conclude that road connectivity leads to significant differences between villages with better road connectivity and those with poor connectivity status while at the same time favouring the former. However, it can be observed that the 'Distance' classification (i.e. distance of village from the nearest AWR) does not show significant differences on the population development between the two categories of villages under it.

5.2.2 Employment Distribution

The second set of development parameter tested for the study is how employment is distributed in the villages. In other words, it accounted for the economic activities of the population, which is represented by the composition of workers. The calculated t-statistic for mean differences of these indicators across the four classifications is shown in Table 5.2.

Table 5.2 Testing of Difference in Workers' Composition

Sl. No.	Variable	t-value for difference of means			
		AWR Connectivity	Main Route	Distance	Road Density
1	Percentage of Workers to Total Population	1.15	2.20*	0.52	3.10**
2	Workers' Sex Ratio	-0.98	-0.39	-1.66	0.71
3	Main Workers (% to Total Workers)	2.41*	0.67	2.05*	1.68
	Cultivators	*-2.11**	*-3.99****	*1.72*	*-0.31*
	Agriculture Labourers	*3.06***	*4.33****	*0.20*	*0.68*
	Household Industry Workers	*0.59*	*1.03*	*-1.15*	*2.43**
4	Marginal Workers (% to Total Workers)	-1.68	-0.36	-1.58	-0.82
	Cultivators	*-1.26*	*-1.24*	*-1.13*	*-0.53*
	Agriculture Labourers	*4.70****	*5.12****	*0.02*	*2.18**
	Household Industry Workers	*0.39*	*0.99*	*-0.82*	*1.59*

*** - significant at all levels, ** - significant at 1%, * - significant at 5%

In the classification of villages on whether they are connected with AWR, the t-statistic is significant at all levels for agricultural labourers (marginal) while that of the main workers is significant at 1 percent. At the same time, the table suggests that a mere connection with AWR does not translate into the improvement in the percentage of workers in the total population, workers' sex ratio, and percentage of marginal workers. It is interesting to note that AWR connectivity has affected the prevalence of agricultural labourers, for main workers as well as marginal workers, acknowledging the significant t-statistic and the higher percentage averaged in this category as shown in the previous chapter.

The locational status of the villages i.e. along the main transport route or outside, have shown little impact on the composition of workers excepting cultivators, agricultural labourers and total workers. Meanwhile, the other two measures that are adopted as connectivity parameters in the study, namely distance from AWR and Road Density, were found to have hardly impacted the quality of workers' composition as the t-statistic are insignificant in a majority of the cases.

5.2.3 Agriculture Land Use

The third parameter of rural development identified for the study is agriculture development, which is derived from the land use patterns of the villages. Table 4.3 shows land use data tested against t-statistic.

Table 5.3 Difference in the Indicators of Rural Land Use

Sl. No.	Variable	t-value for difference of means			
		AWR Connectivity	Main Route	Distance	Road Density
1	Percentage of WRC Area	0.09	-0.70	1.45	-1.71
2	Percentage of Agriculture Plantation Area	4.79***	5.56***	-0.48	4.86***
3	Percentage of Forest Area	-2.36*	0.57	-1.61	0.65
4	Average Jhum Area per Household (ha)	-4.81***	-5.97***	-0.62	0.299
5	Geographical Area of the Village	0.61	1.43	-2.10*	6.98***
6	Area within 1km from motorable road	11.44***	8.71***	2.70**	27.23***

*** - significant at all levels, ** - significant at 1%, * - significant at 5%

The t-test shows that the statistic is significant at all levels for agriculture plantation area, average jhum area per household, and area within 1 km of motorable road for the 'AWR Connectivity' and 'Main Route' classifications, while for the 'Road Density' classification, it is significant at the same level for agriculture plantation area and total area of the village. This denotes that the classifications according to whether or not they are connected with AWR and whether they lie along the main route shows results of significant differences across their respective categories for plantation area, jhum area, and area of village within 1 km of motorable road. Thus, the condition that it is being connected with AWR and/or that it lies along the main transport route result in a favourable state for the village which can be interpreted as agriculture development because a larger area of agriculture plantation and a smaller area of jhum cover was observed in the analysis undertaken in the previous chapter. These villages also have a larger area within motorable road which can translate into higher opportunities for agriculture marketing.

It may also be noted that a higher agriculture plantation area was observed in villages with higher road density. The highly significant difference in average jhum size per household shows a more extensive practice of traditional jhum system in the villages with poor connectivity. We can therefore conclude that the average performance of the villages having better connectivity conditions is significantly higher with respect to agriculture development. However, the classification of villages according to their distance from the nearest AWR does not show any significant difference between its categories. Thus, we can say that the distance of the village from AWR does not have a noteworthy impact on agriculture development, so also for land use.

5.2.4 Availability of Social Amenities

The availability of basic social infrastructures is adopted in the study as a parameter of development as well. The social infrastructures under study are educational facilities and its personnel, the supply of piped drinking water and availability of health care institutions and qualified medical personnel. First, the test of difference for educational institutions is presented in Table 5.4.

Table 5.4 Testing of Difference for Availability of Educational Institutions

Sl. No.	Variables	t-value for difference of means			
		AWR Connectivity	Main Route	Distance	Road Density
1	No. of Primary Schools	5.85***	6.04***	-0.62	7.68***
2	No. of Middle Schools	5.80***	6.77***	1.07	7.76***
3	No. of High Schools	6.85***	6.32***	0.44	6.81***
4	No. of Higher Secondary Schools	4.07***	3.96***	0.36	5.00***
5	Total No. of Schools	6.80***	7.14***	0.16	8.56***

*** - significant at all levels

The table (Table 5.4) shows that t-statistic is significant at all levels in all the variables for AWR Connectivity, Main Route, and Road Density classifications. This implies that within the categories of these classifications, there are significant differences in the availability of educational institutions – from Primary to Higher Secondary levels. We can therefore conclude that villages having better connectivity conditions outperform villages with poor road connectivity in the contest of availability of educational institutions as it is higher for these villages (also presented in Chapter 4). On the other hand, it can be seen that the classification of villages according to their distance from the nearest AWR does not seem to result in significant differences among its categories (within 15 km and outside 15 km).

In line with the above, Table 5.5 shows the availability of educators. Here, the denotation of the teacher-student ratio is the number of teachers present for 100 students.

Table 5.5 Testing on the Availability of Educators

Sl. No.	Variable	t-value for difference of means			
		AWR Connectivity	Main Route	Distance	Road Density
1	Primary School Teacher-Student Ratio	1.77	1.19	-0.82	1.06
2	Middle School Teacher-Student Ratio	-0.07	-0.15	-0.13	1.05
3	High School Teacher-Student Ratio	4.57***	3.36**	0.16	4.39***
4	Higher Secondary Teacher-Student Ratio	4.08***	3.90***	-0.55	5.01***
5	Total Teacher-Student Ratio	1.23	1.01	-0.86	1.57

*** - significant at all levels, ** - significant at 1%

It can be derived from the table that, on an average, villages with better road connectivity have a significantly higher performance in the development of secondary education. It is shown that the test is significant at all levels for the average number of teachers per 100 students in high schools and higher secondary schools for the classification of ‘AWR Connectivity.’ A more or less similar trend can be seen in ‘Main Route’ and ‘Road Density’ classifications. Therefore, the status of village that it is connected with AWR, that it lies along the main transport route and that it has a greater road density has higher teacher-student ratio than their respective counterparts, which would result in a higher quality of secondary education, the reasoning of which is explained in the previous chapter. In contrast, the availability of teachers in favourable numbers is not affected by distance of the village from nearest AWR as the t-statistic is insignificant for all the levels of schooling.

Another infrastructure tested is the amount of piped drinking water supplied in the village. The t-test for amount of water supply is shown in Table 5.6.

Table 5.6 Test on Amount of Water Supply

Sl. No.	Classification	t-value for difference of means
1	AWR Connectivity	1.25
2	Main Route	3.43**
3	Distance	-1.92
4	Road Density	1.77

** - significant at 1%

The t-statistic for amount of supply of piped drinking water is not significant for the various classifications of road connectivity except on 'Main Route' classification i.e., whether the village lies along the main transport route of the state, where it is significant at 1 percent level.

In addition to water supply and educational institutions and personnel, the availability of health personnel in the villages was also tested. The t-statistic for it is presented in Table 5.7.

Table 5.7 Testing on the Availability of Qualified Medical Personnel

Sl. No.	Variables	t-value for difference of means			
		AWR Connectivity	Main Route	Distance	Road Density
1	No. of Doctors	3.83***	2.79**	-1.45	3.15**
2	No. of Nurses	3.85***	2.79**	-1.45	3.36**
3	No. of Health Workers	-0.11	1.48	-2.32*	0.36

*** - significant at all levels, ** - significant at 1%, * - significant at 5%

The table shows that the average performance of the villages having better connectivity conditions is significantly higher with respect to availability of health care personnel, particularly doctors and nurses. Here, the t-statistic for the two types of personnel is significant at all levels for the classification of 'AWR Connectivity' while for the ‘Main Route’ and ‘Road Density’ classifications, it is significant at 1 percent. However, none is significant for the ‘Distance’ classification except for the number of health workers which is significant negatively at 5 percent level. Nevertheless, it can be inferred from the findings of the test that villages with better road connectivity conditions have a significantly higher number of qualified medical personnel in the village.

Lastly, with respect to health care facilities, the institutions being considered in the study are Primary Health Centres, Community Health Centres, Sub-Centres, and Sub-Centre Clinics. It is important to note that normally, these institutions are not available in all the villages and even in those villages that they are, only one is generally established. So, the only option for testing the difference is to test the frequency difference. Consequently, the chi-square test of independence of attributes was found suitable for this test. This is defined as

$$\chi^2 = \sum \left[\frac{(O_i - E_i)^2}{E_i} \right]$$

where O_i = Number of villages observed to have such health care institution, and
E_i = Expected number of villages to have such institution,
which follows chi-square distribution with (r – 1) (c – 1) degrees of freedom. (r = no. of rows, c = no. of columns)

The result is presented in Table 5.8 in which the chi-square value is significant for ‘AWR connectivity’ classification, ‘Main Route’ classification and ‘Road Density’ classification. This means that the classification of a village on whether it is connected with AWR or not, whether it lies along the main transport route or not and its density of road network results in significant differences between their categories on the availability of health care institutions.

Table 5.8 Test on Availability of Health Care Institutions

Sl. No.	Classification	Chi-Square Value	Significance
1	AWR Connectivity	36.56***	0.000
2	Main Route	44.29***	0.000
3	Distance	6.68	0.083
4	Road Density	47.07***	0.000

*** - significant at all levels

It can therefore be concluded that the performance of the villages having better connectivity conditions is significantly higher with respect to these facilities. On the other hand, it has been observed that the 'Distance' classification (i.e. distance of village from AWR) does not result in significant differences for the availability of health care institutions.

5.3 Relationship between Road Connectivity and Rural Development – A Regression Model

To examine the relationship between road connectivity and development, it is attempted to fit a regression equation where the development parameters are taken as dependent variables and the connectivity measures as independent variables or regressor. As the AWR Connectivity variable is qualitative or categorical in nature, the normal classical regression model could not be applied. Consequently, the study decided to adopt Dummy Variable Regression Model which comprises development variables as dependent variables, and the qualitative (which takes the value 1 and 0) and quantitative connectivity variables as the explanatory variables.

To explain this further, the two connectivity variables, namely road density and distance from the nearest AWR can be quantified in kilometres. The variable of

AWR connectivity is categorical in nature and thus, the values 1 and 0 were assigned for connected and unconnected villages respectively; while the same is the case for the location of the village on whether it lies along the main road or not. However, the status of the village whether it is located along the main road was found to be overlapping with its status on AWR connectivity because those located along the main route are connected by AWR. There will therefore be a problem called *dummy variable trap* if both are simultaneously introduced in the same model. It was thus decided to exclude the dummy variable of Main Route, while adopting the AWR Connectivity dummy as it has better significance of difference in most of the cases. In addition, AWR connectivity is the most commonly accepted indicator of rural road connectivity in economic literature (Parida, 2014; Ibok and Daniel, 2013; Ulimwengu et al., 2009; Mu and van de Walle, 2007; Khandker et al., 2006).

As two of the independent variables are quantitative while one is qualitative in nature having values of 1 and 0 only, it is appropriate to use Analysis of Covariance (ANOCOVA) dummy regression model. In most economic research a regression model contains some explanatory variables that are quantitative and some that are qualitative (Gujarati et al., 2012). Thus, the following regression model is estimated:

$$Y_i = \beta_0 + \beta_1 D_{1i} + \beta_2 X_{1i} + \beta_3 X_{2i} + U_i$$

where Y_i = Development variable of interest obtained from the villages.

β_0 = Intercept term

D_{1i} = 1, if the village is connected with AWR

= 0, otherwise

X_{1i} = Road Density (km)

X_{2i} = Distance of Village from nearest AWR (km).

U_i = Error term

Since three explanatory variables are being used in the model, the problem of multicollinearity should be a matter of concern. To measure the presence or degree of multicollinearity, the Condition Index (CI) given by

$$CI = \sqrt{\frac{Maximum\ Eigenvalue}{Minimum\ Eigenvalue}}$$

is adopted with the following rule of thumb: (i) if $10 \leq CI \leq 30$, there is moderate to strong multicollinearity, (ii) if $CI > 30$, there is strong multicollinearity, and (iii) if $CI < 10$, there is weak or low multicollinearity.

In the process of estimating the regression model, it is observed that the R-Square as a ratio of explained variation to the total variation were found to be very low in many of the cases even though the estimated coefficients are highly significant with a highly significant F-statistic. It should be remembered that connectivity is in fact only one of the determinants of economic development of a village. For example, it is the size of the population, rather than the status of road connectivity, that normally determines the demand for provision of basic social amenities like schools, medical institutions, etc in countries like India. Since this is the case, the main concern is to test if the connectivity variable is a significant estimator of development and the overall significance of the model measured through F-statistic.

The estimated regression models to each major development variable are presented in the following sub-sections.

5.3.1 Relationship between Road Connectivity and Population Quality

Table 5.9 shows the result of estimated regression of population quality on road connectivity.

Table 5.9 Estimated Regression of the Population Development on Road Connectivity

Sl. No.	Dependent Variable	Constant	Coefficient of Independent Variables			R-square	F- Statistic
			AWR Connectivity	Road Density	Distance		
1	Total Population	593.50 (0.000)	250.92 (0.015)	34.53 (0.000)	3.35 (0.313)	0.174	35.92 (0.000)
2	Population Density	61.30 (0.200)	88.30 (0.126)	-4.78 (0.048)	-0.70 (0.706)	0.012	2.02 (0.110)
3	Sex Ratio	923.09 (0.000)	20.00 (0.048)	0.79 (0.061)	0.94 (0.004)	0.024	4.16 (0.006)
4	Child-Population Ratio	194.07 (0.000)	-14.97 (0.001)	-0.66 (0.000)	0.10 (0.462)	0.118	22.96 (0.000)
5	Child Sex Ratio	974.38 (0.000)	-41.51 (0.143)	5.27 (0.000)	0.30 (0.741)	0.037	6.64 (0.000)
6	No. of Households	114.77 (0.000)	55.17 (0.008)	7.23 (0.000)	0.70 (0.288)	0.190	40.16 (0.000)
7	Family Size	5.09 (0.000)	-0.09 (0.162)	-0.01 (0.001)	0.00 (0.938)	0.046	8.16 (0.000)
8	Literacy Rate	62.52 (0.000)	5.74 (0.007)	0.40 (0.000)	0.06 (0.391)	0.088	16.44 (0.000)
9	Female Literacy Rate	57.47 (0.000)	6.84 (0.009)	0.49 (0.000)	0.07 (0.399)	0.085	15.84 (0.000)

1) Figure in bracket indicates significance level

2) Condition Index (CI) as indicator on the presence of multicollinearity equals 4.83

The calculated condition index (CI) is 4.83 and is in the acceptable range. Table 5.9 shows that the calculated F-statistics are significant in all cases except for Population Density, though R-square is comparatively low in all cases. This suggests the significance of the estimated regression equation of population development on road connectivity. Meanwhile, as the overall regression is not significant, population density is not significantly related to road connectivity. This is in line with the observation given in the t-test of the preceding section. It can be observed that the coefficients of AWR Connectivity are significant in most of the cases apart from Population Density, Child Sex Ratio, and Family Size. The positively significant coefficient implicates increasing population size, sex ratio, number of households, literacy rate, and female literacy rate with AWR connection while the negatively significant coefficient suggest the decline in child-population ratio with AWR connectivity of the village. Thus, it is safe to conclude that population development is directly associated with AWR connectivity by taking low dependency ratio (child-population ratio) as one of the development parameters.

The estimated coefficient on Road Density was found to be significant at 5 percent level in most of the cases except for Sex Ratio, which is also significant at 10 percent level. It is interesting to note that the coefficients are positive for Total Population, Sex Ratio, Child Sex Ratio, Number of Households, Literacy Rate, and Female Literacy Rate while it is negative for Population Density, Child-Population Ratio, and Family Size. It is thus clear that the increase in road density is strongly related to population development. However, the estimated coefficient of distance of the village from the nearest AWR, which otherwise may be taken as access to road communication throughout the year, was found to be significant only for Sex Ratio.

5.3.2 Relationship between Road Connectivity and Composition of Workforce

Table 5.10 presents the estimated regression coefficient for various indicators of the structures of employment in the village on the three connectivity variables.

First, the calculated F-statistic as an indicator on the significance of the estimated regression is not significant for Workers’ Sex Ratio, Household Industry Workers (Main), and Marginal Workers (Cultivators and Household Industry Workers). Moreover, the estimated R-square is very low in most of the cases, which suggests a weak impact of rural road connectivity in shaping the situation of employment and its composition in rural areas. This may otherwise be taken as low industrial development in rural areas of Mizoram which normally comes with the improvement of road infrastructure.

Table 5.10 Estimated Regression of the Composition of Workers on Road Connectivity

Sl. No.	Dependent Variable	Constant	Coefficient of Independent Variables			R-square	F- Statistic
			AWR Connectivity	Road Density	Distance		
1	Percentage of Workers to Total Population	49.41 (0.000)	-2.09 (0.132)	0.20 (0.001)	-0.08 (0.076)	0.033	5.80 (0.001)
2	Workers' Sex Ratio	722.53 (0.000)	-16.93 (0.575)	1.67 (0.184)	0.99 (0.310)	0.007	1.82 (0.316)
3	Percentage of Main Workers to Total Workers	89.96 (0.000)	-0.55 (0.782)	-0.02 (0.783)	-0.22 (0.001)	0.034	5.94 (0.001)
	Cultivators	77.00 (0.000)	-6.62 (0.020)	-0.16 (0.169)	-0.19 (0.035)	0.020	3.45 (0.016)
	Agriculture Labourers	3.04 (0.022)	1.84 (0.251)	0.12 (0.076)	-0.03 (0.504)	0.025	4.42 (0.004)
	Household Industry Workers	0.36 (0.012)	0.05 (0.789)	0.01 (0.088)	0.00 (0.453)	0.007	1.21 (0.304)
4	Percentage of Marginal Workers to Total Workers	5.58 (0.000)	-0.10 (0.928)	0.03 (0.532)	0.08 (0.029)	0.015	2.61 (0.051)
	Cultivators	43.02 (0.000)	1.87 (0.697)	-0.03 (0.891)	0.31 (0.044)	0.011	1.93 (0.123)
	Agriculture Labourers	8.81 (0.000)	8.48 (0.005)	0.09 (0.472)	-0.04 (0.654)	0.043	7.60 (0.000)
	Household Industry Workers	2.53 (0.010)	-0.36 (0.757)	0.08 (0.117)	0.00 (0.972)	0.005	0.88 (0.450)

Figure in bracket indicates significance level

Second, it can be observed that the estimated coefficient of AWR Connectivity is insignificant for all major classification of workers, while it is significant for Cultivators (Main) and Agricultural Labourers (Marginal). The negatively significant Cultivators (Main) may implicate the situation that shifting cultivation remains the main provider of employment in the unconnected villages. At the same time, the significant estimate for Agricultural Labourers (Marginal) may imply scarcity of land for jhumming which compel many workers to work in other landowners' farms and also the practice of shifting cultivation as a mere subsidiary livelihood in the villages connected with AWR. This is in light of the observation that there are more areas of agriculture plantation in these villages.

Third, the estimated coefficients of Road Density are significant and positive for the percentage of Workers to Total Population and Agricultural Labourers showing their increase with the increasing road density. Lastly, the coefficient for Distance from AWR are significant for Main Workers, Cultivators (Main), Marginal Workers and Cultivators (Marginal). The negative coefficient for the percentage of Main Workers shows its decrease with the increase in the distance from AWR while the positive value for Marginal Workers suggests the increasing percentage of marginal workers with the declining distance from AWR.

5.3.3 Relationship between Road Connectivity and Agriculture Development

Table 5.11 shows the relationship between road connectivity and agriculture development as indicated by the dynamics of agriculture land use. This is measured by the estimated regression of agricultural land use on the three connectivity measures. It can be observed that the estimated regression is significant for all cases except the percentage of WRC area. Thus, one may state that road connectivity has significant contribution in the change in agricultural land use.

The coefficient of AWR Connectivity for agriculture plantation is 0.16 which is significant at 1 percent level. The coefficients for average jhum size per household and village area are -1.34 and -6.81, which are also significant at 1 percent level. This result shows the practice of agriculture plantation at a more intense level in the villages connected by AWR and the increase in jhum size per household for villages not connected with AWR, which have a relatively lower geographical area.

Thus, there is more practice of settled cultivation in AWR-connected villages while the shifting cultivation is more extensive in the unconnected villages.

Table 5.11 Estimated Regression of the Agricultural Land Use on Road Connectivity

Sl. No.	Dependent Variable	Constant	Coefficient of Independent Variables			R-square	F- Statistic
			AWR Connectivity	Road Density	Distance		
1	Percentage of WRC Area	1.14 (0.000)	-0.05 (0.882)	-0.02 (0.142)	-0.01 (0.226)	0.007	1.12 (0.339)
2	Percentage of Agriculture Plantation Area	0.07 (0.173)	0.16 (0.018)	0.01 (0.010)	0.00 (0.805)	0.056	10.06 (0.000)
3	Percentage of Forest Area	73.27 (0.000)	-0.04 (0.977)	0.06 (0.340)	0.15 (0.001)	0.032	5.66 (0.001)
4	Average Jhum Area per Household (ha)	4.42 (0.000)	-1.34 (0.000)	0.03 (0.002)	0.00 (0.948)	0.071	13.04 (0.000)
5	Geographical Area of the Village	24.01 (0.000)	-6.81 (0.010)	1.76 (0.000)	0.37 (0.000)	0.340	88.18 (0.000)

Figure in bracket indicates significance level

The table also shows the significant impact of road density on agriculture as its estimated coefficients are significant for plantation, jhum size and total geographical area of the village. The results indicate the coming up of agricultural plantation with the increase in road density and also for jhum size, surprisingly. At the same time, the coefficient with respect to distance is significant for total geographical area of village only.

5.3.4 Relationship between Road Connectivity and the Availability of Basic Social Amenities

As noted earlier, the basic social amenities under study are availability of educational facilities and personnel, the amount of piped drinking water supplied and the availability of health care institutions and trained medical personnel in the village.

First, Table 5.12 shows the result of estimated regression of educational facilities on road connectivity.

Table 5.12 Estimated Regression of Educational Institutions on Road Connectivity

Sl. No.	Dependent Variable	Constant	Coefficient of Independent Variables			R-square	F- Statistic
			AWR Connectivity	Road Density	Distance		
1	No. of Primary Schools	1.34 (0.000)	0.56 (0.009)	0.07 (0.000)	0.01 (0.105)	0.161	32.86 (0.000)
2	No. of Middle Schools	1.11 (0.000)	0.29 (0.037)	0.04 (0.000)	0.00 (0.647)	0.144	28.73 (0.000)
3	No. of High Schools	0.31 (0.000)	0.27 (0.001)	0.02 (0.000)	0.00 (0.828)	0.129	25.34 (0.000)
4	No. of Higher Secondary Schools	0.00 (0.934)	0.04 (0.206)	0.01 (0.000)	0.00 (0.917)	0.069	12.65 (0.000)
5	Total Number of Schools	2.76 (0.000)	1.16 (0.004)	0.13 (0.000)	0.01 (0.284)	0.185	38.86 (0.000)

Figure in bracket indicates significance level

The significance of the estimated regression equation of educational facilities on road connectivity can be inferred as the calculated F-statistics are significant in all the dependent variables. It can be observed that the coefficients on AWR Connectivity are significant in most of the cases except for a number of Higher Secondary Schools. More specifically, the coefficient is positively significant at 1 percent level for Primary Schools, High Schools and the Total Number of Schools while it is significant at 5 percent for the average number of Middle Schools. This implies that availability of educational institutions is positively associated with AWR connectivity. At the same time, the estimated coefficient on Road Density was found to be significant at all levels for all the cases thus showing the greatest difference-inducing capacity among the classifications under study. This gives an impression that increase in road density is strongly related to this factor of educational development.

However, the estimated coefficient of the village's distance from the nearest AWR is not significant for any of the levels of educational institutions.

Second is the estimated regression of educational personnel/teachers on road connectivity. As is shown in Table 5.13, the estimated regression is significant for cases of Middle School, High School and Higher Secondary School. This may indicate that road connectivity does have a significant effect on the availability of a higher number of educational personnel.

Table 5.13 Estimated Regression of Educational Personnel on Road Connectivity

Sl. No.	Dependent Variable	Constant	Coefficient of Independent Variables			R-square	F- Statistic
			AWR Connectivity	Road Density	Distance		
1	Primary School Teacher-Student Ratio	5.91 (0.000)	0.53 (0.304)	0.00 (0.930)	-0.01 (0.656)	0.006	1.10 (0.347)
2	Middle School Teacher-Student Ratio	14.65 (0.000)	-2.57 (0.101)	0.18 (0.005)	-0.05 (0.363)	0.018	3.11 (0.026)
3	High School Teacher-Student Ratio	6.79 (0.000)	3.92 (0.011)	0.12 (0.065)	-0.01 (0.898)	0.045	8.14 (0.000)
4	Higher Secondary Teacher-Student Ratio	-0.34 (0.310)	0.47 (0.252)	0.10 (0.000)	0.01 (0.682)	0.092	17.42 (0.000)
5	Total Teacher-Student Ratio	9.75 (0.000)	0.04 (0.959)	0.03 (0.345)	-0.02 (0.432)	0.006	1.05 (0.368)

Figure in bracket indicates significance level

It can be observed that the estimated coefficient of AWR Connectivity is significant at 5 percent for high school level of education while the coefficient for Distance from AWR is insignificant for all levels. On the other hand, the estimated coefficient of Road Density is found to be significant at all levels for higher secondary while it is significant at 1 percent level for middle school and 10 percent for high school. Therefore, among the three, what can be stated as one of the factors influencing the availability of educational personnel and that of the institutions is the increase in road density in which the size of population is incidentally higher (as shown in section *5.3.1*).

Third, the calculated F-Statistic as an indicator on the significance of the estimated regression of amount of piped water supply on road connectivity was found to be insignificant (0.272) and so, is not shown.

The fourth social amenity tested is the availability of qualified medical personnel in the village. The relationship of this with that of road connectivity is shown in Table 5.14 where the estimated regression is significant for all cases. It may therefore be stated that a significant relationship exists between road connectivity and availability of doctors, nurses, and health workers in the village.

Table 5.14 Estimated Regression of Availability of Qualified Medical Personnel on Road Connectivity

Sl. No.	Dependent Variable	Constant	Coefficient of Independent Variables			R-square	F- Statistic
			AWR Connectivity	Road Density	Distance		
1	No. of Doctors	-0.01 (0.778)	0.06 (0.011)	0.003 (0.013)	0.00 (0.266)	0.041	7.26 (0.000)
2	No. of Nurses	-0.02 (0.761)	0.18 (0.011)	0.01 (0.008)	0.00 (0.239)	0.043	7.65 (0.000)
3	No. of Health Workers	0.90 (0.023)	-1.11 (0.020)	0.15 (0.000)	0.01 (0.475)	0.096	18.09 (0.000)

Figure in bracket indicates significance level

The coefficients of AWR Connectivity for Doctors and Nurses are 0.06 and 0.18 which are both significant at 5 percent level. Also significant at 5 percent is ‘Health Workers,’ which has a negative coefficient. This means that while there are more doctors and nurses in villages connected with AWR, health workers tend to be more concentrated in villages not connected with AWR. This is in line with the observation of the previous chapter.

It is also shown that there is an impact of Road Density on this development variable as its estimated coefficients are significant at all levels for Health Workers, at 1 percent for Nurses and at 5 percent level for doctors. The positively significant coefficients of Road Density imply that the availability of medical personnel is strongly related to the concentration of road network of the village. However, no significant differences can be seen in the coefficients of Distance from AWR.

5.4 Concluding Remarks

It can be observed from the t-test for the significance of difference between the villages with better road connectivity and poor road connectivity that there is a significant difference between the two areas in most of the key development parameters, where the former is endowed with favourable conditions. Similarly, the estimated regressions are also significant in most of the cases as indicated by the significant F-Statistic, though R-Square is relatively low. A clear conclusion that could be drawn from this is that road connectivity is indeed a significant factor for economic development. This is in line with the findings of several researchers (Parida, 2014; Ibok and Daniel, 2013; Ulimwengu et al., 2009; Umoren et al., 2009; Oraboune, 2008; Mu and van de Walle, 2007; Khandker et al., 2006). The following summarises some of the notable points of the analyses:

First, the well connected villages are richer with several attributes of population development than their counterpart – unconnected villages. This may be evident from the higher literacy rate and female literacy rate, while observing lower family size with less child dependency as indicated by low child-population ratio, which is a basic characteristic of more advanced societies across the world. The significance and sign of estimated regression coefficient suggest the tendency of this measure to move in this direction with the improvement in road connectivity.

Second, the study observed the situation where the composition of employment (workers' composition) is hardly impacted by road connectivity in most of the cases. However, an interesting observation is the increase of agricultural labourers with better connectivity situation, which suggests the existence of land scarcity where the poor landless suffer.

Third, with respect to the status of agriculture development, the study observed a higher prevalence of settled cultivation in the form of agricultural plantation in the well connected villages whereas jhumming is practiced more extensively in unconnected villages because the average jhum size per household is significantly higher in the latter cases. The sign of regression coefficients implicate the increasing trends of plantation areas with connectivity improvement and at the same time, the increasing jhum size with poor connectivity. It may be noted that it is an all-time objective of the state government to replace the unsustainable practice of traditional jhumming by settled cultivation, which is considered more sustainable and profitable, for development of the agriculture sector of the state. Thus, we may conclude that agriculture development is directly associated with connectivity.

Fourth, in spite of the fact that villages having better connectivity are having a larger population size vis-à-vis the notion that demand for availability of basic social infrastructure is determined by population, the study observed a situation where well connected villages are better endowed with such infrastructures. In fact, the availability of educational facilities in terms of infrastructure and manpower is more or less the same in the two areas for primary education. However, the availability of educational infrastructure for middle school and above is significantly higher in the connected villages than in the unconnected ones. It may be noted that the scarcity of teachers in the villages may result in school dropouts in the poorly connected villages. Therefore, the significant estimated regression coefficient of AWR connectivity and teacher-student ratio for middle school and high school should be a matter of concern keeping in view the objective of National Policy on Education, 1992, which aims at universal access to elementary education.

Fifth, a notable feature on the availability of social infrastructure is the significantly different number of qualified medical staff between the well connected and poorly connected villages. In fact, the numbers of health workers (who runs health sub centres) are not significantly different between the two areas. However, the existence of health sub centres under the supervision of health workers in the village does not necessarily translate into access to institutional health care because they are entrusted only for vaccination of children and pregnant women, while institutional child delivery can be done only in institutions where doctors and nurses are present. At the same time, the availability of doctors and nurses in the well connected villages are significantly higher. Thus, it is safe to conclude that well connected villages have better performance in terms of medical facilities.

Lastly, it would be an academic interest to address the comparatively low R-square of the estimated regression model, even for different types of regression models. At the same time, the significance of the calculated F-statistic with moderately low presence of multicollinearity should be interpreted as the model where the explanatory variables do have a significant impact on the dependent variables. The explanatory variable introduced in the model may be only one group of significant factors among other factors, while we cannot rule out the possibility of sequential process on the impact of road connectivity on development, e.g. connectivity improves the availability of educational infrastructure, which would further led to an improvement in population quality (literacy, etc). Nevertheless, based on the significance of estimated regression, it is safe to conclude that road connectivity is undoubtedly a significant factor for development in rural areas.

CHAPTER 6

SUMMARY OF FINDINGS AND RECOMMENDATIONS

6.1 Introduction

The primary objective of the study is to examine the impact of road connectivity on rural development. While the development indicators are clubbed under four major heads, namely, population quality, composition of workers, agricultural land use, and availability of basic social infrastructures, the study adopted four connectivity variables comprising of AWR connectivity (whether the village is connected with AWR or not), main transport route (whether the village lies along the main transport route of the state), distance of the village from the nearest AWR and the density of road within the village. However, due to the apparent endogeneity of the key connectivity variables when taken as explanatory variables, it was found rather difficult to assess the direct impact of road connectivity on development. For example, the provision of basic social infrastructures in a democratic set-up is normally in places where the number of residents is high. These infrastructures usually enhance the quality of the population through increased literacy and the like. Therefore, the viable methodology to analyse the impact of road connectivity is to examine the differences in development levels between the well connected and poorly connected villages in terms of these connectivity variables. This has been done using t-test for difference of means.

In addition to this, the study adopted dummy variable regression model to enable us to analyse the changing pattern of development due to change in connectivity status. Of the four connectivity variables introduced, AWR Connectivity was found to be having the most significant effect as it showed stark differences between its two categories – villages connected with AWR and those that are not. As such, the findings presented in the following will give emphasis on this connectivity variable.

This chapter presents the key findings and observations of the study. The rest of the chapter is divided into three sections titled General Trend of Road Connectivity and Economic Development, Analytical Results of the Impact of Road Connectivity on Rural Development, and Conclusion and Recommendations.

6.2 General Trend of Road Connectivity and Economic Development

6.2.1 Accounting for the different levels of road connectivity infrastructure present across the states of India and that of their performances in different socio-economic indicators, those that have infrastructures better than the national average are also the states that have higher than average performances in the various demographic and socio-economic development indicators like high literacy rates and child sex ratio, and low infant mortality rate. Moreover households availing banking services and those with latrine facilities within the premises were also higher in the states with high network of road connectivity.

6.2.2 The total length of roads in Mizoram is 7548.029 km of which 4776.823 km (63.28 percent) are surfaced. Here, the national and state highways (986.530 km and 310.450 km, respectively) are surfaced while for district roads and town roads, the percentage of surfaced roads are respectively 84.84 percent and 85.13 percent. Of all the types of roads in Mizoram, the worst are of village roads, where only 984.06 km (36.11 percent) out of the total length of 2625.55 km are surfaced. Moreover, only 52.22 percent of the villages are connected with all weather roads (AWR).

6.2.3 The Total Plan Budget of Mizoram during the last ten year (2004-05 to 2013-14) grew at the rate of 14.45 percent. However, the calculated compound annual growth rate (CAGR) for the transport sector as a whole is –3.53 percent while for roads and road transport in particular, the CAGR is –3.73 percent. At the same time, the CAGR of number of all types of vehicles for the period of 2010 to 2014 is 14.22 percent.

6.2.4 A district-wise analysis of AWR connectivity status showed that while at least half of the villages in the districts of Mamit, Kolasib, Aizawl, Champhai and Lunglei are AWR-connected, Serchhip, Lawngtlai and Saiha districts have less than 50 percent of their villages connected with all-weather roads. It was also found that the district with the highest percentage of its villages connected with AWR is Kolasib at 75.86 percent while it is the lowest in Saiha district as only 28.57 percent of its villages are connected.

6.2.5 The percentage of villages along the main transport route, described here as the national highways, state highways, and roads connecting major transport destinations, is 21.66 percent. Aizawl district ranks the highest with 44.30 percent of its total villages along the main route while Lawngtlai district is at the bottom, as only 6.06 percent of its total villages lie along the main transport route of the state.

6.2.6 The average road density of the villages of Mizoram was found to be 7.55 km. Adopting this as a demarcation, there are 304 villages with road density below this average and 213 above it. This means that 58.80 percent of villages have road density lower than 7.5 km while 41.20 percent have density of road network that is higher than 7.5 km. Moreover, 132 of the villages not connected with AWR (53.44 percent) are found to be within 15 km of the nearest AWR while 115 villages (46.56 percent) are outside 15 km of the nearest AWR.

6.2.7 Analysis of the villages with the different connectivity variables introduced in the study and their status of demography showed that villages having better road connectivity have better achievement with respect to population development in most of the cases. An example may be cited of the literacy rate where AWR-connected villages have a per village average of 73.98 percent while for those not connected, the average percentage is 64.85. Similar patterns were found in the other connectivity variables as well.

6.2.8 Mention may also be made of sex ratio whose average is higher in villages with better road connectivity. In AWR-connected villages, there are 952 females per 1000 males while in those not connected with AWR, the average is 944. On the other hand, the ratio of children to total population was found to be higher in villages with poor road connectivity. The percentage for unconnected villages is 19.40 percent while it is 17.13 percent for connected villages. This means that there are more children in villages with poor road connectivity that rely on others, which can be translated as higher dependency ratios in these villages.

6.2.9 In consonance with the total number of population which is higher in the villages with better road connectivity, the average number of households is also higher in these villages. The AWR Connectivity classification showed that the average number of households for connected villages is 255 while it is only 150 for the unconnected ones. However, the size of the family is larger in villages with poor road connectivity. It was found that the average family size for villages not connected with AWR is 5.06 while connected villages have an average family size of 4.90.

6.2.10 With respect to employment as indicated by workers' composition, villages with better road connectivity can be identified as being more developed because the percentage of workers to population and the percentage of main workers in particular are higher in these villages when taken in average. The percentage of total workers to total population in villages with AWR is 49.64 percent while it is 48.48 percent for the case of villages without AWR. Moreover, the percentage of main workers to total workers in the former is 89.13 percent while in the latter, main workers compose 83.60 percent of the total workers.

6.2.11 The percentage of marginal workers is higher in villages with poor road connectivity. This has been taken to denote the undeveloped state of agriculture through the mirror of mass practice of unsustainable shifting cultivation, which is mostly seasonal in nature. In the villages connected with AWR, 5.83 percent of the total workers are those who work for less than 6 months in a year while for villages without AWR connectivity, the percentage is 7.21.

6.2.12 The percentage of agriculture labourers is higher in villages with better road connectivity. In relation to the total number of workers, the average percentage of agriculture labourers in villages connected with AWR is 8.58 percent while for the unconnected, it is 4.42 percent. Also, the ratio of agriculture labourers in villages along the main route is significantly higher at

12.41 percent while the same is only 4.98 percent for villages outside the main route. It may be hypothesised that the problem of land availability has emerged as a result of road connectivity, especially in the areas along the main transport route. Lands in these villages with better connectivity attract wealthy investors, which in turn raises the price of such lands. So, workers are required to work in other people's farms thus becoming agricultural labourers.

6.2.13 It was also found that there are more cultivators in villages with poor road connectivity. Their percentage in total number of workers is 82.93 percent in villages not connected with AWR and in villages with AWR connectivity, the percentage is 75.02. On the other hand, although still at a low level in both categories of workers, a greater contribution of industrial activities was found among the main and marginal workers of villages with better road connectivity. 0.55 percent of main workers are household industry workers in villages connected with AWR while its counterpart showed 0.47 percent only. At the same time, 3.07 percent of marginal workers of villages with AWR are household industry workers while in villages not connected with AWR, the percentage is 2.74.

6.2.14 Examination of the existing state of land utilisation for determining the status of agriculture development shows that the area of wet rice cultivation (WRC) is higher in villages with better road connectivity. In villages connected with AWR, the percentage of WRC to total area of village is higher at 0.85 while for those not connected with it, it is 0.83 percent.

6.2.15 Agriculture plantation area is also higher in villages with better road connectivity. It was found that 0.31 percent of these villages are areas under plantation. On the other hand, the percentage for unconnected villages is only 0.09. The fact that agriculture plantation area is higher in the former denotes a favourable state of agriculture because it is a viable option when the topography of the state is taken into consideration.

6.2.16 The percentage of forest area to the total area of the village was found to be higher in villages that are poorly connected. In AWR-connected villages, the percentage is 73.88 but in those not connected, the percentage of forest area is 76.27. Moreover, the jhum size per family was also found to be higher in the villages with poor road connectivity. The jhum size in villages not connected with AWR is 4.36 hectares while in villages connected with AWR, it is 3.44 hectares. This points to the fact that jhumming is practiced at a more extensive level in poorly connected villages.

6.2.17 The geographical area of the well connected villages is larger than the poorly connected ones. The average area of villages connected with AWR is 37.86 sq km while that of unconnected villages is 36.43 sq km. Moreover, the area within 1 km from motorable road was also found to be significantly higher in the villages with better road connectivity. The area for AWR-connected villages is 11.73 km while for unconnected villages, it is 2.98 km.

6.2.18 In most of the cases, the connected villages show higher availability of educational facilities and more favourable achievement in their personnel, which are respectively measured through the number of schools per village and the teacher-pupil ratio. The average number of schools – primary to higher secondary schools – is 5.48 for villages connected with AWR but for those not connected with it, the average is 3.42. At the same time, in AWR-connected villages, there are 10.11 teachers per 100 students while for villages not connected with AWR, the ratio is 9.49 percent.

6.3.19 Analysis of the average number of health care facilities like Community Health Centres, Primary Health Centres, Sub-Centres, and Sub-Centre Clinics and the average number of doctors, nurses and health workers per 1000 population shows a higher performance in villages with better road connectivity. Out of the total villages that are connected with AWR, 68.89 percent have health facilities at least of some type while for those that are not connected with AWR, the percentage of the same is 52.22 percent. Furthermore, in the measure of the availability of drinking water supply, the villages with better road connectivity also showed better performance. With an overall average of 32.58 litres per capita per day (LPCD), the AWR-connected villages enjoy 33.79 LPCD while the unconnected have an LPCD of 31.27.

6.3 Analytical Results of the Impact of Road Connectivity on Rural Development

6.3.1 The t-test for the significance of differences between the villages with better road connectivity and poor road connectivity showed that there is a significant difference between the two areas in most of the key development parameters where the former is endowed with more favourable conditions. In the test of demographic status, the t-statistic was found to be significant in most of the cases except population density, sex ratio, and child sex ratio. As it was observed that villages with superior road connectivity showed better situations, it can be concluded that road connectivity leads to significant differences between villages with better road connectivity and those with poor connectivity statuses while at the same time favouring the former.

6.3.2 The result of estimated regression of population quality on road connectivity showed that the coefficients of AWR Connectivity are significant in most of the cases. A positively significant coefficient implicates increasing population size, sex ratio, number of households, literacy rate and female literacy rate with AWR connection. At the same time, a negatively significant coefficient suggests a decline in child-population ratio with AWR connectivity of the village. It can thus be concluded that population development is directly associated with AWR connectivity by taking low dependency ratio (child-population ratio) as one of the development parameters.

6.3.3 The study observed the situation where the composition of employment (workers' composition) is barely impacted by road connectivity in most of the cases. However, an interesting observation is the increase of agricultural labourers with better connectivity situations, which suggests the existence of land scarcity where the poor landless suffer. In the t-test, the statistics for the percentage of agriculture labourers of main and marginal workers were found to be significant in AWR Connectivity and Main Route classifications. At the same time, the regression model showed a significant estimate for agricultural labourers (marginal) in the AWR Connectivity classification. This may imply two things. First, scarcity of land for jhumming which compels many workers to work in other landowners' farm, and second, the practice of shifting cultivation as a mere subsidiary livelihood in the villages connected with AWR.

6.3.4 Moreover, the estimated regression of the composition of workers on AWR Connectivity also showed a negatively significant percentage of cultivators among main workers, which can be taken to imply the situation that shifting cultivation remains to be the main provider of employment in the poorly connected villages. In addition, it was found that the percentage of workers to total population and agriculture labourers increased with increasing road density; and that the percentage of main workers decreased while that of marginal workers increased with increasing distance from AWR.

6.3.5 With respect to the status of agriculture development, the study observed a higher prevalence of settled cultivation in the form of agricultural plantation in the well connected villages whereas jhumming is practiced more extensively in unconnected villages. The t-statistics were found to be significant for both these cases in AWR Connectivity and Main Route classifications while Road Density showed a significant difference between its categories in the percentage of agriculture plantation area. Moreover, the sign of the regression coefficients implicates the increasing trends of plantation areas with connectivity improvement and at the same time, the increase in jhum size with poor connectivity. The study found a positive coefficient for agriculture plantation area and a negative coefficient for average jhum size per household. This result shows the practice of agricultural plantation at a more intense level in the villages connected by AWR and the increase in jhum size per household for villages not connected with AWR, which have relatively smaller geographical area.

6.3.6 The study observed a situation where the well connected villages are better endowed with educational infrastructure and manpower (teachers). The t-test showed that the number of schools is significantly higher in all levels of schooling. However, the test for teacher-student ratio showed significant differences in high schools and higher secondary schools only. At the same time, coefficients of the estimated regression of educational institutions on AWR Connectivity were found to be significant for the availability of schools at various levels while for Road Density, it was found to be significant at all levels. The other estimated regression i.e. educational personnel on road connectivity showed that the coefficient of AWR connectivity is significant for high schools while that of Road Density is significant for middle, high, and higher secondary schools. This shows that although the availability of these educational facilities are more or less the same in the two areas for primary education, the availability for middle school and above is significantly higher in the connected villages than in the unconnected ones.

6.3.7 The chi-square test showed that the value for the availability of health care institutions is significant at all levels. This level of significance and its sign means that there are more health care facilities available in villages with better road connectivity than in villages with poor road connectivity. In other words, the average performance of the villages having better connectivity conditions is significantly higher with respect to the availability of the various health care facilities.

6.3.8 Another notable feature is the significantly different number of qualified medical staff between the well connected and poorly connected villages. The t-statistic was found to be significantly higher in the villages with better road connectivity for total number of doctors and nurses. At the same time, the estimated regression showed that the coefficients of AWR Connectivity and

Road Density for doctors and nurses are significant. The availability of doctors and nurses in the well connected villages being significantly higher gives confidence to the conclusion that well connected villages have a better performance in terms of medical care.

6.4 Conclusion and Recommendations

In spite of the fact that there are various factors at play that lead to spatial patterns of development set up across the different villages of Mizoram, the study observed clear distinction in the indicators of economic development among the villages that possesses different connectivity status. This can be seen from the significantly different performances between the categories of villages in the various development indicators like child-population ratio, family size, literacy rates, percentage of total workers, agriculture plantation area, jhum area, and in the availability of basic social infrastructures viz., education and health care. In addition, taking the sign of regression coefficient as the mode in which road connectivity impacted development (whether positively or negatively), it can be stated that road connectivity does have a direct bearing on economic development in the study areas.

The estimated regression equation showed a positively significant coefficient for agriculture plantation while a negatively significant coefficient was observed for jhum size. It may thus be concluded that road connectivity significantly increases agriculture plantation area while it has a negative impact on the intensity of jhum practice. This is in support of Hypothesis 1. Likewise, the significant coefficient for literacy implicates increasing literacy rate with road connectivity (Hypothesis 2). In addition, the study observed a significantly increasing percentage of main workers while also observing increasing percentage of agriculture labourers with road connectivity, which justifies Hypothesis 3.

Meanwhile, although the R-square of the estimated regression model is comparatively low, the significance of the calculated F-statistic with low presence of multicollinearity can be interpreted as a model where the explanatory (road connectivity) variables undoubtedly have a significant impact on the dependent (development) variables. It should be noted that the explanatory variables introduced in the model may be one group of significant factors among others; while the possibility of a sequential process in the impact of road connectivity on development cannot be ruled out. Nevertheless, based on the significance of estimated regression, it is safe to conclude that road connectivity is a significant factor for economic development in rural areas.

In light of the findings of the study, there are some key issues that need to be addressed to achieve sustained rural development in the state. They are given as follows:

a) The extreme dependence of the state on central government for the enhancement of road connectivity, as indicated by a higher percentage of surfaced national highways and the declining budget allocation for roads, should be a matter of concern. Moreover, the state’s own roads like village and town roads are in a deplorable state and the majority of them are still unsurfaced. Keeping in view the impact of road connectivity noted above, it is considered necessary that more effort be given by the state government towards the provision of this public good.

b) The study did not find active participation of the community in the construction and maintenance of rural roads. The villagers themselves should be considered the true stakeholders in this and so, it is necessary to evolve strategies to include the people especially in building and in the maintenance of roads like internal and agriculture link roads.

c) The increasing percentage of agriculture labourers in well connected villages should be a matter of concern. In fact, the study observed large (average) area of jhum cultivation in the villages. It is thus recommended that measures to minimise the prevalent practice of shifting the cultivation from one tract of land to the other be forwarded, so that the current landless agriculture labourers could exploit such lands for cultivation.

d) Health infrastructure was found to be significantly inadequate in poorly connected villages which thwart the goal of universal health care coverage. This differing availability should be positively addressed by the state government. Keeping in view the provisions of the Directive Principles of State Policy, even the remotest of the villages should be provided these facilities. This also holds true for the case of educational infrastructures.

e) The significant estimated regression coefficient of AWR connectivity on availability of schools and teacher-student ratio for middle school, high school, and higher secondary school should be a matter of concern because its unavailability in the poorly connected villages could result in discontinuation of schooling after the students have completed the primary level.

f) The practice of jhum cultivation is done at a more intense level in the villages with poor road connectivity, the reason for which may be the absence of alternative livelihood options. At the same time, the study found that jhumming is still practiced in the well connected areas where agriculture plantation is being undertaken at a larger extent. This means that jhum cultivation is practiced in the villages of Mizoram irrespective of whether they are well-connected or not, although at a lesser degree in the former. Considering not only the environmental effect of jhum cultivation but also how hard it is for the people to completely move away from it, efficient measures to regulate and control the intensity of jhum practice are indispensable.

g) The significantly positive relationship between road density and agriculture plantation area points to the fact that the success of agriculture plantation transpires with the increasing road network or vice versa. Thus, it is necessary that larger road network, especially agriculture link roads, be created in the village for the further expansion of agriculture plantation area – which is considered to be the main alternative for jhum practice.

The exercise and observations of the analysis of road connectivity on rural development suggest the need for further research in some specific areas. The following are the areas found to be relatively important:

i) As cited earlier, the percentage of agriculture labourers rises with road connectivity which clearly shows that connectivity leads to changes in land ownership. This calls for a study focusing on how road connectivity affects existing land relation in rural areas. To elaborate, road connectivity often leads to the emergence of market for land. Moreover, enhanced communication through road connectivity allows the urban rich to access such lands thus raising the value of lands along the roadside. The poor villagers would sell their land because of one reason or the other to these buyers and in the end, this result in a new form of land relation. This also leads to a rise in the number of agriculture labourers as the villagers without other livelihood options can now only serve as labourers in other people’s farms. It is necessary to undergo a research that studies the causes of such morphology of land relation and rise in agriculture labourers because it has been experienced that alienation of land had led to social uprisings such as the Naxalism movement and the like.

ii) The findings of the study note that jhumming is done at an intensive level in the remote villages but also in the well connected villages, although at a lesser intensity. Further research is necessary to study the extent to which the residents of these villages are dependent on this practice and also in finding ways to make the current practice more sustainable.

iii) Analysis of the existing data sets revealed that there is a change in the socio-economic condition of the villages with improvements in road connectivity. However, what is perceptible is that there is endogeneity in the development process and so, a more intensive research is called for to study which key variable(s) is being affected foremost by road connectivity and how that key variable has impacts on other development variables. Moreover, due to limited availability of data, some indicators of quality of life like infant mortality rate, school dropouts, maternal mortality, etc. were not covered in the study. It is considered necessary to study whether these indicators are sensitive to road connectivity and/or to the lack of it.

iv) The study proved that road connectivity leads to favourable changes in the agriculture scenario of the state as agriculture plantation area rises and jhum area falls with improvements in connectivity. However, the present data set lacked certain variables like agriculture value chain which may have a susceptible relationship with road transport. Therefore, an analysis of the impact of roads and road transport on such a chain of agriculture marketing could provide a deeper understanding of how enhancement in road connectivity affects the agricultural sector.

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