ABSTRACT

Title of Document: SOCIETY AND INFRASTRUCTURE: GEOGRAPHICAL ACCESSIBILITY AND ITS EFFECTS ON SCHOOL ENROLMENT IN NEPAL

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This research examines the effects of geographical isolation on school enrolment in Nepal using mainly the Nepal Living Standards Survey-II (2003-2004). Nepal, a country with severe road accessibility problems, presents an especially suitable population for this research. Geographical access is measured as the time required by the household to reach the nearest motorable (dirt or paved) road. The accessibility profile that emerges reflects three forms of imbalance in the state-society relations in Nepal. The first imbalance is regional. The second imbalance is socio-economic reflected mainly in higher concentrations of poverty and illiteracy in inaccessible areas. The third imbalance is the state's inability to cater essential services for the people there.

Stepwise regressions of the NLSS-II cross sectional data show that isolated children are less likely to be enrolled in part because they are poorer, have less educated parents and are from disadvantaged caste/ethnic groups. Another important part of the reason is isolated children are served by distant and low quality schools and also lack basic services such as electricity. Among secondary aged children, isolation continues to have an independent effect even after taking into account all other determinants of

enrolment. This suggests that isolation operates beyond the socio-economic, familial and institutional disadvantages the children face in getting enrolled in school.   Adolescent (but not pre-adolescent) girls are more likely to be impacted by inaccessibility than boys. There is no evidence that inaccessibility operates differentially amongst the poor and the non-poor in sending children to school.

Analyses of the NLSS panel data reveals that improvements in accessibility improves the chance of the children to continue being enrolled in school, but the remoteness they lived through in their childhood also affects such chances in later years.

'Physical' networks in the form of roads have the potential to enhance social networks and the political voice of isolated households, which in turn enables them to value and demand education for their children. Sociology of roads is a field that needs to be expanded to get a better insight on the social changes that are associated with the building of roads.

SOCIETY AND INFRASTRUCTURE: GEOGRAPHICAL ACCESSIBILITY AND ITS EFFECTS ON SCHOOL ENROLMENT IN NEPAL

By

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To my parents, *Shrimati* Pabitra Khatri and *Shri* Dol Bahadur Khatri

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Chapter I

Introduction

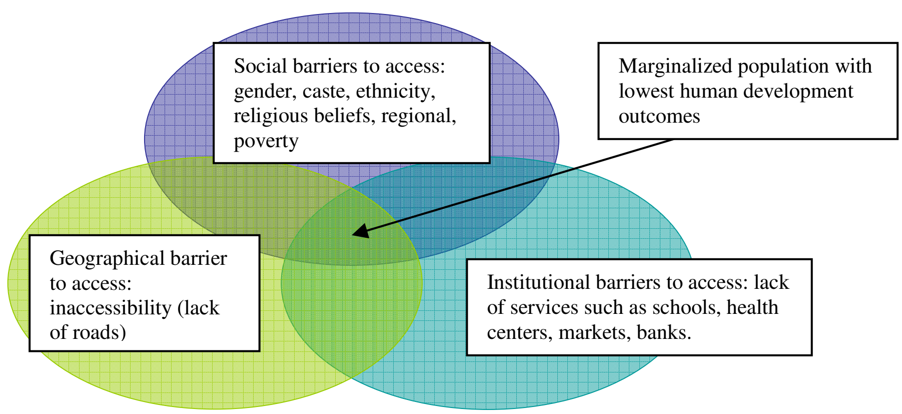
"The trail is very dangerous, so at least one guardian per child takes them to school and brings them back everyday."
A guardian in remote village in Nepal (The Kathmandu Post, 2007/4/11)

Geographical inaccessibility has often been cited, and rightly so, as a major hurdle for the rural poor in developing countries to embark on a path to better lives. Just as inaccessibility prevents them from reaching facilities for getting basic services, such as education and medical care, it also restricts movement of external actors who are trying to reach them. In this research, I explore the effect of geographical accessibility/isolation, as measured by access to motorable roads, on school enrolment in Nepal using mainly the Nepal Living Standard Survey-II (2003-2004), and also drawing from the insights from a field level study that I carried out in July 2006 in Nepal. Nepal, a country with severe accessibility problems and low level of school enrolment presents an especially suitable population for this research. About 56% of the rural population lives at least an hour's walking distance from the paved roads, and about 28% do so even from the dirt roads. About three fifths of the rural population 6 years or older has never attended school (Central Bureau of Statistics 2004a).

Many studies have examined the relationship between geographical accessibility and development. However, most of the research focuses around improved accessibility through roads as a factor of economic growth. A focus on economic outcomes corresponds well with methods that evaluate road projects based on monetary costs and benefits. Although measuring social outcomes of investments on roads such as increase in school participation has generally remained peripheral in roads evaluation, recently a renewed emphasis in the development community has examined how and whether roads can help achieve social development. The social evaluation has been triggered, in part, by the realization that it is extremely difficult to achieve several millennium development goals, most of which are social in nature, requires first improving people's accessibility. This emphasis on the "social" is bringing about, or at least has the potential to bring about some major shifts in the way planners are devising interventions to improve accessibility level of households. First and foremost, it helps answer whether roads help attain social development such as accessing schools and health centers. Second, it lets us probe who benefits more from roads—girls or boys, poor or rich, high caste or untouchables, etc. Third, bringing the "social" in is also coincides with shift in the way outputs of transport interventions are being measured, such as from measuring some aspect of network size (for example, kilometers of roads per square kilometer of land) to the actual time it requires households to reach roads (Roberts, KC and Rastogi 2006).

Apart from the lack of roads that reflects the geographical dimension of inaccessibility, households also lack institutions that provide services within reasonable walking distances. Further, these geographical and institutional barriers to access operate together with several socio-economic barriers—such as gender, caste, ethnicity or religion based discrimination, poverty and low level of education. Figure 1.1 shows how the three kinds of accessibility barriers can overlap in relation to development outcomes. Conceptually thus, the households and individuals which face the triple accessibility barriers are the most marginalized group when it comes to benefiting from development. This dissertation develops this conceptual model as a framework for analyzing the impact of accessibility on school participation and applies it to the case of Nepal. Our analysis of the NLSS-II data shows that improved geographical accessibility—derived through both dirt and paved roads—has statistically significant and direct effect on the chances of children enrolling in school.

Figure 1.1: Conceptual macro-level model showing the group excluded most from development outcomes



Should roads, a field that has generally been handled by economists, engineers and politicians interest sociologists? Economists ensure that the roads have enough economic returns so that investors are willing to invest. Engineers design and supervise the making of roads. Politicians are interested because the politics of bringing in road projects—at the international, national and regional levels—entails the possibility of exerting influence on the electorate. Is there any sociology of roads? To the least, is there any scope for such sociology? Do sociologists have any role in road making beyond the marginal role they are assigned in carrying out conventional socio-economic and environmental impact assessments?

The most obvious answer why there is room for sociology of roads is that roads have huge social returns, not only economic. The second answer is that no matter what length, what type, or for what purpose, when a road is built, social change is inevitable. As we will see throughout this research, the impact of roads is not neutral of the society and the people they connect (or do not connect).

Chapter II consolidates this theoretical framework further by reviewing the available literature on accessibility and its relationship with development outcomes, especially school enrolment. The chapter investigates the concept of accessibility and other barriers to accessing services. It develops a model about various pathways in which accessibility may affect enrolments and presents the research questions and hypotheses. Chapter III introduces the estimation models in detail as well as the methods and variables employed in this research. Chapter IV introduces Nepal as the study area, and presents its geographical accessibility profile. In doing so the chapter looks at how accessibility level varies vertically and horizontally in Nepal, and indicates why accessibility is a central concern for development in Nepal. Chapter V investigates the main effects of geographical accessibility on school enrolment using the NLSS-II cross sectional data. Following the analysis of the main effects, the research advances to examine the interaction effects between geographical inaccessibility and gender in chapter VI, and poverty in chapter VII. Chapter VIII analyzes if the changes in accessibility between 1996 and 2004 has affected the change in school enrolment using the NLSS panel data. The dissertation concludes by discussing the scope for sociology of roads as well as by delineating some policy implications of this research in chapter IX.

Chapter II

Literature review, conceptual framework and model building

Most of the economically advanced world has reached a stage where a society is inconceivable without the comfort and freedom that are derived from improved infrastructure. Amongst many such infrastructures, the advancement of transportation has increased both the accessibility and mobility level of individuals, which in turn have enabled them to interact with the rest of the world and increase their social and economic opportunities. However, worldwide there are still millions who do not have access to such provisions including access to basic services such as education, health care, and proper sanitary arrangements and the freedom that comes from having a higher degree of accessibility and mobility. Among other factors, lack of accessibility also hinders the "real freedoms" people enjoy (Sen 2000). Sen argues that development is the expansion of real freedoms that depend not only on growth of GNP or individual's incomes but also on "other determinants such as social and economic arrangements, for example, facilities for education and health care" (Sen 2000:3). He notes:

> "Sometimes the lack of substantive freedoms relates directly to economic poverty …. In other cases, the unfreedoms link closely to the lack of public facilities and social care, such as absence of epidemiological programs, or of organized arrangements for health care and educational facilities…" (2000:4).

By improving people's accessibility and mobility levels, transport infrastructures such as roads have a huge potential to alter the "socio-economic arrangements" and bring people out of the basic "unfreedoms" they face. If development requires "the removal of sources of unfreedom" Sen (2000), then roads have some potential to do so by improving accessibility levels, breaking the associated isolation, and enabling rural residents to gain more equal access to the newer benefits of development—including education, health and economic services. Although only one of the several factors that are required to break the "unfreedoms," in many instances transport "plays a key role, and in all cases it sets the limits" (Owen 1968). Today, many still live in an overwhelmingly "walking world" (Porter 2002) where over one billion people do not have adequate access (The World Bank 2007a). For many of these walkers, the nearest road is situated further than a day's walk. Other facilities that provide basic services such as education and health care are also beyond their reach.

People from isolated areas in developing countries most often consider not having motorable roads in their villages as a major factor of their underdevelopment that inhibits them in all walks of their lives. In many societies roads are considered as symbols of development (Colombijn 2002). They view lack of roads as constraints to social opportunities and economic growth and feel left out or un-integrated with the rest of the country. The inability of many rural residents in low income developing countries to afford the resources and travel time necessary for accessing basic human and social needs has severely limited their ability to benefit from development. Also rural inaccessibility has limited the ability of major development actors—the state, civil society, donors and the private sector—to help the rural people's efforts to better their livelihoods. These double accessibility constraints faced by rural households in accessing the benefits of development operate together with many other non-physical barriers emanating from local social, cultural and political systems—such as poverty, gender, caste and ethnicity, age, educational stratification and locational differences.

It is also argued that absence of adequate accessibility undermines the process of empowering the citizens economically, politically and socially. In Nepal, road inaccessibility means not only difficulty in providing access to services, but also restriction in access to information, and difficulty for social mobilization and community participation in development activities (United Nations Development Program 2004). Roads undoubtedly help rural individuals and communities to grow socially and come out of their social isolation. The linkage provided by roads extends the geographical reach of rural households within which they can interact in a variety of ways. “Physical” roads have the potential to improve “social” access and mobility, and thus help establish social linkages within an extended geographical reach. Roads also allow the outside world to reach the villagers. Through this added power to reach and link, roads assist rural households to meet their practical needs, strategic interests and community expectations, including for matters related to their basic survival issues, such as education and health care. Thus it is safe to concur with the villagers’ informal measure—having roads or not—as their indicator of how well they are “developed” and linked with the rest of the world.

Broadly speaking, this research is situated at the intersection of society, geography, infrastructure provision and human development in least developed countries, and examines if roads have the potential to alter the basic socio-economic arrangements and break the “unfreedoms” experienced by many in the developing world. Specifically, it examines how improving accessibility levels of households through building roads can affect school enrolment of children, and how such provisioning may differentially affect various groups in society such as boys and girls, younger children and older children, and poor and non-poor households. In doing so it explores the social structure of accessibility and allows us to speculate whether improving accessibility has the potential to alter the social structure in favor of the socially disadvantaged. It also investigates if the availability and quality of "socio-economic arrangements" differ by people's accessibility levels and allows us to reflect if improving accessibility also alters these institutional arrangements for the socially disadvantaged. To surmise, it probes if the impact of roads (improved accessibility) is beneficial for human development and more beneficial to the "un-free" and the disadvantaged.

Current research on geographical accessibility has been advancing in four significant ways. First, there has been a renewed emphasis to bring the *social in* in appraising and evaluating rural road projects. Conventional methods of estimating benefits of investments on roads—mainly the internal rate of return or cost benefit analysis methods—have relied on real cost savings or monetary benefits and are found to be inadequate when it comes to assessing social benefits (Lebo and Schelling 2001, Van de Walle 2002). Second, concurrent to this, it has been realized that without first improving geographical accessibility, it is extremely difficult to achieve many social development targets. Specifically with the international development community glued to achieve the ambitious millennium development goals, accessibility is viewed as a cross-cutting requirement. The need to make villages and households more accessible is therefore finding more prominence amongst agencies and governments. Third, there have been efforts to define and measure geographical accessibility in ways that reflect how adequately rural households are served by transportation systems, rather than some aspect of the road network size at national or regional levels. Finally, the concept of accessibility is broadening to include not only geographical accessibility but also ideas of social inclusion and social exclusion (Donnges, Ojha and Pearse 2005, Farrington and Farrington 2005). Farrington and Farrington (2005:3) assert, “Accessibility is a concept which has come of age. No longer solely a transport, or rural, geographer’s way of expressing an ideological goal, or merely shorthand for a research paradigm, it has gained acceptance as a policy ideological goal.”

Together with this maturing of the notion of accessibility there is now need to investigate, in a more evidence based manner, the extent to which road provisioning can affect social outcomes such as school enrolment. Surely, roads improve accessibility levels of households and help break the geographical isolation of communities. However roads play both direct and an intermediary role in achieving development targets and their ultimate impacts depend on a host of non-geographical factors that are social and institutional in nature. In this sense the relationship between accessibility and social outcomes is complex and multi-dimensional. Farrington & Farrington (2005:3) explain, “there are multiple and complex cause-effect relationships between *economic and social constraints* and accessibility constraints and their combined effects on life chances. Economic and social constraints such as low income or education levels may themselves be affected or even caused by poverty of access and vice versa.” Yet to a great extent, the understanding of the relationship is based on simple bi-variate associations and anecdotal evidences that do not take into account a host of social and institutional determinants that may be affecting the accessibility’s relationship with the outcome. Porter, Blaufuss and Owusu-Acheampong (2006) observe that children and teachers face many difficulties getting to school in rural parts of Africa, Asia and Latin America but point out that there is lack of sufficient evidence to show the extent and nature of impacts on school enrolment and attendance. In a similar tone, Rama (2005) also sees the need for further investigating the impact of a lack of transport infrastructure on children's development, wellbeing and their livelihood contexts. That the roads are a necessity for overall development of a nation goes unchallenged, but evidence based research on how it is so, particularly on achieving educational attainment is inadequate.

In the remainder of this chapter I review the literature on accessibility and its three forms—geographical, institutional and social—with emphasis on the geographical. I then explore issues such as access to whom, access to what, the dimensions and the inter-relationship between the three forms of accessibility. I argue that achieving geographical accessibility may be beneficial for breaking other forms of accessibility barriers— the barriers originating from socio-economic stratification in the society, and the lack of or low quality institutions. I discuss the importance of bringing the "social in" when studying accessibility. Then I look at existing research on the impact of roads on development focusing on education outcomes. In doing so I explore pathways in which accessibility may be beneficial for school enrolment. Following this I discuss briefly the political economy of roads. Finally after summarizing this literature review, I present my research model, questions and hypotheses.

The concept of accessibility

What is accessibility? Specifically what does it mean as it is employed in the development literature? In common use English, access implies "right or opportunity to reach or use or visit" (Pocket Oxford Dictionary 1994) but it is hard to find a common definition for the term (Bhat, Handy, Kockelman, Mahmassani, Chen and Watson 2000) in the infrastructure literature. Although our focus is on the geographical dimension of accessibility, the term as employed in the development literature has a much broader meaning. The term is often employed in relation to access to services, opportunities, goods and resources which have the potential to improve people's basic living conditions which are generated through provisions of transport, health, education, commercial establishments, banks, markets and communication infrastructures. Moreover, the term also has social implications—the distance between a person and services that she/he seeks for is not only geographical, but also may arise out of various individual and social conditions. For a better understanding of the effect of geographical accessibility on social outcomes, it is therefore essential to probe a gamut of issues that relate to accessibility. The issues are: dimensions of accessibility, access to whom (or, who benefits?), measurement issues, factors that prohibit or encourage people's access to various socio-economic arrangements and the social structure of accessibility. We will now explore each of these issues in some detail.

Dimensions: The distance one has to travel to acquire basic services, the quality of available service, affordability, reliability, and the ease at which services can be acquired are the major dimensions of accessibility. Donnges, Ojha and Pearse (2005:14) who have documented for Nepal the International Labor Organization (ILO) propagated local Integrated Rural Accessibility Planning (IRAP) guidelines define accessibility as the ease or difficulty of reaching or using a facility or service, and therefore contend that it concerns both the mobility of people and the availability of services. They view accessibility as a function not only of distance/time to roads but also of distribution of settlements, size of settlements, quality of transport infrastructure, modes of transport, frequency of travel, cost of travel, distribution of facilities and services, availability of goods and services and quality of goods and services. Based on these dimensions, a settlement can be categorized as having varying degrees of accessibility. Donnges *et al.* (2005:19) use average traveling time from all the individual households in the settlement to a service or facility for computing the accessibility index of a settlement for a particular service.

Access to whom: It is not uncommon to find several of the services or the “socio-economic arrangements” in least developing countries placed in locations without seriously considering the accessibility needs of different population segments. For example, roads may follow routes that are desired by central planners, or services placed in locations that are not particularly suited for the villagers. In this context it is important to look at who is benefiting from services by segregating different socio-economic groups.

The need to view “physical accessibility as a social indicator” (Wachs and Kumagi 1973) is not new and has been stressed for quite some time. Although illustrating for a developed world context of Los Angeles, Wachs and Kumagi (1973) had argued that an accessibility measure should be able to reflect the ease with which a citizen may reach a variety of opportunities for employment and services. They measured accessibility as the time required to reach services to show the differences by income status and location of residence. Most importantly they emphasized the need for such a measure to be able to recognize social inequalities.

Also, the process of development entails a two-way interaction between local people and external development actors who are trying to access each other and create—through improved accessibility—places and systems that generate services, opportunities and resources for the local people. Improved accessibility assists both the local people and external actors.

Measurement issues: While the integrated approaches such as one taken by ILO (Dennis 1998, Donnges *et al.* 2005) take into account accessibility to all kinds of infrastructure, for those in the transport sector the emphasis is more on access to transportation systems. Lebo and Schelling (2001) for example, categorize for the rural setting four levels of access: no motorized access, partial access, basic access and full access. Full access is defined as "uninterrupted all-year, high quality (high speed, low-roughness) access" while basic access is defined as "reliable all-season access for the prevailing means of transport, with limited periods of inaccessibility" (Lebo and Schelling 2001:11). The definition of full access is close to one formulated for an urban setting in economically advanced countries such as "a measure of the ease of an individual to pursue an activity of a desired type, at a desired location by a desired mode, and at a desired time" (Bhat *et al.* 2000). This is a very high standard of accessibility compared to generally existing levels of accessibility in less developed countries. Many of the developing countries are still struggling to reach even the basic access level.

Concurrent to this struggle for achieving basic access, the World Bank has adopted a "rural accessibility index" defining it as "portion of rural residents residing within 2 Kilometers, typically a walk of 20-25 minutes of an all-weather road" (Roberts 2005 in Roberts, KC and Rastogi 2006) in order to index each country's accessibility level. This definition marks a conceptual shift from measuring accessibility as simply some aspect of road network size such as road density, and emphasizes the accessibility level of the target population to the road network (Roberts *et al.* 2006). Such a shift also requires that accessibility be measured at a lower social unit rather than assuming all households within a larger unit such as a village have the same level of access once a village is connected by roads. Yet this cutoff of 25 minutes is still a long way to go for many developing countries. For example, a major rural access project in Nepal considers a walking distance of 1½ hours to a seasonal road, 4 hours to an all-weather road and 8 hours to a black-top road as "acceptable" category for the country, while only 8 hours and 12 hours distances from the nearest seasonal and all-weather roads respectively have been considered as "serious problem of access" (Rural Access Program 2003a).

Factors prohibiting access: There are primarily three broad kinds of factors that prohibit accessibility to the available development benefits—geographical, institutional and social. Geographical barriers imply long distances to travel to reach the institutions that provide the facilities. Conversely this barrier also implies the long distances the facilitators of development, that is, the external actors, to reach rural households. Institutional barriers imply the lack of or low quality institutions (schools, health posts, etc.) within the reach of rural residents that can provide the much needed facilities to the villagers. Social barriers imply barriers that emanate from local cultural, social and political systems. In this category of barriers, household characteristics such as caste, ethnicity, religion, education level of household members, location (urban-rural, ecological belt, region) and household welfare level can be listed. Similarly gender, age and morbidity are some personal traits that can determine one's accessibility levels.

The relationships between these three kinds of barriers are not as straight forward as they appear. Farrington and Farrington (2005) who define accessibility as the "ability of people to reach and engage in opportunities and activities" emphasize that *reach* implies spatial (geographic) separation but spatial separation is only one form of separation—others being age, gender, ethnicity, income. People have "poverty of (geographical) access" but that is itself determined by many other factors such as people's time budgets, household commitments, physical capabilities, and attitudes to participation (Farrington and Farrington 2005).

Thus, having the same level of one kind of barrier/access does not necessarily mean the same level of barrier/access to the other two. That is, two different people facing equal degree of one kind of barrier may face different degree of other two kinds of barriers. For instance, a Dalit girl from an accessible area may have higher chances of school enrolment than a Dalit girl from an inaccessible area although both carry similar social traits. Or, a rich child and a poor child from a remote village may be exposed to the same degree of geographical (roads) and institutional (schools) barriers, but the rich child might have a greater capacity to overcome these barriers and get enrolled in school. Based on his field level studies in remote Bhojpur in Nepal, Adhikari (2005) notes that while providing roads up to a nearby location may reduce the (geographical) barriers for all, it does not necessarily make the new found opportunities equally accessible to all members in the community because of social differences. Realizing the social differences in accessibility levels, Donnges *et al.* (2005) point out the need for measuring accessibility for everyone for all socio-economic and caste backgrounds in Nepal. Each barrier—geographical, socio-economic and institutional—have some kinds of association with schooling outcomes, but researches seldom take in to account the effect of all three kinds of barriers together to tease out the effect of geographical accessibility. This research attempts to fill the gap.

Social structure: Thus far we have noted that the three kinds of accessibility may differ for households. However we suspect that geographical accessibility itself exhibits some specific social characteristics. In general, geographically inaccessible areas are found to have higher concentrations of poverty and illiteracy. Besides, one can suspect that some caste/ethnicity groups have a higher degree of geographical inaccessibility compared to others. We will discuss the nature of geographical accessibility for Nepal in detail in chapter four where we find our data clearly indicative of the social structure of accessibility.

The varying accessibility level associated with different locations may be changing the demographics of a country by pulling in and pushing out people from various locations. While accessible areas, because of the social and economic opportunities there, tend to draw the educated and the able population, inaccessible areas are generally unable to retain them. Given this, altering accessibility levels has the capacity to alter the social demography of a country as well.

Which barrier to break?

Which of the barriers—geographical, institutional or socio-economic—has the most potential to obstruct rural people's capability to access benefits of development is a contested issue. Accessibility of households can be improved in more than one way. Donnges *et al.* (2005) contend that accessibility can be improved either by enhancing mobility through the development of transport infrastructure and services, or by bringing the needed facilities and services closer to households. As suggested, certain categories of basic social services have been established to some extent without breaking the geographical inaccessibility. An instance of this is the impressive spread of primary schools (Prennushi 1999) across Nepal. As of 2004, Nepal had about 25,000 primary schools (Department of Education 2004a) with only less than 10% of the households located more than half an hour away from a primary school (Central Bureau of Statistics Nepal 2004a). Yet, generally speaking, the incidence of poorly performing schools with high degree of teacher absenteeism and textbooks arriving in the middle of an academic year, dysfunctional health centers run by clerks without modern medical equipment, or partially functioning water systems because the local maintenance worker does not have the right supplies to replace the broken one, is much higher in geographically isolated areas than in accessible areas.

The rate at which new infrastructure are built in the inaccessible areas are slower than in accessible areas. Even where infrastructures are built, per unit costs of construction and maintenance are higher because of expensive movement cost of resources. The maintenance and supervision in remote areas is also infrequent. Villages without roads are also the ones which are without medical services, veterinarians, or teachers (Owen 1968:3). Hine (2003:4) explains:

> "Any external institution (commercial, government, NGO etc.) planning to locate staff and facilities in a remote location will think twice if vehicle access is very poor …… Perhaps correctly, new road investment in rural areas of developing countries is seen as the precursor of many other interventions including schools, clinics, water supply, government offices, NGO activity and commercial investment."

Similarly, there have been efforts to raise social “awareness” through development interventions in geographically isolated areas—such as training traditional healers on modern medicine, or running awareness campaigns against untouchability. Yet such elevated awareness remains generally unmatched with the rural people’s desire to access (achieve) the benefits of development. The geographical inaccessibility and the inability of villagers to access the facilities for their basic survival has formed a chain—almost trapping them in a vicious cycle—and marginalized them relative to those with better access to benefits. Porter (2003) drawing from her work in Africa, argues that social exclusion is more likely to be severe for villagers who live away from roads, and is particularly pronounced for specific populations in a village such as women, the poor, the aged, the very young and the disabled. Isolated, low population density areas—served by no roads, or very low-volume roads, tracks and paths—are in the most need of basic services such as secured food supplies, health and education services, and are most vulnerable (Howe 2003).

By all means, each sector of development—transport, energy, education, health, communications, irrigation, electricity, water supply, markets and many others—have the capacity to make distinct contributions to uplift the living standards of the rural poor. Yet it appears plausible to argue that by breaking the geographical inaccessibility faced by rural households, we can improve access to institutions and begin breaking some of the other social and economic barriers they face.

Undoubtedly, closer roads mean better accessibility because they reduce the travel burden on rural women and men constrained by time as well as cash. Closer roads result in travelers not requiring overnight stays to reach a destination, time savings and cost savings. Closer roads also mean better carriage of people and materials. Through added social linkages over an extended reach, roads can also change rural households' ideas about their needs, interests and expectations.

Bringing the social in

Conventional methods of estimating benefits of investments on roads typically project the increase in traffic volume (average daily traffic count) and the money savings in terms of passenger time and actual vehicle operating costs (Hine 2003) to estimate benefits. Evidently, these strictly economic methods cannot capture the non-monetary benefits derived for rural households from improving their geographical accessibility levels. Moreover, such methods generally treat all beneficiaries as a homogenous group, implying that the methodologies are not sensitive to how the benefits may be distributed differentially across different social groups. Low traffic volume may mean low levels of economic transaction in rural areas of developing countries, yet as is evident from the activities around rural road corridors, even a bus that operates once a week or a jeep-load of goods entering a village on an irregular basis, has the potential to bring about radical changes in people's social and economic behaviors. Thus, such methods to evaluate projects are problematic, particularly in rural areas where new roads generate very low traffic and where there might be a host of other social benefits (Van de Walle 2002, Howe 2003). These shortcomings have created the demand for including "social benefits" in roads evaluations (Howe 2003).

However, unlike economic benefits, social benefits of road projects are difficult to define, quantify and evaluate. This is partly because the social benefits are indirect and partly because they are non-monetary. Suggested benefits are often in the areas of education, health and social networking. Education indicators include distance to primary/secondary school, enrolment, school attendance, costs of attending school and literacy rates. Health indicators include distance to health facilities, attendance, cost of attending— access & fees, and life expectancy. Social network indicators include the proportion of expenditure on social activities, distance to social activities, frequency of social trip-making, distribution of places of worship, etc (Davis 2005).

Who benefits: What exactly constitutes "social" benefits and how they can be separated from the economic is a contested issue (Hine 2003, Porter 2003) and perhaps not very useful. The debate about bringing the *social in* is more an issue of expanding the range of benefits and the beneficiaries in rural access evaluations, otherwise likely to be excluded from the process. Bringing the *social in* suggests:

> "an emphasis .. on the people who commonly suffer marginalization, invisibility and lack of voice, so-called 'social exclusion'… These are precisely the groups which are likely to experience substantial benefits beyond the explicitly economic if their access and mobility conditions are improved. Such benefits might encompass not only direct improvements in health and education (through improved access to schools and health centers, and through reduced load carrying), but also less tangible (and thus less easily measurable) benefits which come from the empowering experience of mobility and travel and the confidence, broader horizons and new perspectives this can bring. All of these benefits may, of course, also have far reaching economic (and political) implications" (Porter 2003).

Together with this issue of who benefits and what kind of benefits, bringing the "social in" allows us to explore how benefits are distributed amongst the population, i.e., by location (remote vs. well-connected households), road accessibility (with/without road intervention), economic grouping (income/occupation) and social grouping (gender/age) (Ahmed, 2005) and other social axes such as caste, race and ethnicity. In similar lines, Gannon and Liu (1997) contend, "With few exceptions the distributive impact of transport projects (i.e., how much various social groups gain and lose) and the potential for transport projects to play a direct proactive role in assisting the poor has received less attention." The World Bank's Independent Evaluation Group (2007b:16) in its review of its assistance to the transport sector from 1995-2005 has noted, "The distributional impact of transport projects is relatively under researched."

Development thinking: The renewed emphasis on assessing social benefits in roads project planning, implementation, evaluation and impact studies corresponds well to the paradigmatic shift in developmental thinking over the past six decades. One can note that the mainstream approach has been the "economic" one that evaluates real monetary costs and benefits, and generally marginalizes the "social" or the "who benefits" issues. The *basic needs* approach of the 1970s emphasized fulfilling the fundamental needs of the people, some of which such as education and health services were "directly transport-oriented" (Howe 2003). The human development perspective of the mid-1980s and the emphasis in the 1990s on poverty reduction meshed in people empowerment and social capital approaches has even more enforced the need for addressing the problems of the marginalized in roads interventions, including poor, women and children. Most recently, with the advent of the millennium development goals, the importance of improving rural access has become more evident than ever. Although improving access does not appear as a specific target in achieving any of these goals—eradicating poverty & hunger; universal primary education; promoting gender equality; reducing child mortality; improving maternal health; combating AIDS, malaria and other diseases; achieving environmental sustainability and developing partnerships for development—it is difficult to conceive any of these goals being achieved without good level of geographical accessibility. Most interventions such as schools, health clinics, nutrition programs, and social services rely on transport access as a "complimentary input for their effective delivery" (Gannon and Liu 1997).

Better access, for example, can be expected to reduce transportation costs, make agricultural inputs readily available and thus increase agricultural yield and contribute directly to "eradicate extreme poverty and hunger" (MDG1). Similarly, by reducing the time required to reach schools and health centers and by helping improve their quality, better access can contribute to achieving universal primary education (MDG 2) and better child and maternal health (MDG 4 and MDG 5). In a study on transport's role in attaining the millennium development goals, distance and transport has been noted as serious obstacles (Africa Union and UN Economic Commission for Africa 2005: 21) along with cultural factors that restrict enrolment in school outside the child's own community. There are many other pathways in which road access can help social outcomes such as school enrolment which we will explore in detail later on in this chapter.

We have so far discussed accessibility and several related concepts—its dimensions and measurement issues, factors prohibiting access, social dimensions of geographical accessibility and the relationship between geographical, institutional and social accessibility. In summary, our literature review thus far suggests that each individual has varying level of accessibility which affect his/her life chances (for example being enrolled in school); such accessibility is a construct composed of many geographical (roads), institutional (availability and quality of schools) and social (age, gender, caste/ethnicity, poverty, family structure) elements that are particular to the individual; breaking one kind of barrier may help overcome the other two kinds of barriers; and that there are reasons to believe that breaking the geographical barrier helps break the institutional and social barriers faced by individuals (for example in enrolling in school).

Next we look at some of the specific studies that show how geographical accessibility (attained through roads) has benefited the residents in developing countries. We subscribe loosely to the economic-social distinction, and proceed with the discussions on the "economic" outcomes first. Where the same research examines both economic and social outcomes we will discuss them separately.

Prior research, economic outcomes

Most studies point to a positive effect of roads on the livelihoods of rural residents derived through increased agricultural input, economic growth and poverty reduction. There are numerous researches of this kind of which we will discuss specific researches focusing on South Asia and South East Asia. Using household level panel data within two project villages in Bangladesh, Khandker, Bakht and Koolwal (2005) conclude that rural road improvements helped reduce poverty (income measure) significantly with benefits going proportionately higher for households from low income quintiles. They note the relevant linkages between this relationship as higher agricultural production, higher wages, lower input and transportation costs, and higher output prices. Also in Bangladesh, Ahmed and Hossain (1990) studied the impact of rural infrastructure on development in 129 villages. They found villages with highest infrastructure ratings had lower cost but higher use of fertilizers, higher labor rates and more irrigation. They ranked the villages by computing the cost of access (product of distance and cost of travel per mile) to 13 different infrastructures and selecting six among them whose individual cost of access had the highest correlation coefficient with the total cost of access of all infrastructures. The ones selected were primary market, secondary market, secondary school (boys), bank, bus stop and *upzilla* (sub-district) center.

Road investment measured as the total length of roads at the state level was found to contribute to fertilizer use, bank expansion and growth of agricultural output in their study of 85 randomly drawn villages from 13 states in India by Binswanger, Khandker and Rozensweig (1993:364). They mainly used the Additional Rural Income Survey covering the period 1960/61 to 1981/1982. Likewise, 10% increase in the road network (kilometers of road per sq km of land) was found to lead to a 3.4% increase in income per capita by Nagagraj, Varoudakis and Veganzones (2000) who studied 17 India states over a 24 year period.

Evenson (1986) studied farm level data between 1948-1984 in the Manila Los Banos region in Philippines and found roads investment intensifying production as a result of fertilizer use and mechanization of agriculture. Kwon (2001) who examined the Indonesian provinces cross-sectionally using provincial level panel data (1976-1996) found road access to have its “own-effect” as well as “through-effect” on poverty reduction. The “through-effect” was through better irrigation resulting to better yield. Kwon categorized the provinces as having adequate road access if the paved road density (km roads per 1000 square kilometers) in the province was higher than the mean province road density, and inadequate if lower than the mean density.

Further to the above researches from South and South-east Asia, a few Nepal specific studies also provide evidence of the economic importance of roads. Jacoby (2000) using NLSS-I (1995-1996) found that improved access to markets, measured as median of the time reported by the households in a village, generated benefits such as increase in land values and wages. He found that the poor would benefit substantially but not to an extent that it would reduce income inequality. Using the same data, Fafchamps & Shilpi (2000) found agricultural employment dominating the economy for households in far away villages. An impact evaluation study found the economic impacts of roads in Nepal generally positive in the areas of trade, markets and prices and in the effects on labor employment during construction; off farm income-generation opportunity increased even for poorer people (Rural Access program 2003b).

The above researches provide us with evidence on how better accessibility may be helpful for reducing poverty, especially through changes in agricultural practice. Lowering poverty rates should affect enrolments positively. However these researches rely on accessibility variables that fail to capture household level variations in accessibility. Similarly, these studies rarely consider socio-economic variations such as caste-ethnicity, gender, religion or other axis that may be extremely useful in explaining accessibility's relationship with the outcomes that were examined.

Social benefits, focus education

Improved accessibility has been found to relate positively with social benefits as well, although the studies focusing on social benefits are relatively fewer than those that focus on economic outcomes. Generally speaking, schooling as an outcome appears peripheral or combined with a host of outcomes when examined in road project impact studies. Nevertheless there have been some important researches that look into the relationship between roads and educational attainment. Employing a variety of methods—qualitative and quantitative—these researches provide evidence and useful insights on how roads may affect enrolment.

Fentiman, Hall and Bundy (1999) for example, note that parents in Ghana had the notion that a child should be older before walking several kilometers to reach schools. Through their focus group discussions, they also found that lack of accommodation in communities with junior secondary schools was a factor prohibiting transition to junior secondary school. Tansel (2002) using the 1994 Turkey Household Income and Expenditure Survey used distance to regional centers and the capital as a proxy of spread of modern attitudes about schooling. Although not exactly a roads variable, the research found that proximity to the capital increased chances of school enrolment for both boys and girls in Turkey.

In Morocoo, using the Morocco Living Standards and Literacy Survey (1990-1991), Khandker, Lavy and Filmer (1994) found that presence of paved roads in a community increased school enrolment. They predicted that if all communities in Morocco had paved roads, school enrolment would increase to 56% from 49%, with girls likely to benefit more. They also noted that a community with low quality school also had lesser percent of paved roads and more months of roads blocked in a year.

Coming closer to Nepal, researches carried out in South Asia and South East Asia reveal that poorer access to roads may affect school attainment negatively in a variety of ways. Hettige (2006) for example, studying six road projects of lengths between 10 to 21

Kilometers in Sri Lanka, Philippines, and Indonesia, and using qualitative as well as household surveys in control as well as project villages of size of 156 to 600 households, found better monitoring services by government officials, better service delivery by teachers and medical professionals in the project villages as a result mainly of travel time savings resulting from improved transportation. An interesting finding of their research is that whether the poor benefit from rural roads depends on the contextual situation as well as the assets they hold.

Measuring schooling by the percent of school aged children (5-17) who are enrolled in school for each household as the outcome variable, and a dummy variable for project village and non-project village to measure improvement in roads, Khandker *et al.* (2005) found development of roads to benefit both girls' and boy's schooling in Bangladesh. In Pakistan, based on a cross sectional analysis of a nationally representative Pakistan Integrated Household Survey-II data, Essakali (2005) observed a higher schooling rate, pre- and post- natal care and higher proportions of childbirth attended by skilled personnel in villages that had access to all-weather roads compared to those which did not. In some isolated parts of Bhutan, school access time was reported to have dropped to 1 hour from 6 hours as an impact of a rural access project. Based on a socio-economic impact assessment around corridors of roads completed under the Rural Access Program (Kyingkher Consultancy Services 2005), it was found that the roads enabled transportation of materials for school construction and extension, as well as of children from villages where no schools existed.

Provider absence: A factor frequently cited as a reason affecting school enrolments in inaccessible areas is the low school quality and lack of supervision there.

For instance Africa Union/UN Economic Commission for Africa (2005: 19) notes that geographical access is vital for "carriage of pupils, teachers and supplies" and the costs, dependability, and safety of transport affects education attainment directly. Moreover it points out that, especially in rural areas the effect is more indirect "through their effect on the quality of teachers who can be recruited and on the extent to which inspectors will monitor the school's operation."

Some researches have studied teacher absence directly. Levy (2004), using village level data collected from service providers and villagers around control and project roads lists lesser teacher absenteeism, easier hiring of teachers and more school construction as benefits of improving roads in Morocco. In Peru, which has a terrain that resembles that of Nepal's, the mean teacher absence was 21% in schools located 15 kilometers or more from paved roads, a rate 2 ½ times higher than in schools located within 15 kilometers (Alcazar, Rogers, Chaudhury, Hammer, Kremer and Muralidharan 2006). Moreover, being 15 kilometers or more away from paved roads in Peru raised the probability of teacher absence by about 8-12 %. Using the same multi-country World Bank data on provider absence, Chaudhury, Hammer, Kremer, Muralidharan and Rogers (2006) also found a higher mean teacher absence in rural areas than urban in India and Indonesia. However the dummies for whether the school is near a paved road was found to be insignificant in all six countries— Bangladesh, Ecuador, India, Indonesia, Peru and Uganda—once other characteristics of the school, such as poor infrastructure, was controlled for. While a desired posting, the researchers suspect that schools near paved roads may offset the effects on teacher absence because it encourages teachers to locate themselves further away from roads and pursue alternate activities. While this speculation is intuitive, evidence such as provided by Hettige (2006) suggests the opposite where she found better service delivery by teachers when roads are introduced.

Chaudhury *et al.* (2006) also note that teachers from local areas are less likely to be absent across six countries. While it is more likely to find locally qualified men and women in accessible areas it is extremely difficult in remote parts of the less developed world to find educated adults who can serve as teachers. For example in Nepal, beyond 30 minutes off the road, less than 4% of the men and women over the age of 15 had an educational qualification required for teaching in a primary school (NLSS-II computation). Chaudhary *et al.* also found teacher absence rates higher in poor areas (2006:98), and in poor working conditions (measured by infrastructural quality-toilets, electricity, non-dirt floor, covered classroom, school library). Areas that are less accessible are also the areas that are poorer, suffer from poor infrastructures and lack qualified human resources. Porter *et al.* (2006) point out that teachers are unwilling to assume positions in remote villages schools because "poor transport options isolate them from regular interaction with colleagues and other people of similar status." In situations like this when institutions become weak because of poor infrastructural quality or lack of human resources, both of which are consequences of geographically inaccessibility, their ability to supply public goods (education and health) is severely diminished. As Chaudhary *et al.* (2006) point out, weak institutions are a significant barrier to economic development in many countries. Moreover, roads add incentive to qualified teachers, including females, to be posted in otherwise inaccessible areas.

Nepal specific researches: There have been some researches—academic and non-academic—that point at how roads may be affecting school enrolment in Nepal as well.

Amongst the non-academic researches, local newspapers constantly report how remote areas suffer from lack of education opportunities. For example, in one remote village in Nepal only 15% of those who had passed lower secondary level were reported as enrolled in secondary because there was no secondary school in the village (Bishta 2007). Those who were not enrolled were not able to afford the cost of renting a room outside of their village. In another remote village, parents were reported to be accompanying their children to school and waiting for them the whole day because of a cliff that separates the children from school (The Kathmandu Post 2007, details in box below). News of crowded classrooms or no classrooms, lack of teachers, discrimination of Dalit children, etc. constantly pour in from remote areas.

Guardians linger at school with kids

SANKHUWASABHA, April 10, 2007 – It's normal for parents to work day and night to earn for their children's education and a better future. But parents in two villages of Aankhibhui VDC here are compelled to do more: accompany their children to school, wait for them at the school premises the whole day, and bring them back home. Parents of 33 families of Pipaltar and Chuwade villages of Ward-5 go to the Siddhadevi Primary School with their wards and return along with them after school is over because the trail to school, at one point, twists perilously across a cliff. Accompanying the children is essential for ensuring their safety. "The trail is very dangerous, so at least one guardian per child takes them to school and brings them back everyday," said Bhakta Bahadur Katuwal of Pipaltar. Katuwal further revealed that it takes nearly three hours to reach this "nearest school", where the parents spend their whole day waiting idly for the final bell to ring. Sometimes, these waiting parents go fishing at the Arun River just to kill time. "There is another school in Siruwani," said Lilamani Chapagain, another local. "But we chose Siddhadevi School although the trail is dangerous as the other school is located farther away." The villagers said that establishing a school in the village or in adjoining areas could solve this everyday problem.

Source: The Kathmandu Post (April 10, 2007)

Other researches are more systematic. A case study by Ghimire (2002) looks at the transport task structure in two villages in Nepal. Although no direct mention has been made regarding how transport may assist schooling outcomes, it lists several benefits of motorable roads that may indirectly benefit education. In particular, bicycle ownership has improved women's mobility and shifted some of tasks such as fodder collection to the men.

Seddon and Shrestha (2002) who investigate the impact of roads on a village have noted increase in transport services and increase in number of students attending school in road-side schools which they suspect is probably due to construction of additional schools along the road. Molesworth (2005) who conducted an ethnography on the health impacts of a highway on an off road village in Dolakha district also found that the boys and girls there were unable to attend the nearest secondary school. She attributes this mainly to the inability of the eligible children to afford the bus fare to travel to the school. The nearest school for the village is reported as 10 kilometers along the road, after 1½ to 2 hours of walking to the nearest roads.

There are some researches which look at education attainment for more than one or few villages using roads as an explanatory variable. Bhatta (2006) for example examines in detail the determinants of student performance in the annual national level School Leaving Certificate (SLC) examination taken in 2002, 2003 and 2004, using large data collected for the purpose. Passing students had a 27 minutes mean distance to school compared to 33 minutes for those who failed. Note here that these values are for the small percentage of students who have survived through school to take the SLC exam. 65 % of those students who appeared in SLC were within 1 hour of a bazaar and motorable roads (Bhatta 2006). As we will later see, secondary schools are not well spread across all accessibility zones in Nepal. Students who were nearer had a pass rate 16% higher and a mean score 6% higher than those who were located more than 1 hour away. The distance to schools from households were found to be insignificant but whether the school was located within one hour of road/bazaar was found to be statistically significant for the probability of a student passing SLC. Also those who passed had a text book wait time of 15 days compared to 26 days for those who failed. This corresponds well with the national finding that only 30% of the students had textbooks within one week of school opening (Department of Education Nepal, 2004b).

Beutel and Axinn (2002) studied the impact of community-level social change on gender differences in school enrolment and school continuity in Chitwan valley of Nepal. Amongst others, they measured years of transportation enjoyed within 10 minutes by settlements as one aspect of social change, and examined its impact on over 1,100 children. They found that longer the nearby transport service is present, the higher the enrolment. This is perhaps a study that has a high relevance to our study. Not only did they describe several possible pathways in which improved accessibility to transport can affect school enrolment, but they also cite improved transport infrastructure as a dimension of social change that induces other social changes such as schools, wage labor employment and markets.

Availability of schools and transport services directly reduce the cost involved in sending children to school which in turn potentially motivate families to send and retain children in school. Beutel and Axinn (2002) also argue that families are motivated to send children to school with the hope that they are eligible for employments that offer wages, especially government jobs. Here they contend that this is because Nepal like much of South Asia follows the British system of formal education which is based on principle of certifying individuals for specific jobs. Likewise they emphasize, following Adam Smith, as markets spread, demand for money increases which in turn motivates families to send children to schools such that they are able to secure jobs that make money. In similar vein, Molesworth (2005:7) also indicates, "Increased transport and communications broaden livelihood options and raise the value of education and stimulate literacy and skills development amongst rural peoples."

What is important at this point is the primacy that Beutel and Axinn (2002) award to provision of transport infrastructures over the spread of other three forms of non-family institutions. They emphasize that increasing transport provision increases access to the other three forms of social change, that is, proliferation of schools, increase in wage labor employment opportunities and markets. One important thing to note, the research by Beutel and Axinn (2002) also indicates a time lag that may be faced by some segments of the society as a key feature of the impact of the spread of non-family institutions. Thus while everybody benefits from the spread of these institutions, some such as women and the poor may benefit later than others.

In Nepal, often many residents of inaccessible areas are compelled to migrate for employments, most often ending in unskilled labor force in the accessible areas of urban Nepal or India. While the remittance for these inaccessible areas is minimal, the areas also become short of labor. Shortage of labor in the household may lead to gradual pull out or not sending children to school in order to supplement household labor. I would like to recall here what a teacher in a remote village in Nepal expressed to me in 1996. In one of my field visits when I was assessing development potential for 14 remote villages in Syangja and Tanahun, north to the Kali Gandaki River, a teacher confessed, out of frustration:

> "The ones who remain to be taught in school are those who are the *lula langada* (disabled) and *sushta manasthiti bhayeka* (retarded)—anyone who is 13 wants to leave the village in search of jobs in the plains or India."

Molesworth (2005) also observes such migration trends in her ethnography in a Nepali village located a couple of hours from roads. Her argument is provision of roads may have enabled the migration of the men from the village thereby making the village labor deficit. However migration from hinterlands of Nepal is not a recent phenomenon and has existed prior to roads. In fact, as noted by Molesworth, roads might have stretched the villagers' "geographical sphere of labor options" (2005:15). Roads also have the potential to aid return trips for those who migrate seasonally.

Social interaction: One main effect of roads is that they help break inaccessibility not only in the material sense that we have discussed thus far but also in the non-material sense. In isolated areas, most people do not have the time and money to make long travels, and "their lives and thoughts rarely range more than a short distance from where they were born" (Owen 1968). However an individual "possesses a built in ability to move, albeit within a limited area and has a sense of territoriality: he identifies life and activities with specific places" (Bamford & Robinson 1978). Roads help expand the territory. By enabling external actors to reach rural areas, and by enabling villagers to reach the outside world, roads provide cheaper, easier and convenient paths for the villagers to increase their ties and interaction with the external world. Colombijn

(2002:597) observes, "At each stage, before, during, and after construction of a new road, the road leads to intense social interaction." Roads cannot simply be treated as neutral lines (Wilson 2004) joining one place with another but "stretched-out places where intersecting social relations cluster and adhere to" (Wilson 2004:529). There are limited evidence on how roads may increase social capital, but researchers point at various pathways in which this may happen.

Following Emile Durkheim, Beutel and Axinn (2002) contend that the social changes in the form of spread of non-family institutions such as schools, markets and transport increases the number of people who interact with each other or the "moral density" of the society. This finding is validated by research by Paolisso, Hallman, Haddad and Regmi (2002) in three villages in Nepal, where they found that longer distance from extension offices to households meant less day-to day contacts with extension agents and an increased reluctance of villagers to commit resources to new technologies. Also, an impact study at the project level found social and kinship networks strengthened as a consequence of increased mobility, particularly for women who were able to reestablish links with their families of origin (Rural Access Program 2003b). The spread of non-family institutions such as transport, markets and schools, which is the variable used by Beutel and Axinn (2002) to measure social change, ultimately brings more of the social life outside of the family, alters patterns of social interactions as well as affects the inter- and intra-household level relationships. They note the implication of these alterations for gender impacts on enrolment which we will discuss later when we examine the gender differences in school enrolment as a consequence of improved accessibility.

Seddon and Shrestha (2002) note that a fifth of all those traveling by road from a village in Nepal gave personal travel as the reason for their journey and assert, “Increase in mobility has resulted in more exposure to and interactions with outsiders.” A sense of connection to the rest of the world and the increased social capital due to increased ties may enable villagers to have a broader outlook that may bring attitudinal changes. The increased ability to value the importance of education should raise awareness about the need to send their own children to school and also to work towards having more and quality schools in their villages. Fan (2006) aptly puts it “With roads, people travel out and bring in new knowledge. They change their behavior. Roads are a window to the outside world.”

Pathways

Let us now proceed to examine the pathways in which geographical accessibility and school enrolment may be related, so as to arrive at an analytical model for our research. Many of the institutional (availability and quality of schools) and social determinants of school enrolment (age, gender, caste/ethnicity, poverty, family structure, enabling infrastructures such as water and electricity) that are associated with isolation are also associated with school enrolments.

The main question we seek to answer in this research is how the geographical accessibility-enrolment relationship changes after taking into account other crucial determinants of school enrolment. Some determinants such as age and gender of a child are not affected by geographical accessibility. Yet many others such as poverty, illiteracy, distant and low quality schools may be direct consequences of inaccessibility.

Another Nepal specific factor—the Maoist insurgency—may be related to inaccessibility because the associated destruction of infrastructure, fatalities and displacements may have affected school enrolment.

Also, some locational characteristics such as urban/rural, ecological belt or political divisions of the households may offset or compensate some of the accessibility effects on school enrolment. These characteristics reflect different geographical, historical, cultural and political realities specific to the location. They are causally prior to both geographical accessibility as well as enrolments and their effects need to be separated out when looking at the geographical accessibility-enrolment relationship.

There are several pathways in which inaccessibility may be related to school enrolment. Inaccessibility operates in obvious and subtle ways to induce/exacerbate the effect of the socio-economic and institutional barriers on school enrolment. First, inaccessibility directly makes schools harder to attend because schools in inaccessible areas are sparsely distributed. Second, inaccessibility causes household poverty and makes households less educated and that reduces enrolments. Third, inaccessibility also directly makes school lower quality which discourages households from sending children to school. Fourth, inaccessibility not only affects the distribution and quality of schools, but also other enabling infrastructures such as water and electricity. And a fifth reason why inaccessibility may be affecting school enrolments is the households' poor social networks and ties outside of their communities. We will discuss each of the pathways in sequence based on above as well as additional evidence.

Inaccessibility makes schools harder to reach: The long and difficult journeys children need to travel on foot in inaccessible areas to reach schools may affect some children's and some teacher's probability of attending school. With schools nearby, the cost of sending children to school goes down and parents are more willing to send their children to school (Beutel and Axinn 2002). Also as Ahmed and Hossain (1990) point out (for the Bangladeshi context) for a secondary school to be viable pupil will need to be drawn from a number of villages. Transport services derived from improved accessibility can play a vital role in making schools reachable and thus viable.

Inaccessibility exacerbates poverty which affects school enrolment: Without doubt, there are several effects other than the obvious "distance to school" effect of inaccessibility that may affect school enrolment. Poorer households are likely to have difficulty meeting the cost associated with education, especially at secondary level. Moreover, inaccessibility itself may exacerbate poverty. Inaccessible areas have limited economic opportunities to overcome poverty barriers which may affect the capability of households to send their children to school.

Inaccessibility makes schools low quality: Roads can play an important role in improving school quality by making the movement of students, teachers and materials less cumbersome. We might expect roads to assist them to travel for extracurricular activities outside of their schools, making school going an attractive activity. We can also expect roads to enable better school inputs in the form of timely and cheaper delivery of textbooks, stationery, supplies, equipment for science labs with ease that are essential to run a school smoothly.

Inaccessibility makes other services inaccessible: Apart from having sparser and low quality schools, households that are remote from roads are also generally remote from other kinds of services that provide basic services to them and make schooling more possible. Unavailability of schools has a more direct effect on school enrolment but lack of other services such as electricity and water have indirect effects on school enrolment also. Having electricity allows children convenient source of lighting for their studies, and more night hours, thus providing an enabling environment to keep the children in school. Khandker, Lavy and Filmer (1994) predict using the Morocco Living Standards and Literacy (1990-1991) Survey data that presence of electricity and running water would increase school enrolment significantly. As for Nepal, while on the one hand, extending electricity lines from national grids to remote areas has to overcome real geographical barriers in the form of steep hills and huge rivers, on the other hand Nepal has thus far not been successful in exploiting much of the local hydropower potential in inaccessible areas. Again, geographical inaccessibility poses a barrier in the form of high project costs incurred in hauling materials and equipment.

Inaccessibility effect intensified: Lack of other services apart from water and electricity affects enrolments in their own ways. Having distant/no health facilities in remote areas often results in sick children who are unable to attend school. Services such as telephones and post offices are also sparse and very slow in remoter areas, intensifying the inaccessibility effect. It is not uncommon for newspapers to reach after several weeks even in government offices, and for residents to walk for several hours to place phone calls if there is a call to make. Lack of commercial infrastructures such as banks, markets and shops indicates limited economic opportunities, including limited access to formal credits. This lack of opportunity reduces economic returns to schooling which in turn reduces the incentives for enrolment. It also means items such as clean fuel which could ease the travel burden of household members is either unavailable or too expensive. Lack of nearby markets means long travel to export and import produces as well.

The poor quality or unavailability of other infrastructures means not only lack of enabling environment for overall development but serious time deprivation on the rural household. Long travels to get services from these infrastructure facilities—such as to treat a sick child or to get a sick cow inspected by a veterinarian—put a tremendous pressure on the households' time. This may mean that school aged children need to share the increased time demand on the household, that is, to supplement household labor for regular activities such as collecting firewood and water, herding the cattle, working in the farm, portering farm produce, and so on.

While none or distant infrastructures are primarily a result of expensive per unit costs, poor quality infrastructures result from lack of human and other resources for regular monitoring, supervision and maintenance of institutions that is committed to work in inaccessible areas. For example, in Nepal although the rules have provisioned civil servants to accumulate merit points for a promotion if they are stationed in remoter districts, in practice postings in such *durgam* (remote) areas have been used as a means to 'punish' civil servants. Many civil servants often find ways not to be posted in *durgam* areas, again because of the fear that they will be 'stuck' there in a world without opportunities. This discrimination against remote areas is rooted in the psyche of those operating from more accessible areas.

Inaccessible areas have poor social networks outside of their areas causing them to put less value on education: As mentioned earlier inaccessibility tends to be associated with greater concentration of poverty and illiteracy, which combined tend to restrict horizons and thoughts, form a vicious cycle, and make rural households unable to value the importance of education, and to demand better schooling. To reemphasize, having roads has the potential to break such vicious cycles because "physical" roads serve as "social" networks for households, by extending their reach to the external world.

Below we present specific ways in which improved geographical accessibility helps school enrolment. Overall we can divide the contribution areas under three categories: household level decisions, external activities, and investment decisions by agencies.

Some examples of how roads facilitate school enrolment

Type of activity	Mechanisms in which school enrolment is assisted
Household level decisions	1. Frees up time for girls and boys by reducing the travel time burden. 2. Increases household confidence to send girls to school. 3. Enables taking board exams that are generally conducted at centers that are far away from villages. 4. Makes better access to cleaner fuels which in turn saves time and improves health of the children. 5. Allows interaction to an extended reach, increases awareness on importance of education. 6. Increases ability to multi-tasking by children: school + shopping + marketing of household level produce.
Movement of external resources	1. Adds incentive to qualified teachers by making schools more accessible. 2. Schools are more accessible for monitoring and supervision staff. 3. Reduces cost of transportation of raw materials to build schools. 4. Enables text-books, supplies and stationery on time.
Investment decisions by non government, private and government agencies	1. Enables placing/construction of new schools. 2. Enables timely maintenance of schools. 3. Enables activities for improving/maintaining school quality. 4. Helps launch non-formal education programs.

Inaccessibility may be operating differentially for different social groups (such as the poor and non-poor, girls and boys): We will explore the literature on how school enrolment of boys and girls, and poor and non-poor may be impacted differentially by geographical inaccessibility when we look at the interaction effects of geographical accessibility and gender (chapter VI) and poverty (chapter VII) on school enrolment.

Inaccessibility may have fueled Maoist insurgency and affected enrolment: Any contemporary study on Nepal will remain incomplete without considering the impact of the protracted Maoist insurgency (1995-2006). Several researchers have pointed out that discontent associated with inaccessibility fueled the Maoist insurgency (Deraniyagala 2005; KC 2002; Seddon & Hussein 2002; Sharma 2006). Sharma (2006:1248) contends that development efforts in Nepal failed to reach the poor and have "contributed to a rise in unemployment, poverty, and rural-urban inequality, which significantly increased frustration and resentment among disadvantaged youth in the rural and remote areas." It is my contention that Maoists in Nepal successfully utilized the triple rural isolation—geographical, institutional and socio-economic—to their advantage. The Maoists began their rebellion successfully from the mid-western hinterlands of Nepal—isolated geographically and disadvantaged institutionally and socio-economically. Indeed, inaccessibility generally meant a slow response by the state not only in delivering services, but also in tackling the insurgency militarily in the mountainous areas (Deraniyagala 2005).

Although this relationship between accessibility and conflict was true in the earlier stages of conflict, by 2004, the time of the NLSS-II survey the conflict had spread to all the districts of Nepal irrespective of their accessibility level. It is also important to note that in the first half of the insurgency the most inaccessible mountainous areas were less affected. Inaccessibility may have affected conflict, but it is difficult to speculate to what extent and how enrolments were disturbed by the conflict. One may suspect school enrolment likely to have decreased in areas severely affected by the conflict because of displacement of households, the induction of school aged children as fighters, destruction of schools by insurgents, frequent forced closure of schools and the use of schools as army camps. In some cases there were reports that the Maoists were using their own curriculum in schools, suggesting children were still in school. A World Bank analysis based on NLSS-II notes that the insurgency could have posed an impediment to education but does not seem to have hindered education gains (The World Bank 2006). In addition, it also notes that access to schools and hospitals also improved during the period.

The same report has recorded reduction in poverty rate for Nepal between 1996 and 2004. It attributes this "resilience amidst conflict" that Nepal was able to exhibit, amongst others, to the improved national road network which grew 6.7% a year between 1996 and 2004, and rural and district roads that grew 11% a year. It notes such improvements stimulated entrepreneurial activities raising incomes of those working in non-agricultural jobs. The four other stimulators for poverty reduction during the period have been identified by the report as increased remittances, increase in wages (more people migrated abroad and local employers started competing for a shrinking pool of workers), urbanization (urban population doubled) and smaller families (the number of non-working family members per working adult decreased). We can suspect increased accessibility to have played a positive role on these stimulators.

Political economy of roads

States have for long relied on infrastructural power such as "transport of people and resources through improved roads, ships, telegraphy etc" for effectively penetrating civil society and implementing "logistically political decisions throughout the realm" and gain "a territorially centralized form of organization" (Mann 1988). It is interesting to note that not only the Nepali state was focused on building roads to inaccessible districts most affected by conflicts as one of its counter insurgency measures, but the Maoist insurgents were also engaged in construction of roads in some remote districts. Neither were they opposed to road building in general. This somewhat improbable scenario drives home the centrality of accessibility in Nepal's contested political scenario, just as it reiterates that the issue of accessibility is a people's issue.

Whatever the road project may be meant for—either an access road to a hydro-electricity project or a road deliberately built to connect remote districts—it has to interact with the people surrounding the zone of influence of the roads. It is not a surprise that coming up with a final alignment for a road often is a contested issue in developing countries wherein people from various political jurisdictions compete to have the roads pass through their villages. Ultimately the impact of roads is felt by the people who live by them, and who will have to live with them. Roads shape people's movement as new towns and hamlets spring up along road corridors, and disappear when newer shorter routes are constructed. Once more, roads have the potential to structure the social composition.

One has also to keep in mind that not all roads are the same. Often roads are categorized in a variety of ways—all season vs. seasonal road, dirt vs. paved or graveled, rural vs. urban road, agricultural road, feeder road access road, and so on. Roads vary by volume of traffic that plies on the road, by operability and by quality. For example, paved roads are high quality roads which are extremely expensive because of the materials and resources they require for construction. As such many governments from the developing countries rely on loans or grants for building such roads. However countries have significant portion of their road network which is not paved or all-season but are mostly seasonal. Often the high quality black-topped/paved roads are found to be concentrated in urban areas, and generally begin to spread from the capital and regional headquarters towards the districts.

In contrast to these high quality roads, the dirt/earthen/seasonal roads which are “not so glamorous” (Rosenberg 2006) are found mostly concentrated in rural areas. For example in Nepal, of the total roads, over two thirds are not paved, but have spread impressively in the villages and districts. Such a spread of these low quality roads compared to the better quality ones has been possible to a large extent because of local capacity, interest and participation to construct them. They also reflect a desire of inaccessible villages (the periphery) to be linked to the external world (the center).

Indeed very different kind of political economies exist for the two kinds of roads. Despite differing political economies, there are advantages to be accessible by both types of roads. With better operability, the paved roads surely have the potential for more and reliable traffic compared to the dirt roads. In developing country contexts where roads are limited, traffic volume is a function not only of road quality. But even low and irregular traffic movement improves the accessibility of rural households tremendously. Although it is argued that longer term social and economic impacts may not begin to be visible unless there is reliable round the year access, it is intuitive that even lower quality roads have the potential to bring about several changes that relate to rural livelihoods. Using provincial level data for 1982-1989, Fan and Chan-Kang (2006) found low-quality rural roads having benefit-cost ratios for national GDP to be four times greater than the benefit-cost ratios for high quality roads. There the lower quality roads raised more poor above the poverty line per Yuan invested than did the high quality roads. Analyzing NLSS-I data, Prennushi (1999:ii) found access provided by passable dirt roads in Nepal to have a positive impact on agricultural production and on incomes "without the need to provide higher grade access, for instance through paved roads."

Negative effects of roads

Thus far our discussion has focused mainly on what good roads can do. However, roads are associated with several negative developments as well. For example, road corridors are found to be also corridors for spread of HIV/AIDS, construction of roads displace livelihoods, causes off-road and livelihoods markets to die (Porter 2003) and alter the forest landscape and the "soundscape" (Colombijn 2002). Blaikie, Cameron and Seddon (1980) cited the inability of motorable road provision in Nepal "to generate a systematic response in terms of agricultural output or diversification" as a key characteristics of underdevelopment. It may be the case that roads reinforce or expand the gap between the haves and have-nots (Fairhead 1992). We do not dispute the fact that with roads, the bad also comes in as does the good. However, this research is located in a setting which includes people situated hours, if not days away from roads where our intuition tells us that improving accessibility has the potential to do more good than bad. The inevitable of the bad does not allow us to stand for against road, but to look for means to reduce the bad.

Schooling policies in Nepal

Although the focus policy variable in this research is geographical accessibility, it is important at this juncture to make an overview the educational programs and policies in Nepal that may impact our outcome variable, i.e., school enrolment. These include schooling levels, types of school, targets, and some specific measures to increase school enrolment.

Schooling levels: In Nepal the grade levels for primary, lower secondary, secondary, and higher secondary schools are 1-5, 6-7-8, 9-10 and 11-12 respectively (Government of Nepal 2002). The specified age groups for grades 1 to 12 are 6 to 17 respectively, but existing data on school enrolments suggest prevalence of delayed enrolments (Manandhar and Shrestha 2003, The World Bank 2006).

Public, private and community schools: Most schools in Nepal are public which receive regular government assistance in for their operation. In 2001, such schools absorbed 89% of the primary enrolment, and 86% of the secondary enrolment (Manandhar and Shrestha 2003). Also, in terms of the total number of schools, the share of private schools is higher (28%) at the secondary level compared to about 12% at the primary level (Ministry of Education and Sports 2005). Private schools are mostly concentrated in urban areas, and can rarely be found in inaccessible areas.

Most schools were managed by the community until early 1970s (The World Bank 2003). In 1971, the National Education System Plan (NESP) was introduced under which Nepal nationalized its schools, pertinent features of which were emphasis on universal primary education, adoption of uniform textbooks, Nepali as the medium of instruction and centralization of the education administration. Under a more liberal policy, private schools opened from the Eighties. Most recently the government of Nepal, aided by a host of donor agencies, is encouraging communities to take over the management of public schools.

Successive governments in Nepal have targeted and acted to increase school enrolment in Nepal. As a result Nepal has made impressive gains in school enrolments in the past five and half decades. Nepal's literacy rate (six years and over) stood only at about 5% in 1952, about two years after the end of the autocratic Rana regime. The rate increased to 14% in 1971, 23% in 1981 and to 54% in 2001. However, easier gains in enrolment have likely already been accomplished (The World Bank 2006). The most recent target set by the Government of Nepal for attaining universal primary education is 2015, which complies with the Millennium Development Goals.

In the past one and half decade, specific projects such as Primary Education Development Project (1992-1997), Basic and Primary Education Project (1993-2004) Phase I and Phase II, Secondary Education Development Project (1993-2000) and Education for All (2004-2010) have been implemented with the aim of expanding access to primary and secondary education, improving educational management and raising the quality of teaching and learning (Manandhar and Shrestha 2003). Under these projects, the government of Nepal has provided several incentives to bring the out-of-school children in to school. This includes measures such as free tuition, specific measures to increase girls' enrolment such as female teachers and provision of scholarships for girls in some districts, teacher training, curriculum development, etc. The government programs continue to provide day meal, cooking oil and scholarship to primary girls to increase their enrolment in districts that have low accessibility to education and low enrolment (Ministry of Finance 2007).

Addition to the literature

The Nepal-specific and other research that we have overviewed provide us important clues and evidence to as how spread of accessibility may promote educational attainment. We would like to add to these researches in several meaningful ways. First we will expand the research from localized settings to represent all of Nepal.   For example the district of Chitwan where the research by Beutel and Axinn (2002) is located is representative of some of the socio-economic characteristics of Nepal, but is not representative of the large variation in accessibility levels across the country. Chitwan which generally has a flat terrain and is also the major transport hub of the country has a very high accessibility level. The district has visibly developed much more rapidly than most other districts. This has been well noted by Beutel and Axinn (2002:116), "One of the key features that makes Chitwan different from other parts of rural Nepal has been the tremendous proliferation of non-family organizations and services throughout the area."

This dissertation adds to the ongoing research agenda on accessibility in five more distinct ways by analyzing the impact of accessibility on school enrolment. First, by adopting a household level measure of accessibility, it recognizes the heterogeneity of households and captures how transport accessibility relates to specific household characteristics. Second, by analyzing geographical accessibility barriers along with socio-economic and institutional barriers, it helps to tease out the direct and indirect impacts of geographical accessibility barriers on school enrolment. Third, it attempts to understand how accessibility may have differential impacts on school enrolment for different social groups—for girls and boys, and for the poor and non-poor children. Distributional aspects of benefits of roads are rarely analyzed in terms of social axes. Fourth, it evaluates the impact of accessibility on school enrolment using both paved road accessibility and dirt road accessibility measures, which allows us to appreciate the impact of lower quality but cheaper roads *vis a vis* the high quality but expensive roads. Finally, the overall approach may provide a framework for evaluating the combined effects of all road projects on social outcomes at a national level. Often evaluations in the sector attempt to delineate impact at the project level, which is generally not accurate because a host of wider, beyond-project factors are influencing the outcome. Instead, this dissertation uses large nationally representative cross-sectional and panel household samples, complemented by qualitative insights, to look at accessibility level and changes at the household level, and how the level/change in accessibility relates to level/change in school enrolment. I now proceed to present the research questions, hypothesis and the general model for this dissertation.

Models, research questions and hypotheses

The various models we wish to estimate using the cross sectional data are based on the following fundamental relationship between development and accessibility:

Development outcome =f (accessibility) which based on our theory, we expand to:

Social development outcome=

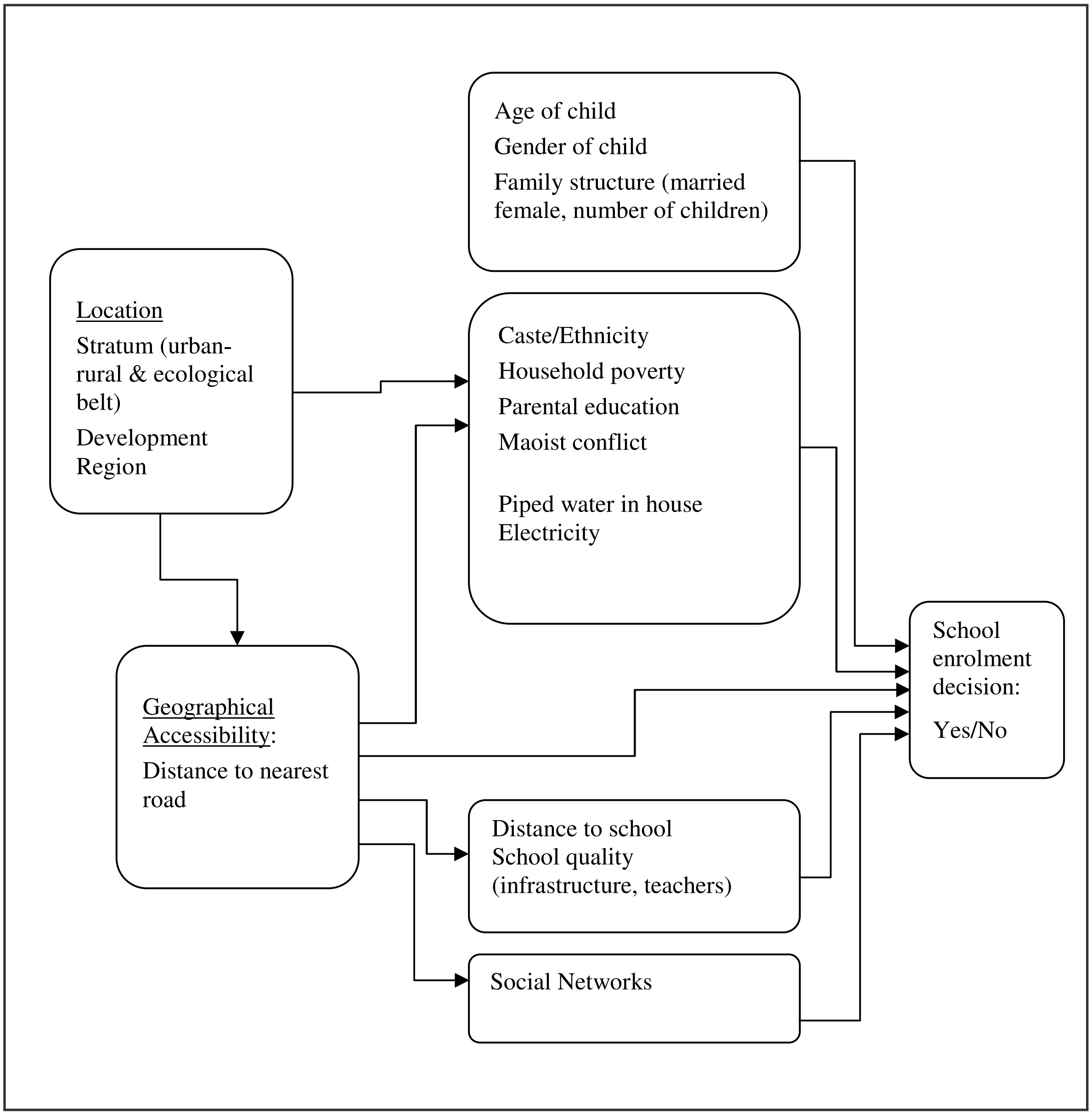
f (location, geographical access, socio-economic access, institutional access)

As has been discussed earlier we have chosen school enrolment as our outcome of interest to examine the effect of geographical inaccessibility on social development.

We have presented two important concepts about the relationship between accessibility and development. One, the households which face the triple barrier—geographical, institutional and socio-economic—are the most marginalized group when it comes to benefiting from development. Two, breaking the geographical inaccessibility faced by rural households can help break the institutional and socio-economic barriers they face. These concepts are presented diagrammatically in Figure 2.1.

In presenting these concepts and the above model, I am in no way arguing that geographical accessibility is the antidote for all other kinds of barriers that rural households have faced since centuries. Moreover, I am influenced by my own experience with development—somewhat ambivalent—as well, around the rural hinterlands of Western, Midwestern and Far-western Hills in Nepal in the 1990s—first as a civil engineer, then a sociologist, and finally combining the two disciplines to manage development programs in areas accessible only by foot. My experience with development has been bittersweet and reveals mixed portraits of development in the 'periphery'.

Figure 2.1: Model showing the relationship between accessibility variables and school enrolment



Some were beyond belief—hardworking farmers whose produce barely carried their families through the year, abandoned irrigation canals, water stand posts that were never connected to waterlines sometimes used to fasten cattle, schools with no English or Math teachers, health posts without practitioners and medicines, a handful of manipulating rural elites speaking on behalf of all other villagers, people from untouchable caste group specifically asked to wash their own dishes in village tea shops, menstruating women spending days in dark *goofas* (solitary cubicles in the backyard), and so on. As argued by the dependency school, it almost appeared that development was not producing any results for the periphery. Yet despite these bitter realities, there was hope as well—small kids in haste to reach their schools after their morning household chores, an extension worker visiting farmers to talk about the new variety of seed, a health worker talking about the importance of *jeewan jal* (oral re-hydration), a postman walking for hours to deliver letters to far away households, NGO volunteers helping construct toilets for households, eager and competent local government officials, a dozer excavating earth to open a track, and so on.

Development was not working in the periphery, and at the same time it was working. For this reason, being a development worker or a development researcher then is to be able to survive with this ambivalence about development's potential for the periphery, rather than assigning oneself for or against any development theory. Alvin So (1990:267) suggests, "Researchers now need to examine each concrete case against its own historical conjuncture before deciding whether development has a positive or negative effect and on which segment of the population." The coexistence of failure and success fits well with the new trends in development studies which indicate that development has both harmful and beneficial effects (So 1990).

I begin my research in this premise and some sense of ambivalence about the outcomes of this research. In a broader sense, by using the lens of roads expansion, I hope to understand the effects of development effort of Nepal in the past five and half decades of the development project. Specifically I ask:

(i) Has improved geographical accessibility resulted in better school enrolments for households in Nepal?

(ii) If it has, can this relationship be further explained *vis. a vis.* the availability of institutional facilities such as schools?

(iii) Does geographical accessibility have differential impact on the school enrolment of boys and girls, and the poor and non-poor?

I propose to test the following hypotheses:

1) Children from households with better geographical accessibility are more likely to have higher school enrolment rates.
2) Part of the reason why improving geographical accessibility increases school enrolment is because schools become more accessible.
3) Part of the reason why improving geographical accessibility betters school enrolment is because schools improve their quality.
4) Children from households with better geographical accessibility are more likely to have higher school enrolment rates, for both boys and girls, with benefits going more to the girls.

5) Children from households with better geographical accessibility are more likely to have higher school enrolment rates, for poor and non-poor, with benefits going more to the poor.
6) Improving geographical accessibility improves the children's chances of being enrolled in school.

In the next section I will discuss the data, my proposed methods for this research and describe the variables that I use.

Chapter III

Data, variables and methods

In this research I primarily employ statistical analysis to tease out the direct and indirect impact of accessibility on school enrolment using the Nepal Living Standards Survey-II (NLSS-II) dataset. I also draw from the insights I received during my field visits in Nepal during July 2006, which I carried out after designing the theoretical model. In this chapter I will first discuss the datasets, the variables and procedure for my statistical analysis, and the approaches taken for field study. Let us first locate Nepal in the global map and discuss briefly why Nepal provides an especially suitable site for this research.

Nepal is a low income, land-locked country in the Central Himalayas, surrounded by two expanding economies China and India. Five Indian states—Sikkim and West Bengal in the east, Bihar and Uttar Pradesh in the south and Uttaranchal Pradesh in the west—surround Nepal, while in the north, across the Himalayas, lies the Chinese Autonomous Region of Tibet. In terms of area, Nepal is about 21 times smaller than India, and about 65 times smaller than China with an area of about 147,000 square kilometers. With a projected population of about 27 million for 2007, Nepal ranked 40th in the world in terms of population. As seen in the map (Fig 3.1), there are three distinct ecological zones spreading north south—the mountain region, the hill region and the Tarai region (plains). The altitude ascends from about 75 meters mean sea level of the southern Gangetic plains to up to 8850 meters of the northern Himalayas within a stretch of less than 100 kilometers.

--Figure 3.1 about here--

Large parts of the country are hills and mountains with some very inaccessible areas. In some instances, settlements are located hours apart even within a Village Development Committee (VDC). The hills comprise 44% and the mountains 7% of the population. The Tarai region, which covers only about 16% of the country's area, houses about 49% of the population. Administratively, Nepal is divided in to five regions and 75 districts. Each district is divided in to VDCs and municipalities resulting to a total of 3912 VDCs and 58 municipalities. Each VDC is further divided to nine wards and each municipality to 9 to 34 wards. In general VDCs form the rural areas of the country, while municipalities form the urban.

The regions, called "development regions" are political aggregations of the districts and comprise all three ecological belts, namely the Mountains, Hills and Tarai. The regions from east to west are: Eastern Development Region (EDR), Central Development Region (CDR), Western Development Region (WDR), Mid-Western Development Region (MWDR) and Far Western Development Region (FWDR). Kathmandu, the capital falls in the Central region. In general, the mid-western region and far western region, which are furthest from the capital, are the least developed. Both these regions have a Human Development Index of 0.40. The other three regions have the HDI of about 0.49 (United Nations Development Program 2004). Nepal ranks 138th out of 177 in this index which is the lowest amongst the South Asian countries after Sri Lanka (93rd), India (126th), Pakistan (134th), Bhutan (135th) and Bangladesh (137th) (UNDP 2004).

Nepal presents a testable population for this research because of the wide variation in accessibility levels among the population. In addition it presents a testable population because it has witnessed a significant growth in its road density, associated accessibility, and school enrolments in its modern history. There also exist various forms of inequalities in outcomes based on locations (urban-rural, ecological belt, development region), caste/ethnicity, gender and class. We will discuss these variations in accessibility and school enrolment in Chapter IV and Chapter V respectively.

Primary Data

The primary data for this research comes from NLSS-II which provides household and individual level data for (i) 3912 nationally representative households and 20268 members residing in them for the year 2003/2004 and (ii) two wave panel data for 962 nationally representative households surveyed in 1995/1996 and in 2003/2004. NLSS defines (Central Bureau of Statistics 1995) a household as a group of people who have lived and eaten their meals together at least 6 of the past 12 months. Such persons are the household members. Exceptions to this who were also taken as household members are infants who are six months or less, newly married who have been living together for less than 6 months and persons living together for less than six months but expected to live in the household permanently. Servants, lodgers, farm-workers, and other individuals who lived and took meals with the household for 6 of the past 12 months have been counted as household members. However, those who lived for more than 6 months in the past one year, but who had died or permanently left the household were not considered as household members.

In addition the survey also provides community level data for 326 wards—an administrative subdivision of the village development committees (VDC) and municipalities—which are also the primary sampling units for this survey. These datasets were collected between April 2003 to April 2004 by Nepal's Central Bureau of Statistics with the support of, and following the well established World Bank Living Standard Measurement Survey (LSMS) methodology[1] which have been employed in 40 countries. LSMS surveys include multi-topic questionnaires that are designed to study multiple aspects of household welfare and behavior (Grosh and Glewwe 1996). The dataset was made public around mid-2005 by the Nepal Central Bureau of Statistics, and is also the most recent nationally representative multi-topic dataset available for Nepal.

Sampling in NLSS-II

Cross Section sample: As mentioned this survey uses a ward as the primary sampling unit (PSU), and a two-stage stratified sampling procedure to arrive at a nationally representative sample of households. The size of each ward measured in terms of number of households was used as a unit of sample frame. Based on the 2001 Population Census, wards with less than 20 households were appended to neighboring ones of the same VDC, while some larger wards were broken down to smaller units resulting in to a sample frame of 36067 primary sampling units (CBS 2004a).

In the first stage of the sampling, strata were determined based on two locational factors—rural/urban and the three ecological zones (Mountains, Hills and Tarai) resulting to six sampling strata—Mountains (M), Kathmandu Valley Urban (KVU), Hill Urban

[1] Gannon and Liu (1997) suggest making "expanded use of LSMS" to help the identification and evaluation of the transport needs of the poor and the impact of transport projects on the poor.

(HU), Hill Rural (HR), Tarai Urban (TU) and Tarai Rural (TR). The mountain belt is treated as one stratum, the hill belt divided to three strata—urban Kathmandu, other urban and rural, while the Tarai belt is divided to urban and rural. In this stage of the sampling, 334 PSUs (out of 36067) were selected from the six strata employing the probability proportional to size (PPS)[2] technique. In the second stage, 12 households each were selected from all the houses listed in each PSU employing the systematic random sampling[3] methods, resulting altogether in a sample of 4008 households. The final number of PSUs surveyed however reduced to 326 and the households to 3912 as 96 households in 8 PSUs could not be enumerated due to the unfavorable security situations arising out of the Maoist insurgency. These PSUs were all rural, 6 of which were from the hills and 2 from mountains. Development region wise, the loss was one PSU from the central region, 1 from the mid-western region and the other 6 from the far-western region. This is a loss of about 2.5 % of the sample. However with consultation of NLSS designers, dropping these PSUs was deemed acceptable (CBS, 2004a).

The share of PSUs and households by each stratum in the final sample is as follows: Mountains (384 households in 32 PSUs), Kathmandu Valley Urban (408 households in 34 PSUs), Hill Urban (336 households in 28 PSUs), Hill Rural (1152 households in 96 PSUs), Tarai Rural (408 households in 34 PSUs), Tarai Rural (1224 households in 102 PSUs). Locations of the sampled PSUs are shown in Figure 3.2.

--Figure 3.2 about here--

[2] A sampling method in which the probability of selecting a sampling unit (here a PSU) is proportional to the size (here the number of households) of the PSU.
[3] A method of sampling by which the first case from a list of the population is randomly selected and thereafter every *k*th case is selected (Healey 2002).

Cross sectional weights: The dataset also provides household weights for the cross-section sample. These weights are PSU-specific which means that they are constant for all households in a PSU. The household weight for any sample household tells us the number of households in the population represented by the sample household. By applying the weight in our statistical analysis we are taking the sample data and extrapolating the results to the population. The NLSS-II household weights for all households add up to 4,466,897 which is the estimated number of households in Nepal in 2003/04 (Bontch-Osmolovski 2006).

Household data

The household dataset consists of 18 modules—survey information, household information, housing, access to facilities, migration, food expenses and home production, non-food expenditures and inventory of durable goods, education, health, marriage and maternal history, wage employment, farming and livestock, non-agricultural enterprises/activities, credit and savings, remittances and transfers, other income, children away from home, adequacy of consumption and government services/ facilities, and panel sample household tracking. We have drawn our variables from four of the modules, namely household roster (module 1), housing information (module 2), access to facilities (module 3) and education (module 7). We have also used the panel sample household tracking file (module 18) to track the children from NLSS-I to NLSS-II. The designated respondents to the first three modules are the head of the household with best informed person as the substitute. For the education module, the designated respondent is all household members five or older, while for very young or absent members the substitutes were either the parent or the best informed person involved. A separate file on samples gave the household weights, stratum and location variables such as urban/rural, development region, ecological belt and stratum.

We have four sets of independent variables—locational, geographical accessibility, socio-economic accessibility and institutional accessibility. Our socio-economic accessibility variables pertaining to the child's individual and family level characteristics (age, sex, caste, number of children in household, number of married women in household, poverty level) are drawn from the household information module. The housing module provides two of our infrastructure variables, i.e., whether the household has electricity or water piped into the household. The access module provides us the measure for accessibility/isolation which is our principal independent variable. Finally the education module gives us our dependent variable which is whether the child is enrolled in school or not. This module also gives us the education level of the head of the household. In the following paragraphs we will discuss the access and education module in some detail, followed by the community module.

Access module: The access module of NLSS-II has information on households' accessibility to twelve different facilities. For each facility the survey asks the mode of transport, and the one way travel time (in days, hours and minutes) required to reach the nearest facility. Both the rounds of NLSS have asked the travel time (in days/hours/minutes) for 12 facilities, namely, primary school, health facility (health post/hospital), bus stop, paved road, vehicle passable dirt road, vehicle impassable dirt road, local shop, *haat* bazaar (periodically organized local, traditional markets), market center, agricultural centre, cooperative (*sajha*) and bank. NLSS-II has information for three additional facilities—drinking water, post office and telephone.

Travel time has been measured as *one way travel time* to reach the facility closest to the household. If there is more than one facility, time taken to reach the most commonly used facility by the household members has been considered. Each household also reports the *mode of transport* in terms of whether the mode is foot without load (i.e., walking), bicycle/rickshaw (non-motorized two/three wheelers), motorcycle/tampoo (motorized two/three wheelers), mixed (foot + motorized), car/bus (motorized), present next to household, and not applicable. When the facility is present "next to household", time to reach such facility is recorded as zero. Annex 3.1 includes the household access module as employed by NLSS-II.

Education Module: The education module enumerates data on the literacy level of each household member five years and over, specifically if the member can read a letter, write a letter and where—school, home, other courses—one learnt to do so. It then divides the household members to three categories—who never attended school, who attended in the past and who are currently attending school. For those who never attended school, it asks the reason for not doing so. For past enrollees it collects information on type (private/government) of school, highest grade completed, years required to complete primary education if completed that level, years required to complete School Leaving Certificate exams (secondary school) if completed secondary level, and reasons for leaving school/college. Finally the survey collects information on children who are currently enrolled, defined as those currently attending school/college. Information collected are type of school, current grade, years required to complete primary education if completed that level, years required to complete School Leaving Certificate exams (secondary school) if completed secondary level, mode of transport to school, time spent in commuting to school, expenditure in the schooling in the past one year, whether the child received scholarship, and the amount of scholarship if received one. Annex 3.2 includes the household education module (literacy) as employed by NLSS-II.

Community module

The community dataset is separate for rural and urban communities. The rural has 8 modules-population characteristics and infrastructure, access to facilities, agriculture and forestry, migration, development programs, user groups and quality of life, primary school, rural health facilities, and markets and prices. The urban dataset is limited to four modules—population characteristics and infrastructure, access to facilities, quality of life, and markets and prices. The community module, particularly the rural, provides us with several primary school and some post-primary school level variables that allow us to measure the quality and availability of schools. We make use of two modules of the community survey—access to education facilities (module 2) which provides us with the distance to secondary school and rural primary school (module 6) which allows us to measure infrastructural and other quality dimensions of the rural primary school. The designated respondents to the community questionnaires are the leaders and knowledgeable persons representing the community of the primary sampling unit. Annex 3.3 includes the community module for access to schools, and for rural primary school as employed by NLSS-II.

Conflict dataset

Apart from the NLSS-II data, this research also utilizes the conflict dataset maintained by Informal Sector Service Centre (INSEC), a Kathmandu based human rights organization monitoring the violent internal conflict in Nepal. This dataset compiles district-level data on displacement, fatalities and abduction related to the Maoist insurgency from the beginning of the insurgency in 1996. We use the fatality figures between 1996, the start year of the insurgency, and 2003, the year when NLSS-II enumeration was carried out, to measure the scale of conflict.

Following this overview of the datasets and the modules therein, we will next discuss the specific variables that are employed in this research for the cross sectional analysis of the NLSS-II data *vis. a vis.* our research question—that is how geographical accessibility impacts school enrolment. We will discuss the construction of the variables for the analysis of the panel data separately in Chapter VIII. We will first discuss variables used to measure geographical accessibility, our main independent variable, followed by the outcome variable which is whether the child is enrolled in school or not. Thereafter we will discuss the variables for measuring the location, socio-economic accessibility and institutional accessibility pertaining to the child.

Variables

Main independent variable: Geographical accessibility

We use the following two measures of accessibility: (i) One way travel time required by an adult (without load) to reach the closest vehicle passable dirt road in the dry season using the household's most often used mode of travel. The dirt road as enumerated is a "road through which a tractor passes at least in one season." This is equivalent to the category "seasonal road" often employed in the roads/transport literature. Where the road nearest to the house is paved, or a paved and dirt road are at the same distance, the mode of travel has been coded as "not applicable" (CBS 1995) for dirt roads, in which case we have given the value of reported distance to paved road as the measure of accessibility. For about 22% of sample households in NLSS-II, the mode of travel to the nearest road is coded as "not applicable". 17% points of such households are located by paved road. Thus, although we name this variable distance to dirt road, it is essentially the distance to any road from the household that we are measuring. (ii) One way travel time required by an adult to reach the closest paved road using the most often used mode of travel. If roads are present next to household, then time taken is coded as "not applicable". We assume this "not applicable" category as zero minutes by foot mode (CBS 1995). We have converted the days/hours/minutes measure to hours with the assumption that 1 day of walk is equivalent to 8 hours of walk. While we will use the hour-continuous form of this variable to test our models, we will also use two other functional forms—minutes-logged and categorical dummies to test the robustness of distance as a measure of accessibility.

Both the variables—distance to paved road and distance to dirt road—correlate with each other in the order of over +0.9 (Table 4.15). The high correlation is partly because we assigned the same value for both dirt road and paved road accessibility when there is a paved road nearer or together with a paved road. However, as discussed in the previous chapter, given the differing political economy of these two kinds of roads, we will estimate our regression models using both the variables separately. This will allow us to appreciate the impact of both kinds of roads on our outcome variable, and to measure the robustness of these indicators in measuring accessibility. There is also the distance to bus stop variable, which correlates with the other two variables at the order of 0.9+. Although this measure appears as a good indicator of operability of available roads, it has some definitional problems. Buses in rural (for that matter even in urban) Nepal may stop anywhere along one particular road. Besides, not having a bus stop nearby does not necessarily mean other vehicles do not ply on the roads, if available.

Limitations: The use of reported time as an accessibility measure can be critiqued on two grounds. One, it may be questioned to why not use distance in actual kilometers instead of estimates of time required to reach the roads. For an overwhelmingly hilly country like Nepal "collecting data on actual distance, even using satellite telemetry" would be of little value (Jacoby 2000). In Nepal households are well scattered within a village, and the terrain and altitude vary greatly within a few hundred meters of a horizontal distance. This makes it difficult to estimate distance in kilometers. Moreover, in the hills and mountainous regions, a half kilometer uphill to a road is much "further" than half a kilometer along a level path to that road. These considerations make it more sensible to estimate the distance in terms of the time taken.

The second issue is that distance measured in terms of different modes is potentially endogenous (Jacoby 2000) given that travel time is dependent on the mode of transport. Jacoby (2000) in an analysis using NLSS-I data, takes the measure of travel time the median of travel times by 'wards' (also the primary sampling units) based on households that report travel times by foot, a mode reported by a majority of households.

Napaporn, Hermalin, and Knodel (1984) who study access to family planning have also argued that reliance on community-level indicators of accessibility is more advantageous over individual responses because perceived times are in part determined by the history of use or the experience with the service is likely to affect reported distances or times. Yet Mroz, Bollen, Speizer and Dominic (1999) find that use of community measures with disregard to household variation may be why family planning programs sometimes have small effects on family planning use when individual-level factors are included in the same model.

Jacoby (2000) further argues that this procedure to measure time standardizes travel times for mode of transport and mitigates measurement error likely to be present in household level reporting of travel times. While this may be a sensible strategy for a PSU level analysis, for household or individual level analysis the procedure loses household level information that in Nepal some households can be much further from a road than other households in the same PSU. Table 3.1 presents an example of how the time taken to reach a seasonal road can vary within a ward connected by a seasonal road in the three ecological belts Mountain, Hill, and Tarai respectively. The range of travel time has been reported as 0-60, 0-45 and 0-20 minutes respectively.

--Table 3.1 about here--

This dissertation will rely mostly on the household level measure reported in the survey. In the panel analysis, when we make estimates at the PSU level, we will construct PSU level measures of accessibility. The mode of travel time to dirt roads is almost universally (over 99.4%) by foot, hence the issue of endogeneity is not a major problem for dirt road accessibility. For our regressions using the dirt road accessibility we take the sample that uses foot mode only. In the case of paved roads only about 60% of the households report foot mode for their travel. Thus in the regressions using paved roads as an accessibility measure we will control for the mode of transport using dummy variables for whether the mode is by foot or by cycle, by mixed mode or by some motorized means.

Despite these potential limitations, measuring geographical accessibility at the household level has several distinct advantages. One, although this is a distance measure to road infrastructure, it is a good proxy of the capacity of road transport system to offer mobility to rural people. In many developing countries, without road access we cannot expect to improve geographical accessibility. Two, it is important for us to define accessibility in a way that allows measuring change in accessibility over time. Dichotomous measures such as whether a village was connected or not do not capture change adequately. Unlike the impacts of other infrastructure sectors such as water supply and energy, in which accessibility can be reported dichotomously as yes or no, it does not make as much sense to report access to roads in this manner. Three, this measure avoids the general assumption that all households within a primary sampling unit are located at the same distance from transport infrastructures, and so allows the researcher to capture how transport accessibility relates to specific household characteristics.

Nepal's overall accessibility rate is very poor with a mean household distance of 2 hours 11 minutes to dirt roads and 4 hours 8 minutes to paved roads. Undoubtedly there is a tremendous variation in accessibility in Nepal by household characteristics and locations. In chapter IV we will present a detailed profile of such variation.

Outcome Variable: Enrolment

The outcome variable of this research is a binary variable—whether the child was enrolled at the time of survey—defined in the survey as those currently attending school—or not. The education module (literacy) of the survey (Annex 3.2), which has collected information on all household members older than five years, gives us our outcome variable. In Nepal the specified age groups for grades 1 to 12 are 6 to 17 respectively. In this research, we extend the age group under study to 19 so as to incorporate delayed enrolment which appears pervasive in Nepal. About 80% of the children enrolled in grade 12, and 49% enrolled in grade 1 are older than the specified age for those grades.

We study enrolments in two age groups—6 to 12 and 13 to 19. According to the estimates based on our dataset, 79% of children of age group 6 to 12 are attending school in Nepal. The net primary enrolment rate in Nepal ranks well in South Asia. Rates are higher than India, Bangladesh and Pakistan but lower than that of Sri Lanka (The World Bank 2006). The enrolment rate for the age group 13 to 19 is 56%. There is considerable variation in enrolment by geographical accessibility and the other independent variables—location, and socio-economic and institutional characteristics—which we will discuss in detail later in Chapter V when we look at the impact of roads on enrolment. Next we discuss in sequence how we measure these independent variables from our dataset and how the sample is distributed in our dataset.

Other Independent variables

Age: Altogether 3741 of the children fall in the age group 6 to 12 and 3082 in the age group 13 to 19. This gives us a total sample size of 6823 cases from the 3912 households. Although students falling under these age groups are closer to be going to primary and secondary schools respectively, they are not strictly so. Obviously there are some children from the 13 to 19 age group going to primary school and a few from the younger groups going to secondary. Thus, essentially, we are looking at enrolments irrespective of the grade the child is attending. However we will frequently refer to the age group 6-12 as primary aged, and 13-19 as secondary aged throughout this research.

--Table 3.2 about here--

Sex: About 47.5% of our total sample is male, and 52.5% female. For the age group 6-12 the female share is lower at 48%, while for the age group 13-19 the female share is 52%.

Independent Variables: Location

There are three location characteristics- urban/rural, ecological belt and development region—that characterize the horizontal differences in geographical accessibility as well as development outcomes in Nepal. The urban/rural and ecological belts are captured by the *stratum* variable, used as the sampling strata in NLSS-II. Six strata—mountains, Kathmandu Valley urban, urban hills, rural hills, urban Tarai (plains) and rural Tarai have been used. We include dummies for each stratum as well as for each development region in our models so as to capture the huge geo-political and geo-cultural diversities that can be found in Nepal across these ecological belts, urban-rural locale and development regions. About 16 % of our weighted sample households are from urban areas and 84 % from rural. 7 % are from the mountains, 45 % from the hills and close to 48 % from the Tarai. In terms of stratum, mountains have 7 %, Kathmandu Valley Urban has 6 %, Hill Urban has 4 %, Hill Rural has 36 %, Tarai Urban has 7 % and Tarai Rural has 41 % of the sample households. Similarly in terms of development regions, Eastern region has 25%, Central has 36 %, Western 21 %, Mid-Western 12 % and Far Western has 7 %.

Independent variables: Socio-economic

Caste-ethnic group: Caste and ethnicity may be a strong determinant of achieving human capital while it may also be associated with accessibility. There are altogether 102 caste and ethnic groups listed in NLSS-II. In this paper I divide the 102 caste/ethnicity groups to seven major groups capturing the caste/ethnicity, religion and linguistic variation amongst these groups. I have used a number of sources for this categorization, namely publications by Dahal, Gurung, Acharya, Hemchuri and Swarnakar (2002), Gurung (1998), National Foundation for Indigenous Nationalities (2007), Nepal Rajpatra (Government of Nepal 2002b) and Rastriya Janajati Bikas Samiti (2007). My groups are—Chettris, Bahuns (also called Brahmans), *Adivasi Janajatis* (Indigenous nationalities), Dalits, Newars, Muslim and Other Caste.

The caste hierarchy prevalent in Nepal, the only Hindu state until 2006, is not different from that of India. Chettris and Bahuns are the two high caste groups. The official Indian classification of Scheduled Caste is equivalent to the official Nepali classification of Dalits. However it is difficult to equate the Indian classification of

Scheduled Tribe to the Nepali classification of Indigenous Nationalities, because of the different mixture of indigenous groups in these two countries. Most analyses in Nepal tend to lump Brahmin and Chettris together, and my separation of the latter from this social group is an attempt to understand the large variation that may be present amongst these two high caste Hindu groups in terms of accessibility. The category Other Caste includes caste/ethnicity groups that could still not be clearly categorized as any of the others. Most of these Other Castes are clearly from the Tarai within the Hindu system, and also includes some very minority cultural groups such as Bengalis, Sikhs and Christians (less than 1%). Counting the caste/ethnicity in terms of the household head's caste/ethnicity, we find that Chettris constitute 17%, Brahmins 15%, the Nationalities 32%, Dalits 12%, Newars 8%, Muslims 5% and Other Castes 12% of hour households. We use seven caste group dummies for our regression analysis. Table 3.3 gives the details of the categorization.

--Table 3.4 about here--

Household welfare and poverty: Inaccessible areas are characterized by higher degree of poverty while poverty itself may be a hindrance to school enrolment. I use the household per capita expenditure (consumption) per annum as the variable for my measure of household welfare, a variable computed by Nepal Central Bureau of Statistics using aggregation methodologies based on guidelines provided in Deaton and Zaidi (2002) (CBS 2005). Annual household expenditure was computed as the sum of food consumption and non-food expenses of the past 12 months. Non-food expenditure includes expenditures on education, consumption of durable goods, consumption of housing and consumption of utilities, tobacco consumption and selected non-food expenditures (CBS 2004a, CBS 2004b). The Bureau of statistics has also computed price indices for regional level differences in cost of living allowing us to compute adjusted real per capita expenditure for both NLSS-I and NLSS-II. For 2003/2004, the poorest 20% of the households had a real per capita expenditure mean of Nepali Rs. 3524 (approx US $ 54 at 2007/6/22 exchange rate), while the richest quintile had NRs. 25,387 ($391). The average was NRs. 10318 ($159) (CBS 2005:6).

For most of my regressions, I use the log continuous form of the real per capita expenditure. When testing interaction effects of accessibility and welfare, I use the poor/non-poor dummy variable, which distinguishes a household as poor if the household had an annual per capita expenditure level below the poverty line of NRs. 7696 or $118 (CBS 2005:56). As of 2003/2004, 26% of the sample households are poor by this measure. I also use the welfare quintile variables to describe how accessibility and enrolment vary across different welfare groups.

Education level: Like poverty, low level of education can be found in inaccessible areas, and also affects intergenerational transfer of education. We take the education level completed by the head of the household as a measure of educational stratification amongst the households. We have assigned values equivalent to grade 3 for those who have had non-formal education, and also to those who can only read a letter. Given the difficult transition through the SLC for most Nepali, a national board exam at the end of grade 10, we have assigned the education level of SLC passers as 11. For our bivariate tables, we have constructed four education categories—illiterate, primary, secondary, SLC or beyond. Amongst the household heads, 48% are illiterate, 27% are educated up to the primary level, 15% up to class ten and the remaining 10% have a SLC or more.

Family structure: Variables *number of children in the family*, and *number of married female* provide measures of the family structure that might affect children's likelihood of enrolment. It is commonly found that enrolment rates decrease with sibling size in the household. More number of married women in a household means the family is extended. Having extended families may mitigate the sibling size effect. We have counted all members of the household nineteen and under as children, and all female in the household who are currently married, divorced, separated and widows as married. We use both these variables in the continuous form. 47% of the households had two or less children in the households while 53% had more than two. Similarly 59% households had one married female in the household compared to 39% which had more than one.

Enabling services: Variables *electricity* and *water* measure whether the household's lighting source is electricity or not and whether the household has water piped inside the house or not. Consumption items such as electricity and water may have direct effects on the likelihood of enrolment because they reduce children's work burden and increase light hours for doing school work. 63% of the households were electrified, and 14% had water piped inside their house. We use dummies for both these variables.

Maoist insurgency: There are some chances that the Maoist related conflict might have influenced enrolment chances of children, while the conflict itself originated in inaccessible areas. The conflict variable that I have created is based on the total number of war related fatalities from February 1996, the time when the Maoist insurgency began through the seventh year (February 2003), just before the time of the NLSS-II survey.

These figures are district levels so are applied to all households in the district are assigned the same value. I have ranked the intensity of conflict in the district as low (less than 25 fatalities), medium (25 to 100 fatalities) and intense (more than 100 fatalities). Based on the measure, 17 of the districts appear to have been severely affected during 1996-2003 which are Sindhuli, Gorakha , Lamjung, Arghakhanchi, Rolpa, Rukum, Salyan, Dang, Banke, Bardiya, Surkhet, Jajarkot, Jumla, Kalikot, Achham, Kailali and Kanchanpur. There is a mix of accessible and inaccessible districts, but all except four are from the remoter Mid Western and Far Western region. Similarly 19 of the districts appear to be minimally affected until that period which are Jhapa, Sunsari, Dhankuta, Bhojpur, Dhanusha, Mahottari, Lalitpur, Bhaktapur, Kathmandu, Rasuwa, Makawanpur, Bara, Parsa, Kaski, Manang, Mustang, Rupandehi, Kapilvastu and Humla. Most of these districts are accessible Tarai or Kathmandu Valley districts.

Independent variables: Institutional

We have argued that much of the benefits of roads are derived through improved accessibility to institutions (schools) that provide the services and resources necessary to obtain our outcomes of interest (enrolment). We measure these variables using two dimensions of the institutions—availability and quality.

Primary school availability: For our analysis of the children of the age group 6 to 12, we use the one way distance (reported in hours/ minutes) from the household to the nearest primary school. We construct a dummy variable for walking distances to primary—those within 30 minutes and those walking more than 30 minutes. The distance to primary school is obtained from the household level access module. Only less than 10% of the households are located further than 30 minutes from a primary school.

Secondary school availability: The household module does not enumerate distance to secondary school, so we obtain this from the community module which asks if there is a secondary school in the NLSS-II primary sampling unit (ward), and if not enumerates the distance to the school from the center of the ward. For rural ward, if the school is located in the ward, we assume the distance to be less than 30 minutes. Since urban wards do not have this data, we assume the distance to secondary school as 30 minutes or less for an urban ward. We construct a dummy for this variable as well—if the child is located in a community which has a secondary school within 30 minutes' distance from its center. Our dataset shows that 38% of the households are located in communities that have the nearest secondary school more than 30 minutes away from the center of the ward they live in.

School quality: For the rural sample we use the following three school quality variables:

--Table 3.5 about here--

Rural primary school infrastructural quality: We construct a 0 to 10 quality index based on condition/availability of 10 of the following infrastructure and facilities in the primary school that serves the household. For all items we create a 0/1 dummy and add them up as follows: Main construction material of outside wall (cement bonded, concrete and other permanent=1, mud bonded, unbaked bricks, wood/branches =0), Main flooring material (wood, stone, brick, cement, tile=1, earth=0), window fittings (shutters, screen, glass=1, no windows, no covering=0), usable blackboards (yes=1, no=0), electricity (yes=1, no=0), teachers' toilet (yes=1, no=0), boys' toilet (yes=1, no=0), girls' toilet (yes=1, no=0), chairs (for all students=1, for some and none=0) and desks (for all students=1, for some and none=0). Our computed scale has a moderately high Cronbach's alpha reliability coefficient of 0.69.

The mean score of this scale for the rural sample is 5.1 and the median is 5. 8% of the schools rate 8 or more on the scale, but 16% of the school rate 2 or lower on this scale. 40% of the schools rate between 3 to 5 and 36% between 6 to 8.

Unscheduled closure: We also measure the extent to which schools closed for unscheduled reasons. We create a dummy variable for schools that closed for more than 17 days in the 12 moths preceding the survey across rural Nepal, which is the mean number of days schools closed. About 20% of the schools closed for more than 17 days in the past one year of the survey.

Teacher availability: We create a dummy variable for if schools had teachers as per sanctioned. 21% of the primary schools did not have the number of sanctioned teachers in the school at the time of survey. However this variable may not be the best proxy to measure teacher absence which we suspect to be concentrated more in remoter areas, and also to affect enrolment. At the first place we are not certain if the number sanctioned itself is a sufficient number of teachers for the school, and second, it does not indicate the degree of absence.

The school quality variables that we have used are measuring more of the schooling climate in the household's local area, rather than the quality of the school the child attends. The primary school quality and secondary school availability variables are measured at the PSU (ward) level, so all children in the PSU will be assigned the same value. Also our variables—time to primary school, primary school quality index, primary school unscheduled closure and primary school teacher availability—do not strictly correspond to our 6 to 12 aged sample just as secondary school availability not to the 13 to 19 sample because of under-age and over-age enrolment. Moreover, because we have no information from the dataset to measure secondary school quality, we use the primary school quality variables as proxies when we analyze the 13 to 19 age group. Perhaps the relationship would be stronger if we could match the exactly appropriate school quality/distance to each child. However it is reasonable to assume that (a) primary school quality/accessibility is a good proxy for secondary school quality/accessibility and (b) that inaccessible/low quality primary schools will have their own detrimental impact on secondary school enrolment.

Statistical Analysis

We will assess the effects of accessibility on school enrolment through a series of regressions modeling the effect of accessibility/isolation on school enrolment. We estimate models separately for two groups—for children aged 6-12 and for those aged 13-19. For each group we first estimate a simple bivariate model with only distance to roads as the regressor variable (Model I). We then estimate the model with controls for locational factors (Model II) to assess if locational characteristics of the households are offsetting or compensating any of the accessibility effects on school enrolment. Because they are causally prior to both accessibility as well as enrolments, we will always control them in our regression models. We then control socio-economic factors relevant to the child and his/her household (Model III) to assess the direct effects of inaccessibility separate from the indirect effects that are mediated through poverty and other social factors. In the fourth model, we add the institutional control of school availability (Model IV) to what extent availability of school mediates the accessibility-enrolment relationships. For children residing in rural areas, we estimate a fifth model in which we include additional institutional controls that reflect the quality of the closest rural primary school (Model V) again to assess the extent to which school quality mediates the relationship. We will discuss the changes in the accessibility-enrolment association across each model by comparing the strength and direction of the accessibility coefficients. This would allow us to appreciate the potential channels through which isolation may affect household decisions. The successive models look like follows:

$Y= \alpha + \beta_G (G) + \varepsilon$ .... Model (1)

$Y= \alpha + \beta_G G + \sum\beta_L L + \varepsilon$ .... Model (2)

$Y= \alpha + \beta_G G + \sum\beta_L L + \sum\beta_S S + \varepsilon$ .... Model (3)

$Y= \alpha + \beta_G (G) + \sum\beta_L L + \sum\beta_S S + \beta_I (I) + \varepsilon$ .... Model (4)

$Y= \alpha + \beta_G (G) + \sum\beta_L L + \sum\beta_S S + \beta_I (I) + \beta_Q (Q) + \varepsilon$ .... Model (5)

Where, Y= Probability of the child being enrolled in school, G= Geographical accessibility, L= Locational characteristics, S= Socio-economic characteristics and I= Availability of institutions and Q=Quality of institutions associated with the child.

Differential impact of geographical accessibility- gender, poverty: Geographical accessibility is expected not only to break institutional barriers, but also some of the socio-economic barriers faced by households. In other words, where geographical accessibility is better, the differences in school enrolment (such as by gender, by welfare groups) is also expected to be less pronounced. This effect is an interaction implying that better geographical accessibility has the potential of helping the disadvantaged groups especially. While everybody benefits, *girls* and the *poor* become more "able" in obtaining enrolment since they are the most excluded groups. Thus our research interest here is to figure out if the level of households' geographical accessibility affects outcomes differentially based on gender or welfare level. In order to answer these questions, we introduce an interaction term between geographical accessibility and gender:

$$Y= \alpha + \beta_G (G) + \sum\beta_L L + \sum\beta_S S + \beta_I (I) + \beta_Q (Q) + \beta_{GB} (G^*boy) + \varepsilon \qquad \text{.....Model (6)}$$

and also between accessibility and poverty:

$$Y= \alpha + \beta_G (G) + \sum\beta_L L + \sum\beta_S S + \beta_I (I) + \beta_Q (Q) + \beta_{GP} (G^*poor) + \varepsilon \qquad \text{... Model (7)}$$

In the above models, the coefficient of the interaction term gives the magnitude and sign of the interaction effect. If the estimated coefficients β_{GB} is negative, we interpret them as better geographical accessibility especially enabling girls in school enrolment. If the estimated coefficients β_{GP} is positive, we interpret them as better geographical accessibility especially benefiting the poor.

Unit of Analysis: The outcome variables of this research are individual level variables, and our unit of analysis in this respect is the child. Some of our regressor variables are strictly at the individual level (e.g., age and sex), others are at the household level (e.g., caste of head of household, geographic accessibility, location, poverty level, number of school-age children, number of married female in the household), and still others are at the community or higher level (e.g., availability of school in the community, quality of school and conflict).

Data clustering: Also the two stage stratified random sampling approach of NLSS-II where households have been selected within wards (PSUs) results in data clustering at the PSU level which means that observations share similarities that violate the assumption of independent observations (Long and Freese 2006). It is reasonable to assume that the observations within the groups, which are known as clusters, are not independent. With clustering, the usual standard errors will be incorrect. This requires us to make appropriate corrections for stratification and clustering. Such an adjustment ensures that the standard errors of the estimated coefficients are computed correctly or the variance of the estimate is not inflated.

The software STATA which we use for our analysis provides a set of commands designed specifically for the purpose of analyzing survey data of this nature. In order to make adjustments in all estimates for clustering at the PSU level, we first use the *svyset* command to set the variable used for stratification, the variable representing the PSU and the variable representing the household weight, and run analysis using the *svy* command. The variance estimator used by the *svy* commands allows any amount of correlation or clustering within the primary sampling units and this method of only accounting explicitly for the primary sampling units is a standard one in survey statistics (Sribney 1998). Regressions carried out in this manner yields exactly the same coefficients and almost the same standard errors as obtained by using the *cluster* option.

Further to the data clustering at the PSU level, there is clustering at the household level as well. In each age group, we have more than one child who are eligible for attending school. Amongst the age group 6-12, we have 3741 eligible children who come from 2147 households. Amongst the age group 13-19, the 3082 eligible children come from 1917 households (see Table 3.6). This means that we will also require adjustments of the standard errors in the regressions because of data clustering at the household level. In order to test the robustness of our results to both the PSU and household clustering effects, we will conduct regressions in the following two additional ways and compare the accessibility coefficients across our models: (i) Replacing household weight by a new weight obtained by dividing the household weight by the number of children in the respective age group. In doing this we are distributing the household weight amongst the eligible children within the household, such that all children in the household are represented as if they were one child; (ii) Perform regressions on a sample that randomly retains one child per household. In doing this we will replace the household weight by the individual weight which is obtained by multiplying the household weight by the household size. This option however would mean losing the information for 43% of the primary aged sample and 38% of the secondary aged sample. Both these methods are conservative methods of dealing with household clustering problem, that is, they overcorrect for clustering within households and lose too much information in the process.

Logistic regression

Because our outcome variable—whether enrolled in school or not enrolled in school—is categorical, its relationship with the independent variables becomes non linear (Long and Freese 2006). This means that we cannot model school enrolment as a linear function of the independent variables. The coefficients β_G, β_L, β_S, β_I, β_Q cannot capture the marginal impacts of the corresponding right hand side variable on the probability of the outcome as they would have done for linear regression models. For binary categorical dependent variable such as enrolled or not-enrolled, we require to use a non-linear *logistic* function of the explanatory variables (Long and Freese 2006) to model the probability of the outcome. When the binary logistic function is used the probability of a child being enrolled, based on Model V, will be equal to:

$$\frac{e^{(\alpha + \beta_G G + \sum\beta_L L + \sum\beta_S S + \beta_I I + \beta_Q Q)}}{1+e^{(\alpha + \beta_G G + \sum\beta_L L + \sum\beta_S S + \beta_I I + \beta_Q Q)}}$$

This equation ensures that the probability that the child is enrolled in school is always between 0 and 1. In this type of regression, the slope coefficients are estimated using the Maximum Likelihood method. Because the model is nonlinear, the effect of change in any one independent variable on the outcome variable depends on the levels of all independent variables (Long and Freese 2006:131). Thus, we conduct a series of binary logistic regressions, with appropriate adjustments made for clustering at the PSU level, to model the effect of accessibility/isolation on school enrolment.

Multi-collinearity issues: A very high collinearity between our independent variables would limit our ability to determine which independent variable is producing the effect on our outcome variable. Thus we check the degree of multi-collinearity between our independent variables by computing the Variance Inflation Factors (VIF) for each independent variable. VIF for each variable is equivalent to the reciprocal of (1-R squared), where R is the correlation coefficient of the variable with other independent variables. The VIF for each variable shows how much the variance of the coefficient estimate is being inflated because of multi-collinearity. For example, a variable correlated at 0.95 would produce a VIF of 20, whereas a zero correlation would produce a VIF of 1. The square root of the VIF informs us how large the standard error of a variable would be compared to an ideal case scenario if that variable were uncorrelated with other independent variables in our model. As shown in Table 3.6 and 3.7, in our case most VIFs are 2.5 or less. Only one is about 5. Chen, Ender, Mitchell and Wells (2003) suggest that as a rule of thumb, a variable whose VIF values are greater than 10 may merit further investigation.

--Table 3.7 about here--

--Table 3.8 about here--

The VIF for dirt road accessibility is 1.48 in the primary aged group and 1.40 in the secondary aged group. When paved road accessibility is also added in the model, VIF for each of them increases by four to five folds, indicating that a high degree of multi-collinearity exists between the two accessibility measures.

Panel analysis using survey data

The cross-sectional regression models we have discussed are for how differences in geographical accessibility among households may affect school enrolment at one point in time, i.e., during 2003/2004. NLSS also has a sample of 962 households that were interviewed both in 1995/1996 and 2003/2004 using similar modules, potentially allowing us to analyze the relationship between change in accessibility within households (ΔG) and change in enrolment (ΔY) over 8 years. We discuss the sampling, modules, data, models and measurement for the panel analysis in Chapter VIII where we analyze the panel data.

Qualitative insights

Although my primary method of analysis in this research is statistical, I also draw from the qualitative insights I gained during my visits to two villages in Central and Western Nepal and to Kathmandu. Approval from the Institutional Review Board of University of Maryland was obtained to interact with subjects on June 9, 2006 as Protocol Number 06-0307.

During July of 2006, I visited Malyangkot Village Development Committee (VDC) in Syangja district of Western Nepal on the Mirdi-Jagatbhanjyang-Chapakot road, and Sunaulabazaar VDC in Dhading district of Central Nepal on the Dhadingbesi-Sunaula Bazaar road. Both these roads were seasonal. In these villages I carried 'rapid assessments' based on observations and 'natural conversations' (Agar 1995) with people from different walks of life in the native language. In both villages, I took the help of local development workers who were familiar with the villages.

During my visits, I spoke with villagers who lived by the roads and off the road as I met them in their natural state while traversing the villages. I spoke with drivers who drove on the roads, fellow passengers who conversed with each other and were curious to figure out each other's journey purpose, shopkeepers, students on their way to school, school teachers, and NGO workers. No formal appointments were involved in any of these interviews, and interviews were conducted without control or structure. However these informal conversations were held with purpose, wherever possible focusing on the travel experience of the respondents and the effect of roads. My observations and conversations focused on the frequency and reliability of transport infrastructure, condition of roads, goods transported, use of roads and the kind of passengers who used the transport facilities. For example, my conversation with a driver focused on the type of passengers (students, sick persons, delivery cases), and the goods he carried in and out of the villages. My conversation with teachers focused around the effect of roads on them and the schools. My conversation with villagers focused around the effect of roads on their villages, change in transport cost, etc.

While no notes were taken during the course of the conversations, the researcher recalled conversations made or heard during the day after the conversations were held. Insights gained from these ‘informal interviewing’ (Agar 1995) allowed the researcher an opportunity to validate the conceptual framework and models.

I also interacted with several rural transport professionals in Kathmandu representing the government and non-government organization. I collected published secondary data on education and roads, and also the NLSS-II community data from the Central Bureau of Statistics. I participated in a workshop “A GIS-based Approach to Rural Accessibility and Road Network Development” (July 25, 2007) organized by the Department of Roads of Government of Nepal. In this workshop, professionals engaged in the field of rural accessibility in Nepal discussed amongst others a Geographic Information Systems based methodology to measure rural accessibility, the use of accessibility data for future road expansion, and the need to incorporate lower quality local roads while estimating rural access.

I have used the insights I have obtained during the course of my field visit to support and assess the results of my statistical research in appropriate sections in the remainder of this dissertation. In the next chapter we will examine the overall accessibility profile of Nepal based mainly on NLSS-II.

Figure 3.1: Nepal topography and road access

(Source: United Nations OCHA, United Nations, Nepal) (Source: www.bbc.com)

Figure 3.2: Locations of the sampled Primary Sampling Units for NLSS-II, 2003/2004
(Source: Central Bureau of Statistics 2004a)

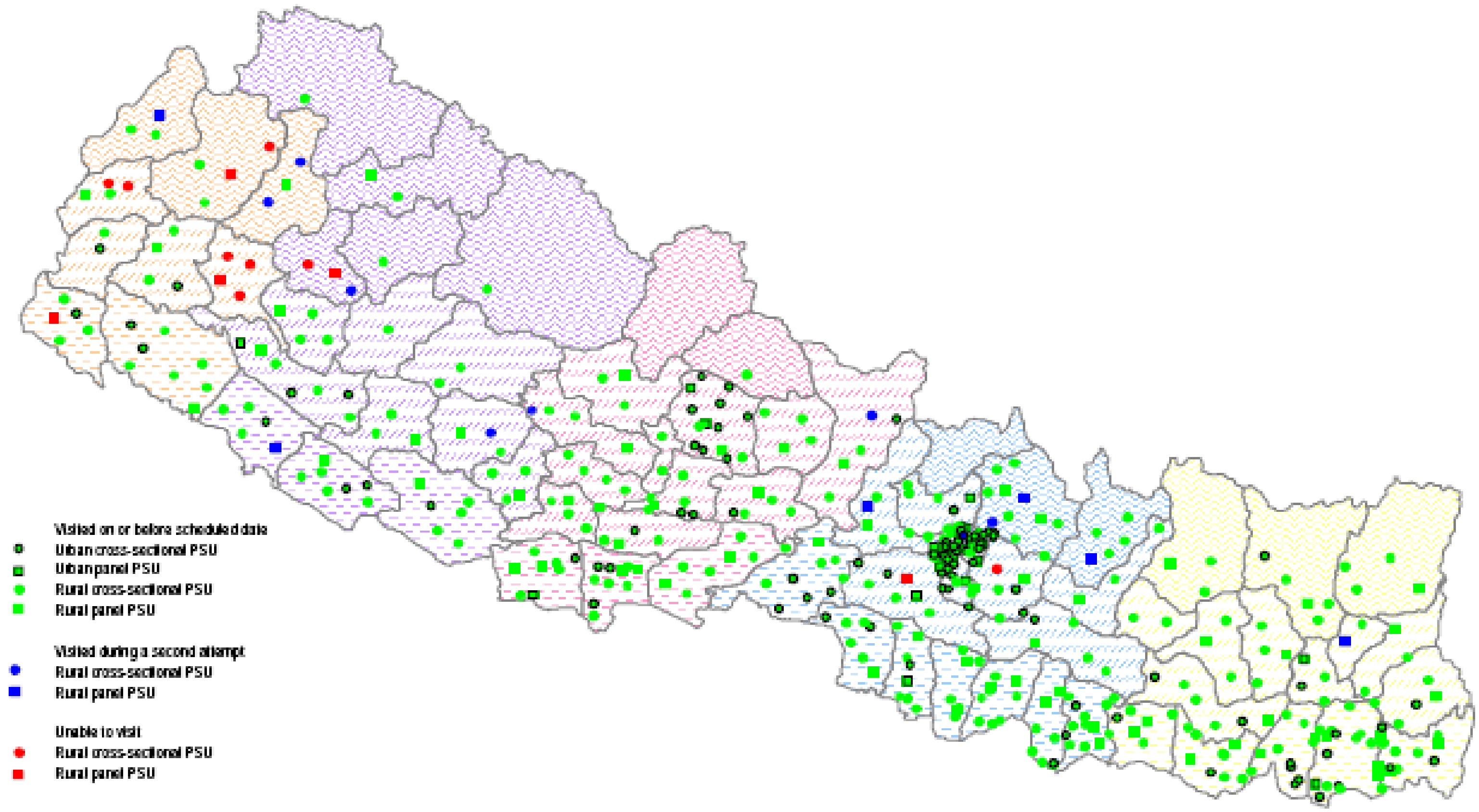


Table 3.1. Variation in time taken to reach the nearest dirt road

Time Taken (minutes)	Number of households (District/ Belt/ PSU No.)		
	Dolakha/Mountain/620	Salyan/Hill/502	Rautahat/Tarai/510
0	1	4	3
5	-	1	-
10	1	3	3
15	2	-	-
20	2	-	6
30	2	3	-
45	1	1	-
60	3	-	-
Range	0-60	0-45	0-20
Mean	30	15	13
Median	25	10	15

Table 3.2. Mean, standard deviation, maximum and minimum values of individual level independent variables

Variables	N	Mean	Std. Dev.	Minimum	Maximum
Enrolled					
6-12	3741	0.79	0.40	0	1
13-19	3082	0.56	0.50	0	1
Sex					
Male	17726	0.47	0.50	0	1
6-12 boys	3741	0.52	0.50	0	1
13-19 boys	3082	0.48	0.50	0	1
Age					
All	17726	28	19	5	99
6-12	3741	9	2	6	12
13-19	3082	16	2	13	19

Table 3.3. Mean, standard deviation, maximum and minimum values of household level independent variables

Variables	Mean	Std. Dev.	Minimum	Maximum
	N=3912			
Distance to roads				
Distance to dirt road (minutes)	131	386	0	4320
Distance to paved road (minutes)	248	488	0	4800
Urban/ Rural				
Rural	0.84	0.37	0	1
Urban	0.16	0.37	0	1
Ecological Belt				
Mountain	0.07	0.26	0	1
Hills	0.45	0.50	0	1
Tarai	0.47	0.50	0	1
Development Region				
Eastern	0.25	0.43	0	1
Central	0.36	0.48	0	1
Western	0.21	0.41	0	1
Mid-Western	0.12	0.32	0	1
Far-Western	0.07	0.25	0	1
NLSS-II sampling strata				
Mountain	0.07	0.26	0	1
Kathmandu Valley Urban	0.06	0.23	0	1
Urban Hills	0.04	0.19	0	1
Rural Hills	0.36	0.48	0	1
Urban Tarai	0.07	0.25	0	1
Rural Tarai	0.41	0.49	0	1
Caste-ethnicity				
Chettri	0.17	0.37	0	1
Bahun	0.15	0.35	0	1
Adivasi Janajati	0.32	0.47	0	1
Dalit	0.12	0.33	0	1
Newar	0.08	0.27	0	1
Other Caste	0.12	0.32	0	1
Muslim	0.05	0.22	0	1

contd….

Variables	Mean	Std. Dev.	Minimum	Maximum
	N=3912			
Poverty quintiles				
Poorest	0.17	0.37	0	1
second	0.18	0.38	0	1
Third	0.20	0.40	0	1
Fourth	0.21	0.41	0	1
Richest	0.24	0.43	0	1
Non-poor grouped	0.74	0.44	0	1
Poor grouped	0.26	0.44	0	1
Household head's education				
Illiterate	0.48	0.50	0	1
Literate/Primary	0.27	0.44	0	1
Up to class 10	0.15	0.35	0	1
SLC or more	0.10	0.30	0	1
Family structure				
Number of children <=19	2.79	1.89	0	18
Number of married women	1.49	0.80	0	8
Modern amenities				
With electricity	0.37	0.48	0	1
With piped water inside house	0.14	0.35	0	1
Intensity of Maoist Conflict				
Low	0.35	0.48	0	1
Moderate	0.47	0.50	0	1
Intense	0.17	0.38	0	1
Distance to school				
Time to primary school (mean minutes)	17	19	0	300
Primary school within 30 minutes	0.91	0.28	0	1
Secondary school within 30 minutes[a]	0.62	0.48	0	1

[a] Data correspond to the school that serves the community (N=3900).

Table 3.4. Classification of the 102 caste-ethnicity options in NLSS-II

Classification	Caste/ Ethnicity	
	Hill/Mountain	Tarai
Adivasi Janajati (Indigenous Nationalities)	Magar, Tamang, Rai, Gurung, Limbu,Sherpa, Bhujel/Gharti, Sunuwar, Thami, Bhote, Yakha, Pahari, Chhantel, Baramu/Bramhu, Jirel, Janjati/Aadibashi, Dura, Lepcha, Byangsi, Hayu, Walung, Hyalmo, Kusunda, Chepang/Praja, Thakali, Kumal, Majhi, Danuwar, Darai, Bote, Raji, Raute	Tharu, Dhanuk, Rajbanshi, Santhal/Satar, Jhangad, Gangai, Dhimal, Tajpuriya, Meche, Kisan, Koche, Munda, Pattharkatta/kuswadiya
Bahun	Hill Brahmin, Sanyashi	Tarai Brahmin
Chettri	Chhetri, Thakuri	
Dalits	Kami, Damai/Dhobi, Sarki, Gaine, Badi	Chamar/Harijan, Musahar, Dusadh/Paswan, Tatma, Khatwe, Dhobi, Baantar, Chidimar, Dom, Halkhor
Muslim		Muslim, Churoute
Newar	Newar	
Other Caste		Baniya, Rajput, Kayastha, Marwadi,Nurang, Yadav, Teli, Koiri, Kurmi, Kewat, Mallah, Kalwar, Thakur/Hazam, Kanu, Sudhi, Lohar, Nuniya, Kumhar, Haluwai, Badhai, Barae, Kahar, Lodha, Rajbhar, Bing/Bida, Bhediyari/Gaderi, Mali,Kamar, Dhuniya, Sonar, Panjabi/Sikh, Bangali, Jaine, Others

Sources: National Foundation for Indigenous nationalities (http://nfdin.gov.np 2006); Gurung (1998), Dahal, Gurung, Acharya, Hemchuri and Swarnakar (2002); Nepal Rajpatra (Government of Nepal 2002b); and Rastriya Janajati Bikas Samiti (2007).

Table 3.5. Mean, standard deviation, maximum and minimum values of rural primary school quality independent variables

Variables	N	Mean	Std. Dev.	Minimum	Maximum
Infrastructural Quality Index (1-10)	228	5.05	2.30	0	10
Closing more than mean closure days	226	0.20	0.40	0	1
Teachers as per sanctioned	227	0.79	0.41	0	1
Schools with at least one female teacher	227	0.60	0.49	0	1
Schools with girls toilet	225	0.39	0.49	0	1
Schools with boys toilet	226	0.48	0.50	0	1

Table 3.6. Number of households and number of children

Age 6-12			Age 13-19		
Eligible children per family	Number of Households	Total eligible children	Eligible children per family	Number of Households	Total eligible children
1	988	988	1	1056	1056
2	800	1600	2	613	1226
3	299	897	3	201	603
4	51	204	4	41	164
5	4	20	5	5	25
6	3	18	6	0	0
7	2	14	7	0	0
8	0	0	8	1	8
	2147	3741		1917	3082

Table 3.7. Collinearity Diagnostics: Variance Inflation Factor (age 6-12)

Variable	VIF(=1/ Tolerance)	Sq root of VIF	Tolerance (1-R sqd.)	R Squared
Distance to dirt road (hours)	1.48	1.22	0.67	0.33
Development region (Western omitted)				
Eastern	1.95	1.40	0.51	0.49
Central	2.25	1.50	0.44	0.56
Mid Western	2.35	1.53	0.43	0.57
Far Western	1.77	1.33	0.57	0.43
Stratum (Mountain omitted)				
Urban Kathmandu	2.82	1.68	0.35	0.65
Urban Hill	2.37	1.54	0.42	0.58
Rural Hill	3.83	1.96	0.26	0.74
Urban Tarai	2.86	1.69	0.35	0.65
Rural Tarai	5.28	2.30	0.19	0.81
Age of child (Age six omitted)				
Seven	1.70	1.30	0.59	0.41
Eight	1.73	1.32	0.58	0.42
Nine	1.68	1.30	0.59	0.41
Ten	1.78	1.34	0.56	0.44
Eleven	1.62	1.27	0.62	0.38
Twelve	1.80	1.34	0.56	0.44
Boys	1.02	1.01	0.98	0.02

contd …

Variable	VIF(=1/ Tolerance)	Sq root of VIF	Tolerance (1- R sqd.)	R Squared
Caste-ethnic group (Bahun omitted)				
Chhetri	2.18	1.48	0.46	0.54
Adivasi Janajati	2.84	1.68	0.35	0.65
Dalit	1.95	1.40	0.51	0.49
Newar	1.73	1.31	0.58	0.42
Other Caste	2.24	1.50	0.45	0.55
Muslim	1.83	1.35	0.55	0.45
Household per capita expenditure (NRs. logged)	2.00	1.42	0.50	0.50
Education level of household head (0-15)	1.42	1.19	0.70	0.30
Intensity of Maoist conflict (Low omitted)				
Moderate	1.73	1.32	0.58	0.42
Intense	2.58	1.61	0.39	0.61
Number of children <=19 in household	1.72	1.31	0.58	0.42
Number of married female in household	1.51	1.23	0.66	0.34
Water piped inside house	1.56	1.25	0.64	0.36
Lighting source is electricity	1.79	1.34	0.56	0.44
Primary school within 30 minutes	1.16	1.08	0.86	0.14
Secondary school within 30 minutes	1.47	1.21	0.68	0.32

Table 3.8. Collinearity Diagnostics: Variance Inflation Factor (age 13-19)

Variable	VIF(=1/ Tolerance)	Sq root of VIF	Tolerance (1- R sqd.)	R Squared
Distance to dirt road (hours)	1.40	1.18	0.72	0.28
Development region (Western omitted)				
Eastern	1.97	1.41	0.51	0.49
Central	2.36	1.54	0.42	0.58
Mid Western	2.37	1.54	0.42	0.58
Far Western	1.90	1.38	0.53	0.47
Stratum (Mountain omitted)				
Urban Kathmandu	3.34	1.83	0.30	0.70
Urban Hill	2.40	1.55	0.42	0.58
Rural Hill	3.76	1.94	0.27	0.73
Urban Tarai	3.21	1.79	0.31	0.69
Rural Tarai	5.03	2.24	0.20	0.80
Age of child (Age thirteen omitted)				
Fourteen	1.74	1.32	0.58	0.42
Fifteen	1.77	1.33	0.57	0.43
Sixteen	1.75	1.32	0.57	0.43
Seventeen	1.63	1.28	0.61	0.39
Eighteen	1.80	1.34	0.56	0.44
Nineteen	1.60	1.26	0.63	0.37
Boys	1.02	1.01	0.98	0.02

contd …

Variable	VIF(=1/ Tolerance)	Sq root of VIF	Tolerance (1- R sqd.)	R Squared
Caste-ethnic group (Bahun omitted)				
Chhetri	1.96	1.40	0.51	0.49
Adivasi Janajati	2.45	1.57	0.41	0.59
Dalit	1.69	1.30	0.59	0.41
Newar	1.78	1.33	0.56	0.44
Other Caste	1.79	1.34	0.56	0.44
Muslim	1.48	1.22	0.67	0.33
Household per capita expenditure (NRs. logged)	2.22	1.49	0.45	0.55
Education level of household head (0-15)	1.48	1.22	0.67	0.33
Intensity of Maoist conflict (Low omitted)				
Moderate	1.75	1.32	0.57	0.43
Intense	2.81	1.68	0.36	0.64
Number of children <=19 in household	1.68	1.30	0.60	0.40
Number of married female in household	1.49	1.22	0.67	0.33
Water piped inside house	1.60	1.27	0.62	0.38
Lighting source is electricity	1.90	1.38	0.53	0.47
Primary school within 30 minutes	1.15	1.07	0.87	0.13
Secondary school within 30 minutes	1.58	1.26	0.63	0.37

Annex 3.1: NLSS-II household access module

SECTION 3. ACCESS TO FACILITIES

1. How long does it take to get from your house to the closest ..[FACILITY]..?	CODE	2. MODE OF TRANSPORT: FOOT (WITHOUT LOAD) ...1; BICYCLE/RICKSHAW ......2; MOTORCYCLE/TAMPOO .....3; CAR/BUS ....4; MIXED (FOOT+VEHICLE) ..5; PRESENT NEXT TO HH ....6 (→NEXT FACILITY); NOT APPLICABLE ....7 (→NEXT FACILITY)	3. TIME TAKEN: (ONE WAY) DAYS	HOURS	MINUTES
Primary School	101				
Health Post/Hospital	102				
Bus Stop	103				
Paved Road	104				
Dirt Road, vehicle passable	105				
Dirt Road, vehicle impassable	106				
Local Shop/Shops	107				
Haat Bazaar	108				
Market Center	109				
Agriculture Center	110				
Sajha/Cooperatives	111				
Bank	112				
Source of Drinking Water	113				
Post Office	114				
Telephone Booth	115				

12

(Source: CBS 2004a)

Annex 3.2: NLSS-II household education module (literacy)

SECTION 7. EDUCATION PART A | LITERACY (ALL PERSONS 5 YEARS AND OLDER)

IDENTIFICATION CODE	1. ID CODE OF RESPONDENT WRITE ID CODE FROM HOUSEHOLD ROSTER OF PERSON PROVIDING THIS INFORMATION ID CODE	2. Can ..[NAME].. read a letter? YES .... 1 NO .... 2(→5)	3. Can ..[NAME].. write a letter? YES..... 1 NO .... 2(→5)	4. Where did ..[NAME].. learn to read and write? FORMAL SCHOOLING .. 1 TAUGHT AT HOME .... 2 GOVT. LITERACY COURSE .... 3 NGO LITERACY COURSE4 OTHER 5	5. INTERVIEWER: ASK EACH PERSON ABOUT THEIR EDUCATIONAL BACKGROUND, AND CODE THEIR EDUCATIONAL BACKGROUND AS FOLLOWS: NEVER ATTENDED SCHOOL .... 1 ATTENDED SCHOOL/COLLEGE IN THE PAST .... 2(→PART B) CURRENTLY ATTENDING SCHOOL/COLLEGE .... 3(→PART C)	6. Why didn't ..[NAME].. ever attend school? SCHOOL NOT PRESENT ....1 TOO EXPENSIVE ....2 TOO FAR AWAY ....3 HAD TO HELP AT HOME ....4 EDUCATION NOT USEFUL ......5 PARENTS DID NOT WANT ......6 NOT WILLING TO ATTEND .....7 HANDICAPPED ....8 OTHER REASONS ....9 →NEXT
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						

23

(Source: CBS 2004a)

Annex 3.3: NLSS-II community module, access to education

SECTION 2

ACCESS TO FACILITIES (CONT.)

EDUCATION

	LIST ALL SCHOOLS PRESENT IN THE VDC:	1. Which ward is the school located in?	2. Is the school public or private? PUBLIC .....1 PRIVATE 2	3. For how many years has the school been operating?	4. What are the lowest and highest classes offered in this school? SISU CLASS .... 0 PRIMARY, CLASS 1 .... 1 PRIMARY, CLASS 2 .... 2 PRIMARY, CLASS 3 .... 3 PRIMARY, CLASS 4 .... 4 PRIMARY, CLASS 5 .... 5 LOWER SEC. CLASS 6 .... 6 LOWER SEC. CLASS 7 .... 7 LOWER SEC. CLASS 8 .... 8 SECONDARY, CLASS 9 .... 9 SECONDARY, CLASS 10 .... 10 INTERMEDIATE, CLASS 11 .... 11 INTERMEDIATE, CLASS 12 .... 12 OTHER NON-STANDARD LEVELS . 13		5. Approximately how many students are presently enrolled in this school?	
	NAME OF SCHOOL	WARD NUMBER		YEARS	LOWEST	HIGHEST	BOYS	GIRLS
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								

7

(Source: CBS 2004a)

Annex 3.3: NLSS-II community module, access to education (contd…)

SECTION 2 | ACCESS TO FACILITIES (CONT.)

SUPERVISOR: IF THE FOLLOWING CLASSES ARE NOT OFFERED BY A SCHOOL LOCATED IN THE NLSS WARD, ASK Q. 6 AND 7 ABOUT DISTANCE OF CLOSEST SCHOOL:

FACILITY		6. What is the mode of transport used to reach the closest [SCHOOL]? FOOT (WITHOUT LOAD) .... 1 BICYCLE .... 2 MOTORCYCLE .... 3 CAR/BUS .... 4 FOOT/VEHICLE (MIXED) ... 5	7. How long does it take to reach the closest [SCHOOL] using this mode of transport from the center of this ward? REPORT ONE WAY TIME		
			DAYS	HOURS	MINUTES
16	PRIMARY SCHOOL (1-5)				
17	LOWER SEC. SCHOOL (6-7)				
18	SECONDARY SCHOOL (9-10)				

8. About what proportion of the children of primary school age (6-10 years) in this ward are enrolled in school? That is, is it....

ALMOST ALL 1
MORE THAN HALF 2
ABOUT HALF 3
LESS THAN HALF 4
ONLY A FEW 5
NONE 6

BOYS: [ ]

GIRLS: [ ]

9. If there is an Adult Literacy Program in the ward, how many persons are currently enrolled?

NUMBER OF WOMEN ENROLLED [ ]

NUMBER OF MEN ENROLLED [ ]

10. What are the main schooling problems from the point of view of the people in this ward?

LIST UPTO 3 IN ORDER OF IMPORTANCE, FROM MOST IMPORTANT TO LEAST IMPORTANT.

SCHOOL IS TOO FAR 1
SCHOOL FEES TOO HIGH 2
NOT ENOUGH TEACHERS 3
NOT ENOUGH BOOKS/EQUIPMENT/TEACHING SUPPLIES 4
QUALITY OF INSTRUCTION IS LOW 5
SCHOOLING DOES NOT HELP CHILDREN GET JOBS 6
SCHOOL BUILDINGS ARE IN POOR REPAIR 7
INSUFFICIENT FUNDS TO PAY TEACHERS 8
NOT ENOUGH PLACES AT SCHOOL 9
NOT ENOUGH EQUIPMENT (DESKS, BOOKS) 10
OTHER (SPECIFY:_________________) 11

FIRST [ ]

SECOND [ ]

THIRD [ ]

8

(Source: CBS 2004a)

Annex 3.3: NLSS-II community module, rural primary school

SECTION 6

RURAL PRIMARY SCHOOL

GENERAL DESCRIPTION AND ENROLLMENT

NAME OF SCHOOL: ______________________________________

COPY LINE NUMBER OF SCHOOL FROM PAGE 7 OR 8: [ ]

1. For how many years has the school been operating?

   NO. OF YEARS [ ]

2. How many students are presently enrolled in the school?

	BOYS	GIRLS	TOTAL
NURSERY (SISU)			
Class 1			
Class 2			
Class 3			
Class 4			
Class 5			
TOTAL STUDENTS			

3. On average, what percentage of students who begin Class 1 will actually complete Class 5 (that is, what percentage of the students enrolled in the school are expected to complete their primary education)?

   PERCENTAGE [ ]

4. For how many weeks was the school closed during the last school year, excluding holidays and vacation (that is closed for unscheduled reasons)?

   DAYS [ ]

INFRASTRUCTURE AND SUPPLIES

SUPERVISOR: INSPECT THE PHYSICAL STRUCTURE OF THE SCHOOL, AND PROVIDE THE FOLLOWING INFORMATION:

5. MAIN CONSTRUCTION MATERIAL OF THE OUTSIDE WALLS: [ ]

   CEMENT BONDED BRICKS/STONES 1
   MUD BONDED BRICKS/STONES ... 2
   WOOD/BRANCHES 3
   CONCRETE 4
   UNBAKED BRICKS 5
   OTHER PERMANENT MATERIALS .. 6
   NO OUTSIDE WALLS 7

6. MAIN FLOORING MATERIAL: [ ]

   EARTH 1
   WOOD 2
   STONE/BRICK 3
   CEMENT/TILE 4
   OTHER 5

7. MAIN MATERIAL OF ROOF IS MADE OF: [ ]

   STRAW/THATCH 1
   EARTH/MUD 2
   WOOD/PLANKS 3
   GALVANIZED IRON/TIN, ETC. .. 4
   CONCRETE/CEMENT 5
   TILES/SLATE 6
   OTHER 7

8. THE WINDOWS ARE FITTED WITH... [ ]

   NO WINDOWS/NO COVERING 1
   SHUTTERS 2
   SCREENS/GLASS 3
   OTHER 4

23

(Source: CBS 2004a)

Annex 3.3: NLSS-II community module, rural primary school (contd..)

SECTION 6 RURAL PRIMARY SCHOOL (CONT.)

9. Does the school have classrooms?

YES 1
NO .... 2 (→11)

10. How many classrooms are there? NUMBER

11. Where are classes normally held?

IN THE CLASSROOMS 1
IN THE COURTYARD 2
SOME OTHER PLACE 3

12. Does the school have usable blackboards?

YES 1
NO 2

13. Does the school have electricity?

YES 1
NO .... 2 (→15)

14. What is the primary source of electric power?

CONNECTED TO GRID 1
LOCAL HYDROPOWER 2
GENERATOR 3
OTHER 4

15. What is the primary source of water for the school?

PIPED WATER (PRIVATE) . 1
PUBLIC STANDPIPE 2
HAND PUMP 3
COVERED WELL/TUBEWELL . 4
OPEN WELL/NATURAL WELL 5
STORAGE TANK 6
CANAL/RIVER WATER 7
OTHER 8

16. Does the school have toilet facilities for teachers?

YES 1
NO 2

17. Does the school have toilet facilities for students?

YES 1
NO 2

18. Are desks provided for students?

YES, FOR ALL STUDENTS . 1
YES, FOR SOME STUDENTS 2
NO 3

19. Are chairs provided for students?

YES, FOR ALL STUDENTS . 1
YES, FOR SOME STUDENTS 2
NO 3

20. What is the medium of instruction used in the school for...

NEPALI 1
ENGLISH 2
OTHER 3
(SPECIFY ___________)

(a) lectures and general classroom training
(b) textbooks

21. How do students normally obtain the textbooks?

PROVIDED BY THE SCHOOL .. 1
PURCHASED FROM SCHOOL OR SHOP BUT PARENTS WILL RECEIVE REIMBURSEMENT IF CHILD ATTENDS SCHOOL 2
PURCHASED IN THE LOCAL MARKET 3
SOME PROVIDED BY SCHOOL, SOME PURCHASED . 4

BOYS

GIRLS

24

(Source: CBS 2004a)

Annex 3.3: NLSS-II community module, rural primary school (contd..)

SECTION 6

RURAL PRIMARY SCHOOL (CONT.)

	22. How many textbooks are required by students in ..[CLASS].?	23. What is the average cost of purchasing books during the school year for ..[CLASS]..? LEAVE BLANK IF BOOKS ARE PROVIDED BY SCHOOL (i.e. ANSWER TO Q.21 IS 1)
CLASS	NUMBER OF BOOKS	RUPEES
Class 1		
Class 2		
Class 3		
Class 4		
Class 5		

24. Does the school require that students wear uniform?

YES 1
NO .... 2 (→ 26)

25. Is the uniform regulation strictly enforced?

YES 1
NO 2

26. Is there a fee for school entrance or are there monthly fees or examination fees?

YES 1
NO .... 2 (→30)

	27. What is the entrance fee for ..[CLASS]..? IF NONE, WRITE ZERO	28. What is the monthly fees for ..[CLASS]..? IF NONE, WRITE ZERO	29. What is the examination fee for ..[CLASS]..? IF NONE, WRITE ZERO
CLASS	RUPEES	RUPEES	RUPEES
NURSERY (SISU)			
Class 1			
Class 2			
Class 3			
Class 4			
Class 5			

30. How many posts are sanctioned for teachers in Classes 1-5 for this school?

NUMBER OF TEACHERS

31. How many teachers are currently teaching Classes 1-5?

NUMBER OF TEACHERS

32. Of these teachers, how many are female?

NUMBER OF FEMALE TEACHERS

(Source: CBS 2004a)

Chapter IV

Dimensions of geographical accessibility in Nepal

This chapter presents the overall geographical accessibility profile of Nepal. While Nepal is understood as a country that has severe accessibility problems, the underlying dimensions of accessibility have rarely been examined. The NLSS-II data reveals that there is substantial variation in accessibility—both horizontal across spaces, and vertical across socio-economic groups in Nepal. The accessibility profile that emerges provides us with additional insights to understand the nature of inclusion-exclusion in Nepal, the changing social demography and the mobility patterns of different socio-economic groups.

Based on our analysis, we discern six main characteristics of accessibility in Nepal. First, the overall accessibility level in Nepal is very poor compared to the rest of the world. Second, accessibility in Nepal varies horizontally across locations. Mountains and rural hills lag behind than the rest of the country. Third, there is greater concentration of poverty and illiteracy in inaccessible areas, and some caste-ethnic groups have better accessibility than others. Fourth, living further away from roads also means to be served with distant "socio-economic arrangements" (Sen, 2000) for attaining human development. One such institution directly related to school enrolment is the availability of schools. Fifth, not only are such arrangements distributed less in isolated areas, they are also of lesser quality. Sixth, as we have illustrated in the previous chapter, there is substantial intra-village variation in the accessibility level households enjoy.

Before analyzing these characteristics in detail using the NLSS-II dataset, let us first briefly discuss the modern development history of Nepal with a focus on road building.

Road building in Nepal

It is difficult to trace the history of road building and transport services in Nepal. A French historian Sylvan Levi who arrived in 1898 on foot to Thankot, an eastern entry point to Kathmandu speaks about some 14 kilometers of roads leading to Kathmandu. He writes:

> "… the path (to Kathmandu) leaves the torrent, ascends in a steep climb alongside the Chandragiri .. and ends in Chitalang… again … to climb perpendicular. The descent into Nepal[4] would be impractical without rough steps, from top to bottom on measuring of some 700 meters, to build rough steps. … The valley of Thankot is reached and 14 Kilometers of even road that lead to Kathmandu. I jump into my *dandi* and my bearers carry me to run (Levy 1898 in Joshi 2006:8-9).

A hundred and ten years later, the accessibility picture that emerges for Kathmandu and the rest of Nepal is undoubtedly much better. The Department of Roads (Department of Roads 2007) has recorded over 17,000 kilometers of roads in Nepal as of 2004. Roads have grown gradually from 376 kilometers in 1951 to 7,330 Kilometers in 1990. In the 14 years following 1990, road length has grown at a rate higher than ever before—about 10 % per year reaching 17,280 Kilometers in 2004. Of the total roads, 31% was black topped, 27% gravel and 43% earthen (Department of Roads 2007). There exists an estimated additional 11, 000 kilometers of village and agricultural roads (The World Bank 2007c).

--Table 4.1 about here--

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[4] Kathmandu valley was popularly referred to as Nepal then.

As a result, 64 of Nepal's 75 district headquarters have been connected by roads, and it is today possible to travel from one part of the country to another without entering India. The road building has resulted in an overall improvement of accessibility for rural households. As of 2004, an estimated 37% of the population resided within half an hour of paved roads while more than two thirds was residing within half an hour of dirt roads (Central Bureau of Statistics Nepal 2004a). The growth of air service is now possible through 47 airports spread across the country (Civil Aviation Authority of Nepal 2007).

This year (2007) Nepal winds up its tenth five-year plan and completes five decades of planned development. Transport and improved accessibility has undoubtedly played a pivotal role in most of the development successes the country has had—expansion of schools and hospitals, growth of industries, growth of cities, movement of people and movement of goods to and from areas served by roads is clearly visible in today's Nepal. The importance of roads for the country's development continues to be well addressed by the country's National Transport Policy which targets a "reliable, cost effective, safe facility oriented and sustainable transport system that promotes and sustains the economic, social, cultural and tourism development of Nepal" (Ministry of Physical Planning and Works 2002).

Long journey

But Nepal has a long journey to realize this goal. The results of road building are also tied to rising regional and social inequality in the country. Despite this notable progress, road building in Nepal has failed to improve everybody's accessibility level, and for many perhaps the accessibility scenario still does not look much different from the 110 year old account recorded by Sylvan Levi. Its road network and density is the lowest in the South Asian region (The World Bank 2007c) and the distribution of roads is skewed towards urban centers and the Tarai in the south. Over 60% of the current network is concentrated in the Tarai (The World Bank 2007c). As of finalizing this dissertation (2007 August), headquarters of 11 districts—Sankhuwasabha, Solukhumbu, Khotang, Bhojpur, Manang, Mustang, Dolpa, Humla, Mugu, Jajarkot and Darchula—are yet to be connected by roads. Even amongst the many districts that are connected by roads, it still requires several hours if not days to reach the villages. Of the 47 airports, 12 were reported as not operational as of 2007 July (Civil Aviation Authority of Nepal 2007). 11 of these non-operational airports are from the inaccessible mountainous or high hill districts.

Often the reason given for why huge parts of the hills and mountains remain inaccessible is the difficult topography which makes road construction difficult and expensive. While this reasoning partly explains the poor accessibility in mountainous terrains and the better accessibility in the lowland Tarai, it cannot explain all regional imbalances in road construction in Nepal. If this were the only reason then it would be difficult to explain why Kathmandu Valley and other urban hill centers, almost as inaccessible as other hilly districts until the 1950s are so highly accessible today. The Tarai is highly accessible partly due to its plain topography and partly due to targeted strategic interventions such as the East-West highway that runs through the entire upper Tarai.

Apart from the topography, the politics and economics surrounding roads construction explains why some areas are poorer in accessibility than others. The economics that was at play is not hard to understand. Constructing roads to remote areas never became economically feasible because the costs exceeded the expected economic returns from these roads. Until recently the focus of the State in Nepal had generally been building fewer higher quality roads, rather than connecting remote villages by lower quality seasonal roads.

The politics of planning, prioritizing and implementation have not always been objective, but driven mainly by the desire of Kathmandu to be connected to the rest of the world. Thus most highways begin from Kathmandu. Even then, to travel to the eastern Tarai of Nepal from Kathmandu, one first travels significantly towards the west, goes south, and then turns east. Expansion of other means of transportation—ropeways and railways—has been negligible. Flying is expensive and often an unreliable option for hilly and mountainous districts. For many people, thus, accessibility to the external world is heavily restricted by the long distance between households and the road.

Detailed analysis

In the following sections we look at how accessibility varies, for dirt roads as well as paved roads. We begin by looking at how accessibility level in Nepal varies across locations—by urban and rural, by development region and by ecological belts. Then we examine the differences in accessibility across social groups, namely caste-ethnic groups, household poverty level, household education level and family structure variables. We will then look at how areas with different accessibility levels may have had different levels of impact by the Maoist insurgency. We then investigate how the distribution of various services varies across accessible and inaccessible areas of the country. Finally we look at how the quality of rural primary schools varies with accessibility.

Overall accessibility scenario

To recall, Nepal's overall accessibility rate is very poor with a mean household distance of 2 hours 11 minutes to dirt roads and 4 hours 8 minutes to paved roads. About one in five households are located more than 1½ hours and one in every 16 are located more than one day away from the closest dirt road. Two in every five are located 1½ hours away and one in every eight a day away from paved roads. It is difficult to find any of the 45 mountain/hill districts except the three Kathmandu valley districts that do not have settlements that are at least a days' walk from roads. We must remember here that even these are distances reported when walking without a load. In many parts of the hills and mountains, the only means of transporting goods is by humans and where available, by pack animals. Since most of the transport of goods is done by the local residents themselves, it is expected that the actual time taken may be even longer for many of these areas.

The reported mode of travel to dirt roads is almost universally by foot, with about half a percent of the sample reporting two wheel mode of travel. To reach the nearest paved road, two in five households use either a bicycle (5%), motorized transport (3%) or a combination of some form of walking and motorized means (31%).

--Table 4.2 about here--

--Table 4.3 about here--

About two fifths of the households reside more than 1½ hours away from any kind of motorable road, just as about one fourth of the households reside within 15 minutes of both these roads. However a substantial portion, about a fifth resides within 1½ hours of the dirt roads but further than 1½ hours of paved roads, indicating their better accessibility to the dirt roads.

Variation in accessibility by location

Development Region: The Mid-Western Development Region (MWDR) fares the worst accessibility level with a mean travel time of nearly 6 hours to reach dirt roads and over 10½ hours to reach the nearest paved road. This region houses five of the eleven districts whose headquarters were still not connected by roads at the time of NLSS-II survey—Jajarkot, Mugu, Dolpa, Jumla and Kalikot. Jumla and Kalikot were connected only in 2007. Of the others, Mugu and Dolpa have no roads at all. In MWDR, about a third of the households are at least one day away from dirt roads, while about two thirds are at least one day away from paved roads.

--Table 4.4 about here--

Far Western, Western and Eastern Development Regions have similar mean distance from roads, about 2½ hours mean time to dirt roads and 4½ hours to paved roads. However Far West has more households residing over 1½ hours away from paved roads (57%) compared to about 40% each for Western and Eastern Regions. The Central Region has by far the best accessibility rates with a mean time of about ½ hour to reach the nearest dirt road and a mean time of one hour 21 minutes to reach the paved roads. The Central Region is the only region which has all 18 district headquarters are connected by roads. In the Central Region, only one tenth of the households are at a distance of more than a day of dirt roads, and about a quarter beyond a day of paved roads.

Ecological belt: The mountainous region of the North (4877 meters above mean sea level) is by far the most inaccessible ecological belt. One in about every 14 household is a mountainous household, and on average requires more than one day and three hours to reach the nearest dirt road and over two days on average to reach the nearest paved road. There, over a third of the households need to walk for over a day to reach a dirt road while almost sixty percent need to walk over a day to reach the paved road. Without a doubt, these are one of the remotest territories not only in Nepal but in the world.

--Table 4.5 about here--

The hills (between 610 meters to 4876 meters above mean sea level), which form the middle part of the country house about 45 % of the households. The mean time in the hills to reach the nearest dirt road is about two hours 13 minutes and the mean time to reach the paved roads is over five hours. Only about a third walk more than 1½ hours to reach a dirt road, indicating generally good dirt road accessibility condition for the hills compared to paved roads. One in six still need to walk over a day to reach the nearest paved road.

The lowlands of Tarai (starting at 75m to 610 meters above mean sea level) are by far the most accessible ecological belt in Nepal. Dirt roads are only at six minutes mean distance while paved roads are at about one hour's mean distance from households. In Tarai we do not find any of the households located further than 1 day away from roads.

Yet one in every twelve household is located 15 minutes away from dirt roads, and one in six households is located 1½ hours away from paved roads. The Tarai houses almost half of Nepal's population.

Rural Urban: The urban areas enjoy a much higher accessibility rate compared to the rural. The mean time to reach dirt road is three minutes and the mean time to read paved roads is 21 minutes. There are very few (less than 2%) households beyond 1½ hours off of roads in urban areas. However almost 6 out of 7 households in Nepal are rural and require on average more than 2½ hours to reach the nearest dirt road and almost 5 hours on average to reach the nearest paved road. One in 12 rural households needs to walk over one day to reach the nearest household and one in seven needs to walk over a day to reach the nearest paved road.

--Table 4.6 about here--

There is considerable rural urban disparity in accessibility levels within each ecological belt. Almost all of urban Tarai is within 15 minutes of roads and has a mean time of one minute from the nearest dirt road. But in rural Tarai one person out of 10 is outside of 15 minutes away from dirt roads. In terms of paved roads, 80% of urban Tarai is within 15 minutes with a mean time of 11 minutes compared to rural Tarai which has only one in five household within 15 minutes and a mean time of 67 minutes to reach paved roads.

Amongst the hill stratum, urban Kathmandu is undisputedly the most accessible, with all households located within 15 minutes of roads, and a mean of 0 minutes to dirt roads and three minutes to paved roads. Urban hill is far ahead with only eight minutes mean time to dirt road and 24 minutes to paved road compared to over 3½ hours and almost 7 hours respectively for rural hills. Urban hill cities such as Kathmandu, Patan, Bhaktapur and Pokhara enjoy accessibility levels at par with many cities in the developed world.

--Table 4.7 about here--

Variation in accessibility by socio-economic characteristics

Household welfare: Household per capita expenditure is negatively correlated with distance to roads (Table 4.8). Households in the poorest quintile are also the household that are the most isolated, and the households in the richest quintile are those which are the most accessible. The poorest quintile households have a mean accessibility of about 3½ hours to the nearest dirt road, and about six hours to the nearest paved roads. This distance reduces gradually as households get richer. Households from the richest quintile are on average only about 51 minute away from dirt roads and one hour 42 minutes on average from paved roads. The jump in accessibility level from the second richest to the richest quintile is much higher, suggesting that the richest people enjoy much higher degree of accessibility. Only 8% of the households in the lowest quintile are within 15 minutes of dirt roads compared to 57 % for the richest households. Isolation in Nepal is thus characterized by greater concentration of poverty.

--Table 4.8 about here--

--Table 4.9 about here--

Education level: Household head's education is correlated negatively with distance to roads (Table 4.8). Households which have illiterate or only primary educated household heads appear much more inaccessible. They live on average 2½ hours away from dirt roads and 4½ hours away from paved roads. Those household heads that have passed primary and completed grade ten have better accessibility rates—they are located on average 1 hour 49 minutes from dirt road and on average over 3½ hours to paved road. The most educated group having at least an SLC, have a much better accessibility level—they can reach dirt roads in 44 minutes on average and paved roads on average in less than two hours. About nine out of every ten households who have a household head with an SLC lives within 15 minutes of dirt roads, and about 6 out of 10 lives within 15 minutes of paved road. On the other hand of those households which have an illiterate head, less than 6 out of ten live within dirt roads, and only one in seven lives within 15 minutes of dirt roads. This is an indication that illiteracy is more concentrated in inaccessible areas where as secondary/higher education is concentrated in more accessible areas.

--Table 4.10 about here--

Caste-ethnic groups: The distribution of accessibility by caste ethnic groups is not as straightforward as that emerges for distribution by poverty and education groups. Muslims and other caste groups who hail mostly from the plains of Tarai have better accessibility than any other social groups. Leaving aside these Tarai-specific groups, Newars show the best accessibility rates. Three quarters of the Newars are within 1½ hours of paved roads and 90 % within 1½ hours of dirt roads. This is because they are concentrated mostly in the accessible Kathmandu valley and other urban centers. Bahuns, the upper caste group, show the best accessibility rates after the Tarai-specific groups and Newars—about less than an hour to reach the nearest dirt road and two hours 20 minutes to reach the paved roads.

Chettris, another upper caste group, however show the lowest accessibility rates—a mean of four hours to reach the nearest dirt road and 7½ hours to reach the paved roads. Adivasi Janajatis and Dalits show equal levels of accessibility—they fare better than Chettris but lag behind than the other groups. Each require on average, nearly three hours to reach the nearest dirt road and about five hours to reach the nearest paved road.

--Table 4.11 about here--

That the Adivasi Janajatis and Dalits exhibit better accessibility than the upper caste Chettris is somewhat non-intuitive, but part of this is explained by the Chettri's concentration in the remote districts of Mid and Far West. Another reason for this may be that Janajatis and the Dalits have a greater concentration in the accessible Tarai (thus lesser concentration in the hill/mountains) compared to Chettris. Our comparison of accessibility levels is based on all Janajatis and all Dalits irrespective of their locations, so the Tarai Janajati and Tarai Dalit population may be affecting the mean for the Janajatis and Dalits. In this respect it would be interesting to see how the hill Janajatis and hill Dalits compare with the high castes from the hills in terms of their accessibility.

After disaggregating the hill/mountain Janajatis from the Tarai and inner Tarai Janajatis, and the hill/mountain Dalits from the Tarai Dalits, we find that the hill Janajatis and hill Dalits are on average slightly further away from dirt roads than Chettris but are closer to paved roads. We find that distribution of hill Janajati, hill Dalit and Chettri households to be of the same proportion in the hills/ mountains and the Tarai. About three in four of each from these three groups—hill Janajati, hill Dalit and Chettris—live in the relatively inaccessible hills/ mountains, and one in four lives in the Tarai. Of all

Chettri households, one in five is in the inaccessible mountains compared to about one in ten each for the Janajati and Dalit households.

Chettris, Janajatis and Dalits are positively correlated with distance to roads implying that belonging to these caste-ethnic groups is associated with higher values of distance. Bahuns, Newars, other castes and Muslims are negatively related with distance means belonging to these groups means lower chances of being far away from roads (Table 4.8).

Interesting demographic patterns, potentially partially aided by better accessibility conditions, emerge in Nepal. In particular, people have moved from inaccessible rural to accessible urban areas, inaccessible areas specific to a certain caste-ethnic group to accessible but multi-cultural areas, from the inaccessible hills/mountains to the Tarai and from the accessible Tarai to the accessible hill areas. Accessible areas look more diverse than before in terms of different caste-ethnic groups. Take for example urban Kathmandu which has historically been a Newar stronghold. Today almost half of urban Kathmandu is non-Newar—11% are Chettris, 16% are Bahuns, 15% are hill Janajatis and 6% are Tarai specific caste groups. Also if we disaggregated the population of the accessible Tarai, we find that hill Janajatis comprise 12 %, followed by Bahuns (11%) and Chettris (9%). Similarly in urban hills, 21% are Chettris, 20% Bahuns, 23 % are hill Janajatis and 10% are Tarai specific caste-groups.

In today’s Nepal, within 15 minutes of dirt road the caste-ethnicity composition of households looks like this: 12% Chettris, 16% Bahuns, 28% Janajatis, 11% Dalits, 8% Newars, 12 % Other caste and 7 % Muslims. The composition of those living more than one day is 30% Chettris, 5 % Bahuns, 42% Adivasi Janajatis, 18% Dalits, 4% Newars, and no Muslims and Other Caste groups.

--Table 4.12 about here--

The caste-ethnicity distribution signal that Nepal has assimilated considerably over the years. People are moving out from places associated historically and geographically to the group they belong to. Of course there is more room for assimilation of different caste-ethnic groups but Nepal is more assimilated than ever in terms of caste-ethnic groups, possibly to the changing accessibility scenario.

Family structure: We are unable to discern any different trends between the structures of families in accessible areas and in inaccessible areas. Number of married female in the households, an indicator of joint families, is about the same (at about 1.3 to 1.4 per family) across all accessibility zones, whether defined by dirt roads or paved roads. However the number of children 19 and under in the family is on average less in the very inaccessible areas as well as in very accessible areas. This suggests larger family size in areas in between.

--Table 4.13 about here--

Variation in accessibility by intensity of Maoist insurgency

The correlation coefficient between distance to roads and intensity of conflict is positive suggesting lower intensity of conflict in accessible areas (Table 4.8). The most accessible households are the least affected ones by the Maoist conflict. Intensity of conflict is higher for households that are beyond 15 minutes off of the dirt than those are within 15 minutes, but we do not see any major escalation in the intensity of conflict with further increase in dirt road inaccessibility. As for paved roads accessibility, intensity of conflict increases in the areas between 15 minutes and 1½ hours, and increases further in areas beyond 1½ hours. That we do not see much difference in the intensity of conflict in areas beyond 1½ hours may be attributed to two factors—first, it was difficult even for insurgents to operate in some areas which were very remote. Second, even relatively accessible areas began to witness rapid escalation in conflict after a few years into the insurgency.

--Table 4.14 about here--

Distribution of services by accessibility

Transportation services-dirt road, paved road and bus stop: Distance to dirt road, distance to paved road and distance to bus-stops are correlated extremely high—in the order of over +0.9 with each other. Households on average would reach a bus stop in about 2¾ hours. It would take an additional 1¼ hours on average to reach a paved road, but about ½ an hour less on average to reach a dirt road. These results are an indication that transportation services are patterned not only by good quality dirt roads, but also by the lesser quality dirt roads. For those who are located within 15 minutes of dirt roads, the bus-stop is on average ½ an hour away and for those located within 15 minutes to 1½ hours, the bus-stop is located little more than 1½ hours on average. Within 15 minutes of paved roads bus stops are just 10 minutes away on average, and for those located between 15 minutes to 1½ hours, the bus-stop is located 37 minutes away from their households.

Economic services-markets, banks and cooperatives: A high correlation is observed between distance to roads and many of the services that are available to households. For example banks have a correlation coefficient of +0.72 and +0.73, market centers +0.66 and 0.65 and co-operatives +0.64 and +0.68, respectively with distance to dirt road and distance to paved road. This means that households which are located far from roads are also located far from banks, markets and cooperatives. The mean distance to reach a bank is about 3 hours, to reach a cooperative about 2½ hours and the nearest market 2 ¼ hours compared to over 4 hours to paved roads and about 2 ¼ hours to dirt roads. Those very close to roads are better served but for those living beyond 15 minutes of roads these services begin to become really distant. Market centers, banks and cooperatives are often concentrated in accessible areas because frequent flow of goods and money demands a minimal level of accessibility. This may be a reason why households that are distant from roads are distant from these services.

Communication services-telephone and post offices: Telephone service is less likely to be patterned by roads, yet we find it highly correlated to the availability of roads. Correlation of +0.74 and +0.71 exist respectively with distance to dirt road and distance to paved road. The mean distance to reach a telephone is about 2 hours. Those very close to roads are better served (about ½ hour mean distance) but beyond that the mean distance jumps to 2 hours and finally to about 1 day 2 hours. Although making some progress in recent years because of improved technology, expansion of telephone has generally been slow in Nepal. Part of the reason could be that repeater towers were prime targets of destruction during the Maoist insurgency disabling hundreds of telephone lines.

The conventional forms of communication, the post offices are however better spread in Nepal. Distance to post offices are correlated +0.27 and +0.32 respectively, indicating that they are closer to households than are roads, banks, market centers, telephones or cooperatives. Although the service provided is generally sluggish, post offices are one of the oldest service institutions in Nepal that have spread deep into remote areas. The mean time to reach a post office is only 51 minutes.

Post offices in Nepal have generally been successful in utilizing local human and physical resources to establish post offices. Postmen deliver mail on foot in inaccessible areas and in bicycles in accessible areas. Despite better overall presence of post offices and health posts, households that are further away from roads still require to travel more to reach these services. To reach a post office, households within 15 minutes of dirt roads need to walk on average 30 minutes, compared to about 2 hours needed by those living a day or more.

Health services: Health services are also much closer to households. The mean time to reach a health post or a hospital is only 47 minutes. The generally good spread of health posts has been possible because of targeted government interventions. But still a household located within fifteen minutes of dirt road walks only half an hour to reach a health post or a hospital on average compared to about 1½ hours for those living beyond 1½ hours. It must also be noted here that despite the relatively better spread, health-posts in remote areas are generally without medicines, doctors or equipments.

--Table 4.15 about here--

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Modern amenities- electricity and water: Nepal has been slow in expanding electricity, mainly to inaccessible areas. The overall electrification rate is low at 37%, and even in accessible areas 1 in 2 households do not have electricity. However, there is a wide disparity amongst accessible and inaccessible households. About half the households within 15 minutes of dirt roads have electricity, but beyond 15 minutes the electrification rate drops rapidly to reach a very low of 3 % for households that are located more than a day away from dirt roads. The correlation coefficient of having the household electrified is -0.21 and -0.29 with respect to distance to dirt roads and paved roads respectively. Although rich in water resources suitable for generating electricity—both through large projects or local ones—Nepal has depended heavily on bigger projects that transmit electricity through gridlines. Transmitting electricity in this manner to inaccessible areas by crossing high hills is a cumbersome process.

We would not expect distance to the (natural) source of drinking water to be patterned in any way by roads. The correlation with distance to source of drinking water (not the tap stand itself) is rather weak at +0.12 and +0.14 for dirt roads and paved roads respectively. However in terms of household actually having water piped inside their houses, only 14% households have such a facility. The correlation of households having piped water inside their houses with distance to roads is negative but lower than one would expect, -0.05 and -0.07 respectively. Piped drinking water to communities (not piped inside households, note the difference) have generally spread well in remote areas as a result of sustained effort by government and donors. This could be part of the reason why we do not find high correlation between water piped to house and the distance to roads.

Educational services- primary schools and secondary schools: Primary schools are the best spread service besides the source of drinking water. Households need to walk only 17 minutes on average to reach them. Distance to primary schools is correlated only at + 0.19 and +0.21 indicating its better spread even for those households located further away from roads. Primary schools seem to have been less patterned by the spread of roads in Nepal. This is because at the first place primary schools in Nepal require less material that needs to be hauled for its construction and upkeep. In the second place they require teachers with lesser educational qualification who are more likely to be present locally in inaccessible areas as well. Despite the better spread of primary schools, still the households located further away from roads have a greater distance to walk to reach the nearest primary school—about half an hour on average compared to those living within 15 minutes who need to walk only about 12 minutes.

Secondary schools come after primary schools, health posts and post offices in terms of better accessibility levels that households enjoy. About eight in ten households within 15 minutes of dirt roads have a secondary school within 30 minutes from the centre of the community they live in. However, proportions of such households drop rapidly beyond 15 minutes, declining to 25% for households that are at least one day away from dirt roads. The correlation coefficients of dirt road accessibility and paved road accessibility with having a secondary school within ½ an hour from the village center are -0.25 and -0.30. Compared to primary schools roads are more likely to pattern the distribution of secondary schools. This is so because secondary schools will require moving sophisticated equipments (such as for science labs) and more qualified teachers. Our data has already shown that inaccessible areas have a very low concentration of households that have a head who is educated SLC or more who could serve locally for such secondary schools.

Variation in school quality with accessibility

The quality of rural primary schools decays with the distance to roads. The infrastructural quality index, constructed using conditions of ten aspects of the rural primary school serving the NLSS-II communities, is correlated -0.27 and -0.31 with distance to dirt roads and paved roads respectively. The quality measured on a scale of 0-10 declines from 5.8 steadily to 3.6 as we move from dirt road accessible to dirt road inaccessible areas.

--Table 4.18 about here--

--Table 4.19 about here--

Schools were found to be closed for more days in the most inaccessible areas. Also, the number of households served by schools that have toilets for girls reduces as inaccessibility increases The percentage of schools with at least one female teacher is also found to be less in inaccessible areas. Somewhat unexpected, we do not find big differences in schools by accessibility levels that had fewer teachers than sanctioned. About a fifth of the school samples do not have the sanctioned number of teachers, and they are on average located further from roads than those which have the sanctioned number of teachers. Similar trends can be observed for quality of rural primary schools with respect to distance to paved roads.

Thus to be located further away from roads thus does not only mean to be served by distant schools, but also lower quality ones. The education rules of Nepal

(Government of Nepal 2002a) have provisions for schools to be categorized as A, B, C, and D based on physical facilities, teachers management, students number, academic achievement, total expenditure, school operation period. In this setting, it is likely that schools in remote areas will always be graded lower and always be at a disadvantage.

Conclusion

The accessibility profile that emerges presents various forms of imbalances in the relationship between the state and society. The first imbalance is regional. The "development" regions were introduced during the Fourth Five Year Plan with the aim of minimizing the differences in the development levels of the ecological belts (Sharma 2004:80). The accessibility picture that emerges unfortunately shows problems persist in this direction. The second imbalance is socio-economic. Certain caste groups suffer greater access poverty than others. Illiteracy and poverty are concentrated in isolated areas, while accessible areas have a higher concentration of rich and educated people. The third imbalance is in terms of the state's capacity to cater the basic needs of the people in isolated areas. Distant and low quality institutions in areas far away from roads means the population there has not been able to benefit from development.

Finally what emerges from this analysis of accessibility in Nepal is a country that is deeply divided in terms of the level of accessibility its residents enjoy. Moreover, to be a resident of an inaccessible area means to be marginalized in terms of several axes. Not only is one likely to be in a household with very less financial capital, and a household which has a head with a very low level of human capital but the person is likely to be served by very distant and poorer quality services of all kinds—transportation, economic centers, communication facilities, modern amenities, and education institutions—which means his or her chances of accumulating human, social and economic capital is also limited.

In the remainder of this dissertation I will explore in detail, through multivariate regressions, how difference/change inaccessibility affects children's chances of enrolling in school—the very first step a child takes in gaining meaningful human capital and increase his/her life chances. Many of the consequences of inaccessibility that we have discerned in this chapter also affect school enrolments in their own unique ways (modeled in Figure 2.1). I will control for each of these and other determinants to tease out the direct and indirect impacts of inaccessibility on school enrolment. I will also explore if the effects of inaccessibility on school enrolment is greater for girls than boys.

Table 4.1. Transport infrastructure development in Nepal (1951-2004)

Infrastructure	Unit	1951	1971	1991	2004
Roads	Km	376	2730	8328	17280--
Earthen		288	1474	3064	7394--
All-weather: gravel		83	435	2181	4613--
All-weather: black top		5	821	3083	5273--
Village or agricultural		N/A	N/A	N/A	11000+
Air Strips	No.	1	21	43	47**
Ropeway	Km	26	42	42	6*
Railway	Km	99	52	52	52*
Trolley	No.	-	12.5	12.5	12.5*
Suspension bridge	No.	30	65	408	955*

Source: Figures for 1951, 1971 and 1991 from Shrestha (2004)

* 2001 figures from Shrestha (2004)

Additional sources:

-- Department of Roads (2007)

\+ The World Bank (2007c), 2007 figure, not added to the total road length of 17280 kms.

** Civil Aviation Authority of Nepal (2007), 2007 figure

Table 4.2. One way time to nearest road from households

Time taken (one way)	Dirt road[a]		Paved road					
	N (un-weighted)	Weighted %	N (un-weighted)	Weighted %	Mode of travel (%)			
					Walk	Bicycle	Motorized	Mixed
<=15 minutes	2603	64	1353	27	96	3	1	0
>15 minutes <=1.5 hour	583	16	1150	34	60	11	5	24
>1.5 hour <=1 day[b]	465	13	941	28	42	2	3	53
>1 day	261	7	468	12	26	0	0	74
Total N/ % households	3912	101	3912	100	61	5	3	31

[a] 99.4% by foot

[b] 8 hours=1 day

Table 4.3. % households (weighted)- distance to nearest dirt road vs. distance to nearest paved road

Distance to dirt road	Distance to paved road				Total %	Unweighted N
	<=15 minutes	>15 minutes <=1.5 hour	>1.5 hour <=1 day	>1 day		
<=15 minutes	27	27	9	1	64	2603
>15 minutes <=1.5 hour	0	6	9	1	16	583
>1.5 hour <=1 day	0	0	9	4	13	465
>1 day	0	0	0	7	7	261
Total %	27	34	28	12	100	-
Unweighted N	1353	1150	941	468	-	3912

Table 4.4. Accessibility levels by Development Regions

Development Region	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt Road						
Eastern	25	150	63	11	17	10
Central	36	28	75	16	9	0
Western	21	150	59	22	13	6
Mid-Western	12	351	51	17	14	18
Far-Western	7	155	48	21	23	9
Total/Avg	N=3912	131	64	16	13	7
Paved road						
Eastern	25	274	21	39	19	21
Central	36	81	35	38	26	1
Western	21	268	28	31	31	10
Mid-Western	12	634	19	17	38	26
Far-Western	7	286	13	30	43	14
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.5. Accessibility levels by ecological belt

Ecological belt	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road						
Mountain	7	677	11	28	26	35
Hill	45	173	44	24	24	9
Tarai	47	6	92	7	1	0
Total/Avg	N=3912	131	64	16	13	7
Paved road						
Mountain	7	1009	2	9	30	59
Hill	45	321	26	18	40	16
Tarai	47	59	31	53	16	0
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.6. Accessibility levels by urban rural location

Urban/ rural	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
<u>Dirt road</u>						
Urban	16.5	3	97	2	1	0
Rural	83.5	156	58	19	16	8
Total/Avg	N=3912	131	64	16	13	7
<u>Paved Road</u>						
Urban	16.5	21	83	14	1	1
Rural	83.5	292	15	38	33	14
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.7. Accessibility levels by NLSS-II sample stratum

Stratum	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road						
Mountain	7	677	11	28	26	35
Urban Kathmandu	6	0	100	0	0	0
Urban Hill	4	8	90	7	3	0
Rural Hill	36	218	30	30	30	11
Urban Tarai	7	1	99	1	0	0
Rural Tarai	41	7	91	8	1	0
Total/Avg	N=3912	131	64	16	13	7
Paved Road						
Mountain	7	1009	2	9	30	59
Urban Kathmandu	6	3	100	0	0	0
Urban Hill	4	24	68	26	5	0
Rural Hill	36	404	10	20	50	21
Urban Tarai	7	11	80	19	0	0
Rural Tarai	41	67	23	59	19	0
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.8. Correlation between access to dirt roads, paved roads and poverty, education, conflict and caste-ethnicity

	Dirt road	Paved road	Per capita expenditure	Education (hh head)	Level of conflict
Dirt road					
Paved road	0.91*				
Per capita expenditure	-0.08*	-0.12*			
Education (hh head)	-0.08*	-0.10*	0.33*		
Level of conflict	0.15*	0.23*	-0.18*	-0.10*	
Chettri	0.13*	0.18*	0.00	0.09*	0.18*
Bahun	-0.08*	-0.09*	0.11*	0.22*	-0.03
AJ	0.08*	0.07*	-0.10*	-0.13*	0.05*
Dalits	0.04*	0.04*	-0.09*	-0.16*	0.05*
Newar	-0.07*	-0.08*	0.21*	0.12*	-0.14*
Other caste	-0.12*	-0.14*	-0.03	-0.02	-0.15*
Muslim	-0.07*	-0.09*	-0.05*	-0.10*	-0.04*

Table 4.9. Accessibility levels by poverty quintile

Quintile	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road						
Poorest	17	205	41	23	26	11
Second	18	158	52	23	17	9
Third	20	151	61	20	12	7
Fourth	22	122	70	15	10	5
Richest	24	51	87	6	5	2
Poor	26	181	43	24	23	9
Nonpoor	74	114	71	13	10	5
Total/Avg	N=3912	131	64	16	13	7
Paved road						
Poorest	17	360	8	29	44	19
Second	18	323	13	34	37	16
Third	20	285	17	41	28	14
Fourth	22	225	27	40	24	10
Richest	24	102	57	26	13	4
Poor	26	339	10	31	42	17
Nonpoor	74	216	32	35	23	10
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.10. Accessibility levels by education level of household head

Stratum	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road						
Illiterate	48	147	58	19	16	7
Primary	27	146	64	16	13	7
Secondary	15	109	70	15	9	6
SLC or more	10	44	86	5	6	3
Total/Avg	N=3912	131	64	16	13	7
Paved road						
Illiterate	48	276	16	39	32	14
Primary	27	265	28	32	28	12
Secondary	15	215	36	32	22	10
SLC or more	10	111	62	18	14	6
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.11. Accessibility levels by caste-ethnic groups

Caste-ethnic group	Weighted sample (%)	Mean (minutes)	% living in different accessibility zones[a]			
			<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road						
Chhetri	17	239	46	20	22	12
Bahun	15	55	69	19	10	2
Adivasi Janajati (all)	32	178	55	19	18	8
-Adivasi Janajati (Hill/Mt)	22	253	39	23	26	12
-Adivasi Janajati (Inner Tarai)	9	16	74	26	0	0
-Adivasi Janajati (Tarai)	1	4	93	7	0	0
Dalits (all)	12	176	58	20	12	10
-Hill Dalits	8	256	43	25	18	15
-Tarai Dalits	4	7	90	9	1	0
Newar	8	43	82	9	6	4
Other caste	12	8	94	4	1	0
Muslim	5	8	86	13	1	0
Total/Avg	N=3912	131	64	16	13	7
Paved Road						
Chhetri	17	447	22	21	33	24
Bahun	15	140	38	32	25	5
Adivasi Janajati	32	299	20	33	33	14
-Adivasi Janajati (Hill/Mt)	22	392	20	22	38	20
-Adivasi Janajati (Inner Tarai)	9	74	23	60	18	0
-Adivasi Janajati (Tarai)	1	166	42	51	7	0
Dalits	12	307	17	38	29	16
-Hill Dalits	8	414	19	28	30	24
-Tarai Dalits	4	81	14	60	27	0
Other caste	12	61	24	59	17	0
Muslim	5	66	31	46	23	0
Total/Avg	N=3912	248	27	34	28	12

[a] The four categories add to 100% in each row.

Table 4.12. Distribution of caste-ethnic groups by accessibility levels

Distance (accessibility) to roads	Weighted %	% in each caste-ethnicity group							
		Chhetri	Bahun	Janajati	Dalits	Newar	Other caste	Muslim	Total
<u>Dirt road</u>									
<=15 minutes	64	12	16	28	11	10	17	7	100
>15 minutes <=1.5 hour	16	21	17	37	14	4	3	4	100
>1.5 hour <=1 day	13	28	11	44	11	4	1	0	100
>1 day	6	30	5	42	18	4	0	0	100
	N=3912	17	15	32	12	8	12	5	100
National mean (minutes)		239	55	178	176	43	8	8	131
<u>Paved road</u>									
<=15 minutes	27	14	21	25	8	16	10	6	100
>15 minutes <=1.5 hour	34	10	14	31	14	4	20	7	100
>1.5 hour <=1 day	28	20	13	38	13	5	7	4	100
>1 day	12	35	7	38	16	4	0	0	100
	N=3912	17	15	32	12	8	12	5	100
National mean (minutes)		447	140	299	307	109	61	66	248

Table 4.13. Variation in family structure variables by accessibility

Family Structure variable	Unit	Mean by accessibility level				
		All sample	<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road						
Married female in household	person	1.4	1.4	1.4	1.3	1.3
Children 19 and under in the household	person	2.8	2.8	2.9	2.9	2.4
Total / Weighted % households	N=3912		64	16	13	7
Paved road						
Married female in household	person	1.4	1.3	1.4	1.4	1.3
Children 19 and under in the household	person	2.8	2.3	3.0	3.0	2.6
Total / Weighted % households	N=3912		27	34	28	12

Table 4.14. % living in different accessibility zones[a]

Conflict variables	Unit	Mean by accessibility level				
		All sample	<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt Road						
Intensity of conflict	scale (1-3)	1.82	1.67	2.09	2.07	2.11
Insurgency related fatalities	persons	77	57	122	78	148
Total / Weighted % households	N=3912		64	16	13	7
Paved Road						
Intensity of conflict	scale (1-3)	1.82	1.51	1.77	2.05	2.11
Mean conflict related fatalities	persons	77	51	57	107	120
Total / Weighted % households	N=3912		27	34	28	12

[a] Data computed from INSEC and NLSS-II data/ Data correspond to the district that the household is located

Table 4.15. Correlation between access to dirt roads, paved roads and other services

	Dirt road	Paved road	Bus stop	Pri-school	Sec-school	Health post	Bank	Market	Co-operative	Post office	Tele-phone	Electr.	Source of dr. water
Dirt Road													
Paved road	0.91**												
Bus stop	0.97**	0.94**											
Pri-school	0.19**	0.21**	0.18**										
Sec school[a]	-0.25**	-0.30**	-0.27**	-0.30**									
Health post	0.18**	0.24**	0.20**	0.38**	-0.39**								
Bank	0.72**	0.73**	0.72**	0.17**	-0.34**	0.28**							
Market	0.66**	0.65**	0.67**	0.16**	-0.29**	0.24**	0.80**						
Cooperative	0.64**	0.68**	0.66**	0.22**	-0.33**	0.31**	0.85**	0.62**					
Post Office	0.27**	0.32**	0.29**	0.31**	-0.34**	0.47**	0.38**	0.28**	0.44**				
Telephone	0.74**	0.71**	0.72**	0.19**	-0.31**	0.25**	0.87**	0.82**	0.72**	0.32**			
Electricity[b]	-0.21**	-0.29**	-0.24**	-0.25**	0.38**	-0.23**	-0.29**	-0.26**	-0.29**	-0.25**	-0.27**		
Water[c]	-0.05**	-0.07**	-0.06**	-0.08**	0.16**	-0.09**	-0.12**	-0.09**	-0.11**	-0.07**	-0.10**	0.33**	
Source of dr. water	0.12**	0.14**	0.13**	0.10**	-0.06**	0.08**	0.12**	0.10**	0.12**	0.08**	0.14**	-0.07**	-0.06**

**p<.001 [a] Secondary school within 30 minutes of the village [b] Household electrified [c] Piped water inside house

Table 4.16. Variation in availability of services by dirt road accessibility

Services	Unit	Mean by accessibility level				
		All sample	<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt road	minutes	131	-	-	-	-
Paved road	minutes	248	64	209	478	1686
Bus-stop	minutes	167	31	96	312	1398
Market	minutes	136	52	142	296	626
Bank	minutes	178	74	191	373	780
Cooperative	minutes	146	57	159	342	584
Telephone	minutes	114	29	119	283	594
Post office	minutes	51	30	71	95	118
Health post	minutes	47	29	67	82	100
Electricity	%	37	51	17	11	3
Drinking water	minutes	4	1	5	12	10
Piped water inside house	%	14	17	8	12	10
Primary school	minutes	17	12	21	30	28
Secondary school within 30 minutes[a]	%	62	78	36	38	25
Total / weighted % households	N=3912		64	16	13	7

[a] Data correspond to the school that serves the community (N=3900)

Table 4.17. Variation in availability of services by paved road accessibility

Services	Unit	Mean by accessibility level				
		All sample	<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Paved road	minutes	248	-	-	-	-
Dirt road	minutes	131	2	11	94	858
Bus-stop	minutes	167	10	37	136	969
Market	minutes	136	22	69	180	483
Bank	minutes	178	33	81	246	630
Cooperative	minutes	146	32	66	206	488
Telephone	minutes	114	9	38	147	493
Post office	minutes	51	20	41	71	104
Health post	minutes	47	20	37	68	85
Electricity	%	37	79	33	16	4
Drinking water	minutes	4	1	2	5	13
Piped water inside house	%	14	35	5	8	12
Primary school	minutes	17	10	15	23	27
Secondary school within 30 minutes[a]	%	62	93	66	43	30
Total / weighted % households	N=3912		27	34	28	12

[a] Data correspond to the school that serves the community (N=3900)

Table 4.18. Correlation between access to dirt roads, paved roads and primary school quality variables

Variable	Dirt road	Paved road
Dirt road		
Paved road	0.91*	
Infrastructural quality	-0.27*	-0.32*
Unscheduled closure	0.41*	0.31*
Teacher as sanctioned	-0.01	-0.01
Female teacher	-0.12*	-0.13*

* $p < 0.05$

Table 4.19. Variation in rural primary school quality by dirt road accessibility [a]

Primary school quality variables	Unit	Mean by accessibility level				
		All sample	<=15 min	>15 min <=1.5 hrs	>1.5 hrs<=1 day	>1 day
Dirt Road						
Mean number of closure per year	days	17	16	10	14	46
Teachers as sanctioned	%	79	80	77	76	76
At least one female teacher in school	%	61	68	60	44	52
Infrastructure quality	scale (1-10)	5.2	5.8	5.0	4.0	3.6
Toilet for girls	%	41	47	35	32	24
Total N / weighted % households	N=2748		57	19	16	8
Paved Road						
Mean number of closure per year	days	17	26	13	10	33
Teachers as sanctioned	%	79	79	79	78	78
At least one female teacher in school	%	61	81	65	53	50
Infrastructure quality	scale (1-10)	5.2	6.4	5.6	4.7	3.6
Toilet for girls	%	41	59	43	36	26
Total N / weighted % households	N=2748		15	38	33	14

[a] Data Correspond to the school that serves the community

Chapter V

The impact of geographical accessibility on school enrolment in Nepal

One of the many people I met during my field trip during the Monsoon of 2006 was a secondary school teacher stationed in a village in Eastern Syangja, He required traveling for about 20 kilometers, roughly equivalent to about 2.5 to 3 hours, on a dirt road and then for about an hour on a paved to reach the district headquarters. His hometown also required an additional hour travel on paved road after the dirt road journey. During the week I was in the village, the teacher had planned to attend a marriage near his hometown. It also happened that the night before his scheduled travel for the marriage, Radio Nepal announced in its news bulletin that the results of the national School Leaving Certificate Examination (SLCE) had been published. While the entire community was eager to learn of the results of the village children who appeared in the exams, there were no other means—neither a telephone was available nearby nor would any bulletins carrying the results reach the village any time soon. The next day after teaching an early morning class, the teacher traveled—thanks to the roads—to attend a marriage and also to get the SLCE results. The teacher could return to his duty station the same day by evening, an unusual travel pattern for teachers stationed in most of rural Nepal. The Mirdi-Jagatbhanjyang-Chapakot road, part of which has been taken up for upgrading under a World Bank funded project, leading to the village where the teacher was stationed had opened up a couple of years ago and had made possible for the teacher to carry out within a day his personal and/or official tasks that required visiting district headquarters or his hometown. This in turn has helped him to be more regular at his duty station, unlike his peers assigned at many remote locations in the country.

Remote villages in many developing countries may be "without adequate teachers for long periods and teachers posted to these locations may take regular unofficial absences" (Porter, Blaufuss and Owusu-Acheampong 2006:3). Teacher absence and irregularity is just one aspect of how isolation can discourage households from sending their children to school in remote villages. There are several other pathways in which isolation may impact household decisions about sending their children to school. In this chapter we enter into examining the main theme of this research project using the NLSS-II cross sectional data, i.e., whether and why accessibility/isolation affects school participation of school aged children. Do children who reside in inaccessible or remoter parts of the country have reduced chances of attending school? Or from the reverse direction, do children who reside in accessible parts of the country have higher chances of attending school? Further, what is it about being remote that hinders the chances of children participating in school? We begin this chapter by presenting a brief school enrolment profile of Nepal *vis a vis* the geographical access households have.

Geographical accessibility and school enrolment

According to the NLSS-II estimates, 79% of children of age group 6-12 are attending school in Nepal. The enrolment rate for the age group 13-19 is 56%, lower by 23 percentage points compared to children 6-12. Of the 21% primary aged children who are not attending school, 2% had attended in the past whereas 19% never joined school. As for the secondary aged children, of the 44% not currently enrolled in school, 20%

never went to school and 24% were enrolled in the past. As we had anticipated, children living in the most inaccessible parts of the country show lower level of enrolments at both age levels (Table 5.1). Children age 6-12 residing over 1½ hours from dirt roads have an enrolment rate of less than 75% compared to over 80% for those living within 1½ hours. For this age group we do not find much difference in enrolment for households which are within 1½ hours. Enrolments are higher for each accessibility level when we use distance to paved road as the accessibility measure. About 89% of the children living within 15 minutes and 79% or less living beyond 15 minutes of paved roads are enrolled.

---Table 5.1 about here---

For the secondary age group the accessibility-enrolment relationship is more linear. We observe a gradual decrease in enrolment as households become more inaccessible. Those living within 15 minutes to dirt roads have an enrolment rate of about 60%, which decreases to 41% for those living more than a day's trip (equivalent to 8 hours). Again, more children are enrolled for each paved road accessibility level. Over two thirds of the children this age group living within 15 minutes are enrolled, which decreases gradually to 49% for those who live over a day's walk. Enrolment rates tend to merge to a lower value when areas become inaccessible either in terms of dirt roads, or paved roads. The differences in enrolment for children having varying accessibility levels is noteworthy and while not yet evidence of a causal connection they certainly justify more detailed research.

Other determinants of school enrolment

In the previous chapters we discerned six specific characteristics of accessibility/isolation in Nepal. One, the overall accessibility level in Nepal is very poor compared to the rest of the world. Two, accessibility in Nepal varied horizontally across spatial locations. Three, it varied vertically across people of different socio-economic status. Four, to be situated in geographically isolated areas meant households there were served by none or distant "socio-economic arrangements" (after Sen, 2000) for attaining human development. One such institution directly related to enrolment was the schools. Five, not only were schools sparsely distributed in isolated areas, they were also of lesser quality. And six, there was substantial intra-village variation in the accessibility level households enjoy. We suspect that many of the above characteristics associated with isolation are also associated with school enrolments. In the following section we look at how each of these factors—locational, socio-economic and institutional (school)—are related to school enrolment.

Locational differences in enrolments

The locational variables reflect different geographical, historical, cultural and political realities in Nepal. In our analysis, three factors capture the locational characteristics associated with the child: the Development Region the child belongs to, the ecological belt the child resides in and whether the child is from an urban or a rural household. Variable 'stratum,' the sampling strata used in NLSS-II captures both urban-rural and ecological belt characteristics.

---Table 5.2 about here---

Development Region: The Western Development Region (WDR) shows the highest school enrolment rate of 92% for the primary age group students. In contrast, the Central Development Region (CDR) shows the lowest rate of 71% for this group. The other three regions, namely the Eastern, the Mid Western and the Far Western Regions (EDR, MWDR and FWDR) have about the same rate of enrolments—80%, 83% and 82 % respectively which are slightly above the national average. Again, the WDR has the best secondary age enrolment rate of 69% and EDR the second best rate of 57%. The MWDR which has on average the poorest accessibility level for households has the poorest enrolments of 46%. The CDR is the second worst with 52% followed by FWDR at 55%, both of which are lower than the national average. The EDR at 57% is slightly above the national average.

Each of Nepal's five development regions comprise the three ecological zones—mountains, hills and Tarai. While the Tarai belts of MWDR and FWDR perform better in terms of enrolments than the hills and mountains there, the Tarais of the western, central, and eastern regions, in particular the central region, perform poorly. Thus the CDR's poorest enrolment also reflects the Tarai's poorest enrolment in the region.

Stratum: The most accessible stratum is Urban Kathmandu which comprises the capital Kathmandu and adjoining cities of Patan and Bhaktapur. Not surprisingly, urban Kathmandu shows very high enrolment rates for both age groups (98 % and 84% respectively). This is followed closely by another accessible strata Urban Hill, the stratum that contains other hill municipalities of Nepal—namely Pokhara, Banepa, Dhulikhel, Byas, Hetaunda, Palpa, Trishuli, Birendranagar, Dipayal, Gorkha, etc. Urban Hill has an enrolment rate of 96 % for primary age and 80% for secondary age. Both

Kathmandu and Urban Hills have acquired near universal enrolment at the primary age level. Enrolment rates for Urban Tarai, also a highly accessible stratum, drops to 86% and 65% for the two age groups respectively.

A clear urban-rural disparity in enrolments and rates unfavorable to the Tarai emerge. All three rural strata—the Mountains, Rural Hills and Rural Tarai—are worse off than the urban areas in both enrolments. Mountains and Rural Tarai have rates much below the national average, but Rural Tarai has the lowest rates for both age groups at 74% and 48% respectively. That the most inaccessible strata—the mountains and rural hills—have lower enrolment rates fits well with our expectation that inaccessibility is detrimental to school enrolment.

However, the accessible Rural Tarai shows poorer enrolment rates is contrary to our expectation that accessibility and school enrolment are positively associated. It is likely that the relatively accessible rural Tarai has some offsetting cultural, social and demographic characteristics that lower enrolments there, while it is also possible that the most inaccessible regions have some compensating characteristics which raise school enrolments there. We suspect that some characteristics specific to rural Tarai are masking the effects of good accessibility on enrolment there, and we will test this later by controlling for the stratum in our regressions. For example, although schools are on average located nearer to households which has been possible due to the good accessibility level, Rural Tarai has much lower secondary schools to pupil ratio. The population of the Tarai continues to grow at a rate much higher than that of the hills and mountains. The Tarai now houses almost half of Nepal's population compared to 38% in 1971 (CBS 2004c). The Education Statistics of Nepal 2003 reveals that schools are relatively well spread geographically in the plains of Tarai but serve more population than the hills and mountains. The district of Chitwan ranks best amongst the Tarai districts on the schools to pupil measure, but even Chitwan stands 37th out of the 75 districts in Nepal. All other 19 Tarai districts rank 48th or lower, with 10 of them—Mahottari, Saptari, Rautahat, Bardiya, Siraha, Sarlahi, Bara, Kapilvastu, Parsa and Kailali—ranking at the bottom ten. All these districts have between 1000 to 1600 secondary aged children per secondary school compared to less than 500 per school for the top ranked 26 districts, which are all from the hills and mountains.

The Tarai region appears more accessible partly due to its plain topography that makes "natural" roads, not just because of systematic interventions. Also Tarai is relatively accessible with respect to the rest of the country partly because of the East West Highway. However the alignment of the highway is more favorable to upper Tarai and foothill towns compared to Southern Tarai. Paved road accessibility in Tarai is far lower compared to dirt road. Tarai is topographically advantaged but is disadvantaged by population. On the other hand, the Mountains and rural hills have a clear topographical disadvantage.

Socio-economic differences in enrolment

There are several potential socio-economic determinants that affect the household level decisions to send children to school in Nepal. The first two are specific to the child—age and sex. Older children and girls are less likely to be enrolled. Other traits are more specific to the households in which the child resides.

--Table 5.3 about here--

Age: For ages six seven and eight, enrolments are 70%, 78% and 81% respectively. Enrolment reaches its highest at age 9 and 10 with about 83% of all children of these ages going to school. The enrolment rates decrease gradually from this age upwards reducing to 58% for children aged 16, and to 29% for children aged 19.

Sex: Boys are significantly more likely to be enrolled in school. For the age group 6-12, boys have an enrolment rate 12 percentage points higher than the girls. At the age group 13-19, boys have rates higher by 18 percentage points.

Caste-ethnic groups: As anticipated, the best performing groups are Bahuns and Newars, which are also the two groups with very good accessibility rates in the country. Bahuns, the priestly caste-group that rank high on the caste-hierarchy, have acquired a near universal enrolment (97%) for the age group 6-12 and 80% for the group 13-19. Newars, who mostly inhabit the accessible Kathmandu Valley, have rates competitive with Bahuns—93% and 73 % respectively. Chettris whose accessibility rates are poorest—an effect coming from their concentration in the poorly accessible areas of MWDR and FWDR—however rank next with rates better than other groups—88% and 66% respectively for the age group 6-12 and 13-19 respectively. We suspect that, the overall social status and networks Chettris enjoy in the hierarchical Hindu society place them in a better position for them to compensate the detrimental effects of poor accessibility on their capability to access schools.

--Table 5.4 about here--

The *Adivasi Janajatis* (Indigenous Nationalities) combined, who also have poor accessibility, show rates close to the national average (79% and 54% respectively) but perform more poorly than the Bahun, Newar and Chettri households. Dalits, whose accessibility level is about the same as that of the *Adivasi Janajatis*, have far lower enrolment rates—70% and 40% respectively for the age group 6-12 and 13-19 respectively. Again we suspect that compared to the Bahuns and Chettris, Dalits' low status in the Hindu hierarchical society prevents them from overcoming the detrimental effects of inaccessibility. Other Caste group and Muslims, both of which inhabit the accessible Tarai region, have even lower rates—despite their better accessibility. Their rates are 68% and 59% respectively for the 6-12 age group and 37% and 13 % respectively for the 13-19 age group. Here again, the low socio-economic status of these groups as well as cultural restrictions may be preventing them from realizing the benefits of improved accessibility for school enrolments.

Household welfare: Poorer households, which also show the poorest average accessibility, register the lowest enrolment rates. The difference is big with the poorest quintile having 6-12 age enrolment rate of 61 %. This rate increases linearly to 95% for the richest quintile. For the age group 13-19, the rates increase from 30% to 76%. Differences in enrolments by poverty groups parallel the differences in accessibility. Recall here that isolated households are the households that on average tend to be poorer and least likely to be sending their children to school. On the other hand, accessible households are the households that tend to be non-poor and are also the households most likely to be sending their children to schools.

--Table 5.5 about here--

Education level: Children coming from households with educated heads show higher enrolment rates. Households whose heads are illiterate have a primary age enrolment of 69%, but this increases gradually to 95% for households whose heads have attained at least an SLC. Similarly, only 43 % of the children between ages 13-19 from households whose head are illiterate are enrolled, but this figure jumps to 79 % for those household whose heads have at least an SLC. Recall here too that the less educated households are also the households that are more isolated. Isolated areas have a higher concentration of families with less educated heads but the most accessible areas have concentration of families with more educated heads.

--Table 5.6 about here--

Family structure: Households with fewer children have higher enrolment rates at both age levels. In particular, households which have two or less children have a primary age enrolment rate of 89%, those having three to five children have a rate of 79% and those having six or more children have an enrolment rate of only 71%. Similarly at the secondary age level, enrolments are 63%, 58% and 43% respectively. Households that tend to be nuclear show a higher enrolment rate at the secondary age level but we find no differences in enrolment at the primary age level.

--Table 5.7 about here--

NLSS-II data shows that having fewer children as well as living in nuclear families is more of an urban trend. Compared to the urban and accessible strata of Urban Kathmandu, Urban Hills and Urban Tarai, households in the most inaccessible parts of the country—in the rural hills and mountains—tend to be joint (more married women) and slightly large (more children). These remote households are also the ones which have low enrolments. However Rural Tarai's accessibility is also associated in similar ways with family structure variables. There the households are the largest and the most non-nuclear in nature and have low enrolment rates as well.

Enabling services: Households which have *water* piped inside the house have higher enrolment rates, 16 percentage points higher for primary and 27 points for secondary aged children. Households which have electricity (as the lighting source) also show an enrolment ratio higher by 20 percentage points and 26 points respectively for the primary and secondary age level. Households that are nearer to roads are also the households that are more electrified and also that have water piped inside the house.

--Table 5.8 about here--

Maoist insurgency: Higher enrolments for the secondary aged children (13-19) are observed for districts that are minimally affected by conflict (62%) compared to those districts moderately affected (53%) and severely affected (51%). These differences are smaller than the caste-ethnicity, income and education differences. For the primary aged, we do not find lower enrolments in the affected areas. In the initial years, the insurgency thrived in a few hilly districts of the Midwestern region. These areas were geographically isolated, and the population there was discontent with the central government because of the associated deprivation. By the time of the NLSS-II survey, the insurgency had spread throughout the country including in accessible areas of the country.

--Table 5.9 about here--

Availability and quality of institutions (schools) and enrolments

Availability of schools: One of the characteristics that we discerned for Nepal was that as remoteness increased fewer and fewer households were served good quality (primary) schools nearby. But we also notice in our sample that households which are served by distant (further than 30 minutes) primary schools have a 20 percentage points lower enrolment rate for the primary age group children, and 15 percentage points lower rate for secondary. Similarly households which are located in villages that do not have a secondary school within than 30 minutes of their residence have an overall primary age and secondary age enrolment lower by 10 and 15 percentage points respectively.

--Table 5.10 about here--

Indeed, there is more than the obvious "distance to school" effect of inaccessibility. Roads not only have the potential to make schools easily accessible for children but they also enable them to travel for extracurricular activities outside of their schools. During my field trip, I asked a secondary aged girl waiting for a bus in the headquarters of Dhading district, where she was headed. She was traveling to Tanahun district headquarters to participate in an educational function (on the occasion of *Bhanu-jayanti*, the birthday of a national poet). Moreover she planned to return the same day, which is by all means an unusual travel pattern for most travelers in rural Nepal.

--Table 5.11 about here--

Primary school infrastructural quality: Rural children nearer to primary schools that have better infrastructures (toilets, classrooms, furniture, *pakki* structures, etc) show a higher enrolment rate and are also the children living closer to roads. Children living in areas served by primary schools having the best infrastructures have a primary age enrolment rate of 94% which is about 15 percentage points higher than the average. This compares with an enrolment rate of 68%, about 11 percentage points lower for children living in areas served by primary schools having the poorest quality infrastructure. A similar trend is found for the secondary aged children when we use primary school quality as a proxy for secondary school quality. Next we discuss some instructional aspects of school quality.

Unscheduled closure: The association between enrolments and unscheduled closures of primary schools is not significant, yet schools that are closed more than the overall average unscheduled closure (17 days per year) are also the schools that are on average located further away from roads.

Teacher availability: Similarly, the relationship between enrolments of children and whether the schools have at least the number of sanctioned teachers is not as we would have expected. About a fifth of the school samples do not have the sanctioned number of teachers, and they are on average located further from roads than those which have the sanctioned number of teachers. But enrolment rates are not lower for schools that do not have the sanctioned number of teachers suggesting that this variable is not affecting enrolments. As we noted in chapter III, this variable may not be the best proxy to measure teacher absence which we suspect to be concentrated more in remoter areas, and also to affect enrolment.

Multivariate analysis

Our discussion thus far confirms that school enrolment in Nepal is correlated with several of the factors that are also correlated with geographical accessibility. We discerned mainly three sets of factors—locational, socio-economic (individual and familial), and institutional. Yet the relationships that we found between these factors, geographical accessibility and enrolment examine each factor separately, without accounting for the possible influence of other factors. It is likely that each variable works in its unique way to affect the accessibility-school participation relationship, providing us good reasons to suspect that part of the accessibility-enrolment relationship we observed are coming from other factors that are also related to accessibility. For example, remoter households are less wealthy, and are less educated, have schools that are located farther away as well as are of lower quality which may reduce the chances of the child's enrolment in school, and could affect the simple bivariate relationship between accessibility and school enrolment.

Thus we will assess the effects of isolation on school enrolment through a series of binary logit regressions modeling the effect of accessibility/isolation on school enrolment. We estimate models separately for two groups—for the younger children age 6-12 (primary age) and for children 13-19 (secondary age). For each group we first estimate a simple bivariate model with only distance to roads as the regressor variable (Model I). We then estimate the model with controls for locational factors (Model II) to assess if locational characteristics of the households are offsetting or compensating any of the accessibility effects on school enrolment. Because they are causally prior to both accessibility as well as enrolments, we will always control them in our regression models. We then control socio-economic factors relevant to the child and his/her household (Model III) to assess the direct effects of inaccessibility separate from the indirect effects that are mediated through poverty and other social factors.

In the next model, we add the institutional control of school availability (Model IV) to see to what extent availability mediates the accessibility-enrolment relationships. For children residing in rural areas, we estimate a fifth model in which we include additional institutional controls that reflect the quality of the closest rural primary school

(Model V), again to assess the extent to which school quality mediates the relationship. We will discuss the changes in the accessibility-enrolment association across each model by comparing the strength and direction of the accessibility coefficients. Our analysis of the NLSS-II shows that roads—both dirt and paved—have significant direct effects on the chances of children getting enrolled in school.

Model I: Simple bivariate relationship between accessibility and enrolment

In the bivariate regressions (presented in Table 5.12 and Table 5.13, Models I), being further away from roads appears to be detrimental for school enrolment for primary as well as secondary aged children. The association between secondary age enrolment and accessibility is statistically significant, but the association between primary enrolment and accessibility is not.

--Table 5.12 about here--

--Table 5.13 about here--

Model II: Controlling for locational factors

In the second model, we include a set of dummies that control for the locational characteristics (development region and stratum) of households. We find that the relationships between accessibility and enrolment become stronger for both age levels. The probability of the children of either age group being enrolled in school reduces significantly as households become more inaccessible. The magnitude of the effect of road access on enrolment increases threefold for children aged 6-12 (-0.015 to -0.044), and the insignificant relationship observed earlier between accessibility and enrolment becomes statistically significant (Table 5.12, Model II). The strength of the relationship for children aged 13-19 increases by two thirds (-0.031 to -0.051) and the significance of the relationship is retained (Table 5.13, Models II). Obviously this is an indication that locations are masking the accessibility effect on school enrolment as we had suspected earlier. Once these social, cultural and demographic differences between the regions are held constant, the effect of accessibility on school participation is more clearly negative.

This model shows that urban Kathmandu has the higher chance of sending its 6-12 age children to school whereas rural Tarai has lower chances. Primary aged children from rest of Nepal do not differ significantly. Secondary aged children from urban Kathmandu followed by those from urban hills have a much higher chance but those from rural Tarai have much lower chances. In terms of development regions, the most advantaged position of primary aged children is in WDR and the most disadvantaged position is in CDR. The other three regions lag behind WDR but are better than CDR, all faring about equal chances of enrolment for primary aged children. For the secondary aged, again WDR shows the best chances. Compared to WDR, CDR and MWDR fare badly, but EDR and FWDR do not differ significantly.

These results of the regressions between accessibility and school participation thus far fit well with the hypothesis we have posed—that having better geographical accessibility increases the probability of children attending school. However the question that we seek to answer is whether geographical accessibility continues to show the same relationship in our successive multivariate models which control for many other crucial determinants of household's school enrolment decision that may also be consequences of inaccessibility. By looking at how accessibility coefficient changes (or does not change) its strength and statistical significance across subsequent models we would be able to understand better why and how accessibility impacts enrolments. The analysis in the next sections helps answer the question of how inaccessibility affects school participation not just whether it affects enrolment. Thus, next we discuss the results of the multivariate analysis that controls for the individual and familial socio-economic characteristics of the child.

Multivariate analysis: Model III- Controlling for socio-economic characteristics

Accessibility continues to have significant positive associations with the probability of the child being enrolled in school after controlling for socio-economic characteristics of the child (Table 5.12 and Table 5.13, Models III). However the accessibility coefficient reduces by about 23% (from -0.044 to -0.034) for the primary aged children suggesting that some of the accessibility association with enrolment is actually a result of the socio-economic differences amongst the children.

The relationship alters in similar ways for the secondary age children. The likelihood of being enrolled in school continues to be lower for children from isolated areas and accessibility continues to show a direct association with school enrolment. Like with primary children, the association between accessibility and enrolment is reduced by 20% (from -0.051 to -0.041) compared to the basic bivariate relationship, suggesting some of the association we observed in the bivariate relationship is being explained by familial and socio-economic characteristics of the child.

After the socio-economic and familial controls, only EDR and CDR continue to lag behind than WDR in terms of primary age enrolment, but the other two regions are no longer statistically different than WDR. For the secondary aged, again WDR shows the best chances. Compared to WDR, CDR and MWDR continue to fare almost as badly. EDR and FWDR also continue not to differ significantly from WDR. In terms of the geographical strata, none are any longer different from each other for both age groups.

The bivariate relationships that we observed between enrolment and the other determinants such as age, sex, household welfare and education level of household head continue to hold true in this model. The intensity of conflict in the child's district however does not seem to have any statistically significant relationship with the chances of the child being enrolled. This means that households from districts exposed to moderate or intense conflict do not behave differently from that of the low conflict areas in terms of sending their children to school. Also, although in the expected direction, having piped water inside the house is not statistically significant. However, having electricity significantly increases the chance of the children being enrolled in school even after controlling for wealth and income. We find that having more number of children in the household is significantly detrimental for the chances of primary age children being enrolled, but it is not detrimental for the secondary age children's enrolment. Also, having more married women in the household increases the chance of the primary age child's enrolment holding constant the number of children, but the relationship is not significant for the secondary age children.

The partial washing away of the effects of accessibility on enrolments on both age groups after these socio-economic controls reveal how inaccessibility may affect enrolments. Households that are remote from roads are also the households that are poorer, less educated, are socially disadvantaged in terms of their caste-ethnic standing, and these are part of the reason why their children have lower enrolments. Further, remoter households are also those households which are least likely to have enabling household level infrastructures such as electricity in their houses. Having these infrastructures frees up time for school for the school aged children by providing more night hours and reducing travel hours spent in fetching water. Yet these results need to be viewed with prudence because our model thus far does not take into account school factors that could also be affecting school enrolments.

In the next two models we look at how much of the impact of accessibility is mediated through a third set of factors. These factors are related to the availability and quality of primary schools. Recall here that on average we find accessible areas served by nearer and better quality schools while the remoter households are served by distant and poor quality schools. Again, we suspect low quality and distant schools are most likely the consequences of inaccessibility, and have detrimental impact on school enrolment. We first test Model IV for the entire sample controlling for school availability.

Multivariate analysis: Model IV including school availability

For the primary age children, in this model controlling for availability of primary and secondary schools, we find the geographical accessibility-enrolment relationship losing its strength further by 18% from -0.034 to -0.028 (Table 5.12 and Table 5.13, Models IV). The relationship is now statistically significant at the 10% level. Primary age enrolment is responsive to having a primary school within less than 30 minutes, but not responsive to having a secondary school within the same distance.

The physical barrier to accessing primary education has been broken to a great extent by placing schools in remoter parts of the country, with only a tenth of the children needing to walk more than 30 minutes to reach a primary school, and a hundredth more than 1½ hours. Remoteness from roads is thus not always associated with remoteness of primary schools. One of the reasons that primary age children in remote areas do not fall far behind than the rest of the country in terms of school enrolment is because they are served well with primary schools. Such a spread of primary schools can be attributed to the lower supply side input (lesser trained teachers, instructional materials and classrooms) needed to establish, operate and maintain a primary school in Nepal. Inaccessibility does not pose as a major barrier in providing such input.

The trend however is different for secondary age level children. Geographical accessibility coefficients continue to remain statistically significant and reduce by only 10% (-0.041 to -0.037) after controlling for availability of primary schools and secondary schools. The association of secondary school availability with probability of enrolment of secondary age children is positively significant in the multivariate model. Although the coefficient for primary school availability is positive, the relationship does not appear to be significant at the 5% level in the multivariate model once secondary school availability is controlled.

Having schools, especially secondary schools, within half an hour walking distance explains some of the effect of geographical accessibility on school enrolment. Households that are remote from roads are also the households that are remote from secondary schools and that is part of the reason why their children have lower enrolments. Again, unlike the low resource demanding primary schools, secondary schools demand much higher resources such as trained teachers, equipment to establish labs, libraries, more classrooms, etc. Providing more resources is greatly facilitated by the presence of roads. This suggests that one of the ways in which providing roads increases enrolments is because secondary schools become closer to needed resources and to the children. Current targets for Nepal are providing at least one higher secondary school per election constituency in the 205 constituencies (National Planning Commission 2003) which indicates the difficulty of running such a school.

Inaccessibility not only acts as a direct physical barrier to the children to reach school but also to the external stakeholders of development whose action can help increase their participation in school in the short and the long run. By making transport of construction material cheaper, faster and less complicated, increased accessibility (through roads) opens up possibilities for newer schools to be constructed nearer to the households. This also enables regular maintenance of older schools, and construction of better sanitary facilities for students and teachers. During my discussions with a school teacher in a village in Dhading, he compared the cases of two schools in his district—one more accessible school had successfully utilized a project grant it received to extend its infrastructures while a remoter one was unable to do so because of longer and complicated transport of raw materials. We can expect, through new and improved schools which are in turn facilitated by improved accessibility, school enrolments to increase and dropouts to decrease.

After the controls for school availability, all locational, familial and socio-economic factors in our model continue to behave like in the earlier model. However compared to the mountains, rural Tarai is again less likely to send its secondary aged children to school.

Multivariate analysis: Model V, including school quality index for rural households

That the secondary age accessibility coefficient is still significant after the scoio-economic and school availability controls suggests that there are still other reasons why access affects enrolments. Next we discuss our final model (Model V), in which we control for three school quality variables—infrastructural quality of school, unscheduled school closure and teacher availability, that are associated with accessibility and may affect enrolment. Amongst these three variables, we find in our sample that the infrastructural quality and teacher availability have significant and positive bi-variate association with school enrolment.

In adding these variables, we limit our sample to rural households because our dataset has information on school quality only for rural primary schools. Table 5.14 and Table 5.15 also provide the results of Models I-IV for this rural sample. These stepwise results are mostly similar to the national results described above, perhaps due to a rural predominance in our sample.

--Table 5.14 about here--

In the final model (Model V) that also controls for the primary school quality variables we find the impact of geographical accessibility further weakened. For the primary aged children the strength is reduced by about one sixth (-0.027 to -0.023), and the relationship is still not statistically significant. The quality of school infrastructure is significantly associated with enrolment. School enrolment continues to be responsive to availability of primary schools. Unscheduled closure and having adequate teachers are not affecting the primary age enrolment-accessibility relationship, and neither of the variables is significant.

--Table 5.15 about here--

For the secondary aged children, the impact of accessibility on enrolment is reduced by 13% (-0.040 to -0.035) but the association between them continues to be statistically significant. The infrastructural quality of the rural primary school is statistically significant. Unscheduled closure and having adequate teachers are not affecting the secondary age enrolment-accessibility relationship. School enrolment for this age level continues to be responsive to availability of secondary schools. Also, in this model, having piped water inside house is beneficial for the primary aged children and becomes statistically significant.

Marginal impacts of accessibility

In this section, we discuss the marginal impacts of accessibility on school enrolment based on the final model for some ideal type children. For example, a rural primary aged child who is average on all other characteristics, for every additional hour she/he needs to travel—essentially on foot—to reach the nearest dirt road, her/his probability of enrolment in secondary school decreases by 0.3%. For such a rural secondary aged child her/his probability of enrolment in secondary school decreases by 0.9% for every additional hour she/he needs to travel. Thus varying household's distance to roads from its minimum of zero to its maximum of 9 days (72 hours equivalent, such as recorded for a very remote mountainous district of Dolpa) decreases the predicted probability of an average rural secondary aged child's enrolment by 42 percent points, from 55% to 13%. Table 5.12 shows the probability of enrolment for different hypothetical types of children. An average secondary age child from rural Nepal has a 53% probability of being enrolled in school. A rural secondary age child living by dirt roads, and served by a school within 30 minutes has a 59% probability. If the child lived 8 hours (a day equivalent) away from roads and had a school within 30 minutes, the probability would drop to 52%. If he lived in the remotest part of the country and still had a nearby school, the chances would be 10% only.

Such a child living by roads, and not served by a school within 30 minutes has a 51% probability of being enrolled in school. If a child lived 8 hours (a day equivalent) away from roads and had no school within 30 minutes, the probability would drop to 47%. If he lived in the remotest part of the country (9 days or 72 hours) and had no nearby school, the chances would be only 8%.

If a child is located by road, is from a household that is above the poverty line, has a head who has at least an SLC, and has a secondary school within 30 minutes of his residence, his/her probability of being enrolled in school is 87%. However a child located 4 hours from road, coming from a family below poverty line and with an illiterate head, and not served by a secondary school within 30 minutes from his/her residence has only a 23% enrolment chance.

--Table 5.16 about here--

Other functional forms of accessibility measures

Our regressions thus far have measured accessibility in terms of hour continuous form. In the next two estimates for all primary aged children and all secondary aged children, we substitute the hour continuous form of the variable by the log continuous functional form. In doing so, we get accessibility coefficients that are consistent with the results obtained when the hour continuous variable was used. The results are presented in Tables 5.17 and 5.18. That the accessibility measured in both functional forms yield similar results indicates the robustness of our result to the accessibility measure.

--Table 5.17 about here--

--Table 5.18 about here--

Next we replace the accessibility measure by four category dummy variables—less than 15 minutes, 15 minutes to 1 ½ hours, 1 ½ hours to one day and more than one day. We perform regressions with the most accessible category as the omitted category. The results of the regressions allow us to parse out the effects of accessibility on enrolments over different accessible zones.

--Table 5.19 about here--

At the primary age level, children within 1½ hours do not differ significantly. Controlling for locational factors, children beyond 1½ hours are affected negatively as inaccessibility increases. After additional controls for socio-economic factors, only children beyond one day continue to be affected negatively. Finally, with controls for school availability, we find no difference amongst children age 6-12 across Nepal in their chances of being enrolled in school as in the results with the continuous measures.

--Table 5.20 about here--

For secondary children, the effect of accessibility is stronger. Controlling for locational factors, children start to be negatively affected with inaccessibility just beyond 15 minutes off the road. After additional controls for socio-economic factors, children beyond 1½ hours still continue to be affected negatively. Finally, with controls for school availability, children beyond 1 day remain to be affected negatively. Although at the 10% significance level, there is also effect of accessibility on enrolment for children living between 1½ hours and 1 day. Clearly, inaccessibility has stronger detrimental impacts on secondary children whether measured continuously or categorically. In table 5.21, we summarize the accessibility coefficients obtained using various functional forms of accessibility.

--Table 5.21 about here--

Corrections for data clustering at the household level

In our estimates thus far we have made adjustments for clustering at the PSU level, but clustering also occurs at the household level which needs to be corrected. Thus, we will now conduct regressions using different weights in an effort to correct for clustering at the household level and compare the accessibility coefficients obtained with the one that we have obtained thus far (shown as Method 1 in Table 5.22). This will allow us to test the robustness of our results to PSU and household clustering effects.

--Table 5.22 about here--

First, we replace the household weight by a new weight obtained by dividing the household weight by the number of children in the respective age group (results shown as as Method 2 in Table 5.22). In doing this we are distributing the household weight amongst the eligible children within the household, such that all children in the household are represented as if they were one child. In this estimate, the magnitude of the accessibility coefficient and the standards error are about the same for the primary aged (--0.029 compared to -0.028). For secondary aged, the magnitude of the accessibility coefficient is smaller (-0.028 compared to -0.037), but the standard error is about the same.

Second, we perform regressions on a sample that randomly retains one child per household. In doing this we will replace the household weight by the individual weight which is obtained by multiplying the household weight by the household size (results shown as Method 3 in Table 5.22). In this estimate, the magnitude of the accessibility coefficient are about the same (-0.026 compared to -0.028) and the standards error are also about the same for the primary aged. For secondary aged, the magnitude of the accessibility coefficient is smaller (-0.026 compared to -0.037) but the standard error is slightly lower. Nevertheless the coefficients remain statistically significant.

While the accessibility coefficient is smaller with adjustment for household clustering, they change in similar ways across different steps of our models compared to the regressions results obtained by adjusting for clustering at the PSU level.

--Table 5.23 here--

The option of randomly retaining one child per household however would mean losing the information for 43% of the primary aged sample and 38% of the secondary aged sample. In the remainder of this dissertation we will estimate our regressions by adjusting for clustering at the PSU level.

Dirt vs. paved road accessibility

Thus far we have spoken about the effect of accessibility on school enrolment by measuring accessibility in terms of the distance required by households to reach the dirt road nearest to them, defined as the roads through which at least a tractor can pass at least one season of the year. In the previous chapter we noted a high degree of positive correlation (over 0.90) between distance to dirt road measure and the distance to nearest paved road measure as reported by households, and reviewed accessibility in Nepal in terms of both these measurements. Also recall here that where the road nearest to the house is paved, or a paved and dirt road are at the same distance we have given the value of reported distance to paved road as the measure of accessibility. Thus, distance to dirt road is essentially the distance to any road from the household. Also recall here (Table 4.3) that about 27 % of the households reside within 15 minutes of both these roads and about 60% within 1½ hours of both these roads. About 6% live over a day away from both kind of roads, and about a fifth of the households are at least 1½ hours away from both these roads. About three quarters are nearer to dirt roads than paved roads. A substantial portion (18%) also resides within 1½ hours of the dirt roads but further than 1½ hours of paved roads, indicating their better accessibility to the dirt roads.

Like dirt roads, we noted early in this chapter that children living furthest from paved roads show the lowest level of enrolments at both age levels. Next we carry out regressions by substituting dirt road hour continuous measure by paved road hour continuous measure. In these regressions, we control for the mode of travel—foot, bicycle, motorized and mixed—to reach paved roads as 40% of the measures time taken by non-foot mode.

--Table 5.24 about here--

--Table 5.25 about here--

In the regressions, we find paved road accessibility behaving mostly in similar ways like dirt road accessibility across the models. That is, the relationship of paved road access with primary age enrolment is not significant at the bivariate level. Controlled for locations, the relationship becomes statistically significant. The relationship retains its statistical significance the socioeconomic controls. Unlike for dirt roads accessibility, the relation holds even after controlling for school availability. For secondary aged children, the accessibility coefficients are negative and statistically significant, and alter their strength similarly across all models. That the accessibility measured in both aspects yield similar results indicates the robustness of our result to the accessibility measures.

The overall strength of dirt road coefficient, as compared in Table 5.21, is higher across all models for both age groups. This is to be read as being away from dirt roads by a certain distance is more detrimental than being away from the same distance from paved roads.

--Table 5.26 about here--

Given that both measures show accessibility's detrimental effect on school enrolment, we will test the models to assess the effect of both kinds of roads on accessibility by placing both accessibility measures as the explanatory variables. When included in the same model, we find the effect of accessibility to be insignificant in the basic (Model II) as well as the full multivariate model (Model IV) for both primary and secondary age groups.

--Table 5.27 about here--

--Table 5.28 about here--

The high collinearity between these two measures does not allow us to test the impact of each of these roads as variables in the same equation. Standard errors of these measures are inflated (almost twice as high) compared to models that include only one of the accessibility measures, making the results as regards to the accessibility-enrolment relationship inconclusive.

As noted earlier in this dissertation, very different kinds of political economies exist in Nepal for the two kinds of roads. The impressive construction of the dirt roads in Nepal villages reflects a desire of inaccessible villages (the periphery) to be linked to the external world. In contrast, the higher quality roads have generally spread from the capital and regional headquarters towards the districts, and in majority of situations stopped there. Despite differing political economies, there are advantages to be accessible by both types of roads. With better operability, indeed the paved roads have the potential for more and reliable traffic compared to the dirt roads. However traffic volume and traffic regularity in Nepal is not only a function of road quality, and vehicles can be seen plying all kinds of roads. As in other rural parts of the developing world, even low and irregular traffic movement improves accessibility of rural households tremendously.

Given this, from the next chapter onwards we will test the models with dirt (any) road accessibility measured in hour continuous form as our access variable. In doing this we also have a couple of advantages. One, we avoid the risk of underreporting the accessibility level of households which could be the case if we take distance to paved roads as our accessibility measure. Two, we also avoid the problem of access measure being responsive to the mode of travel because 99.4% of the reported times for dirt roads are by foot, unlike the paved road in which only about three fifths are foot mode.

Discussion

We infer from our multivariate analysis —based on both the full sample which considers school availability and the rural sample which considers both availability and quality of school—that the likelihood of school enrolment decreases significantly as households become more inaccessible. Given this impact of isolation on school enrolment, we ask, what is it about isolation in particular that prevents children from attending school in Nepal? Our analysis reveals that isolated children are less likely to be enrolled in part because they are poorer, from less educated households and come from disadvantaged caste/ethnic families. Another reason why they have lower chances of enrolment is because they are poorly served by enabling non-school infrastructures such as electricity. Furthermore and most importantly, such households are also served by distant and low quality schools. In case of the secondary children, accessibility continues to have a direct and independent effect even after we take into account the effect of many of the crucial determinants of school enrolment. This suggests that isolation operates in some additional unexplained manner—above and over their familial, socio-economic and institutional disadvantages—to decrease the chances of the secondary age child participating in school.

It is our contention that inaccessibility operates in obvious and subtle ways to induce/exacerbate the effect of the socio-economic and institutional barriers on school enrolment. Inaccessibility may affect enrolments for several reasons. First, inaccessibility causes household poverty and has hindered adults' education both of which reduce children's enrolments. Second, inaccessibility directly makes schools harder to attend because schools are sparsely distributed. Third, inaccessibility also lowers school quality which discourages households from sending their children to school. Fourth, inaccessibility not only affects the distribution and quality of schools, but also other enabling infrastructures such as electricity. And five, there may be some other unexplained mechanisms in which inaccessibility affects enrolments.

As we noted earlier, our measures of school quality are not adequate to capture the school context such as teacher absence, text book and supply availability, class-room size, etc. In addition, an unexplained reason why inaccessibility may be affecting school enrolments is the households' poor social networks and ties outside of their communities. Isolation, poverty and lack of services in the remote areas together tend to form a vicious cycle for the remote households making them unable to value the importance of education, and to demand more schools. Having roads has the potential to break such vicious cycle because "physical" roads serve as "social" networks for households, by extending their reach to the external world.

A local businessman with whom I spoke with in Malyangkot village of Syangja during my field work had this to say about how roads had affected him, "I no longer know who gets into the village and who goes out." One may sense disempowerment of the rural elite in this statement, but on the other hand it also reflects how roads had increased the level of mobility of many villagers and those visiting the village such as teachers, NGO workers and researchers alike. In the same village I attended a marriage in which the groom and the procession arrived and returned the same day by road. Until the roads passed, this would not be possible. Also a fellow passenger on my return trip was unhappy the vehicles had to return without any local produce to the main markets. What he did not realize was that the same vehicle was carrying people—a teacher visiting his hometown, a small child going to school, a couple of people headed to the district headquarters, and a couple headed to Kathmandu. Not to mention it also carried outsiders such as this researcher. Through the carriage of people the road was helping to connect the village with the rest of the world.

Indeed, roads enable external actors to reach rural areas, and also provide cheaper, easier and convenient paths for the villagers to increase their ties and interaction with the external world. More interaction with the external world means education becomes more important. Roads help break the isolation not only in the material sense that we have discussed thus far but also in the non-material sense. A sense of connection to the rest of the world and the increased social capital due to increased ties and interaction may bring attitudinal changes with them. This includes the increased ability to value the importance of education, awareness about the need to send their children to school and also work towards having more and quality schools in their villages. Parents' values may change because their world has changed. Education now is more important for their children's success than it was before being connected. Also their children are likely to have a better chance of using their education to get better jobs.

We see from our analysis that access to dirt roads has almost equal impact on school enrolment compared to access to paved roads. This indicates that quality of roads may not be a crucial determinant for social returns as it is with economic returns. For enabling human development in isolated areas of Nepal providing basic physical access in the forms of simple roads may be a priority than having higher quality access.

To summarize, accessibility has significant direct impact on the chances of children attending school. From the perspective of educational benefits (school attendance), road building programs in Nepal will have positive impacts for households living in inaccessible parts of the country. In the next two chapters we will examine if the benefit of roads differ by different social groups. First we will look at differences in enrolment by gender and then across poor and non-poor households.

Table 5.1. Mean enrolment % by dirt (any) and paved road accessibility

Accessibility level	Dirt (any) roads				Paved roads			
	Age group (6-12)		Age group (13-19)		Age group (6-12)		Age group (13-19)	
	Weighted %	Mean	Weighted %	Mean	Weighted %	Mean	Weighted %	Mean
<= 15 minutes	63	80	65	60	22	89	27	67
>15 min <= 1.5 hrs	18	83	17	52	36	79	33	54
>1.5 hrs <1day	14	74	13	51	31	74	29	51
> 1 day	6	75	5	41	11	79	11	49
	N= 3741	79	N=3082	56	N= 3741	79	N=3082	56

Table 5.2. Mean enrolment % by regions and strata

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
Development Region				
Eastern	23	80	24	57
Central	37	71	35	52
Western	20	92	20	69
Mid-Western	13	83	12	46
Far-Western	8	82	9	55
Chi Square	93.77***		58.92***	
df	4		4	
Cramer's V	0.16		0.14	
Sampling Strata				
Mountain	7	81	7	52
Urban Kathmandu	3	98	5	84
Urban Hill	3	96	3	80
Rural Hill	35	82	36	59
Urban Tarai	5	86	8	65
Rural Tarai	46	74	42	48
Chi Square	124.79***		170.56***	
df	5		5	
Cramer's V	0.18		0.24	
Rural Urban				
Rural	88	78	84	53
Urban	12	92	16	75
Chi Square	87.02***		128.66***	
df	1		1	
Cramer's V	0.15		0.20	

Table 5.3. Mean enrolment % by age and sex

Age		Weighted %	Mean	Boys	Girls
Primary aged (6-12)		N=3741	79	85	73
Age					
Six		15	70	75	66
Seven		14	78	87	70
Eight		15	81	86	75
Nine		13	83	88	78
Ten		15	83	88	78
Eleven		11	82	89	73
Twelve		16	80	86	73
	Chi Square	35.80***			
	df	6			
	Cramer's V	0.10			
Secondary aged (13-19)		N=3082	56	65	48
Thirteen		14	77	84	69
Fourteen		15	71	78	65
Fifteen		17	66	76	55
Sixteen		15	58	66	48
Seventeen		12	47	58	36
Eighteen		15	36	42	32
Nineteen		11	29	36	24
	Chi Square	298.42***			
	df	6			
	Cramer's V	0.31			
Sex					
Boy		51.7	85	48.5	65
Girl		48.3	73	51.6	48
	Chi Square	71.24***		82.64***	
	df	1		1	
	Cramer's V	0.14		0.16	

*** p< .001*

Table 5.4. Mean enrolment % by caste-ethnic group

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
Bahun	12	97	16	80
Newar	5	93	7	73
Chettri	16	88	17	66
Adivasi Janajati	33	79	35	54
Dalit	12	70	11	40
Other Caste	13	68	10	37
Muslim	8	59	5	13
Chi Square	272.71***		353.53**	
df	6		6	
Cramer's V	0.27		0.34	

Table 5.5. Mean enrolment % by household poverty level

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
Poorest	24	61	16	30
Second	23	74	20	42
Third	20	88	20	54
Fourth	19	91	23	68
Richest	14	95	22	76
Chi Square	398.90***		364.86***	
df	4		4	
Cramer's V	0.33		0.34	
Below poverty line (poor)	37	65	26	35
Above poverty line (non-poor)	63	88	74	63
Chi Square	307.26**		213.11**	
df	1		1	
Cramer's V	-0.29		-0.26	

Table 5.6. Mean enrolment % by household head's education

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
Illiterate	50	69	47	43
Primary	27	86	30	62
Upto class ten	15	94	14	75
SLC or above	7	95	9	79
Chi Square	258.85***		264.86***	
df	3		3	
Cramer's V	0.26		0.29	

Table 5.7. Mean enrolment % by family structure

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
<u>Number of children (<=19 years)</u>				
Two or less	17	89	24	63
Three to five	64	80	58	58
More than five	19	71	18	43
Chi Square	76.24***		61.20***	
df	2		2	
Cramer's V	-0.14		-0.14	
<u>Number of married women</u>				
None	1	45	1	41
One	61	80	50	64
More than One	38	79	49	48
Chi Square	22.36***		77.54***	
df	2		2	
Cramer's V	0.08		0.16	

*** *p< .001*

Table 5.8. Mean enrolment % by water, electricity and school availability

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
Water piped inside the house				
Yes	11	94	15	79
No	89	78	85	52
Chi Square	72.14***		167.50**	
df	1		1	
Cramer's V	0.14		0.23	
Households with electricity				
Yes	32	93	39	72
No	68	73	61	46
Chi Square	218.92***		244.26***	
df	1		1	
Cramer's V	0.24		0.28	

*** *p< .001*

Table 5.9. Mean enrolment % by intensity of conflict

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Entire sample	N=3741	79	N=3082	56
Low	32	76	36	62
Moderate	49	81	45	53
Intense	19	81	19	51
Chi Square	4.72+		40.14***	
df	2		2	
Cramer's V	0.04		0.11	

*+ p< .10, ***p< .001*

Table 5.10. Mean enrolment % by school availability

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Time to primary school				
<=30 minutes	91	81	92	57
>30 minutes	9	61	8	42
Chi Square	94.18***		30.21***	
Df	1		1	
Cramer's V	0.16		0.10	
Time to secondary school				
<=30 minutes	40	84	62	62
>30 minutes	60	73	38	47
Chi Square	78.23***		91.34***	
df	1		1	
Cramer's V	0.15		0.17	

*** *p< .001*

Table 5.11. Mean enrolment % by primary school quality indicators

Variable	Age 6-12		Age 13-19	
	Weighted %	Mean	Weighted %	Mean
Quality index of rural primary school				
0-2	16	68	17	42
2-5	40	76	37	50
5-8	38	81	39	55
8-10	6	94	8	74
Chi Square	60.98***		46.31**	
df	3		3	
Cramer's V	0.15		0.15	
Unscheduled closure				
closure<mean (17 days)	81	80	82	49
closure>mean	19	77	18	53
Chi Square	2.55		2.78	
df	1		1	
Cramer's V	-0.03		0.04+	
Teacher availability				
as per sanctioned	79	77	77	51
less than sanctioned	21	82	23	57
Chi Square	7.78***		4.94**	
df	1		1	
Cramer's V	-0.05		-0.05	

*+ p< 0.1, * p< .05, ** p< .01, *** p< 0.001*

Table 5.12. Logistic regression of school enrolment on dirt road accessibility (all children age 6-12)

Variables	Model I	Model II	Model III	Model IV
Distance to dirt road (hours)	-0.015	-0.044**	-0.034*	-0.028+
	(0.011)	(0.017)	(0.013)	(0.016)
Development region (Western omitted)				
Eastern		-0.915**	-0.767**	-0.722*
		(0.328)	(0.295)	(0.306)
Central		-1.581**	-1.483**	-1.430**
		(0.316)	(0.295)	(0.303)
Mid Western		-0.632*	-0.474	-0.516
		(0.300)	(0.383)	(0.395)
Far Western		-0.804*	-0.697	-0.698
		(0.370)	(0.432)	(0.444)
Stratum (Mountain omitted)				
Urban Kathmandu		2.246**	0.254	-0.029
		(0.664)	(0.684)	(0.693)
Urban Hill		0.966	0.465	0.237
		(0.587)	(0.661)	(0.681)
Rural Hill		-0.418	-0.032	0.011
		(0.310)	(0.290)	(0.294)
Urban Tarai		-0.180	-0.472	-0.674
		(0.437)	(0.437)	(0.454)
Rural Tarai		-0.888**	-0.410	-0.564+
		(0.298)	(0.316)	(0.326)
Age of child (Age six omitted)				
Seven			0.597**	0.611**
			(0.181)	(0.181)
				contd …

Variables	Model I	Model II	Model III	Model IV
Eight			0.735**	0.748**
			(0.157)	(0.159)
Nine			0.931**	0.950**
			(0.191)	(0.190)
Ten			0.832**	0.846**
			(0.189)	(0.190)
Eleven			0.716**	0.756**
			(0.196)	(0.197)
Twelve			0.463*	0.500*
			(0.194)	(0.196)
Boys			0.882**	0.892**
			(0.116)	(0.115)
Caste-ethnic group (Bahun omitted)				
Chhetri			-1.201**	-1.149*
			(0.445)	(0.456)
Adivasi Janajati			-1.343**	-1.327**
			(0.377)	(0.402)
Dalit			-1.729**	-1.749**
			(0.382)	(0.408)
Newar			-0.647	-0.672
			(0.518)	(0.531)
Other caste			-2.072**	-2.096**
			(0.383)	(0.404)
Muslim			-2.282**	-2.303**
			(0.431)	(0.449)
				contd …

Variables	Model I	Model II	Model III	Model IV
Household per capita expenditure (NRs. logged)			1.153**	1.077**
			(0.167)	(0.169)
Education level of household head (0-15)			0.122**	0.122**
			(0.024)	(0.025)
Number of children <=19 in household			-0.108**	-0.109**
			(0.037)	(0.037)
Number of married female in household			0.222**	0.220**
			(0.078)	(0.079)
Water piped inside house			0.294	0.369
			(0.302)	(0.276)
Lighting source is electricity			0.814**	0.753**
			(0.237)	(0.236)
Intensity of Maoist conflict (Low omitted)				
Moderate			0.128	0.044
			(0.206)	(0.190)
Intense			-0.029	-0.034
			(0.418)	(0.383)
Primary school within 30 minutes				0.876**
				(0.249)
Secondary school within 30 minutes				0.174
				(0.191)
Constant	1.384**	3.022**	-7.704**	-7.816**
	(0.099)	(0.405)	(1.594)	(1.646)
Pseudo R-squared	0.00	0.07	0.26	0.27
Observations	3728	3728	3728	3728

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.13. Logistic regression of school enrolment on dirt road accessibility (all children age 13-19)

Variables	Model I	Model II	Model III	Model IV
Distance to dirt road (hours)	-0.031**	-0.051**	-0.041**	-0.037**
	(0.011)	(0.015)	(0.012)	(0.012)
Development region (Western omitted)				
Eastern		-0.382+	-0.258	-0.232
		(0.195)	(0.189)	(0.187)
Central		-0.939**	-1.100**	-1.082**
		(0.172)	(0.180)	(0.183)
Mid Western		-0.829**	-0.942**	-0.981**
		(0.217)	(0.251)	(0.242)
Far Western		-0.454	-0.560	-0.551
		(0.299)	(0.356)	(0.356)
Stratum (Mountain omitted)				
Urban Kathmandu		1.459**	0.302	0.129
		(0.315)	(0.375)	(0.390)
Urban Hill		0.629*	-0.272	-0.464
		(0.292)	(0.370)	(0.379)
Rural Hill		-0.101	-0.175	-0.179
		(0.244)	(0.253)	(0.261)
Urban Tarai		0.049	-0.502	-0.694+
		(0.274)	(0.349)	(0.361)
Rural Tarai		-0.665**	-0.542+	-0.669*
		(0.239)	(0.283)	(0.291)
Age of child (Age 13 omitted)				
Fourteen			-0.122	-0.109
			(0.176)	(0.175)

contd …

Variables	Model I	Model II	Model III	Model IV
Fifteen			-0.526**	-0.521**
			(0.170)	(0.170)
Sixteen			-1.147**	-1.143**
			(0.162)	(0.164)
Seventeen			-1.861**	-1.873**
			(0.184)	(0.184)
Eighteen			-2.161**	-2.176**
			(0.186)	(0.186)
Nineteen			-2.909**	-2.921**
			(0.191)	(0.191)
Boys			0.870**	0.870**
			(0.109)	(0.110)
Caste-ethnic group (Bahun omitted)				
Chhetri			-0.268	-0.186
			(0.233)	(0.229)
Adivasi Janajati			-0.670**	-0.595**
			(0.208)	(0.208)
Dalit			-1.353**	-1.358**
			(0.235)	(0.234)
Newar			-0.568+	-0.535+
			(0.310)	(0.306)
Other caste			-1.750**	-1.748**
			(0.243)	(0.242)
Muslim			-2.863**	-2.887**
			(0.358)	(0.345)

contd …

Variables	Model I	Model II	Model III	Model IV
Household per capita expenditure (NRs. logged)			0.778**	0.737**
			(0.160)	(0.160)
Education level of household head (0-15)			0.091**	0.089**
			(0.017)	(0.017)
Number of children <=19 in household			-0.009	-0.010
			(0.039)	(0.039)
Number of married female in household			0.059	0.057
			(0.070)	(0.070)
Water piped inside house			0.216	0.222
			(0.189)	(0.188)
Lighting source is electricity			0.530**	0.442**
			(0.147)	(0.151)
Intensity of Maoist conflict (Low omitted)				
Moderate			-0.286+	-0.277+
			(0.150)	(0.145)
Intense			-0.087	-0.051
			(0.261)	(0.251)
Primary school within 30 minutes				0.463+
				(0.237)
Secondary school within 30 minutes				0.362*
				(0.144)
Constant	0.304**	1.143**	-4.856**	-5.049**
	(0.065)	(0.272)	(1.574)	(1.574)
Pseudo R-squared	0.00	0.06	0.31	0.31
Observations	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.14. Logistic regression of school enrolment on dirt road accessibility (rural children age 6-12)

Variables	Model I	Model II	Model III	Model IV	Model V
Distance to dirt road (hours)	-0.009	-0.043**	-0.033*	-0.027+	-0.023
	(0.011)	(0.016)	(0.014)	(0.016)	(0.016)
Development region (Western omitted)					
Eastern		-1.053**	-0.828**	-0.788*	-0.788*
		(0.334)	(0.316)	(0.327)	(0.341)
Central		-1.680**	-1.525**	-1.470**	-1.429**
		(0.326)	(0.316)	(0.324)	(0.333)
Mid Western		-0.697*	-0.521	-0.563	-0.480
		(0.307)	(0.402)	(0.415)	(0.438)
Far Western		-0.881*	-0.700	-0.711	-0.537
		(0.378)	(0.450)	(0.465)	(0.491)
Stratum (Mountain omitted)					
Rural Hill		-0.417	-0.017	0.024	0.046
		(0.311)	(0.295)	(0.300)	(0.311)
Rural Tarai		-0.858**	-0.338	-0.484	-0.545
		(0.298)	(0.322)	(0.333)	(0.348)
Age of child (Age six omitted)					
Seven			0.571**	0.586**	0.577**
			(0.191)	(0.192)	(0.193)
Eight			0.747**	0.758**	0.761**
			(0.163)	(0.165)	(0.167)
Nine			0.890**	0.908**	0.914**
			(0.198)	(0.197)	(0.198)
Ten			0.833**	0.845**	0.850**
			(0.197)	(0.199)	(0.195)
					contd...

Variables	Model I	Model II	Model III	Model IV	Model V
Eleven			0.721**	0.765**	0.773**
			(0.207)	(0.209)	(0.210)
Twelve			0.481*	0.514*	0.521*
			(0.204)	(0.206)	(0.207)
Boys			0.897**	0.909**	0.921**
			(0.122)	(0.121)	(0.120)
Caste-ethnic group (Bahun omitted)					
Chhetri			-1.196*	-1.139*	-1.001*
			(0.485)	(0.495)	(0.479)
Adivasi Janajati			-1.408**	-1.399**	-1.283**
			(0.405)	(0.431)	(0.427)
Dalit			-1.730**	-1.762**	-1.627**
			(0.413)	(0.440)	(0.431)
Newar			-0.599	-0.629	-0.627
			(0.551)	(0.563)	(0.553)
Other caste			-2.157**	-2.186**	-2.026**
			(0.413)	(0.434)	(0.435)
Muslim			-2.339**	-2.366**	-2.179**
			(0.461)	(0.480)	(0.480)
Household per capita expenditure (NRs. logged)			1.143**	1.070**	1.061**
			(0.173)	(0.177)	(0.178)
Education level of household head (0-15)			0.133**	0.132**	0.130**
			(0.026)	(0.027)	(0.027)
Number of children <=19 in household			-0.100*	-0.101*	-0.100*
			(0.039)	(0.039)	(0.040)
					contd…

Variables	Model I	Model II	Model III	Model IV	Model V
Number of married female in household			0.214**	0.213**	0.218**
			(0.081)	(0.081)	(0.083)
Water piped inside house			0.620	0.709*	0.707*
			(0.384)	(0.343)	(0.329)
Lighting source is electricity			0.813**	0.747**	0.719**
			(0.262)	(0.260)	(0.258)
Intensity of Maoist conflict (Low omitted)					
Moderate			0.132	0.043	0.076
			(0.212)	(0.196)	(0.192)
Intense			-0.023	-0.037	-0.031
			(0.442)	(0.405)	(0.384)
Primary school within 30 minutes				0.886**	0.843**
				(0.256)	(0.241)
Secondary school within 30 minutes				0.144	0.094
				(0.194)	(0.192)
Quality of primary school					0.088*
					(0.041)
Pri school unscheduled closure					0.025
					(0.252)
Pri teacher as per sanctioned					0.070
					(0.234)
Constant	1.262**	3.079**	-7.647**	-7.769**	-8.309**
	(0.105)	(0.411)	(1.679)	(1.741)	(1.752)
Pseudo R squared	0.00	0.06	0.25	0.26	0.27
Observations	2864	2864	2864	2864	2864

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.15. Logistic regression of school enrolment on dirt road accessibility (rural children age 13-19)					
Variables	Model I	Model II	Model III	Model IV	Model V
Distance to dirt road (hours)	-0.020+	-0.049**	-0.043**	-0.040**	-0.035**
	(0.010)	(0.014)	(0.012)	(0.012)	(0.012)
Development region (Western omitted)					
Eastern		-0.471*	-0.396*	-0.365+	-0.350+
		(0.213)	(0.196)	(0.194)	(0.204)
Central		-1.041**	-1.233**	-1.209**	-1.195**
		(0.187)	(0.191)	(0.196)	(0.203)
Mid Western		-0.826**	-1.009**	-1.057**	-1.035**
		(0.226)	(0.270)	(0.259)	(0.258)
Far Western		-0.559+	-0.680+	-0.661+	-0.587
		(0.333)	(0.393)	(0.395)	(0.404)
Stratum (Mountain omitted)					
Rural Hill		-0.121	-0.218	-0.228	-0.254
		(0.251)	(0.276)	(0.288)	(0.295)
Rural Tarai		-0.640**	-0.553+	-0.692*	-0.772*
		(0.245)	(0.315)	(0.325)	(0.343)
Age of child (Age 13 omitted)					
Fourteen			-0.142	-0.135	-0.156
			(0.192)	(0.192)	(0.193)
Fifteen			-0.630**	-0.633**	-0.634**
			(0.186)	(0.187)	(0.187)
Sixteen			-1.204**	-1.205**	-1.217**
			(0.179)	(0.181)	(0.183)
Seventeen			-2.045**	-2.070**	-2.088**
			(0.208)	(0.209)	(0.209)

contd…

Variables	Model I	Model II	Model III	Model IV	Model V
Eighteen			-2.143**	-2.160**	-2.172**
			(0.212)	(0.213)	(0.214)
Nineteen			-3.208**	-3.236**	-3.267**
			(0.225)	(0.226)	(0.224)
Boys			0.987**	0.987**	0.992**
			(0.127)	(0.127)	(0.128)
Caste-ethnic group (Bahun omitted)					
Chhetri			-0.293	-0.190	-0.135
			(0.278)	(0.273)	(0.269)
Adivasi Janajati			-0.654**	-0.568*	-0.545*
			(0.237)	(0.236)	(0.234)
Dalit			-1.392**	-1.395**	-1.361**
			(0.267)	(0.265)	(0.264)
Newar			-0.729+	-0.694+	-0.732+
			(0.399)	(0.397)	(0.392)
Other caste			-2.003**	-2.006**	-1.930**
			(0.299)	(0.297)	(0.295)
Muslim			-3.188**	-3.222**	-3.091**
			(0.446)	(0.429)	(0.441)
Household per capita expenditure (NRs. logged)			0.851**	0.801**	0.796**
			(0.192)	(0.193)	(0.195)
Education level of household head (0-15)			0.100**	0.097**	0.098**
			(0.020)	(0.020)	(0.020)
Number of children <=19 in household			-0.007	-0.008	-0.004
			(0.044)	(0.044)	(0.044)
					contd...

Variables	Model I	Model II	Model III	Model IV	Model V
Number of married female in household			0.064	0.060	0.059
			(0.078)	(0.078)	(0.079)
Water piped inside house			0.238	0.240	0.240
			(0.238)	(0.236)	(0.240)
Lighting source is electricity			0.412*	0.327+	0.288+
			(0.168)	(0.171)	(0.173)
Intensity of Maoist conflict (Low omitted)					
Moderate			-0.376*	-0.376*	-0.345*
			(0.174)	(0.167)	(0.171)
Intense			-0.187	-0.156	-0.094
			(0.280)	(0.270)	(0.266)
Primary school within 30 minutes				0.462+	0.427+
				(0.253)	(0.244)
Secondary school within 30 minutes				0.380*	0.335*
				(0.152)	(0.148)
Quality of primary school					0.070*
					(0.035)
Pri school unscheduled closure					0.142
					(0.211)
Pri teacher as per sanctioned					0.044
					(0.179)
Constant	0.133+	1.175**	-5.296**	-5.391**	-5.836**
	(0.078)	(0.285)	(1.892)	(1.893)	(1.905)
Pseudo R squared	0.00	0.04	0.31	0.32	0.32
Observations	2154	2154	2154	2154	2154

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.16. Ideal types of secondary age children and estimated probabilities of enrolment

Ideal type (all other variables at mean)	Probability of enrolment (95% CI)
The "average" rural child	0.53 (0.50 0.56)
By the road, school within 30 minutes	0.59 (0.54 0.64)
4 hrs from road, school within 30 minutes	0.56 (0.51 0.60)
8 hrs from road, school within 30 minutes	0.52 (0.47 0.58)
16 hrs from road, school within 30 minutes	0.45 (0.36 0.54)
72 hrs from road, school within 30 minutes	0.10 (-0.05 0.26)
By road, school further than 30 minutes	0.51 (0.45 0.56)
4 hrs from road, school further than 30 minutes	0.47 (0.42 0.52)
8 hrs from road, school further than 30 minutes	0.44 (0.38 0.50)
16 hrs from road, school further than 30 minutes	0.37 (0.29 0.46)
72 hrs from road, school further than 30 minutes	0.08 (-0.04 0.19)
By road, non-poor, SLC educated head, school within 30 minutes	0.87 (0.83 0.92)
4 hrs from road, poor, illiterate head, school further than 30 minutes	0.23 (0.19 0.27)
16 hrs from road, poor, illiterate head, school further than 30 minutes	0.16 (0.12 0.21)

Table 5.17. Logistic regression of school enrolment on dirt road accessibility (all children age 6-12), using log functional from

Variables	Model I	Model II	Model III	Model IV
Distance to dirt road (minutes logged)	-0.058+	-0.242**	-0.105*	-0.075
	(0.034)	(0.057)	(0.052)	(0.053)
Development region (Western omitted)				
Eastern		-0.748*	-0.714*	-0.688*
		(0.329)	(0.298)	(0.311)
Central		-1.506**	-1.414**	-1.375**
		(0.303)	(0.288)	(0.299)
Mid Western		-0.564+	-0.521	-0.566
		(0.303)	(0.398)	(0.410)
Far Western		-0.524	-0.614	-0.639
		(0.378)	(0.434)	(0.448)
Stratum (Mountain omitted)				
Urban Kathmandu		1.556*	0.200	-0.022
		(0.704)	(0.696)	(0.715)
Urban Hill		0.551	0.512	0.324
		(0.632)	(0.688)	(0.705)
Rural Hill		-0.294	0.152	0.180
		(0.307)	(0.291)	(0.300)
Urban Tarai		-0.871+	-0.494	-0.631
		(0.515)	(0.463)	(0.486)
Rural Tarai		-1.410**	-0.425	-0.521
		(0.381)	(0.365)	(0.376)
Age of child (Age six omitted)				
Seven			0.617**	0.628**
			(0.180)	(0.181)

contd …

Variables	Model I	Model II	Model III	Model IV
Eight			0.744**	0.754**
			(0.156)	(0.158)
Nine			0.937**	0.954**
			(0.190)	(0.190)
Ten			0.849**	0.859**
			(0.188)	(0.189)
Eleven			0.725**	0.763**
			(0.196)	(0.197)
Twelve			0.483*	0.513**
			(0.193)	(0.195)
Boys			0.883**	0.893**
			(0.116)	(0.114)
Caste-ethnic group (Bahun omitted)				
Chhetri			-1.179**	-1.139*
			(0.438)	(0.454)
Adivasi Janajati			-1.356**	-1.348**
			(0.374)	(0.401)
Dalit			-1.741**	-1.769**
			(0.377)	(0.406)
Newar			-0.650	-0.680
			(0.519)	(0.528)
Other caste			-2.108**	-2.132**
			(0.382)	(0.404)
Muslim			-2.290**	-2.320**
			(0.426)	(0.447)

contd …

Variables	Model I	Model II	Model III	Model IV
Household per capita expenditure (NRs. logged)			1.098**	1.039**
			(0.169)	(0.170)
Education level of household head (0-15)			0.122**	0.121**
			(0.024)	(0.024)
Number of children <=19 in household			-0.101**	-0.103**
			(0.037)	(0.037)
Number of married female in household			0.221**	0.218**
			(0.076)	(0.077)
Water piped inside house			0.337	0.405
			(0.303)	(0.277)
Lighting source is electricity			0.776**	0.732**
			(0.238)	(0.236)
Intensity of Maoist conflict (Low omitted)				
Moderate			0.191	0.095
			(0.207)	(0.190)
Intense			0.039	0.019
			(0.420)	(0.388)
Primary school within 30 minutes				0.881**
				(0.245)
Secondary school within 30 minutes				0.167
				(0.192)
Constant	1.490**	3.679**	-7.197**	-7.508**
	(0.119)	(0.460)	(1.652)	(1.688)
Pseudo R-squared	0.00	0.08	0.26	0.27
Observations	3728	3728	3728	3728

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.18. Logistic regression of school enrolment on dirt road accessibility (all children age 13-19), using log functional from of accessibility

Variables	Model I	Model II	Model III	Model IV
Distance to dirt road (logged minutes)	-0.094**	-0.230**	-0.142**	-0.120**
	(0.027)	(0.036)	(0.038)	(0.038)
Development region (Western omitted)				
Eastern		-0.266	-0.198	-0.181
		(0.194)	(0.192)	(0.191)
Central		-0.927**	-1.044**	-1.030**
		(0.162)	(0.178)	(0.181)
Mid Western		-0.775**	-0.958**	-0.992**
		(0.210)	(0.246)	(0.240)
Far Western		-0.296	-0.524	-0.515
		(0.290)	(0.353)	(0.352)
Stratum (Mountain omitted)				
Urban Kathmandu		0.790*	0.155	0.030
		(0.342)	(0.388)	(0.402)
Urban Hill		0.103	-0.385	-0.527
		(0.301)	(0.373)	(0.379)
Rural Hill		-0.107	-0.083	-0.085
		(0.238)	(0.246)	(0.253)
Urban Tarai		-0.624*	-0.675+	-0.807*
		(0.304)	(0.370)	(0.375)
Rural Tarai		-1.218**	-0.710*	-0.779*
		(0.270)	(0.302)	(0.303)
Age of child (Age six omitted)				
Fourteen			-0.126	-0.114
			(0.174)	(0.174)

contd …

Variables	Model I	Model II	Model III	Model IV
Fifteen			-0.527**	-0.521**
			(0.169)	(0.170)
Sixteen			-1.125**	-1.123**
			(0.162)	(0.163)
Seventeen			-1.841**	-1.854**
			(0.183)	(0.183)
Eighteen			-2.188**	-2.199**
			(0.185)	(0.186)
Nineteen			-2.921**	-2.930**
			(0.191)	(0.192)
Boys			0.863**	0.863**
			(0.109)	(0.109)
Caste-ethnic group (Bahun omitted)				
Chhetri			-0.220	-0.153
			(0.237)	(0.232)
Adivasi Janajati			-0.667**	-0.600**
			(0.213)	(0.212)
Dalit			-1.362**	-1.367**
			(0.238)	(0.237)
Newar			-0.621*	-0.578+
			(0.310)	(0.308)
Other caste			-1.796**	-1.788**
			(0.246)	(0.244)
Muslim			-2.889**	-2.911**
			(0.357)	(0.345)

contd …

Variables	Model I	Model II	Model III	Model IV
Household per capita expenditure (NRs. logged)			0.720**	0.691**
			(0.161)	(0.162)
Education level of household head (0-15)			0.088**	0.087**
			(0.016)	(0.016)
Number of children <=19 in household			-0.006	-0.007
			(0.039)	(0.039)
Number of married female in household			0.064	0.061
			(0.070)	(0.069)
Water piped inside house			0.250	0.251
			(0.188)	(0.187)
Lighting source is electricity			0.463**	0.393*
			(0.153)	(0.155)
Intensity of Maoist conflict (Low omitted)				
Moderate			-0.203	-0.205
			(0.149)	(0.145)
Intense			-0.043	-0.017
			(0.254)	(0.247)
Primary school within 30 minutes				0.428+
				(0.232)
Secondary school within 30 minutes				0.342*
				(0.144)
Constant	0.448**	1.824**	-4.085*	-4.414**
	(0.080)	(0.299)	(1.606)	(1.609)
Pseudo R-squared	0.00	0.07	0.31	0.31
Observations	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.19. Logistic regression of school enrolment on dirt road accessibility (all children age 6-12), 4 categories of accessibility

Variables	Model I	Model II	Model III	Model IV
Distance to dirt road (<=15 mins omitted)				
>15 minutes <=1.5 hour	0.167	-0.320	0.286	0.356
	(0.186)	(0.249)	(0.227)	(0.225)
>1.5 hour <=1 day	-0.359	-1.158**	-0.322	-0.129
	(0.267)	(0.305)	(0.293)	(0.289)
>1 day	-0.319	-1.532**	-0.762*	-0.558
	(0.249)	(0.365)	(0.349)	(0.363)
Development region (Western omitted)				
Eastern		-0.747*	-0.684*	-0.666*
		(0.338)	(0.299)	(0.312)
Central		-1.511**	-1.445**	-1.418**
		(0.306)	(0.288)	(0.302)
Mid Western		-0.586+	-0.474	-0.527
		(0.305)	(0.393)	(0.404)
Far Western		-0.572	-0.582	-0.623
		(0.366)	(0.432)	(0.445)
Stratum (Mountain omitted)				
Urban Kathmandu		1.825**	0.277	0.061
		(0.698)	(0.701)	(0.713)
Urban Hill		0.632	0.497	0.314
		(0.626)	(0.681)	(0.694)
Rural Hill		-0.292	0.067	0.093
		(0.318)	(0.304)	(0.306)
Urban Tarai		-0.640	-0.425	-0.567
		(0.503)	(0.467)	(0.484)
				contd …

Variables	Model I	Model II	Model III	Model IV
Rural Tarai		-1.300**	-0.369	-0.449
		(0.372)	(0.358)	(0.366)
Age of child (Age six omitted)				
Seven			0.610**	0.620**
			(0.182)	(0.183)
Eight			0.737**	0.748**
			(0.157)	(0.160)
Nine			0.937**	0.955**
			(0.192)	(0.191)
Ten			0.847**	0.855**
			(0.189)	(0.191)
Eleven			0.741**	0.778**
			(0.198)	(0.200)
Twelve			0.481*	0.508*
			(0.195)	(0.196)
Boys			0.892**	0.902**
			(0.116)	(0.115)
Caste-ethnic group (Bahun omitted)				
Chhetri			-1.168**	-1.110*
			(0.428)	(0.437)
Adivasi Janajati			-1.322**	-1.296**
			(0.368)	(0.389)
Dalit			-1.680**	-1.690**
			(0.373)	(0.395)
Newar			-0.600	-0.610
			(0.507)	(0.522)
				contd …

Variables	Model I	Model II	Model III	Model IV
Other caste			-2.022**	-2.039**
			(0.374)	(0.391)
Muslim			-2.246**	-2.269**
			(0.424)	(0.439)
Household per capita expenditure (NRs. logged)			1.150**	1.084**
			(0.166)	(0.169)
Education level of household head (0-15)			0.124**	0.122**
			(0.024)	(0.024)
Number of children <=19 in household			-0.105**	-0.106**
			(0.037)	(0.038)
Number of married female in household			0.211**	0.208**
			(0.078)	(0.079)
Water piped inside house			0.341	0.383
			(0.295)	(0.270)
Lighting source is electricity			0.827**	0.783**
			(0.234)	(0.233)
Intensity of Maoist conflict (Low omitted)				
Moderate			0.068	-0.018
			(0.208)	(0.191)
Intense			-0.049	-0.059
			(0.415)	(0.382)
				contd …

Variables	Model I	Model II	Model III	Model IV
Primary school within 30 minutes				0.846**
				(0.249)
Secondary school within 30 minutes				0.211
				(0.190)
Constant	1.402**	3.373**	-7.827**	-8.076**
	(0.111)	(0.458)	(1.591)	(1.641)
Pseudo R-squared	0.00	0.08	0.27	0.28
Observations	3728	3728	3728	3728

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.20. Logistic regression of school enrolment on dirt road accessibility (all children age 13-19), using 4 categories of accessibility

Variables	Model I	Model II	Model III	Model IV
Distance to dirt road (<=15 mins omitted)				
>15 minutes <=1.5 hour	-0.295+	-0.754**	-0.184	-0.104
	(0.166)	(0.185)	(0.202)	(0.202)
>1.5 hour <=1 day	-0.347+	-1.012**	-0.585*	-0.476+
	(0.195)	(0.222)	(0.247)	(0.243)
>1 day	-0.745*	-1.582**	-1.171**	-1.048**
	(0.288)	(0.346)	(0.306)	(0.301)
Development region (Western omitted)				
Eastern		-0.295	-0.187	-0.170
		(0.196)	(0.190)	(0.188)
Central		-0.945**	-1.084**	-1.072**
		(0.168)	(0.181)	(0.184)
Mid Western		-0.806**	-0.967**	-1.000**
		(0.211)	(0.244)	(0.238)
Far Western		-0.310	-0.520	-0.513
		(0.293)	(0.354)	(0.355)
Stratum (Mountain omitted)				
Urban Kathmandu		0.935**	0.186	0.050
		(0.345)	(0.388)	(0.400)
Urban Hill		0.148	-0.406	-0.557
		(0.314)	(0.385)	(0.390)
Rural Hill		-0.133	-0.160	-0.166
		(0.251)	(0.258)	(0.265)
				contd …

Variables	Model I	Model II	Model III	Model IV
Urban Tarai		-0.508	-0.664+	-0.811*
		(0.310)	(0.369)	(0.376)
Rural Tarai		-1.176**	-0.716*	-0.791*
		(0.275)	(0.305)	(0.307)
Age of child (Age 13 omitted)				
Fourteen			-0.119	-0.109
			(0.173)	(0.173)
Fifteen			-0.514**	-0.510**
			(0.168)	(0.169)
Sixteen			-1.144**	-1.145**
			(0.161)	(0.162)
Seventeen			-1.861**	-1.876**
			(0.183)	(0.183)
Eighteen			-2.173**	-2.186**
			(0.184)	(0.185)
Nineteen			-2.924**	-2.935**
			(0.191)	(0.192)
Boys			0.876**	0.876**
			(0.110)	(0.110)
Caste-ethnic group (Bahun omitted)				
Chhetri			-0.234	-0.163
			(0.234)	(0.229)
Adivasi Janajati			-0.651**	-0.581**
			(0.208)	(0.207)
Dalit			-1.345**	-1.348**
			(0.235)	(0.233)

contd …

Variables	Model I	Model II	Model III	Model IV
Newar			-0.581+	-0.542+
			(0.311)	(0.309)
Other caste			-1.749**	-1.741**
			(0.243)	(0.240)
Muslim			-2.857**	-2.879**
			(0.359)	(0.345)
Household per capita expenditure (NRs. logged)			0.752**	0.720**
			(0.160)	(0.161)
Education level of household head (0-15)			0.090**	0.089**
			(0.017)	(0.017)
Number of children <=19 in household			-0.008	-0.009
			(0.040)	(0.039)
Number of married female in household			0.059	0.057
			(0.070)	(0.070)
Water piped inside house			0.259	0.256
			(0.193)	(0.191)
Lighting source is electricity			0.476**	0.405**
			(0.151)	(0.154)
Intensity of Maoist conflict (Low omitted)			-0.265+	-0.266+
Moderate			(0.157)	(0.151)
			-0.057	-0.030
Intense			(0.256)	(0.249)
Primary school within 30 minutes				0.406+
				(0.239)
				contd …

Variables	Model I	Model II	Model III	Model IV
Secondary school within 30 minutes				0.360*
				(0.149)
Constant	0.384**	1.673**	-4.460**	-4.736**
	(0.076)	(0.308)	(1.598)	(1.599)
Pseudo R-squared	0.01	0.07	0.31	0.31
Observations	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.21. Logistic Regression: Comparison of dirt road accessibility coefficients using different functional forms

Child Group	Model I	Model II	Model III	Model IV	Model V
Using hour continuous form					
All primary aged	-0.015	-0.044**	-0.034*	-0.028+	-
All secondary aged	-0.031**	-0.051**	-0.041**	-0.037**	-
Rural primary aged	-0.009	-0.043**	-0.033*	-0.027+	-0.023
Rural secondary aged	-0.020+	-0.049**	-0.043**	-0.040**	-0.035*
Using log continuous form					
All primary aged	-0.058+	-0.242**	-0.105*	-0.075	-
All secondary aged	-0.094**	-0.230**	-0.142**	-0.120**	-
Using 4 categories (omitted category <=15 minutes)					
All primary aged					
>15 minutes <=1.5 hour	0.167	-0.320	0.286	0.356	-
>1.5 hour <=1 day	-0.359	-1.158**	-0.322	-0.129	-
>1 day	-0.319	-1.532**	-0.762*	-0.558	-
All secondary aged					
>15 minutes <=1.5 hour	-0.295+	-0.754**	-0.184	-0.104	-
>1.5 hour <=1 day	-0.347+	-1.012**	-0.585*	-0.476+	-
>1 day	-0.745*	-1.582**	-1.171**	-1.048**	-

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.22. Logistic regression of school enrolment on dirt road accessibility, comparing with results for clustering at the household level

Variables	Aged 6-12			Aged 13-19		
	Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Distance to dirt road (hours)	-0.028+	-0.029*	-0.026+	-0.037**	-0.026**	-0.022*
	(0.016)	(0.013)	(0.014)	(0.012)	(0.010)	(0.009)
Development region (Western omitted)						
Eastern	-0.722*	-0.854**	-0.622+	-0.232	-0.359*	-0.467*
	(0.306)	(0.289)	(0.346)	(0.187)	(0.178)	(0.217)
Central	-1.430**	-1.610**	-1.549**	-1.082**	-1.069**	-1.090**
	(0.303)	(0.281)	(0.344)	(0.183)	(0.172)	(0.225)
Mid Western	-0.516	-0.746+	-0.503	-0.981**	-1.041**	-0.670*
	(0.395)	(0.380)	(0.446)	(0.242)	(0.257)	(0.286)
Far Western	-0.698	-0.915*	-0.819	-0.551	-0.589	-0.456
	(0.444)	(0.425)	(0.515)	(0.356)	(0.377)	(0.388)
Stratum (Mountain omitted)						
Urban Kathmandu	-0.029	-0.043	0.206	0.129	0.350	0.232
	(0.693)	(0.716)	(0.804)	(0.390)	(0.397)	(0.498)
Urban Hill	0.237	0.062	0.333	-0.464	-0.361	-0.410
	(0.681)	(0.629)	(0.705)	(0.379)	(0.392)	(0.522)
Rural Hill	0.011	-0.218	-0.092	-0.179	0.023	-0.098
	(0.294)	(0.303)	(0.359)	(0.261)	(0.276)	(0.318)

contd…

Variables	Aged 6-12			Aged 13-19		
	Method1	Method2	Method3	Method1	Method2	Method3
Urban Tarai	-0.674	-0.862+	-0.714	-0.694+	-0.254	-0.321
	(0.454)	(0.450)	(0.513)	(0.361)	(0.362)	(0.443)
Rural Tarai	-0.564+	-0.704*	-0.597	-0.669*	-0.386	-0.451
	(0.326)	(0.324)	(0.368)	(0.291)	(0.295)	(0.350)
Age of child (Age six omitted)						
Fourteen	0.611**	0.540**	0.567+	-0.109	-0.135	-0.135
	(0.181)	(0.197)	(0.302)	(0.175)	(0.190)	(0.236)
Fifteen	0.748**	0.710**	0.670*	-0.521**	-0.637**	-0.460+
	(0.159)	(0.185)	(0.313)	(0.170)	(0.185)	(0.242)
Sixteen	0.950**	0.855**	1.039**	-1.143**	-1.184**	-1.342**
	(0.190)	(0.214)	(0.320)	(0.164)	(0.185)	(0.259)
Seventeen	0.846**	0.717**	0.614*	-1.873**	-2.001**	-2.072**
	(0.190)	(0.225)	(0.298)	(0.184)	(0.206)	(0.273)
Eighteen	0.756**	0.564**	0.866**	-2.176**	-2.294**	-2.613**
	(0.197)	(0.208)	(0.302)	(0.186)	(0.214)	(0.277)
Nineteen	0.500*	0.492*	0.658*	-2.921**	-2.988**	-3.017**
	(0.196)	(0.207)	(0.313)	(0.191)	(0.222)	(0.281)
Boys	0.892**	0.791**	0.978**	0.870**	0.890**	0.825**
	(0.115)	(0.118)	(0.153)	(0.110)	(0.114)	(0.144)

contd…

Variables	Aged 6-12			Aged 13-19		
	Method1	Method2	Method3	Method1	Method2	Method3
Caste-ethnic group (Bahun omitted)						
Chhetri	-1.149*	-1.139*	-1.946**	-0.186	-0.236	-0.334
	(0.456)	(0.495)	(0.621)	(0.229)	(0.242)	(0.281)
Adivasi Janajati	-1.327**	-1.421**	-2.087**	-0.595**	-0.724**	-0.748**
	(0.402)	(0.436)	(0.558)	(0.208)	(0.216)	(0.265)
Dalit	-1.749**	-1.783**	-2.595**	-1.358**	-1.546**	-1.556**
	(0.408)	(0.449)	(0.559)	(0.234)	(0.240)	(0.306)
Newar	-0.672	-0.967+	-1.334	-0.535+	-0.713*	-0.838*
	(0.531)	(0.579)	(0.824)	(0.306)	(0.311)	(0.390)
Other caste	-2.096**	-2.133**	-2.989**	-1.748**	-1.851**	-1.992**
	(0.404)	(0.432)	(0.579)	(0.242)	(0.249)	(0.299)
Muslim	-2.303**	-2.366**	-3.070**	-2.887**	-2.939**	-3.063**
	(0.449)	(0.512)	(0.618)	(0.345)	(0.375)	(0.484)
Household per capita expenditure (NRs. logged)	1.077**	0.951**	1.032**	0.737**	0.735**	0.723**
	(0.169)	(0.170)	(0.211)	(0.160)	(0.157)	(0.178)
Education level of household head (0-15)	0.122**	0.115**	0.103**	0.089**	0.083**	0.086**
	(0.025)	(0.025)	(0.030)	(0.017)	(0.018)	(0.021)

contd…

Variables	Aged 6-12			Aged 13-19		
	Method1	Method2	Method3	Method1	Method2	Method3
Number of children <=19 in household	-0.109**	-0.107*	-0.105+	-0.010	-0.018	-0.024
	(0.037)	(0.043)	(0.061)	(0.039)	(0.038)	(0.041)
Number of married female in household	0.220**	0.269**	0.202+	0.057	0.065	0.025
	(0.079)	(0.091)	(0.116)	(0.070)	(0.069)	(0.082)
Water piped inside house	0.369	0.424+	0.264	0.222	0.266	0.378
	(0.276)	(0.256)	(0.293)	(0.188)	(0.193)	(0.233)
Lighting source is electricity	0.753**	0.732**	0.694**	0.442**	0.433**	0.481*
	(0.236)	(0.225)	(0.256)	(0.151)	(0.154)	(0.188)
Intensity of Maoist conflict (Low omitted)						
Moderate	0.044	0.034	0.044	-0.277+	-0.214	-0.322+
	(0.190)	(0.186)	(0.208)	(0.145)	(0.146)	(0.172)
Intense	-0.034	-0.056	0.060	-0.051	-0.094	-0.369
	(0.383)	(0.383)	(0.430)	(0.251)	(0.264)	(0.299)
Primary school within 30 minutes	0.876**	0.823**	0.865**	0.463+	0.391	0.459+
	(0.249)	(0.250)	(0.266)	(0.237)	(0.241)	(0.262)

contd…

Variables	Aged 6-12			Aged 13-19		
	Method1	Method2	Method3	Method1	Method2	Method3
Secondary school within 30 minutes	0.174	0.245	0.291	0.362*	0.224	0.228
	(0.191)	(0.189)	(0.200)	(0.144)	(0.147)	(0.165)
Constant	-7.816**	-6.261**	-6.599**	-5.049**	-4.985**	-4.562**
	(1.646)	(1.654)	(2.090)	(1.574)	(1.529)	(1.757)
Pseudo R-squared	0.27	0.26	0.28	0.31	0.31	0.31
Observations	3728	3728	2141	3072	3072	1911

*+ p< 0.10, * p< .05, ** p< .01*

Method 1: svyset PSU (pw=household weight), strata (stratum), more than one child per household

Method 2: svyset PSU (pw=household weight/number of children), strata (stratum), more than one child per household

Method 3: svyset PSU (pw=individual weight), strata (stratum), one child per household

Table 5.23. Logistic regression of school enrolment on dirt road accessibility, comparing results with results for clustering at the household level

Model	Aged 6-12			Aged 13-19		
	Method1	Method 2	Method 3	Method 1	Method 2	Method 3
Model I	-0.015	-0.014	-0.010	-0.031**	-0.026*	-0.013
Model II	-0.044**	-0.043**	-0.039**	-0.051**	-0.042**	-0.029*
Model III	-0.034*	-0.034**	-0.032**	-0.041**	-0.029**	-0.025**
Model IV	-0.028+	-0.029*	-0.026+	-0.037**	-0.026**	-0.022*

*+ $p< 0.10$, * $p< .05$, ** $p< .01$*

Method 1: svyset PSU (pw=household weight), strata (stratum), more than one child per household

Method 2: svyset PSU (pw=household weight/number of children), strata (stratum), more than one child per household

Method 3: svyset PSU (pw=individual weight), strata (stratum), one child per household

Table 5.24. Logistic regression of school enrolment on paved road accessibility (all children age 6-12)

Variables	Model I	Model II	Model III	Model IV
Distance to paved road (hours)	-0.009	-0.039**	-0.030**	-0.027*
	(0.010)	(0.012)	(0.011)	(0.012)
Mode of travel (Foot omitted)				
Bicycle	0.403	0.503	-0.066	-0.004
	(0.330)	(0.323)	(0.334)	(0.345)
Motorcycle/car/bus	-0.685	-0.313	-0.643+	-0.723+
	(0.440)	(0.355)	(0.387)	(0.391)
Mixed	0.004	0.047	-0.050	-0.009
	(0.222)	(0.217)	(0.191)	(0.171)
Development region (West. omitted)				
Eastern		-0.917**	-0.781**	-0.729*
		(0.329)	(0.300)	(0.311)
Central		-1.569**	-1.494**	-1.432**
		(0.318)	(0.307)	(0.313)
Mid Western		-0.507+	-0.370	-0.413
		(0.304)	(0.390)	(0.399)
Far Western		-0.802*	-0.713	-0.706
		(0.369)	(0.434)	(0.445)
Stratum (Mountain omitted)				
Urban Kathmandu		2.150**	0.114	-0.183
		(0.668)	(0.680)	(0.695)
Urban Hill		0.878	0.372	0.132
		(0.596)	(0.674)	(0.692)
Rural Hill		-0.440	-0.055	-0.023
		(0.305)	(0.290)	(0.287)
Urban Tarai		-0.294	-0.576	-0.794+
		(0.459)	(0.445)	(0.461)
Rural Tarai		-0.982**	-0.448	-0.623+
		(0.302)	(0.317)	(0.319)
Age of child (Age six omitted)				
Seven			0.580**	0.593**
			(0.182)	(0.183)
Eight			0.706**	0.721**
			(0.158)	(0.160)

contd…

Variables	Model I	Model II	Model III	Model IV
Nine			0.914**	0.933**
			(0.191)	(0.190)
Ten			0.823**	0.836**
			(0.188)	(0.189)
Eleven			0.688**	0.726**
			(0.197)	(0.200)
Twelve			0.441*	0.480*
			(0.195)	(0.197)
Boys			0.894**	0.904**
			(0.119)	(0.117)
Caste-ethnic group (Bahun omitted)				
Chhetri			-1.151**	-1.122*
			(0.436)	(0.450)
Adivasi Janajati			-1.338**	-1.328**
			(0.372)	(0.398)
Dalit			-1.739**	-1.771**
			(0.377)	(0.404)
Newar			-0.588	-0.634
			(0.524)	(0.533)
Other caste			-2.059**	-2.090**
			(0.384)	(0.405)
Muslim			-2.305**	-2.331**
			(0.425)	(0.444)
Household per capita expenditure (NRs. logged)			1.155**	1.079**
			(0.166)	(0.169)
Education level of household head (0-15)			0.126**	0.124**
			(0.024)	(0.024)
Number of children <=19 in hh			-0.111**	-0.112**
			(0.037)	(0.038)
Number of married female in household			0.220**	0.219**
			(0.079)	(0.079)
Water piped inside house			0.305	0.383
			(0.298)	(0.275)

contd...

Variables	Model I	Model II	Model III	Model IV
Lighting source is electricity			0.778**	0.716**
			(0.236)	(0.235)
Intensity of Maoist conflict (Low omitted)				
Moderate			0.104	0.007
			(0.208)	(0.189)
Intense			-0.072	-0.082
			(0.423)	(0.385)
Primary school within 30 minutes				0.907**
				(0.244)
Secondary school within 30 minutes				0.181
				(0.190)
Constant	1.394**	3.107**	-7.560**	-7.679**
	(0.112)	(0.426)	(1.610)	(1.665)
Pseudo R-squared	0.00	0.08	0.27	0.28
Observations	3728	3728	3728	3728

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.25. Logistic regression of school enrolment on paved road accessibility (all children age 13-19)

	Model I	Model II	Model III	Model IV
Distance to paved road (hours)	-0.023**	-0.042**	-0.030**	-0.028**
	(0.008)	(0.010)	(0.009)	(0.009)
Mode of travel (Foot omitted)				
Bicycle	-0.093	0.171	0.030	0.005
	(0.212)	(0.214)	(0.250)	(0.246)
Motorcycle/car/bus	-0.555	-0.208	-0.349	-0.368
	(0.361)	(0.317)	(0.353)	(0.359)
Mixed	0.012	0.152	0.222	0.224
	(0.144)	(0.155)	(0.154)	(0.152)
Development region (West. omitted)				
Eastern		-0.385*	-0.262	-0.232
		(0.195)	(0.189)	(0.187)
Central		-0.945**	-1.090**	-1.073**
		(0.172)	(0.181)	(0.184)
Mid Western		-0.773**	-0.931**	-0.974**
		(0.226)	(0.262)	(0.250)
Far Western		-0.463	-0.560	-0.550
		(0.302)	(0.354)	(0.354)
Stratum (Mountain omitted)				
Urban Kathmandu		1.399**	0.347	0.167
		(0.325)	(0.384)	(0.396)
Urban Hill		0.569+	-0.221	-0.422
		(0.306)	(0.378)	(0.385)
Rural Hill		-0.148	-0.160	-0.165
		(0.246)	(0.251)	(0.257)
Urban Tarai		-0.024	-0.446	-0.646+
		(0.293)	(0.360)	(0.368)
Rural Tarai		-0.741**	-0.505+	-0.638*
		(0.250)	(0.291)	(0.294)
Age of child (Age 13 omitted)				
Fourteen			-0.147	-0.133
			(0.176)	(0.175)
Fifteen			-0.540**	-0.535**
			(0.170)	(0.171)

contd…

Variables	Model I	Model II	Model III	Model IV
Sixteen			-1.168**	-1.164**
			(0.162)	(0.163)
Seventeen			-1.876**	-1.889**
			(0.184)	(0.184)
Eighteen			-2.167**	-2.181**
			(0.185)	(0.186)
Nineteen			-2.916**	-2.932**
			(0.194)	(0.194)
Boys			0.865**	0.868**
			(0.110)	(0.111)
Caste-ethnic group (Bahun omitted)				
Chhetri			-0.283	-0.195
			(0.234)	(0.229)
Adivasi Janajati			-0.674**	-0.598**
			(0.208)	(0.208)
Dalit			-1.366**	-1.372**
			(0.233)	(0.232)
Newar			-0.574+	-0.542+
			(0.313)	(0.308)
Other caste			-1.752**	-1.751**
			(0.243)	(0.242)
Muslim			-2.840**	-2.866**
			(0.360)	(0.346)
Household per capita expenditure (NRs. logged)			0.787**	0.745**
			(0.161)	(0.161)
Education level of hh head (0-15)			0.091**	0.089**
			(0.017)	(0.017)
Number of children <=19 in household			-0.007	-0.008
			(0.039)	(0.039)
Number of married female in household			0.056	0.052
			(0.070)	(0.070)
Water piped inside house			0.205	0.209
			(0.189)	(0.188)

contd...

Variables	Model I	Model II	Model III	Model IV
Lighting source is electricity			0.546**	0.453**
			(0.151)	(0.153)
Intensity of Maoist conflict (Low omitted)				
Moderate			-0.281+	-0.276+
			(0.151)	(0.146)
Intense			-0.061	-0.028
			(0.265)	(0.254)
Primary school within 30 minutes				0.486*
				(0.237)
Secondary school within 30 minutes				0.375**
				(0.143)
Constant	0.355**	1.211**	-4.995**	-5.190**
	(0.080)	(0.287)	(1.587)	(1.585)
Pseudo R-squared	0.00	0.06	0.31	0.31
Observations	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.26. Logistic Regression: Comparison of dirt road and paved road accessibility coefficients

Child Group	Model I	Model II	Model III	Model IV
Using dirt road (hour continuous)				
All primary aged	-0.015	-0.044**	-0.034*	-0.028+
All secondary aged	-0.031**	-0.051**	-0.041**	-0.037**
Using paved road (hour continuous), controlled for mode of travel				
All primary aged	-0.009	-0.039**	-0.030**	-0.027*
All secondary aged	-0.023**	-0.042**	-0.030**	-0.028**

Table 5.27. Logistic regression of school enrolment on geographical accessibility (all children age 6-12) using both dirt and paved road measures

	Model I	Model II	Model III	Model IV
Distance to dirt road (hours)	-0.026	-0.017	-0.016	-0.007
	(0.023)	(0.025)	(0.022)	(0.022)
Distance to paved road (hours)	0.010	-0.027	-0.018	-0.022
	(0.021)	(0.019)	(0.018)	(0.017)
Mode of travel (Foot omitted)				
Bicycle	0.398	0.500	-0.068	-0.005
	(0.329)	(0.323)	(0.333)	(0.344)
Motorcycle/car/bus	-0.703	-0.324	-0.653+	-0.727+
	(0.441)	(0.356)	(0.389)	(0.391)
Mixed	-0.039	0.025	-0.070	-0.018
	(0.228)	(0.217)	(0.191)	(0.170)
Development region (Western omitted)				
Eastern		-0.913**	-0.774*	-0.726*
		(0.330)	(0.300)	(0.311)
Central		-1.567**	-1.491**	-1.431**
		(0.318)	(0.306)	(0.313)
Mid Western		-0.528+	-0.388	-0.421
		(0.306)	(0.386)	(0.399)
Far Western		-0.807*	-0.713	-0.707
		(0.369)	(0.433)	(0.444)
Stratum (Mountain omitted)				
Urban Kathmandu		2.132**	0.095	-0.190
		(0.666)	(0.679)	(0.696)
Urban Hill		0.861	0.351	0.124
		(0.595)	(0.671)	(0.693)
Rural Hill		-0.463	-0.078	-0.034
		(0.307)	(0.291)	(0.292)
Urban Tarai		-0.312	-0.602	-0.804+
		(0.457)	(0.444)	(0.464)
Rural Tarai		-1.004**	-0.477	-0.635+
		(0.300)	(0.316)	(0.325)
Age of child (Age six omitted)				
Seven			0.583**	0.594**
			(0.182)	(0.183)
Eight			0.713**	0.724**
			(0.157)	(0.160)

contd...

Variables	Model I	Model II	Model III	Model IV
Nine			0.919**	0.935**
			(0.191)	(0.190)
Ten			0.823**	0.836**
			(0.188)	(0.189)
Eleven			0.693**	0.728**
			(0.197)	(0.199)
Twelve			0.446*	0.482*
			(0.195)	(0.197)
Boys			0.893**	0.904**
			(0.119)	(0.117)
Caste-ethnic group (Bahun omitted)				
Chhetri			-1.162**	-1.127*
			(0.435)	(0.449)
Adivasi Janajati			-1.331**	-1.325**
			(0.372)	(0.398)
Dalit			-1.730**	-1.768**
			(0.377)	(0.405)
Newar			-0.595	-0.636
			(0.520)	(0.533)
Other caste			-2.054**	-2.088**
			(0.384)	(0.405)
Muslim			-2.300**	-2.329**
			(0.424)	(0.444)
Household per capita expenditure (NRs. logged)			1.158**	1.080**
			(0.167)	(0.169)
Education level of household head (0-15)			0.125**	0.124**
			(0.024)	(0.024)
Number of children <=19 in household			-0.112**	-0.113**
			(0.037)	(0.038)
Number of married female in household			0.222**	0.219**
			(0.078)	(0.079)
Water piped inside house			0.299	0.379
			(0.300)	(0.276)
Lighting source is electricity			0.780**	0.718**
			(0.236)	(0.235)

contd...

Variables	Model I	Model II	Model III	Model IV
Intensity of Maoist conflict (Low omitted)				
Moderate			0.098	0.005
			(0.207)	(0.189)
Intense			-0.071	-0.081
			(0.420)	(0.384)
Primary school within 30 minutes				0.901**
				(0.244)
Secondary school within 30 minutes				0.181
				(0.190)
Constant	1.386**	3.123**	-7.567**	-7.679**
	(0.113)	(0.424)	(1.614)	(1.666)
Pseudo R-squared	0.01	0.09	0.27	0.28
Observations	3728	3728	3728	3728

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 5.28. Logistic regression of school enrolment on geographical accessibility (all children age 13-19) using both dirt and paved road measures

	Model I	Model II	Model III	Model IV
Distance to dirt road (hours)	-0.022	-0.031	-0.046*	-0.037+
	(0.022)	(0.024)	(0.022)	(0.022)
Distance to paved road (hours)	-0.008	-0.019	0.003	-0.002
	(0.015)	(0.015)	(0.018)	(0.018)
Mode of travel (Foot omitted)				
Bicycle	-0.095	0.169	0.029	0.006
	(0.212)	(0.213)	(0.250)	(0.246)
Motorcycle/car/bus	-0.567	-0.223	-0.371	-0.384
	(0.362)	(0.319)	(0.357)	(0.362)
Mixed	-0.020	0.114	0.170	0.183
	(0.143)	(0.151)	(0.155)	(0.153)
Development region (Western omitted)				
Eastern		-0.382+	-0.261	-0.234
		(0.196)	(0.190)	(0.188)
Central		-0.937**	-1.083**	-1.071**
		(0.172)	(0.181)	(0.184)
Mid Western		-0.806**	-0.987**	-1.021**
		(0.228)	(0.269)	(0.257)
Far Western		-0.461	-0.557	-0.549
		(0.300)	(0.353)	(0.354)
Stratum (Mountain omitted)				
Urban Kathmandu		1.429**	0.366	0.184
		(0.322)	(0.382)	(0.395)
Urban Hill		0.604*	-0.190	-0.396
		(0.302)	(0.375)	(0.383)
Rural Hill		-0.126	-0.149	-0.160
		(0.242)	(0.247)	(0.255)
Urban Tarai		0.012	-0.416	-0.621+
		(0.288)	(0.357)	(0.367)
Rural Tarai		-0.714**	-0.486+	-0.623*
		(0.245)	(0.287)	(0.292)
Age of child (Age 13 omitted)				
Fourteen			-0.143	-0.130
			(0.177)	(0.176)

contd...

Variables	Model I	Model II	Model III	Model IV
Fifteen			-0.548**	-0.542**
			(0.171)	(0.171)
Sixteen			-1.169**	-1.166**
			(0.162)	(0.163)
Seventeen			-1.884**	-1.896**
			(0.185)	(0.185)
Eighteen			-2.179**	-2.191**
			(0.185)	(0.186)
Nineteen			-2.930**	-2.943**
			(0.193)	(0.194)
Boys			0.874**	0.874**
			(0.110)	(0.110)
Caste-ethnic group (Bahun omitted)				
Chhetri			-0.276	-0.194
			(0.233)	(0.229)
Adivasi Janajati			-0.668**	-0.595**
			(0.207)	(0.207)
Dalit			-1.357**	-1.364**
			(0.233)	(0.232)
Newar			-0.566+	-0.536+
			(0.312)	(0.308)
Other caste			-1.751**	-1.749**
			(0.242)	(0.242)
Muslim			-2.844**	-2.868**
			(0.357)	(0.345)
Household per capita expenditure (NRs. logged)			0.782**	0.741**
			(0.160)	(0.161)
Education level of household head (0-15)			0.090**	0.088**
			(0.017)	(0.017)
Number of children <=19 in household			-0.009	-0.010
			(0.039)	(0.039)
Number of married female in household			0.058	0.055
			(0.070)	(0.070)
Water piped inside house			0.199	0.205
			(0.190)	(0.189)

contd...

Variables	Model I	Model II	Model III	Model IV
Lighting source is electricity			0.555**	0.462**
			(0.150)	(0.153)
Intensity of Maoist conflict (Low omitted)				
Moderate			-0.299*	-0.290*
			(0.151)	(0.146)
Intense			-0.073	-0.035
			(0.268)	(0.258)
Primary school within 30 minutes				0.458+
				(0.239)
Secondary school within 30 minutes				0.370*
				(0.144)
Constant	0.348**	1.172**	-4.963**	-5.146**
	(0.081)	(0.282)	(1.581)	(1.579)
Pseudo R-squared	0.01	0.07	0.30	0.30
Observations	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Chapter VI

Geographical inaccessibility, gender and school enrolment

In this chapter we examine if geographical inaccessibility operates differentially upon school enrolment for boys and girls of different age groups. Our analysis thus far has demonstrated that geographical inaccessibility for children in Nepal is associated with a lower probability of being enrolled in school, that is, all isolated children are less likely to be enrolled in school. The analysis has also revealed that boys are more likely to be enrolled in school than girls. Girls in Nepal, particularly adolescents, on average have a much lower school enrolment ratio. To recall, girls 6-12 have an enrolment rate of 73% which is 12 percentage points lower than the boys for the same age group. Girls 13-19 have an enrolment ratio 18 percentage points lower than boys this age group. Further, the multivariate analysis of the previous chapter also confirmed that girls had a significantly lower chance of being enrolled in school even when many crucial determinants of school enrolment were controlled confirming that being a girl hinders her chances of attaining school education in Nepal.

That boys and girls face differential chances of being in school in Nepal has been well established in the literature (Ashby 1985, Beutel and Axinn 2002, Stash and Hannum 2001, The World Bank 2006), and also confirmed by our analysis. However the impact of geographical inaccessibility on gender differences in school participation remains generally under-explored. The association between road provision and female school inclusion is "complex and under-researched" (Molesworth 2005:2). Fernando and Porter (2002:7) explain, "While transport professionals have taken little account of gender, issues of access and mobility have also been marginalized in much of the discourse on gender and development." In Nepal, the situation is the same where no systematic attempts have been made to investigate the relationship between transport development and gender relations (Seddon & Shrestha 2002:235). In one relevant research, Beutel and Axinn (2002) interacted gender with the number of years of transportation enjoyed by settlements within 10 minutes in the relatively accessible Chitwan district of Nepal, and found that the longer the service had been present nearby, the higher the rate of school entrance, and less the gender differences.

The gender-enrolment and accessibility-enrolment relationships are somewhat straightforward but when the three are put together, the interrelationship becomes hard to disentangle. We must remember here that inaccessibility does not vary by gender of the eligible children the way it does by poverty or education level. Gender may affect enrolments like other social characteristics of a child, such as poverty, illiteracy and membership to a certain caste-ethnic group. Yet unlike these other characteristics, gender of a student is neither a consequence of nor affects the geographical accessibility level of a household or a community. In other words boys and girls have equal chances of being isolated or being accessible.

Yet evidence indicates that accessibility or isolation actually operates differentially for boys and girls, and breaking the inaccessibility of remote communities may be more beneficial for girls' education. For example, in Morocco's rural setting improved road provision was found to be associated with increased female school inclusion (Khandker, Lavy & Filmer 1994, Levy 2004). Similar findings were recorded for a village in Nepal by Seddon and Shrestha (2002). Although Seddon and Shrestha

(2002) did not find higher primary enrolment rates for girls, they found higher girls secondary enrolment rates in schools along the road corridor compared to schools in off-road areas. In Pakistan, presence of all weather motorable roads was associated with an increase of 50% in girls' net primary enrolment rate (Essakali 2005). Despite these evidence, why and how inaccessibility is a greater barrier for girls' education than boys' needs more scrutiny.

Pathways

There are at least four pathways (dimensions) in which we can suspect inaccessibility to be more detrimental to girls' school participation than boys', or how the impact of inaccessibility can be gendered. First, while it is difficult for all isolated children to overcome the distance barrier to school, parents' special concerns may make it harder for adolescent girls. Second, low quality schools, which are often concentrated in isolated areas, impose additional disincentives on adolescent girls. Third, the household travel and transport tasks that children, especially girls, in isolated areas are expected to perform leaves less time for them to attend school. Fourth, the virtual shutting in of communities as a result of perpetual inaccessibility, discussed earlier in chapter two, is also characterized by lower value households there give to educating their daughters. We will discuss each of these constraints and the available evidence sequentially.

Distant schools: Distant schools in isolated areas are difficult to access by both boys and girls, of all ages, but in many societies distance poses a greater barrier on girls than boys, particularly the adolescents. Although boys and girls from isolated households are equally disadvantaged in terms of the long distance they need to travel to reach schools, many societies restrict girls, more so as they enter adolescence, from traveling long distances on their own, and from residing outside of the house prior to marriage. Adolescent girls may be "constrained by restrictions on where, how and with whom they travel" (Fernando & Porter 2002:5) and "the lack of access to safe and secure transport impinges upon the physical security of women outside their immediate surroundings, reinforcing the cultural restrictions traditionally imposed on them" (Matin, Mukib, Begum and Khanam 2002). Such restrictions in turn define their entitlements to social visits, political participation, to services like education and health, and income and employment opportunities (Matin *et al.* 2002).

Parental worry for the daughters when they travel to and from distant schools or live away from home to attend schools may also affect girls' education (DeJaeghere, 2004:6). In Pakistan distant schools and the costs associated with travel and chaperons were reasons expressed for girls not going to school (Jejeebhoy and Sathar 2001). Not only for adolescent girls, inaccessibility also restricts mobility of female teachers who in many societies are "role models" for girls (Fentiman, Hall and Bundy 1999) especially in societies where girls are taught only by female teachers in a non-coeducational environment. The female proportion of local teachers had strong impacts on enrolments in government schools among girls in Pakistan (Llyod, Mete and Sathar 2005). Residing locally is likely to be more common in more accessible than remote villages.

Poor school quality: Low quality schools, which our data has shown to be concentrated in isolated areas, may be detrimental for school enrolment of both boys and girls. Yet there are reasons to believe that certain features contributing to lower quality of schools are more likely to be a greater barrier for girls' education than boys, as well as more likely to be present in schools of isolated areas. While lack of or very low presence of female teachers may be one aspect of school quality affecting girls more than boys, lower infrastructural quality of schools, in particular absence of girls' toilet or other gender sensitive facilities (DeJaeghere 2004, World Education 2001) are barriers for girls or female teachers to be present in school.

Lack of toilets or sanitary facilities may not be a barrier for boys and male teachers, but it affects adolescent girls' attendance (DeJaeghere 2004) as it does not provide for their need of "privacy and security during puberty" (World Education 2001). In Ghana (Fentiman *et al.* 1999) and elsewhere, this has been cited as an important reason affecting their participation in school. A girl in Nepal expressed, "How can I go to school when I am menstruating? First there is a problem of pads and then there isn't even a place where I can change my pads. Even urinating is a problem in the toilet facility that we have." Another added, "I need to make excuses—sometimes I say I have a headache and sometimes a stomach ache. We cannot mention this (menstruating) even to the female teachers, forget the male teachers. On top of this, we cannot think about facing the insult we receive when the boys' tease us" (Bastola 2007, original in Nepali).

One may argue that building toilets for girls in isolated areas without providing road access may help solve the problem for their school participation, but again installation of and awareness about proper sanitation facilities and hygiene—like many other rural infrastructures in Nepal—has unfortunately been tied to external resources and technical support, which rarely target isolated communities. Certainly, inaccessibility has meant reduced movement of resources from external developmental actors in these areas, and this has possibly resulted to poor quality or no schools, a strong disincentive for girls to achieve education.

Transport burden for girls: Apart from the probable task of attending school, children in rural areas of developing countries are expected to perform multiple transportation tasks which squeeze them of their possible school time. Several researches show that in the developing world, the girls are more over burdened than the boys and have major responsibility for the invisible and unpaid household-related transport tasks (Rama 2005, Blackden and Wodon 2006). The situation is similar in Nepal where in rural areas girls take the responsibility of transporting firewood and fodder (Ghimire 2002), and water. Such an imbalance in gender division in transport related labor is further widened by the migration from rural Nepal of the men. As a result, Molesworth (2005) argues that school going children are pulled out of school to compensate for the labor gap. She contends that girls in preference to boys are pulled out because “they do not contribute to their parents’ economic welfare in old age” and “returns to girls productive capacity is not channeled into the economy of their paternal households” (Molesworth 2005:16). Beutel and Axinn (2002:111) assert, in rural Nepal “parents are much more inclined to invest in their sons’ human capital than in their daughters’ human capital, as investments in daughters are generally believed to benefit in-laws (not natal).”

Our research has established that not only schools, but also piped water inside the house, non bio-fuels and electricity for lighting, all of which could ease the transport burden faced by girls and boys, are rare in isolated areas of Nepal (see Table 4.16 and 4.17). For example, inadequate and/or costly transport for moving farm produce to markets and other goods may cause families to use their children, especially girls as porters, which delays or prevents their attendance in school (Porter, Blaufuss & Owusu-Acheampong 2006). Improved access also has the potential to reduce the work load on households and their children by bringing alternative products to the communities such as clean fuel, ground flour, or good quality soap. This benefits the girl more as they take up most of the household work and travel burden.

Low value of girls' education: Among many of the features of inaccessibility is the low value parents there place on education, and even lower value they place on girls' education. Inaccessibility limits the villagers' ability to access the outside world, and the outsiders' ability to access the village and be aware about the importance of educating the girl child. The isolation's impact is such that even where opportunities exist, awareness to send the children to school does not.

Beutel and Axinn (2002:113) who view transport as one of the "non-family institutions" that aid diffusion of education, argue that although boys may be the early beneficiaries, over time these institutions also assist education attainment of girls. As these non-family institutions become part of daily life, "family related adult roles are likely to become a less significant feature of adult roles" and consequently the gender differences in the "propensity of parents to send their sons and daughters to school and keep them there" is expected to reduce. Thus they argue the spread of transport and other non-family institutions may be the "key to the success of mass education in providing a new route to status attainment that is independent of key ascribed statuses such as gender."

Based on our discussion thus far it is reasonable to believe that inaccessibility poses differential set of constraints on the girls and boys in accessing schools. Further the capabilities possessed by girls and boys to overcome inaccessibility's direct and indirect impact on accessing schools are also different. In the following sections we will analyze if geographical inaccessibility in Nepal is more detrimental to girls' school enrolment than boys' using the NLSS-II data.

Gender and school participation in Nepal

Our analysis of the NLSS-II data suggests many of the conditions—distant schools, low quality schools, unwilling parents, lack of female teachers, lack of toilets—that may be unfavorable for girls' participation are generally found in inaccessible areas. Geographical inaccessibility in Nepal is associated with sparsely distributed and lower quality schools as well as sparsely distributed infrastructures that enable enrolment, such as electricity.

Beyond 30 minutes, we find less than 4% of the men and women over the age of 15 to have an SLC, the minimum education qualification required for teaching in a primary school. Of this group holding the minimum qualification, we find only 1 in 6 to be a female. There is a higher concentration of female teachers in accessible areas. Within thirty minutes, a third of the households have their nearest primary school served by one female teacher, about a third has two or more, and the remaining third have none. But beyond thirty minutes, about half of the households have no female teachers in their nearest primary school, and about 40% households have only one teacher. It does not come as a surprise then in Nepal, as of 2003, forty two of the seventy five districts had one or less female teacher per primary school, all except two being either a hill or a mountain district (Department of Education 2004a). Nineteen of these districts had less than 0.5 female teachers per primary schools of which 12 districts –Jajarkot, Humla, Accham, Khotang, Dolakha, Dhading, Bajhang, Rukum, Sindhupalchok, Baitadi, Nuwakot and Bajura –had no female teachers at the secondary level at all. Ten other districts—Gulmi, Udayapur, Manang, Solukhumbu, Terhathum Dadeldhura, Mustang, Myagdi, Dolpa and Bara— also had no female teachers at the secondary level, again only one district of the 22 districts not having a secondary female teacher is not a hilly or mountainous district. While districts without female teachers tend to be isolated, those districts which have a higher ratio (0.3 or above) female teachers at the secondary level, tend to be more accessible. All such districts are accessible Terai or the Kathmandu Valley districts, namely Nawalparasi, Chitwan, Kapilvastu, Dhanusha, Jhapa, Kanchanpur, Kavrtepalanchok, Makawanpur, Morang, Rupandehi, Sunsari, Banke, Parsa, Kathamndu, Bhaktapur and Lalitpur (Department of Education 2004a:74).

In most schools of isolated areas in Nepal, there is less presence of toilets but even lesser for girls (Table 4.19). Toilets are a problem everywhere but it is even pronounced in isolated areas and even more a problem for adolescent girls. Within fifteen minutes off dirt roads, 47% of the households are located in a community that has toilets for girls in their nearest primary school, compared to for only about 24% households that are located one day away. Many of the reasons we cited above are factors that are not conducive for enrolling girls in school. It does not come as a surprise then that of those Nepali teenage girls who never attended school, the NLSS-II data shows that 43 % did not do so because their parents were unwilling, compared to 22 % for teenage boys.

Disparities in enrolment by inaccessibility level

Age 6-12: Enrolment rate for the most accessible boys (within fifteen minutes of roads) is highest at 87% and decreases gradually to 76% for those living over a day away from roads. However enrolment is neither highest for most accessible girls nor is it lowest for the most isolated ones. Enrolments are at 73%, 80%, 65% and 73% for girls who are located within 15 minutes, between 15 minutes to 1½ hours, between 1½ hours to one day and over one day respectively. The lower girls' enrolments in 15 minute zone are due to the strong effect coming from rural Tarai which is accessible, draws about 46% of the weighted sample in the survey, and has a primary age girls' enrolment of only 63%. But there may be stronger social and cultural reasons, for example, more rigid religious hierarchies why girls in the rural Tarai have such low enrolments.

---Table 6.1 about here---

The disparity in enrolment between girls from differentially accessible areas is lower than those for boys. Also, the accessibility disparity in enrolment by gender is on average higher for those within 15 minutes against those more than 15 minutes off road.

Age 13-19: For the older children, the pictures that emerge are different. Boys living in the most isolated areas (over 1 day from roads) have an enrolment rate lower by 15 percentage points compared to boys living within 15 minutes of the road, that is it drops linearly from 68% to 53%. For girls, enrolment drops from 52% to 29%, for those living in very accessible areas to those living in very remote areas. While isolation disparity in enrolment is higher for girls for this age group, the gender disparity by isolation level is even more pronounced. In the most inaccessible areas of the country, girls' enrolment lags by about 24 % than the boys', compared to a lag of about 16% in the most accessible areas.

Thus far our data establish that enrolment is on average lower for girls than boys, enrolment decreases with inaccessibility for both boys and girls but does so at a higher rate for 13-19 girls, and there is greater gender disparity in enrolment in isolated areas for the age group 13-19.

Analysis of differential impact

In previous chapter's multivariate analysis looking at the main effects of accessibility on enrolment, we assumed all the explanatory variables in our most comprehensive model to impact school enrolment in similar ways for boys and girls. The results implied that improving accessibility helps all isolated children's chances of enrolment. We now hypothesize however, given the differential sets of constraints and capabilities faced by girls, especially the adolescents, inaccessibility operates more harshly on them than the other children. While inaccessibility hurts all children's chances of enrolment, it hurts the girl children more. It is likely that improving accessibility will have a stronger impact on the probability of the girl children, especially the adolescents, being enrolled in school.

In order to test this, we introduce an interaction term between accessibility, measured as the travel time from households to dirt roads and gender (boy = 1) in the model. This will allow us to test whether gender difference in enrolment increases with isolation level, or reduces with accessibility. In the first model we estimate enrolment as a function of access and gender (Model I). In the next model we introduce the interaction term between the two (Model II). In the third model, we add control for the locational variables (Model III). Next in model IV, we add controls for the socio-economic characteristics of the child such as age, ethnicity, household welfare level, household head's education, number of children and number of married female in the household and household access to electricity and water. In Model V, we add controls for availability of primary and secondary schools. Finally we test a sixth model for the rural sample, adding controls for different dimensions of school quality—infrastructural which is a scale constructed of 10 different dimensions of the school building including availability of girls toilet, and instructional, which are three separate variables—unscheduled closure in the last one year, whether teacher positions are fulfilled and whether the school has a female teacher.

Results

6-12 boys and girls

In the basic model without the interaction term, although the sign of the accessibility coefficient is in the expected direction, it is not statistically significant. However boys are clearly in advantage than girls. When we introduce the interaction term (Table 6.3, Model II), we find the interaction to be negative and statistically significant. This implies distance has a stronger negative impact on boys than girls. Let us look at how this works. Let us first consider boys and girls residing next to roads using Model II.

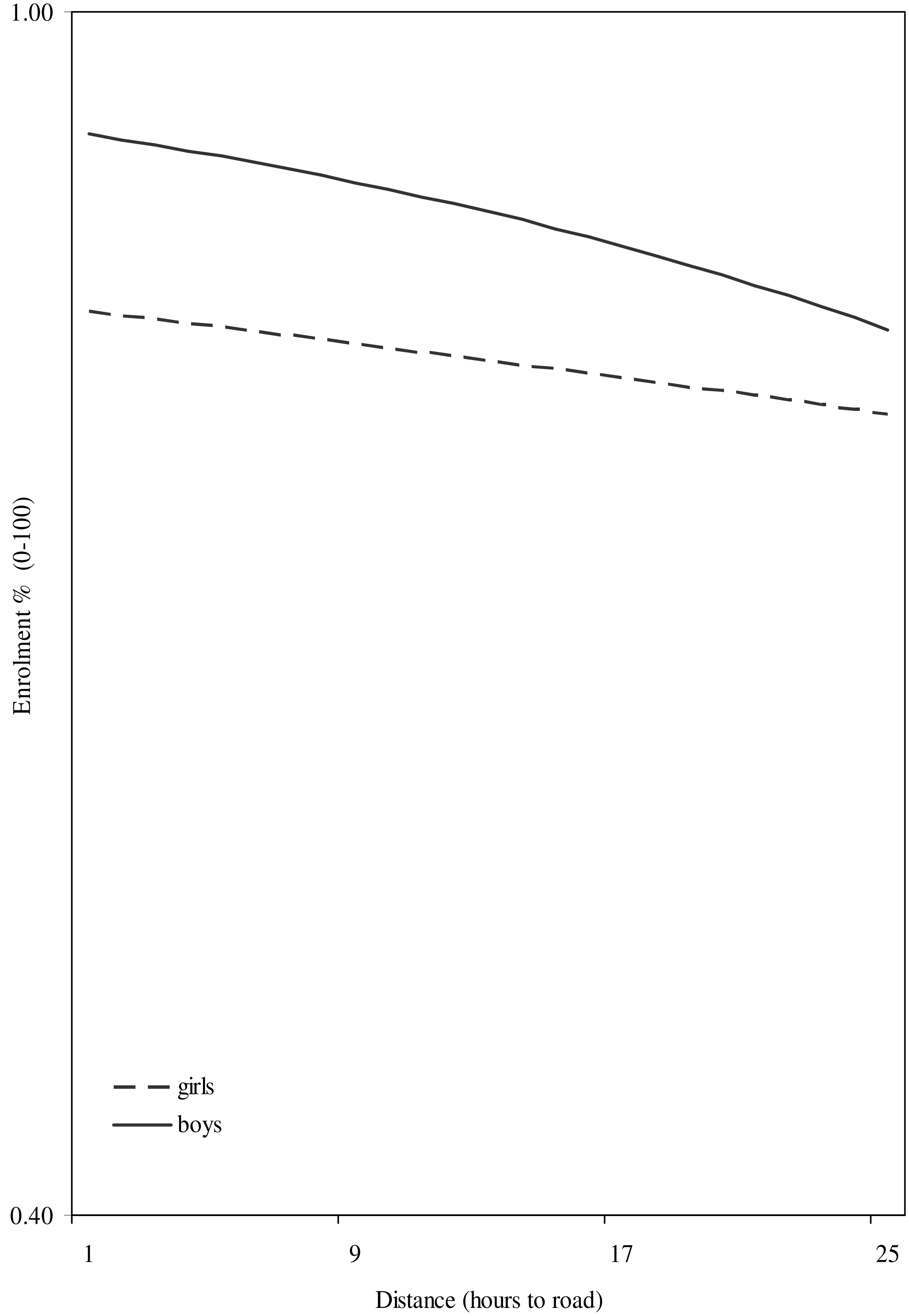
--Table 6.2 about here--

For girls, a zero value of distance and a zero value of sex would reduce all three terms to zero and hence the sum of the three coefficients would be zero. For boys, a zero value of distance and a value of one for sex reduce the distance and the interaction terms to zero, and leaves us with a value of 0.82 which is the coefficient for sex. The value of 0.82 thus represents the advantage that the boys who reside next to roads have over girls living next to roads, other factors not considered. However, the advantage boys have over girls in their chances of being enrolled when they are nearer to households reduces with distance. Following the above calculations, for example, when the distance is 1 day (8 hours), then the advantage that boys have drops to 0.62 in Model II.

We find similar trends in the strength and directions of the access, sex and interaction coefficient across the next three models that control for the locational, socio-economic, and school availability factors respectively. Following similar calculations we find boys next to roads having an advantage over girls next to roads equivalent to a value of 0.86, 0.96 and 0.97 respectively across Models III, IV and V. These are also the sex coefficients across the model. When they are one day beyond roads we find the advantages drop to 0.63, 0.73 and 0.73 respectively.

However these values do not consider the coefficient estimates of other variables and the constant term in the model and do not give us the actual probability of enrolments of boys and girls. The actual probabilities for boys and girls are calculated considering all variables and the constant term. In figure 6.1, we present such probabilities for primary aged boys and girls, based on the results of Model V. Remember here that when estimating probability of the dependent variables, logistic regression assumes all variables to be held at their means.

Figure 6.1. Predicted enrolment by accessibility, boys and girls (age 6-12)

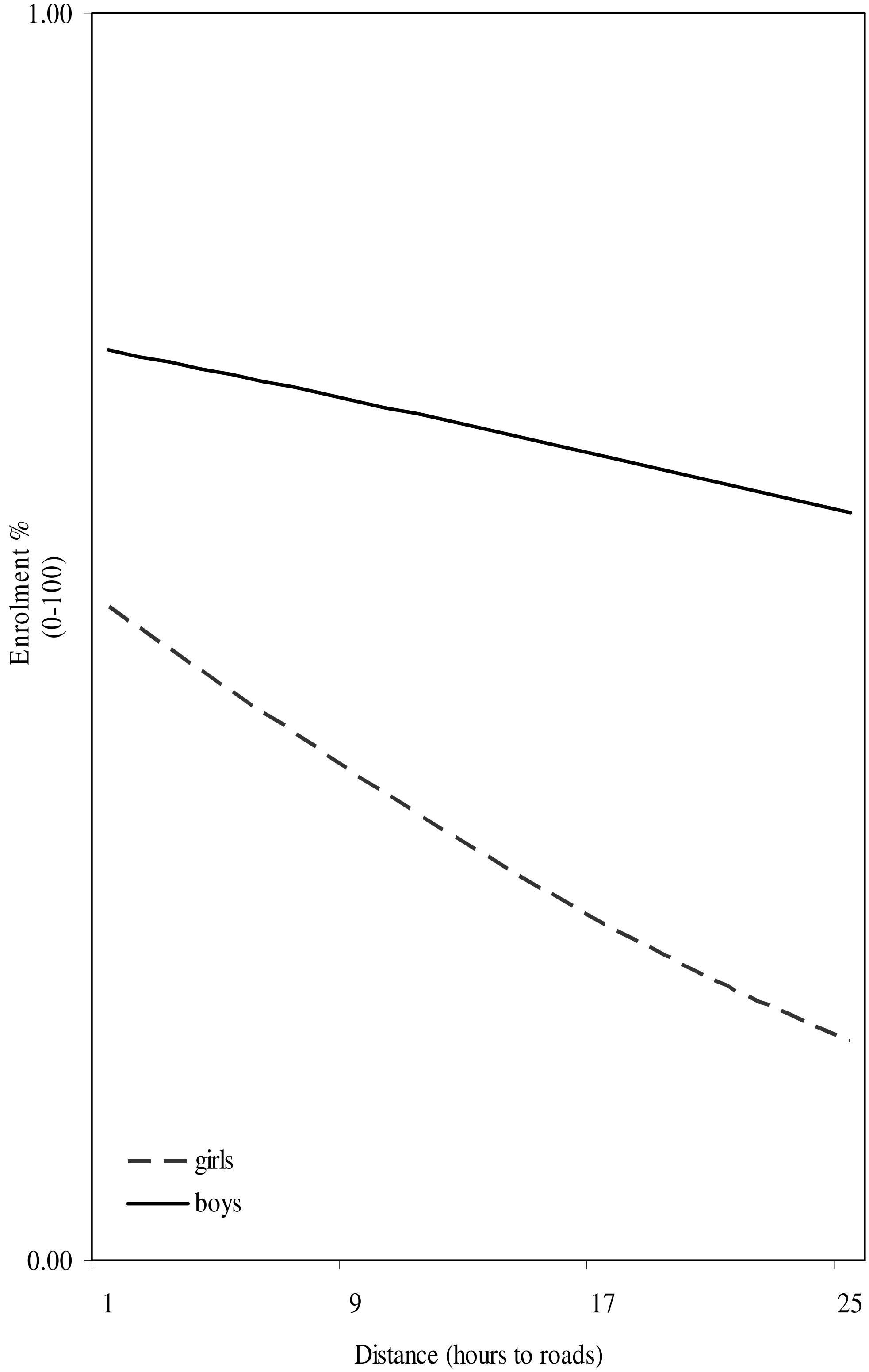


The advantage that boys have continues to narrow with decrease in accessibility. When the road is next to household the probability of enrolment is 94% and 85% respectively for boys and girls, but this difference narrows as areas become inaccessible.

13-19 boys and girls

The results for adolescent boys and girls fit our model better. In the basic model without the interaction term, accessibility coefficient is negative and statistically significant implying isolation is detrimental to the chances of enrolment of the secondary aged children. Also, boys are clearly in advantage than girls. When we introduce the interaction term (Table 6.3, Model II), we find the interaction to be positive but statistically significant at the 10% level. Boys continue to have an advantage over girls but the detrimental effects of isolation are stronger for girls. In this model, the value of 0.67 which is the sex coefficient represents the substantial advantage that the boys who reside next to roads have over girls living next to roads (other factors not considered). Unlike the primary aged boys for whom the advantage over girls decreased with distance, the advantage adolescent boys have over adolescent girls increases with distance. When the distance is 1 day (8 hours) boys' advantage takes a value of 1.01 (other factors not considered).

Figure 6.2. Predicted enrolments by accessibility, boys and girls, 13-19



After controls for locational characteristics in Model III, the interaction term becomes statistically significant and stronger by about 23% (+0.043 to +0.053), the sex coefficient stays about the same, and the accessibility coefficient also gains strength by about 47%. Further controls for the socio-economic and school availability variables in Model IV and Model V respectively yield similar coefficient for the interaction term, a slightly stronger sex term and a slightly weaker accessibility term. All coefficients remain significant. This implies distance has a stronger negative impact on adolescent girls than adolescent boys.

--Table 6.3 about here--

Following similar calculations we find boys next to roads having an advantage over girls next to roads equivalent to a value of 0.69, 0.78 and 0.78 respectively across Models III, IV and V, other factors in the model not considered. These are also the sex coefficients across the model. When they are one day beyond roads we find the advantages for boys increase to 1.11, 1.20 and 1.19 respectively. Again these values do not consider the coefficient estimates of other variables and the constant term in the model.

The actual probabilities for boys and girls are calculated considering all variables and the constant term. In figure 6.2, we present the results based on Model V. The advantage that boys have continues to widen with inaccessibility. Boys next to roads have 73% probability of enrolment compared to 52% for girls. However when one reaches 1 day away from roads, the probability of boys reduces by 4 percentage points to

69%, but for girls' it reduces by 13% to 39%. We can conclude from the results that the disadvantage that adolescent girls face in enrolment increases as accessibility decreases.

When we add controls for rural primary school quality as a proxy for the secondary school quality and run the model for the rural sample (results in Table 6.4), the interaction term continues to be positive and significant and about of the same strength (+0.030) for the primary aged children. The interaction coefficients for the secondary age children is somewhat weaker (+ 0.041) and significant at the 10 percent level (results Table 6.5). Accessibility and sex behave in similar ways as with the full sample for both the age group.

--Table 6.4 about here--

--Table 6.5 about here--

The results that we have obtained by introducing the interaction coefficient are confirmed when we run our models segregated for boys and girls. In Table 6.6 we show the regression results of the full models for primary aged boys, primary aged girls, secondary aged boys and secondary aged girls. Primary aged girls are not at a disadvantage because of distance to roads, but primary boys are. Adolescent girls are disadvantaged, but adolescent boys are not.

Discussion

Our results show that school enrolment of boys 6-12 is more likely to be impacted by inaccessibility than girls'. We would however expect inaccessibility to impact school enrolment of both the younger boys and girls mainly because of the longer distance they need to travel to school. Our results are somewhat counter intuitive, but part of this finding can be explained by the fact that for this age group, more inaccessible households actually have a lower gender disparity in enrolment than accessible households.

The most impressive gains in school enrolment between 1995-1996 and 2003-2004 in Nepal were among 6-10 year old girls. Among these girls, school participation increased by 22 percent points from 51% to 73%, compared to 13 percent points increase from 73 to 85% during the same period for boys (The World Bank and Department of International Development 2006, The World Bank 2006: 85). The World Bank (2006) projects that if current trends in primary enrolment continue, Nepal will achieve complete gender disparity in primary enrolment by the year 2010. The good presence of primary schools in isolated areas and government of Nepal's special focus on increasing girls' enrolment seems to be paying off at this age level nationwide, particularly for isolated areas. Manadhar and Shrestha (2003: 218) attribute the remarkable gain by girls between the period 1993 to 2001 to special, supply side, pro-girl measures taken up by the government, such as appointment of female teachers and provision of scholarships for girls in some districts.

Given the impressive spread of primary schools in inaccessible areas of Nepal, and special pro-girl measures to increase girls' enrolment, it is likely that some of the impacts of inaccessibility have been compensated for girls residing in such areas, but the younger boys there are still at a disadvantage due to factors emanating from inaccessibility. On the other hand, the accessible Tarai has a very low girls' enrolment because of some offsetting factors—particularly the low value placed on girls education and cultural restriction put on girls—that are reducing their enrolments there.

As for children 13-19, the finding is very much in the hypothesized direction—inaccessibility is more detrimental to adolescent girls than boys this age group. This corresponds well with the greater gender disparity in school enrolment we had observed in isolated areas, where girls lagged by 24 percentage points than boys, compared to 17 percentage points in the most accessible areas. The results for the children aged 6-12 make the adolescent results even stronger because inaccessible girls start at less of a disadvantage but end with more of a disadvantage.

Gendered impact of Inaccessibility

In the last chapter we inferred that that all isolated children are less likely to be enrolled, in part because the isolated children are poorer, from less educated households and more disadvantaged caste/ethnic groups, and are served by distant and poorer quality schools. However our analysis shows that for adolescent girls inaccessibility continues to be an additional problem by itself regardless of the socio-economic, familial and infrastructural disadvantages. For them, the impact of accessibility on enrolment is also more direct. Given this gendered impact of inaccessibility on school enrolment we ask, what is it about inaccessibility in particular that prevents adolescent girls from accessing schools above and over her socio-economic and institutional disadvantages? While both boys and girls in isolated areas continue to be disadvantaged, inaccessibility is definitely imposing additional barriers that are harder for the adolescent girl child to overcome. Although primary schools have spread quite well in the past two decades, post-primary education institutions, which require greater degree of human and physical resources for their construction and upkeep, are sparsely distributed. Adolescent boys are more likely to overcome the barriers posed by inaccessibility, girls are unable to overcome the multiple barriers they face in remote villages—lack of appropriate transport facilities, long walks to school, negative social perceptions about girls' education, sexual harassment during travel and lack of gender sensitive sanitary facilities (Matin *et al.* 2002: 148).

Inaccessibility's impact on school enrolment is decisive in this sense that long distance they need to travel (often walk) and the related insecurity inhibit families from sending girls to school. However there is more than the obvious 'distance to school' or 'quality of school' effect of inaccessibility. Inaccessibility not only acts as a direct physical barrier to the girl children but also to the external stakeholders of development whose action can help increase their participation in school in the short and the long run. Improved access can indeed play crucial roles in addressing these direct and indirect negative determinants of school enrolment. It is likely that improving geographical accessibility make schools more reachable by households; enable cheaper construction, expansion and maintenance of newer schools including gender sensitive sanitation facilities; improve quality of schools by enabling movement of human (such as male and female teachers) and education materials (such as textbooks); reduce the transport burden on the girls and boys; and provide the opportunity for communities to interact with the external world for them to understand the value of and demand education for girls. Easily accessed and/or improved schools, and an overall enabling environment induced by roads, should improve all enrolments but especially girls'.

Table 6.1. Time to closest dirt road vs. school enrolment by gender

One-way time to dirt road	Weighted %	Enrolment weighted %			Gender disparity in enrolment by accessibility (%)
		All	Boys	Girls	
<u>Age 6-12</u>					
<= 15 minutes	63	80	87	73	14
>15 min <= 1.5 hrs	18	83	86	80	6
>1.5 hrs <1day	14	74	83	65	18
> 1 day	6	75	76	73	3
Accessibility disparity in enrolment by gender		5	11	0	-
Total	N= 3741	79	85	73	12
<u>Age 13-19</u>					
<= 15 minutes	65	60	68	52	16
>15 min <= 1.5 hrs	17	52	62	43	19
>1.5 hrs <1day	13	51	62	40	22
> 1 day	5	41	53	29	24
Accessibility disparity in enrolment by gender		19	15	23	-
Total	N=3082	56	65	48	18

Table 6.2. Logistic regression of school enrolment on accessibility and interaction between gender and accessibility (all children age 6-12)

Variables	Model I	Model II	Model III	Model IV	Model V
Distance to dirt road (hours)	-0.015	-0.005	-0.034+	-0.022	-0.017
	(0.011)	(0.012)	(0.017)	(0.014)	(0.016)
Sex (boy=1)	0.765**	0.821**	0.859**	0.956**	0.966**
	(0.106)	(0.111)	(0.117)	(0.121)	(0.119)
Distance*sex		-0.025*	-0.029*	-0.028*	-0.029*
		(0.011)	(0.012)	(0.012)	(0.013)
Development region (Western omitted)					
Eastern			-0.933**	-0.759*	-0.714*
			(0.335)	(0.296)	(0.306)
Central			-1.590**	-1.487**	-1.434**
			(0.324)	(0.296)	(0.303)
Mid Western			-0.639*	-0.487	-0.527
			(0.303)	(0.383)	(0.393)
Far Western			-0.789*	-0.715+	-0.716
			(0.371)	(0.432)	(0.443)
Stratum (Mountain omitted)					
Urban Kathmandu			2.225**	0.246	-0.036
			(0.670)	(0.685)	(0.694)
Urban Hill			0.953	0.455	0.230
			(0.591)	(0.658)	(0.678)
Rural Hill			-0.433	-0.043	0.004
			(0.312)	(0.289)	(0.292)
Urban Tarai			-0.206	-0.490	-0.688
			(0.440)	(0.436)	(0.452)
Rural Tarai			-0.937**	-0.425	-0.578+
			(0.299)	(0.314)	(0.322)

contd…

Variables	Model I	Model II	Model III	Model IV	Model V
Age of child (Age six omitted)					
Seven				0.595**	0.609**
				(0.181)	(0.182)
Eight				0.734**	0.748**
				(0.158)	(0.160)
Nine				0.928**	0.947**
				(0.191)	(0.191)
Ten				0.822**	0.838**
				(0.190)	(0.191)
Eleven				0.713**	0.754**
				(0.197)	(0.198)
Twelve				0.460*	0.497*
				(0.195)	(0.197)
Caste-ethnic group (Bahun omitted)					
Chhetri				-1.206**	-1.152*
				(0.447)	(0.458)
Adivasi Janajati				-1.358**	-1.342**
				(0.378)	(0.403)
Dalit				-1.743**	-1.762**
				(0.383)	(0.409)
Newar				-0.651	-0.672
				(0.518)	(0.532)
Other caste				-2.087**	-2.111**
				(0.384)	(0.405)
Muslim				-2.298**	-2.319**
				(0.432)	(0.451)
Household per capita expenditure (NRs. logged)				1.148**	1.074**
				(0.166)	(0.169)

contd…

Variables	Model I	Model II	Model III	Model IV	Model V
Education level of household head (0-15)				0.122**	0.122**
				(0.024)	(0.025)
Number of children <=19 in household				-0.108**	-0.109**
				(0.037)	(0.037)
Number of married female in household				0.224**	0.222**
				(0.078)	(0.079)
Water piped inside house				0.286	0.360
				(0.301)	(0.275)
Lighting source is electricity				0.820**	0.758**
				(0.239)	(0.238)
Intensity of Maoist conflict (Low omitted)					
Moderate				0.127	0.042
				(0.207)	(0.191)
Intense				-0.011	-0.017
				(0.419)	(0.382)
Primary school within 30 minutes					0.877**
					(0.248)
Secondary school within 30 minutes					0.172
					(0.192)
Constant	1.032**	1.011**	2.673**	-7.665**	-7.792**
	(0.109)	(0.108)	(0.410)	(1.592)	(1.645)
Observations	3728	3728	3728	3728	3728

Table 6.3. Logistic regression of school enrolment on accessibility and interaction between gender and accessibility (all children age 13-19)

Variables	Model I	Model II	Model III	Model IV	Model V
Distance to dirt road (hours)	-0.033**	-0.059*	-0.087**	-0.076**	-0.072**
	(0.011)	(0.023)	(0.028)	(0.024)	(0.023)
Sex (boy=1)	0.736**	0.667**	0.686**	0.775**	0.776**
	(0.078)	(0.082)	(0.091)	(0.113)	(0.114)
Distance*sex		0.043+	0.053*	0.053*	0.052*
		(0.022)	(0.026)	(0.026)	(0.025)
Development region (Western omitted)					
Eastern			-0.391+	-0.241	-0.215
			(0.200)	(0.189)	(0.187)
Central			-0.973**	-1.101**	-1.083**
			(0.175)	(0.180)	(0.183)
Mid Western			-0.836**	-0.980**	-1.021**
			(0.224)	(0.255)	(0.247)
Far Western			-0.466	-0.571	-0.566
			(0.307)	(0.355)	(0.356)
Stratum (Mountain omitted)					
Urban Kathmandu			1.440**	0.275	0.102
			(0.328)	(0.376)	(0.391)
Urban Hill			0.568+	-0.287	-0.477
			(0.308)	(0.373)	(0.382)
Rural Hill			-0.135	-0.166	-0.169
			(0.257)	(0.258)	(0.267)
Urban Tarai			-0.043	-0.520	-0.710+
			(0.289)	(0.352)	(0.364)
Rural Tarai			-0.733**	-0.559+	-0.684*
			(0.256)	(0.288)	(0.295)

contd…

Variables	Model I	Model II	Model III	Model IV	Model V
Age of child (Age 13 omitted)					
Fourteen				-0.127	-0.114
				(0.175)	(0.175)
Fifteen				-0.540**	-0.534**
				(0.171)	(0.172)
Sixteen				-1.161**	-1.156**
				(0.162)	(0.163)
Seventeen				-1.871**	-1.881**
				(0.185)	(0.185)
Eighteen				-2.173**	-2.186**
				(0.185)	(0.186)
Nineteen				-2.912**	-2.923**
				(0.192)	(0.192)
Caste-ethnic group (Bahun omitted)					
Chhetri				-0.265	-0.185
				(0.233)	(0.229)
Adivasi Janajati				-0.666**	-0.591**
				(0.207)	(0.207)
Dalit				-1.352**	-1.357**
				(0.235)	(0.234)
Newar				-0.555+	-0.523+
				(0.307)	(0.305)
Other caste				-1.737**	-1.735**
				(0.242)	(0.241)
Muslim				-2.851**	-2.874**
				(0.357)	(0.344)

contd...

Variables	Model I	Model II	Model III	Model IV	Model V
Household per capita expenditure (NRs. logged)				0.780**	0.739**
				(0.159)	(0.160)
Education level of household head (0-15)				0.090**	0.088**
				(0.017)	(0.017)
Number of children <=19 in household				-0.008	-0.009
				(0.040)	(0.039)
Number of married female in household				0.053	0.051
				(0.070)	(0.070)
Water piped inside house				0.233	0.239
				(0.190)	(0.189)
Lighting source is electricity				0.517**	0.430**
				(0.146)	(0.150)
Intensity of Maoist conflict (Low omitted)					
Moderate				-0.287+	-0.277+
				(0.151)	(0.145)
Intense				-0.046	-0.008
				(0.266)	(0.257)
Primary school within 30 minutes					0.466+
					(0.243)
Secondary school within 30 minutes					0.361*
					(0.144)
Constant	-0.041	-0.004	0.897**	-4.799**	-4.997**
	(0.080)	(0.082)	(0.290)	(1.574)	(1.573)
Observations	3072	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 6.4. Logistic regression of school enrolment accessibility and interaction between gender and accessibility (rural children age 6-12)

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Distance to dirt road (hours)	-0.009	0.002	-0.032+	-0.021	-0.015	-0.010
	(0.011)	(0.013)	(0.017)	(0.014)	(0.016)	(0.016)
Sex (boy=1)	0.773**	0.836**	0.873**	0.975**	0.988**	1.007**
	(0.113)	(0.119)	(0.125)	(0.129)	(0.127)	(0.126)
Distance*sex		-0.025*	-0.029*	-0.028*	-0.029*	-0.030*
		(0.011)	(0.012)	(0.012)	(0.013)	(0.013)
Development region (Western omitted)						
Eastern			-1.078**	-0.819*	-0.779*	-0.769*
			(0.342)	(0.317)	(0.328)	(0.343)
Central			-1.692**	-1.529**	-1.474**	-1.420**
			(0.336)	(0.317)	(0.325)	(0.336)
Mid Western			-0.706*	-0.534	-0.574	-0.485
			(0.311)	(0.401)	(0.412)	(0.439)
Far Western			-0.858*	-0.719	-0.729	-0.542
			(0.380)	(0.449)	(0.464)	(0.495)
Stratum (Mountain omitted)						
Rural Hill			-0.427	-0.028	0.017	0.039
			(0.314)	(0.294)	(0.297)	(0.310)
Rural Tarai			-0.899**	-0.354	-0.497	-0.561
			(0.300)	(0.320)	(0.329)	(0.344)
Age of child (Age six omitted)						
Seven				0.568**	0.583**	0.574**
				(0.191)	(0.192)	(0.194)
Eight				0.745**	0.758**	0.761**
				(0.164)	(0.166)	(0.167)

contd…

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Nine				0.888**	0.906**	0.914**
				(0.198)	(0.198)	(0.198)
Ten				0.821**	0.835**	0.834**
				(0.198)	(0.200)	(0.197)
Eleven				0.717**	0.762**	0.766**
				(0.208)	(0.210)	(0.211)
Twelve				0.478*	0.511*	0.517*
				(0.205)	(0.207)	(0.208)
Caste-ethnic group (Bahun omitted)						
Chhetri				-1.201*	-1.143*	-0.995*
				(0.488)	(0.498)	(0.480)
Adivasi Janajati				-1.424**	-1.414**	-1.288**
				(0.407)	(0.432)	(0.426)
Dalit				-1.745**	-1.776**	-1.634**
				(0.414)	(0.441)	(0.432)
Newar				-0.603	-0.629	-0.617
				(0.550)	(0.564)	(0.554)
Other caste				-2.174**	-2.202**	-2.027**
				(0.414)	(0.435)	(0.437)
Muslim				-2.357**	-2.384**	-2.179**
				(0.463)	(0.482)	(0.482)
Household per capita expenditure (NRs. logged)				1.138**	1.066**	1.055**
				(0.173)	(0.176)	(0.178)
Education level of household head (0-15)				0.132**	0.131**	0.129**
				(0.026)	(0.027)	(0.027)
Number of children <=19 in household				-0.100*	-0.101*	-0.100*
				(0.039)	(0.039)	(0.040)

contd…

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Number of married female in household				0.216**	0.214**	0.217**
				(0.081)	(0.081)	(0.083)
Water piped inside house				0.610	0.698*	0.704*
				(0.383)	(0.343)	(0.326)
Lighting source is electricity				0.821**	0.754**	0.720**
				(0.265)	(0.263)	(0.259)
Intensity of Maoist conflict (Low omitted)						
Moderate				0.132	0.042	0.078
				(0.213)	(0.196)	(0.193)
Intense				-0.004	-0.019	-0.007
				(0.442)	(0.405)	(0.381)
Primary school within 30 minutes					0.888**	0.839**
					(0.255)	(0.240)
Secondary school within 30 minutes					0.142	0.085
					(0.195)	(0.195)
Quality of primary school						0.088*
						(0.041)
Pri school unscheduled closure						-0.020
						(0.249)
Pri teacher as per sanctioned						0.080
						(0.234)
At least on female teacher in school						0.059
						(0.164)
Constant	0.905**	0.881**	2.721**	-7.607**	-7.745**	-8.294**
	(0.117)	(0.116)	(0.417)	(1.677)	(1.740)	(1.758)
Observations	2864	2864	2864	2864	2864	2864

Standard errors in parentheses
*+ p< 0.10, * p< .05, ** p< .01*

Table 6.5. Logistic regression of school enrolment accessibility and interaction between gender and accessibility (rural children age 13-19)

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Distance to dirt road (hours)	-0.022*	-0.042*	-0.080**	-0.073**	-0.070**	-0.064**
	(0.010)	(0.021)	(0.026)	(0.024)	(0.023)	(0.024)
Sex (boy=1)	0.799**	0.733**	0.747**	0.892**	0.891**	0.900**
	(0.090)	(0.095)	(0.104)	(0.133)	(0.133)	(0.135)
Distance*sex		0.033+	0.046+	0.045+	0.045+	0.044+
		(0.020)	(0.025)	(0.026)	(0.025)	(0.026)
Development region (Western omitted)						
Eastern			-0.488*	-0.381+	-0.350+	-0.307
			(0.219)	(0.196)	(0.193)	(0.204)
Central			-1.078**	-1.234**	-1.210**	-1.150**
			(0.191)	(0.191)	(0.195)	(0.206)
Mid Western			-0.831**	-1.043**	-1.093**	-1.061**
			(0.234)	(0.274)	(0.264)	(0.265)
Far Western			-0.580+	-0.689+	-0.672+	-0.571
			(0.344)	(0.392)	(0.394)	(0.413)
Stratum (Mountain omitted)						
Rural Hill			-0.151	-0.210	-0.219	-0.245
			(0.264)	(0.281)	(0.294)	(0.305)
Rural Tarai			-0.704**	-0.566+	-0.704*	-0.783*
			(0.262)	(0.320)	(0.329)	(0.351)
Age of child (Age 13 omitted)						
Fourteen				-0.148	-0.142	-0.160
				(0.191)	(0.192)	(0.192)
Fifteen				-0.644**	-0.645**	-0.645**
				(0.187)	(0.188)	(0.188)

contd...

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Sixteen				-1.216**	-1.217**	-1.229**
				(0.178)	(0.180)	(0.183)
Seventeen				-2.054**	-2.078**	-2.097**
				(0.209)	(0.210)	(0.211)
Eighteen				-2.153**	-2.170**	-2.180**
				(0.211)	(0.213)	(0.213)
Nineteen				-3.208**	-3.236**	-3.264**
				(0.226)	(0.227)	(0.224)
Caste-ethnic group (Bahun omitted)						
Chhetri				-0.289	-0.188	-0.116
				(0.278)	(0.273)	(0.269)
Adivasi Janajati				-0.649**	-0.563*	-0.517*
				(0.237)	(0.236)	(0.233)
Dalit				-1.392**	-1.395**	-1.350**
				(0.267)	(0.265)	(0.265)
Newar				-0.712+	-0.678+	-0.705+
				(0.397)	(0.398)	(0.393)
Other caste				-1.986**	-1.991**	-1.880**
				(0.298)	(0.295)	(0.295)
Muslim				-3.174**	-3.208**	-3.037**
				(0.445)	(0.428)	(0.439)
Household per capita expenditure (NRs. logged)				0.853**	0.803**	0.794**
				(0.191)	(0.192)	(0.196)
Education level of household head (0-15)				0.100**	0.096**	0.097**
				(0.020)	(0.020)	(0.020)
Number of children <=19 in household				-0.006	-0.008	-0.005
				(0.044)	(0.044)	(0.044)

contd...

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Number of married female in household				0.057	0.054	0.050
				(0.078)	(0.078)	(0.079)
Water piped inside house				0.258	0.261	0.285
				(0.241)	(0.239)	(0.246)
Lighting source is electricity				0.400*	0.316+	0.247
				(0.167)	(0.170)	(0.175)
Intensity of Maoist conflict (Low omitted)						
Moderate				-0.378*	-0.378*	-0.325+
				(0.174)	(0.167)	(0.169)
Intense				-0.150	-0.118	-0.042
				(0.286)	(0.276)	(0.269)
Primary school within 30 minutes					0.467+	0.422+
					(0.258)	(0.251)
Secondary school within 30 minutes					0.379*	0.321*
					(0.152)	(0.147)
Quality of primary school						0.068+
						(0.035)
Pri school unscheduled closure						-0.119
						(0.212)
Pri teacher as per sanctioned						0.073
						(0.178)
At least on female teacher in school						0.154
						(0.155)
Constant	-0.240*	-0.205*	0.899**	-5.238**	-5.341**	-5.748**
	(0.095)	(0.098)	(0.302)	(1.889)	(1.889)	(1.938)
Observations	2154	2154	2154	2154	2154	2154

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 6.6. Logistic regression of school enrolment on accessibility by gender

Variables	Age 6-12		Age 13-19	
	Boys	Girls	Boys	Girls
Distance to dirt road (hours)	-0.038*	-0.021	-0.016	-0.085**
	(0.019)	(0.016)	(0.011)	(0.026)
Development region (Western omitted)				
Eastern	-0.908*	-0.651+	-0.459+	0.101
	(0.379)	(0.364)	(0.249)	(0.255)
Central	-1.501**	-1.424**	-1.078**	-1.068**
	(0.380)	(0.336)	(0.248)	(0.234)
Mid Western	-0.549	-0.543	-0.909**	-1.101**
	(0.460)	(0.461)	(0.333)	(0.344)
Far Western	-0.483	-0.906+	-0.762*	-0.397
	(0.522)	(0.537)	(0.378)	(0.496)
Stratum (Mountain omitted)				
Urban Kathmandu	0.046	-0.003	-0.275	0.283
	(0.884)	(0.830)	(0.527)	(0.491)
Urban Hill	1.794	-0.276	-0.215	-0.871
	(1.204)	(0.692)	(0.502)	(0.563)
Rural Hill	0.263	-0.152	-0.301	-0.062
	(0.386)	(0.395)	(0.322)	(0.347)
Urban Tarai	-0.609	-0.721	-1.013*	-0.464
	(0.575)	(0.566)	(0.463)	(0.495)
Rural Tarai	-0.369	-0.703+	-0.740*	-0.668+
	(0.439)	(0.416)	(0.353)	(0.403)

contd…

Variables	Age 6-12		Age 13-19	
	Boys	Girls	Boys	Girls
Age of child (Age 6/13 omitted)				
Seven/ Fourteen	1.001**	0.320	-0.211	-0.125
	(0.289)	(0.244)	(0.288)	(0.254)
Eight/ Fifteen	0.890**	0.635**	-0.442+	-0.663**
	(0.246)	(0.231)	(0.262)	(0.248)
Nine/ Sixteen	1.129**	0.804**	-1.221**	-1.111**
	(0.288)	(0.253)	(0.250)	(0.251)
Ten/ Seventeen	1.077**	0.657**	-1.807**	-2.021**
	(0.281)	(0.248)	(0.271)	(0.292)
Eleven/Eighteen	1.152**	0.452	-2.361**	-2.182**
	(0.277)	(0.311)	(0.303)	(0.288)
	0.556*	0.407	-3.139**	-2.765**
Twelve/Nineteen	(0.277)	(0.270)	(0.314)	(0.289)
Caste-ethnic group (Bahun omitted)				
Chhetri	-1.416*	-0.920+	-0.990**	0.396
	(0.699)	(0.554)	(0.331)	(0.285)
Adivasi Janajati	-1.389*	-1.277**	-1.129**	-0.188
	(0.606)	(0.491)	(0.283)	(0.260)
Dalit	-1.694**	-1.806**	-1.875**	-0.999**
	(0.620)	(0.511)	(0.354)	(0.323)
Newar	1.162	-1.150+	-1.095**	-0.084
	(1.461)	(0.658)	(0.420)	(0.414)
Other caste	-1.871**	-2.265**	-2.028**	-1.761**
	(0.640)	(0.513)	(0.339)	(0.319)
Muslim	-2.257**	-2.358**	-3.080**	-3.025**
	(0.635)	(0.563)	(0.480)	(0.611)

contd…

Variables	Age 6-12		Age 13-19	
	Boys	Girls	Boys	Girls
Household per capita expenditure (NRs. logged)	1.166**	0.969**	0.360+	1.124**
	(0.246)	(0.194)	(0.199)	(0.204)
Education level of household head (0-15)	0.095**	0.143**	0.100**	0.087**
	(0.033)	(0.032)	(0.024)	(0.022)
Number of children <=19 in household	-0.062	-0.157**	-0.069	0.041
	(0.057)	(0.045)	(0.056)	(0.054)
Number of married female in household	0.091	0.319**	0.315**	-0.166
	(0.105)	(0.108)	(0.105)	(0.105)
Water piped inside house	0.923*	0.117	0.271	0.241
	(0.427)	(0.318)	(0.304)	(0.231)
Lighting source is electricity	0.615*	0.865**	0.434*	0.464*
	(0.291)	(0.307)	(0.196)	(0.199)
Intensity of Maoist conflict (Low omitted)				
Moderate	0.083	0.051	-0.207	-0.355
	(0.255)	(0.223)	(0.178)	(0.219)
Intense	-0.083	0.044	-0.157	0.144
	(0.410)	(0.444)	(0.301)	(0.366)
Primary school within 30 minutes	1.198**	0.691**	0.857**	0.077
	(0.354)	(0.266)	(0.315)	(0.274)
Secondary school within 30 minutes	-0.031	0.324	0.340*	0.425*
	(0.236)	(0.228)	(0.172)	(0.198)
Constant	-8.183**	-6.459**	-0.589	-8.540**
	(2.365)	(1.944)	(1.973)	(1.984)
Observations	1928	1800	1496	1576

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Chapter VII

Geographical isolation, poverty and school enrolment

In the previous chapter we analyzed how the negative impact of isolation on school enrolment varied by the child's gender. In this chapter we examine how such negative impact on enrolment varies by the poverty level of the household. Poorer children generally have significantly lower chances of school enrolment. The disadvantage has been well established in the literature, and also confirmed for Nepal by our earlier multivariate analysis.

Like the difference between boys and girls, it is reasonable to argue that households of different poverty levels face different sets of constraints in accessing "socio-economic arrangements" (Sen 2000) such as schools, and also different sets of capabilities to overcome the constraints induced by isolation. Irrespective of the poverty level of the households, sending children to school incurs direct and indirect costs that can far exceed immediate benefits. Given such differential sets of costs, constraints and capabilities, we are interested to examine if accessibility impacts differentially the chances of school attendance of poor children compared to more affluent children.

Pathways

There are four pathways in which we can suspect isolation to be more detrimental to poor children's school participation than the non-poor children's. First, while distant schools in isolated areas are difficult to be accessed by both poor and non-poor children, it is likely that distance poses a greater barrier on the poorer kids than the non-poor ones.

We have seen that in Nepal isolated areas are served with very sparse schools, especially the secondary ones. Attending schools there means either long walks to school every day or be able to afford the cost of living in the area where the school is located. Children from poorer households have less capacity to do so. For example, 90% of the students from 10 remote village development committees of Makawanpur district of Nepal who passed lower secondary schools dropped out of school because they could not afford the cost associated with renting a room in the area where secondary schools were located (Bishta 2007, original in Nepali).

Second, as children get promoted to higher grades, the cost of tuition and supplies also increase. Thus even when schools tend to be physically accessible, poorer households are not able to afford the expenses. Third, the household travel and transport tasks that children, especially from poorer households in isolated areas, are expected to perform leaves less time for them to travel to and attend school. Poorer households are cash- and time-deprived compared to richer households, and are likely to be more unwilling to send their children to school even when schools are not too far. Apart from the probable task of attending school, children from poorer families are expected to perform multiple household and farm related transport tasks which squeeze them of their possible school time. Molesworth (2006: 16) argues that school going children are compelled to fill in the labor gap created by high degree of male migration in Nepal causing them to withdraw from school. It is the poorer families that mostly migrate. The opportunity costs are high for the children from poorer families which may require their children to supplement household, farm and other labor for a subsistence living.

Fourth, not only schools, but also piped water inside the house, non bio-fuels and electricity for lighting, all of which could ease the transport burden faced by households, especially poor ones, are rare in isolated areas of Nepal. Inadequate and/or costly transport for moving farm produce to markets and other goods may cause families to use their children, especially girls as porters, which delays or prevents their attendance in school (Porter, Blaufuss & Owusu-Acheampong 2006). Improved access also has the potential to reduce the work load on households and their children by bringing alternative products to the communities such as clean fuel, ground flour, or good quality soap. This may benefit the poor more as their children take up most of the household work and travel burden.

Where roads have connected villages, transportation costs and eventually the cost of goods have generally reduced. For example, during my field studies in Malyangkot village, I found that transportation costs had dropped to about Nepali Rupees 2 per Kilogram from Rs. 7 after the dirt road of about 20 kilometers connected the village to a paved road. We must note here that for households who lived further away from the roads even in the same village, they had to pay additional money to have goods carried to their houses.

Finally, the virtual shutting in of communities as a result of perpetual isolation, discussed in earlier chapters, is also characterized by the low value poorer households there place to educating their children. Among many of the features of the isolation trap, which we have discussed in detail in our theoretical chapter, is the low value poor households there place on education. Poor households in isolated areas have “neither the time nor the money to travel, and their lives and thoughts range no more than a short distance from where they were born" (Owen 1968). While richer households may also suffer from the same isolation, they have more resources to travel even without roads and have more contacts with the world outside their villages. Roads have a tremendous potential

Based on our discussion thus far it is reasonable to believe that although isolation poses similar set of constraints on the poor in accessing schools, their capabilities to overcome isolation's direct and indirect impact on accessing schools are also different. By improving accessibility we can expect some of the poverty difference in enrolment to be reduced.

At this point it is important to note that some contrasting literatures suggest that roads do not always do the good for the poor, or the benefits of roads may not be accessed by the poor as much as it is accessed by the rich. For example, researchers were unable to establish a positive association between poverty reduction and road building in Nepal (Robinson and Stiedl 2001), in Peru (Wilson 2004) and in Zaire (Fairhead 1992). It is likely that like many social and economic opportunities generated by roads are first taken up by those who are already in a socially advantageous position, mainly the rich, and the poor only catch up later or are never able to catch up.

Poverty and school enrolment in Nepal

Our research has already established that poorer households in Nepal have a much lower school enrolment ratio, and are also the households that are more inaccessible. To recall, school enrolment declines steadily as poverty increases. The difference is huge: the poorest quintile having primary age enrolment rate of 61 % that grows steadily to a near universal rate of 95% for the richest quintile. Similarly, for secondary age children the enrolment rates increases from 30% for the poorest quintile to 76% for the richest quintile. When the households are divided into poor and non-poor based on the poverty line[5], the poor children aged 6-12 have an enrolment rate of 65 % which is 23 percentage points lower than the enrolment rate for the non-poor children of the same age group. Poor children aged 13-19 have an enrolment ratio of 35%, which is 28 percentage points lower than non-poor children this age group.

This positive relationship between poverty and enrolment continued to hold true in our most comprehensive model, suggesting that poverty is indeed a significant barrier to attaining school education. In other words, poorer children of all age groups and regions had significantly less likely chances of being enrolled in school.

Poverty and isolation

We also notice that as households get poorer, their isolation level also increases. The poor households have a mean travel time of about 3 hours to a dirt road compared to 1 hour 54 minutes for the non-poor households (Table 4.9). Corresponding to the increase in isolation, poorer households are also served by distant and lower quality schools. In the case of distance to primary schools, most households have schools within half an hour although there is some difference between poverty groups. Distance to primary school does not appear to be a major obstacle in attaining primary education. However in terms of secondary school, only about two in five of the poorest children

[5] Poor child is defined as the child who hails from a household whose annual per capita expenditure level falls below the poverty line. All others are considered non-poor.

have a secondary school within half an hour of where they live. For the richest quintile almost 9 of the 10 students have such a school within half an hour.

To summarize, enrolment is on average lower for poor children than the non-poor, enrolment decreases with isolation for both poor and non-poor children for both age groups. Our data also shows that isolated areas have a greater concentration of poorer households (implies that on average poor households are located further away from roads) and also have a lower distribution of schools (implies that on average isolated households are located further away from schools). Given these multi-dimensional relations between poverty, isolation and enrolment, we suspect that breaking the isolation faced by of remote communities in Nepal may have differential impacts for the poor and the non poor for their education.

Age 6-12: For children of this age group, we do not find much difference in the enrolment rates of poor children from isolated areas and the poor children from accessible areas. The simple bivariate relationships show that children from poor households of isolated areas do not lag behind the children from poor households in the most accessible areas; in fact they have a slightly higher enrolment rate. However in the case of children from non-poor households, the ones from the most isolated areas are enrolled at a slightly lower rate than in the most accessible areas.

--Table 7.1 about here--

Although the poor children have lower enrolment rates compared to the non-poor across all accessibility zones, the poor in the most isolated areas do not lag behind as much as their non-poor counterparts compared to the most accessible areas. Thus the poor non-poor disparity is slightly higher (27%) in accessible areas than in isolated areas

(20%). Nepal has made impressive gains in primary school enrolment between 1995-1996 and 2003-2004 especially among the girls, poor, and those living in remoter regions (The World Bank 2006), and this could be one reason that we do not see the poor of the isolated areas lagging behind the non-poor in terms of enrolment for this age group.

Age 13-19: For the children of this age group, both the poor and non-poor in the most isolated areas have lower enrolment rates compared to the poor and non-poor in most accessible areas. The non-poor in most isolated areas have an enrolment rate of 53%, which is about 12 points lower than those non-poor living in the most accessible areas. For the poor, the most accessible ones have an enrolment rate of 34% which is lower than for the poor living in the most isolated areas (30%), but higher than those living in between (38%).

The poor non-poor disparity in enrolment by accessibility level is high for all accessibility levels (between 23% to 31%), but highest in the most accessible areas. The bivariate analysis does not show that poor children in remoter areas are at a greater disadvantage than the non-poor children, compared to accessible areas.

Poverty accessibility interaction

In the basic multivariate analysis of chapter five, we did not allow interactions between the explanatory variables—poverty and distance. In other words we assumed all the explanatory variables in our most comprehensive model to impact school enrolment in similar ways for both poor and non-poor students. As noted this implies that improving accessibility helps all isolated children's chances of enrolment. We hypothesize however, given the different sets of costs, constraints and capabilities faced by poorer households, isolation operates more harshly on poorer households than it does the richer ones. While isolation hurts all children's chances of enrolment, it hurts the poorer children more. Conversely, as accessibility gets better, all children benefit but the poorer households benefit more.

In order to test the interaction effects, we introduce a multiplicative interaction term between isolation level (measured as the travel time from households to roads) and poverty status (poor = 1) in the model. In the first model (Model I) we estimate enrolment as a function of distance to roads and whether the child is poor or non-poor. In Model II, we add the interaction between the two. In the third model, we add control for the locational variables (stratum and development regions). Next in model IV, we add controls for the socio-economic characteristics of the child such as age, ethnicity, household expenditure level, household head's education, number of children and number of married female in the household and household access to electricity and water. In Model V, we add controls for availability of primary and secondary schools. Finally we test a sixth model for the rural sample, adding controls for different dimensions of school quality—infrastructural and instructional (closure, teacher positions fulfilled).

We test the models for all primary aged children (Table 7.2), all secondary age children (Table 7.3), rural primary children (Table 7.4) and rural secondary children (Table 7.5).

--Table 7.2 about here--

--Table 7.3 about here--

--Table 7.4 about here--

--Table 7.5 about here--

After controls for regions and socio-economic variables, the interaction terms have the expected negative sign for both age groups for all samples in subsequent models. However the poverty*distance interaction terms are not statistically significant. We do not have enough evidence to conclude if distance behaves differently for the poor child's enrolment chances than the non-poor child's. This also implies that the poor non-poor inequalities in school enrolments are similar in accessible and inaccessible areas.

Discussion

While improving accessibility is expected to break several of the barriers that the poor families face in sending their children to school, it is also likely that there is a considerable time lag before the accessibility benefits to education are accrued by the poor. There are several possible reasons for this. For example, schools are likely to become nearer and better quality as accessibility improves, but a poor family's practical needs can not be altered by improvement in accessibility within a short span of time.

Improving accessibility has the potential to improve income opportunities for families through trade, diversification of employment outside of agriculture and selling of agricultural produce. Researchers have found that households living near markets and cities in Nepal are more likely to be engaged in non-farm activity, especially wage non-farm employment (Fafchamps & Shilpi 2005). Unfortunately, the poor families in inaccessible areas in Nepal are either landless or own very little land, and are also cash short. It is not uncommon to find poor children, women and men walking for hours even where transport services exist because of their inability to afford the fares. In the absence of targeted interventions, they are unable to utilize the benefits of accessibility to raise their income so that they can afford to send their children to school. Although our research does not provide evidence that accessibility benefits the rich more in sending children to school, it is quite likely that the rich have more resources to which enables them to capitalize the benefits earlier than the poor.

Schooling returns are not immediate nor are they direct enough to support a poor family's means of livelihood. Returns from schooling require several years of engagement outside the household economy which makes poor households reluctant to send their children to school. The network, connection and the flow of people generated by roads and the social change that is ushered in does elevate the level of awareness amongst the poor regarding the importance of education. But again, their hand-to-mouth existence may be preventing them to immediately translate the awareness to practice immediately. Pro-poor interventions along with improving accessibility, such as providing scholarships in school for poor children and providing credits to open up small business, may help the poor to accrue the benefits of accessibility in sending their children to school.

Table 7.1. Time to closest dirt road vs. school enrolment by poor/non-poor

One-way time to dirt road	Weighted %	Enrolment weighted %			Poor-nonpoor disparity in enrolment by accessibility level (%)
		All	Nonpoor	Poor	
Age 6-12					
<= 15 minutes	63	80	88	61	27
>15 min <= 1.5 hrs	18	83	94	72	22
>1.5 hrs <1day	14	74	86	66	20
> 1 day	6	75	85	65	20
Accessibility disparity in enrolment by gender		5	3	-4	-
Total	N= 3741	79	88	65	23
Age 13-19					
<= 15 minutes	65	60	65	34	31
>15 min <= 1.5 hrs	17	52	61	38	23
>1.5 hrs <1day	13	51	62	38	24
> 1 day	5	41	53	30	23
Accessibility disparity in enrolment by gender	-	19	12	4	-
Total	N=3082	56	64	35	29

Table 7.2. Logistic regression of school enrolment on accessibility and interaction between poverty and accessibility (all children age 6-12)

Variables	Model I	Model II	Model III	Model IV	Model V
Distance to dirt road (hours)	-0.005	-0.011	-0.042*	-0.028+	-0.021
	(0.011)	(0.014)	(0.018)	(0.016)	(0.018)
Poor	-1.373**	-1.398**	-1.451**	-0.847**	-0.792**
	(0.134)	(0.141)	(0.146)	(0.158)	(0.159)
Distance*poor		0.011	-0.003	-0.014	-0.018
		(0.017)	(0.020)	(0.020)	(0.021)
Development region (Western omitted)					
Eastern			-0.809**	-0.737*	-0.681*
			(0.296)	(0.302)	(0.310)
Central			-1.546**	-1.459**	-1.413**
			(0.287)	(0.304)	(0.310)
Mid Western			-0.445	-0.416	-0.478
			(0.286)	(0.390)	(0.400)
Far Western			-0.526	-0.634	-0.643
			(0.375)	(0.441)	(0.451)
Stratum (Mountain omitted)					
Urban Kathmandu			1.805**	0.415	0.090
			(0.659)	(0.675)	(0.686)
Urban Hill			0.755	0.415	0.135
			(0.592)	(0.681)	(0.697)
Rural Hill			-0.192	-0.091	-0.046
			(0.325)	(0.300)	(0.304)
Urban Tarai			-0.440	-0.490	-0.749
			(0.435)	(0.445)	(0.460)
Rural Tarai			-0.973**	-0.353	-0.551
			(0.334)	(0.330)	(0.338)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V
Age of child (Age six omitted)					
Seven				0.577**	0.597**
				(0.180)	(0.181)
Eight				0.762**	0.774**
				(0.155)	(0.158)
Nine				0.945**	0.972**
				(0.189)	(0.189)
Ten				0.841**	0.859**
				(0.188)	(0.190)
Eleven				0.757**	0.802**
				(0.193)	(0.195)
Twelve				0.481*	0.524**
				(0.194)	(0.197)
Boys				0.880**	0.894**
				(0.117)	(0.115)
Caste-ethnic group (Bahun omitted)					
Chhetri				-1.223**	-1.144*
				(0.454)	(0.463)
Adivasi Janajati				-1.412**	-1.370**
				(0.384)	(0.406)
Dalit				-1.802**	-1.795**
				(0.383)	(0.407)
Newar				-0.673	-0.704
				(0.531)	(0.526)
Other caste				-2.103**	-2.115**
				(0.392)	(0.410)
Muslim				-2.274**	-2.289**
				(0.435)	(0.453)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V
Education level of household head (0-15)				0.134**	0.132**
				(0.024)	(0.025)
Number of children <=19 in household				-0.143**	-0.140**
				(0.038)	(0.038)
Number of married female in household				0.270**	0.263**
				(0.078)	(0.079)
Water piped inside house				0.470	0.517+
				(0.300)	(0.269)
Lighting source is electricity				0.951**	0.862**
				(0.242)	(0.242)
Intensity of Maoist conflict (Low omitted)					
Moderate				0.076	-0.020
				(0.208)	(0.188)
Intense				-0.092	-0.092
				(0.445)	(0.396)
Primary school within 30 minutes					0.934**
					(0.255)
Secondary school within 30 minutes					0.248
					(0.189)
Constant	1.999**	2.009**	3.607**	3.153**	2.256**
	(0.118)	(0.119)	(0.428)	(0.598)	(0.629)
Observations	3728	3728	3728	3728	3728

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 7.3. Logistic regression of school enrolment on accessibility and interaction between poverty and accessibility (all children age 13-19)

Variables	Model I	Model II	Model III	Model IV	Model V
Distance to dirt road (hours)	-0.016+	-0.024+	-0.049*	-0.036**	-0.032*
	(0.010)	(0.014)	(0.019)	(0.014)	(0.014)
Poor	-1.139**	-1.191**	-1.199**	-0.752**	-0.719**
	(0.114)	(0.122)	(0.130)	(0.169)	(0.169)
Distance*poor		0.022	0.022	-0.006	-0.006
		(0.016)	(0.020)	(0.018)	(0.017)
Development region (Western omitted)					
Eastern			-0.377*	-0.304	-0.271
			(0.175)	(0.191)	(0.190)
Central			-0.946**	-1.107**	-1.087**
			(0.151)	(0.178)	(0.181)
Mid Western			-0.670**	-0.945**	-0.985**
			(0.207)	(0.254)	(0.245)
Far Western			-0.323	-0.648+	-0.626+
			(0.262)	(0.342)	(0.344)
Stratum (Mountain omitted)					
Urban Kathmandu			1.346**	0.575	0.384
			(0.304)	(0.364)	(0.379)
Urban Hill			0.575*	-0.047	-0.260
			(0.289)	(0.360)	(0.370)
Rural Hill			0.118	-0.130	-0.134
			(0.244)	(0.252)	(0.259)
Urban Tarai			0.008	-0.348	-0.558
			(0.273)	(0.345)	(0.358)
Rural Tarai			-0.610*	-0.416	-0.555+
			(0.241)	(0.279)	(0.288)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V
Age of child (Age 13 omitted)					
Fourteen				-0.103	-0.090
				(0.180)	(0.180)
Fifteen				-0.512**	-0.504**
				(0.173)	(0.174)
Sixteen				-1.146**	-1.142**
				(0.166)	(0.167)
Seventeen				-1.843**	-1.856**
				(0.185)	(0.185)
Eighteen				-2.141**	-2.159**
				(0.187)	(0.188)
Nineteen				-2.870**	-2.882**
				(0.192)	(0.192)
Boys				0.894**	0.892**
				(0.107)	(0.108)
Caste-ethnic group (Bahun omitted)					
Chhetri				-0.328	-0.241
				(0.227)	(0.223)
Adivasi Janajati				-0.725**	-0.644**
				(0.201)	(0.201)
Dalit				-1.431**	-1.436**
				(0.229)	(0.229)
Newar				-0.586+	-0.554+
				(0.299)	(0.294)
Other caste				-1.845**	-1.840**
				(0.233)	(0.232)
Muslim				-2.888**	-2.909**
				(0.360)	(0.347)

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Variables	Model I	Model II	Model III	Model IV	Model V
Education level of household head (0-15)				0.103**	0.101**
				(0.016)	(0.016)
Number of children <=19 in household				-0.037	-0.036
				(0.040)	(0.039)
Number of married female in household				0.102	0.098
				(0.068)	(0.067)
Water piped inside house				0.347+	0.345+
				(0.187)	(0.184)
Lighting source is electricity				0.653**	0.548**
				(0.146)	(0.151)
Intensity of Maoist conflict (Low omitted)					
Moderate				-0.305*	-0.293*
				(0.145)	(0.140)
Intense				-0.113	-0.073
				(0.259)	(0.249)
Primary school within 30 minutes					0.473*
					(0.237)
Secondary school within 30 minutes					0.395**
					(0.144)
Constant	0.576**	0.587**	1.312**	2.518**	1.911**
	(0.067)	(0.068)	(0.267)	(0.389)	(0.453)
Pseudo R squared					
Observations	3072	3072	3072	3072	3072

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 7.4. Logistic regression of school enrolment accessibility and interaction between poverty and accessibility (rural children age 6-12)

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Distance to dirt road (hours)	-0.002	-0.004	-0.041*	-0.027	-0.019	-0.015
	(0.012)	(0.015)	(0.018)	(0.016)	(0.018)	(0.018)
Poor	-1.232**	-1.245**	-1.374**	-0.810**	-0.755**	-0.750**
	(0.140)	(0.149)	(0.152)	(0.165)	(0.167)	(0.170)
Distance*poor		0.005	-0.005	-0.014	-0.018	-0.017
		(0.017)	(0.020)	(0.020)	(0.021)	(0.021)
Development region (Western omitted)						
Eastern			-0.919**	-0.795*	-0.745*	-0.753*
			(0.307)	(0.324)	(0.333)	(0.346)
Central			-1.626**	-1.499**	-1.453**	-1.418**
			(0.300)	(0.326)	(0.332)	(0.342)
Mid Western			-0.504+	-0.470	-0.537	-0.456
			(0.296)	(0.407)	(0.419)	(0.439)
Far Western			-0.572	-0.636	-0.656	-0.483
			(0.391)	(0.459)	(0.475)	(0.500)
Stratum (Mountain omitted)						
Rural Hill			-0.199	-0.081	-0.039	-0.013
			(0.325)	(0.305)	(0.309)	(0.318)
Rural Tarai			-0.945**	-0.283	-0.476	-0.531
			(0.333)	(0.336)	(0.344)	(0.357)
Age of child (Age six omitted)						
Seven				0.553**	0.575**	0.566**
				(0.190)	(0.191)	(0.192)
Eight				0.775**	0.785**	0.789**
				(0.161)	(0.163)	(0.164)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Nine				0.906**	0.931**	0.940**
				(0.195)	(0.196)	(0.196)
Ten				0.839**	0.857**	0.861**
				(0.196)	(0.198)	(0.194)
Eleven				0.767**	0.816**	0.826**
				(0.204)	(0.206)	(0.206)
Twelve				0.502*	0.541**	0.549**
				(0.204)	(0.207)	(0.208)
Boys				0.892**	0.908**	0.919**
				(0.123)	(0.121)	(0.120)
Caste-ethnic group (Bahun omitted)						
Chhetri				-1.220*	-1.134*	-0.992*
				(0.498)	(0.506)	(0.486)
Adivasi Janajati				-1.485**	-1.447**	-1.328**
				(0.415)	(0.439)	(0.433)
Dalit				-1.809**	-1.813**	-1.675**
				(0.416)	(0.443)	(0.432)
Newar				-0.611	-0.650	-0.643
				(0.573)	(0.565)	(0.556)
Other caste				-2.191**	-2.209**	-2.048**
				(0.425)	(0.445)	(0.442)
Muslim				-2.331**	-2.355**	-2.167**
				(0.467)	(0.486)	(0.485)
Education level of household head (0-15)				0.143**	0.140**	0.138**
				(0.026)	(0.027)	(0.027)
Number of children <=19 in household				-0.135**	-0.132**	-0.131**
				(0.040)	(0.040)	(0.041)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Number of married female in household				0.263**	0.257**	0.259**
				(0.080)	(0.081)	(0.082)
Water piped or not				0.756*	0.816*	0.824*
				(0.380)	(0.335)	(0.320)
Water piped inside house				0.948**	0.851**	0.821**
				(0.266)	(0.266)	(0.265)
Intensity of Maoist conflict (Low omitted)						
Moderate				0.077	-0.026	0.012
				(0.214)	(0.194)	(0.190)
Intense				-0.089	-0.099	-0.091
				(0.468)	(0.418)	(0.396)
Primary school within 30 minutes					0.941**	0.897**
					(0.263)	(0.246)
Secondary school within 30 minutes					0.225	0.180
					(0.191)	(0.189)
Quality of primary school						0.087*
						(0.042)
Pri school unscheduled closure						-0.036
						(0.262)
Pri teacher as per sanctioned						0.086
						(0.235)
Constant	1.836**	1.841**	3.613**	3.116**	2.233**	1.627*
	(0.125)	(0.127)	(0.435)	(0.638)	(0.664)	(0.739)
Observations	2864	2864	2864	2864	2864	2864

Standard errors in parentheses
*+ p< 0.10, * p< .05, ** p< .01*

Table 7.5. Logistic regression of school enrolment accessibility and interaction between poverty and accessibility (rural children age 13-19)

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Distance to dirt road (hours)	-0.009	-0.014	-0.046*	-0.038**	-0.034*	-0.031*
	(0.010)	(0.014)	(0.019)	(0.014)	(0.015)	(0.015)
Poor	-0.977**	-1.007**	-1.120**	-0.718**	-0.685**	-0.678**
	(0.124)	(0.133)	(0.138)	(0.187)	(0.187)	(0.187)
Distance*poor		0.011	0.017	-0.010	-0.009	-0.007
		(0.016)	(0.020)	(0.019)	(0.018)	(0.018)
Development region (Western omitted)						
Eastern			-0.444*	-0.409*	-0.370+	-0.364+
			(0.193)	(0.200)	(0.198)	(0.205)
Central			-1.021**	-1.232**	-1.203**	-1.194**
			(0.166)	(0.187)	(0.191)	(0.199)
Mid Western			-0.653**	-1.016**	-1.065**	-1.068**
			(0.216)	(0.274)	(0.264)	(0.262)
Far Western			-0.386	-0.779*	-0.742+	-0.664+
			(0.292)	(0.377)	(0.381)	(0.393)
Stratum (Mountain omitted)						
Rural Hill			0.098	-0.182	-0.190	-0.209
			(0.254)	(0.274)	(0.285)	(0.292)
Rural Tarai			-0.586*	-0.422	-0.577+	-0.660+
			(0.249)	(0.310)	(0.321)	(0.341)
Age of child (Age six omitted)						
Seven				-0.122	-0.116	-0.143
				(0.197)	(0.198)	(0.197)
Eight				-0.621**	-0.619**	-0.626**
				(0.189)	(0.190)	(0.189)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Nine				-1.204**	-1.206**	-1.219**
				(0.182)	(0.185)	(0.185)
Ten				-2.028**	-2.055**	-2.072**
				(0.208)	(0.209)	(0.209)
Eleven				-2.103**	-2.125**	-2.142**
				(0.214)	(0.215)	(0.214)
Twelve				-3.155**	-3.182**	-3.219**
				(0.222)	(0.223)	(0.223)
Boys				1.007**	1.004**	1.008**
				(0.124)	(0.125)	(0.126)
Caste-ethnic group (Bahun omitted)						
Chhetri				-0.340	-0.230	-0.177
				(0.266)	(0.263)	(0.261)
Adivasi Janajati				-0.730**	-0.633**	-0.601**
				(0.226)	(0.226)	(0.228)
Dalit				-1.479**	-1.479**	-1.439**
				(0.257)	(0.256)	(0.256)
Newar				-0.834*	-0.797*	-0.832*
				(0.393)	(0.388)	(0.384)
Other caste				-2.100**	-2.102**	-2.017**
				(0.284)	(0.284)	(0.285)
Muslim				-3.229**	-3.260**	-3.119**
				(0.449)	(0.433)	(0.445)
Education level of household head (0-15)				0.112**	0.108**	0.109**
				(0.020)	(0.020)	(0.020)
Number of children <=19 in household				-0.039	-0.039	-0.035
				(0.044)	(0.044)	(0.044)

contd …

Variables	Model I	Model II	Model III	Model IV	Model V	Model VI
Number of married female in household				0.114	0.108	0.108
				(0.075)	(0.074)	(0.075)
Water piped or not				0.306	0.299	0.301
				(0.243)	(0.237)	(0.242)
Water piped inside house				0.573**	0.464**	0.423*
				(0.167)	(0.170)	(0.174)
Intensity of Maoist conflict (Low omitted)						
Moderate				-0.389*	-0.386*	-0.366*
				(0.167)	(0.160)	(0.165)
Intense				-0.203	-0.167	-0.118
				(0.279)	(0.268)	(0.265)
Primary school within 30 minutes					0.475+	0.446+
					(0.251)	(0.243)
Secondary school within 30 minutes					0.423**	0.372*
					(0.152)	(0.147)
Quality of primary school						0.070*
						(0.034)
Pri school unscheduled closure						-0.058
						(0.200)
Pri teacher as per sanctioned						0.029
						(0.180)
Constant	0.397**	0.404**	1.311**	2.748**	2.145**	1.803**
	(0.082)	(0.084)	(0.279)	(0.426)	(0.495)	(0.539)
Observations	2154	2154	2154	2154	2154	2154

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Chapter VIII

Impact of change in access on school enrolment between 1995/1996 and 2003/2004

The results of the cross-sectional regressions thus far have provided us with useful insights on how inaccessibility may affect school enrolment at one point in time, i.e., during 2003/2004. The regressions also provided us with insights on how the impact varied by gender but not by poverty groups. This cross-sectional relation of road access and school enrolment outcomes however may have more than one possible causal interpretation. For example, impacts of roads can be economy wide, which means potential controls may have been determined by road investment (van de Walle 2002) and thus it is likely that controls such as household poverty levels, may have themselves been determined by investments made to increase accessibility, which is also our main independent variable. More problematic is that both road investments and educational enrolments may be joint consequences of other factors such as political centrality or global connections.

The problems of causal inference can be grouped into three kinds of "unobservable" or omitted characteristics that are associated to the unit of observation—characteristics that are time-constant but unit-variant, those that are time-variant and unit-variant, and those that are time variant but unit-constant (Halaby 2004). Time constant but unit-variant unobservables embody permanent properties of units and represent "unit effects". Variables such as location (ecological belt, stratum, region), gender, caste and age (birth year) that are time constant but unit variant, have been measured in our dataset. But there may be variables in this category such as birth defects, the year the first local school opened, mental ability to attend school, that are unobserved. Table 8.1 provides the time-unit matrix of variables depending on whether they are constant or variable across time and units.

Table 8.1: Matrix of constant and variant variables

	Unit Constant	Unit Variant
Time Constant	-	Observed Development region (L), Ecological belt (L), Gender (S), Caste (S), Birth date (S) Unobserved Birth defect, year the first school opened, mental ability of child, difference in ability ➔Unit effects**
Time Variant	Observed Year Unobserved Global effects such as -globalization -natural disasters change in political system -government policies -increased insurgency ➔ Period effects	Observed Accessibility (G), Poverty (S), School availability (I), School quality (Q) Unobserved Attitude towards schooling Motivation to attend school Natural disasters Social networks ➔ Disturbances**

**Terms unit effects, period effects and disturbances used from Halaby (2004)

Time variant and unit variant unobservables represent "transitory and idiosyncratic forces acting upon units" and are treated as disturbances (Halaby 2004:508). Attitude towards education, level of parental motivation towards education, level of child's motivation to attend school and natural disasters are some of the unobservables in this category. The observed characteristics are accessibility, poverty, school availability and school quality.

The third category of variables, ones that are time-variant but unit-constant, come with the passage of time, represent the period effects (Halaby 2004:508). Surely there are many characteristics, unmeasured and un-measurable that accompany the passage of time but affect all households such as government policy, global effects and change in political system which can affect our outcomes because they are correlated with both our dependent and independent variables. The year which the surveys were carried is an observed variable in this category.

If we were to look at the effect of the change in the outcome using the panel data, some of the causes of the potential for omitted variable bias, also known as 'unmeasured heterogeneity', which is constant over time, created by these time-constant and unit variant variables would be removed, allowing us added power to interpret the causal relationship between accessibility and enrolment. Panel data has the advantages for handling such unobservable characteristics (Halaby 2004). Unlike the findings of the cross sectional regressions, panel findings would be less prone to alternative causal interpretations of the association between accessibility and enrolment. It is quite important to gain the added power of saying that over the past 8 years, households with improved road access had improved enrolment rates, not just the cross-sectional correlation of road access and school outcomes.

Moreover, many of the community, household and individual characteristics associated with the child do not change over time although they vary between cases, some of which are measured in the survey data. For example there is no change over time in the location (**L**) variables (development region, ecological belt, etc) and some of the socio-economic variables **(S)** such as caste group and gender. Similarly the birth year of the child does not change although it may be vary across children. Age of the child progresses over time for all children by the same number of years. But other variables are expected to change between two time periods and between cases as well. In our model, geographical accessibility (**G**) is expected to change between two time periods as well as some socioeconomic (**S**) variables and the institutional (**I**) variables. For example, households might move in and out of poverty and school availability and quality also differ over the years.

Models

The various models we wish to estimate are based on the following relationship between school enrolment and accessibility:

Change in school enrolment= f (change in geographical access, change in location, change in socio-economic access, change in institutional access)

Given these time constant and time variant observed variables, our cross sectional models for the panel reduce to:

Model	Cross Section	Panel
1	$Y= \alpha + \beta_G(G) + \sum\beta_L L + \varepsilon$	$\Delta Y= \alpha + \beta_G (\Delta G) + \varepsilon$
2	$Y= \alpha + \beta_G (G) + \sum\beta_L L + \sum\beta_S S + \varepsilon$	$\Delta Y= \alpha + \beta_G (\Delta G) + \beta_P (\Delta Poverty) + \varepsilon$
3	$Y= \alpha + \beta_G (G) + \sum\beta_L L + \sum\beta_S S + \beta_I I + \varepsilon$	$\Delta Y= \alpha + \beta_G (\Delta G) + \beta_P (\Delta Poverty) + \beta_I (\Delta I) + \varepsilon$

Where ΔY, ΔG, ΔI and ΔPoverty are the change in school enrolment, change in geographical accessibility, change in school availability and change in household per capita income between 1995/1996 and 2003/2004. Location variables are time constant, and so drop out of the panel model. We have not considered the change in family structure variables and change in the intensity of conflict.

Panel sample

In the panel sample, altogether 100 of the 275 PSUs of NLSS-I sample were selected with equal probability within each of the four strata defined by NLSS-I—Mountains, Hill Urban, Hill Rural and Tarai. From each PSU, 12 households were selected with the exception of 16 households each from the PSUs of the Far Western Development Region using systematic random sampling, giving us a total household sample of 1232 households. Four of the PSUs could not be visited at all due to the insecurity created by Maoist insurgency, and one PSU disappeared because it was merged to a Wildlife Reserve (CBS 2006). These PSUs were not replaced with consultation of NLSS-II design experts (CBS 2004a). In addition, 198 of these 1160 households could not be tracked and were replaced, giving the "pure" panel sample of 962 households in 95 PSUs. This is an overall attrition rate of about 22% for the households and 5% for the PSUs.

For nine households from a PSU in Mugu district the distance to paved road and dirt road was found to be coded as zero for 1995/1996. Mugu is a very remote district where accessibility level has not altered over the years. We assign the 2003/2004 value of distance for the 1995/1996 distance to road which makes our measure of access improvement as zero for the district. This avoids reporting a high degree of improvement for the district when actually there has been no improvement. Also, dropping the PSU altogether does not alter the results of our regressions significantly.

Attrition issues examined by Bhatta & Sharma (2006) indicate the final panel sample adequately representing the distribution of households across the different sampling strata. They also conclude that the final panel is representative of the national population of households. Similarly, the Central Bureau of Statistics which carried out NLSS-I and NLSS-II surveys also uses the pure sample of 962 households to analyze the panel households (CBS 2006).

The households in NLSS-II were interviewed using almost identical modules and methodology as in NLSS-I, allowing us to analyze the relationships between change in accessibility and level of school enrolment outcomes over an eight year period between the two rounds of the survey.

Panel weights: Household weights for NLSS-II panel sample are also provided which were initially constructed in a way that applying them to the panel sample gave statistics that are representative of Nepal in 1995/96. However the weights sum up to 2,856,148 households which is about 15% less than the targeted number of households in Nepal in 1995/96, estimated at 3,345,052 (Bontch-Osmolovski 2006). NLSS-II did not alter the panel weights to tackle this issue and suggests that it may be possible to "do some rescaling adjustments to match the target population in 1995/96. This decision is left up to the researchers." For our purpose we use the weights without making any adjustments.

Limitations of panel in measuring change in enrolment

Measuring the change in school enrolment for an eligible child—the outcome variable that we have used for our cross sectional regressions—is however not straightforward, primarily because of the age progression of the children. Although all children age by the same number of years between the two rounds of the Survey, this limits our ability to test the models on the same children. Children who are 6-12 in 1995/1996 grow up to become about 13 to 21 years in 2003/2004 while those who are 13-19 mature to 20 to 28 years. This age progression poses three challenges to analyze enrolment outcome for the same children over time. First, many of the children, mainly the ones aged 13-19 are already beyond school age by 2003/2004. Second, even for those who are of still of school going age in both 1995/1996 and 2003/2004, the children are eligible for a different level of school. This is to say, a child of primary age in 1995/1996 matures to become eligible to attend a secondary school in 2003/2004. Thus, the outcome variable, school enrolment, is essentially different in the two waves. Besides these specific challenges, there is yet another inherent challenge in panel analysis—many of the observed units at one time point—in our case children in 1995/1996—cannot be tracked in later surveys because they have migrated, households have split or some of them have died.

Two alternatives

Given these threefold challenges that we face to maximize the information available in the panel, we proceed with two alternative analyses in this research—1) A village (PSU) level fixed effect[6] analysis for enrolment at each age group. When we want to control for omitted (unobserved) variables that differ between cases but are constant over time, the recommended model to use is the Fixed Effects Regression

[6] Stata offers commands such as (xtreg, fe) and (areg, absorb) for performing this kind of analysis. This is also equivalent to generating dummy variables for each of the cases and including them in a standard linear regression to control for these fixed case effects. Each dummy variable removes one degree of freedom from the model. Alternatively when we are analyzing data for two time points, such as the one we are using, we could regress the change in outcome on change in the independent variables and control for year, and arrive at the same results. Controlling for year takes into account the period effects (http://dss.princeton.edu/).

Model. It lets us use the changes in the variables over time to estimate the effects of the independent variables on our dependent variable, and is the main technique used for analysis of panel data. 2) A child level analysis of the 2003-2004 enrolment status of those children aged 6-12 who were enrolled in 1995/1996 and who could be tracked in 2003/2004. The data shows the actual mean difference in age of those children aged 6-12 in 1995/1996 who we were able to track is 7.6 years. This suggests that children of this age group are still expected to be going to school in an ideal scenario in 2003/2004. These approaches are not free of problems, but provide good alternatives to utilize the panel data for analyzing school enrolment as the dependent variable. Let us now look at how accessibility and enrolment vary between 1995/1996 and 2003/2004 from the panel data.

Change in accessibility between 1995/1996 and 2003/2004

Household level analysis: The mean household distance to nearest dirt road on average improved by about 1½ hours from about 3½ hours to 2 hours 9 minutes. The panel household mean of 2 hour 9 minutes for distance to dirt roads in 2003/2004 compares well with a cross section household mean of 2 hour 11 minutes. The portion of households residing within 15 minutes of dirt roads increased by 14 percentage points from 47% to 61%. As a result the portion of households living 15 minutes to 1½ hours, 1½ hours to 1 day and over one day reduced by about 5 percentage points each. This indicates that more households became nearer to dirt roads between 1995/1996 and 2003/2004. Of the 61% households which were within 15 minutes of dirt roads in 2003/2004, 43 % were already within 15 minutes in 1995/1996. Of the remaining, 14%

were located between 15 minutes and 1½ hours, 4% were located between 1½ hours and 1 day, and none more than 1 day away from dirt roads in 1995/1996. Of the 9 % households which were beyond 1 day from dirt roads in 1995/1996, 5% have moved to 1½ hours to 1 day from roads, 4% points were still a day away from dirt roads in 2003/2004. Similarly of all the 34% households that were beyond 1½ hours from dirt roads in 2003/2004, 11 % points are now within 1½ hours.

--Table 8.1 about here--

--Table 8.2 about here--

For paved roads, the mean household distance improved by about 50 minutes from about 5 hour 19 minutes in 1995/1996 to about 4½ hours in 2003/2004. The portion of households residing within 15 minutes of paved roads increased only by 3 percentage points from 16% to 19%. Similarly those living between 15 minutes to 1½ hours increased by 5 percentage points, from 28% to 33%. Those living between 1½ hours to 1 day and over one day reduced by about 7% points and 2% points respectively. Again although not as much as for dirt roads, households on average got nearer to paved roads over the two time points. Of the 20% households which were within 15 minutes of paved roads in 2003/2004, 7% points were between 15 minutes and 1 ½ hours and 1% point beyond 1 day in 1995/1996. Of the 55% who were beyond 1 ½ hours in 1995/1996, 15% points had their accessibility improved to within 1½ hours in 2003/2004.

Compared to 1995/1996, in terms of dirt road, accessibility improved for 69% of the households. Of the 69%, accessibility improved by one hour or more for 27% points of the households. At the same time accessibility deteriorated for 14% of the households of which for 4% points of the households it deteriorated by one hour or more. Accessibility remained same for 16% of the households.

--Table 8.3 about here--

In terms of paved roads, compared to 1995/1996, accessibility improved for 56% of the households. Of the 56%, accessibility improved by one hour or more for half of them. At the same time accessibility deteriorated for 22% of the households of which for 10% it deteriorated by one hour or more. Accessibility remained same for 22% of the households.

PSU level analysis: The changes in accessibility by PSUs show similar trends. We measure the PSU level accessibility in terms of median PSU time to nearest road. While this measure provides us with one measure for the whole PSU, it does not capture the household level variation within the PSU. On this measure, accessibility improved on average by about 1 hour 19 minutes from about 3 hours 37 minutes to 2 hours 18 minutes. In 2003/2004, 64 of the 95 PSUs were within 15 minutes of dirt roads, compared to 52 in 1995/1996. This is an increase by about 13 %. In 1995/1996, the number of PSUs located between 15 minutes and 1 ½ hours, between 1 ½ hours and 1 day, and more than 1 day away from dirt roads was 11, 22 and 10 respectively. In 2003/3004 in each of these accessibility zones there were 4 less PSUs.

--Table 8.4 about here--

For paved roads, the median PSU distance to paved road improved by about 54 minutes from about 5 hour 21 minutes to about 4 ½ hours. Compared to 1995/1996, 4 more PSUs were within 15 minutes and 8 more between 15 minutes and 1 ½ hours in

2003/2004. There were 10 less PSUs in the accessibility range of between 1 ½ hours and 1 day and 2 less in the more than 1 day range.

Compared to 1995/1996, accessibility in terms of dirt road deteriorated for 11 of the 95 PSUs (Table 8.3). Of them, in one PSU it deteriorated by more than one hour. Accessibility remained same for 10 PSUs, but improved for 74 PSUs. Of the 74 PSUs for which accessibility improved, it did so by more than 15 minutes for 35 PSUs and by one hour or more for 24. As for paved roads, compared to 1995/1996, accessibility deteriorated for 16 of the PSUs of which for 6 PSUs it deteriorated by one hour or more. Accessibility remained same for 22 PSUs, but improved for 67 of the PSUs. Of the 67, accessibility improved by more than 15 minutes for 40 PSUs and by one hour or more for 27 of them.

From our discussions of the accessibility changes at the household level and PSU level, we see that accessibility in Nepal has improved considerably between the two periods, although there are vast areas which remain inaccessible. Moreover, the improvement in accessibility is more with respect to dirt roads than paved roads.

Change in enrolment between 1995/1996 and 2003/2004

It is not only the overall accessibility level that has improved over the two waves, but many other development indicators have also registered better figures. For example, Net Enrolment Rate at primary level also increased from 57% to 72%, and Secondary Net Enrolment increased from 9% to 15% from 1995/1996 to 2003/2004 (CBS 2004a). Net Enrolment rate is the proportion of the correct-age group students enrolled at a level specified for the age group to the total number of children in that age group.

--Table 8.5 about here--

PSU level analysis: At the PSU level, for children aged 6-12, enrolment rate improved by about 15 percentage points from 71% to 86 %. For the age group 13-19, enrolment improved by 5 percentage points from 54% to 59% between 1995/1996 and 2003/2004. While this undoubtedly means improvement in enrolments between the two time points, these are simply a cross sectional age group wise comparison, not the enrolment rates of the same children over time. We must also note here that some PSUs have very few eligible children in each age group which affects the enrolment rates in them. For example 11 of the PSUs have fewer than 3 children of age group 6-12 and 4 PSUs have 3 or fewer children aged 13-19 in them.

Household level analysis: For our sample of concern, that is children aged 6-12, enrolment rate also improved by about 16 percentage points from 66% to 82% (compared to 79% enrolment rate of the NLSS-II cross section sample). For the age group 13-19, enrolment improved at a lower rate from 51% to 56% (compared to 56% of the NLSS-II cross section sample) between 1995/1996 and 2003/2004. Again, we must note that the above comparisons of enrolments for the two time points are simply a cross sectional age group wise comparison of children in 1995/1996 and 2003/2004, not the enrolment rates of the same children over time.

Thus far we have seen that both accessibility and enrolment have improved between the two waves. However our interest is to examine if improvement in accessibility is associated with improvement in enrolment. In order to examine this, we will first carry out a village level analysis including the fixed effects regression, followed by a child level analysis of the children enrolled in 1995-1996.

Change in change analysis at the PSU (village) level

Before proceeding to the fixed effect regressions, we will briefly look at the bivariate relationship between accessibility and enrolment in each wave separately at the PSU level. We will then examine how the enrolment rates differ in those PSUs which experienced improvement in access and those which did not.

Bivariate relationship in each wave (Table 8.6): For 1995/1996, the association between distance to dirt roads (median logged) and enrolment of the primary aged and secondary aged , after controlling for locational factors, is negative and statistically significant which is the expected outcome. For 2003/2004, the enrolment-accessibility associations for both primary aged and secondary aged, after controlling for locational factors is negative, but not statistically significant. In our analysis of the results for the NLSS-II (2003-2004) cross section sample we had found this relationship to be statistically significant.

--Table 8.6 about here--

For paved roads the accessibility-enrolment relationship is negative but not statistically significant for the primary aged as well as the secondary aged in 1995/1996. For 2003/2004, the relationship is negative as well as statistically significant for both the rounds which are also the results for the NLSS-II cross sectional sample.

Change vs. change: When disaggregating PSUs into those that improved median accessibility by more than 15 minutes, and those which did not, we find that enrolment has improved in slightly more of the PSUs that have their accessibility improved compared to those PSUs which have not (Table 8.7).

--Table 8.7 about here--

Thirty five of the 95 PSUs experienced at least a 15 minutes improvement in median dirt road accessibility between the two waves (Table 8.7). For these PSUs the mean enrolment for the 6-12 age group improved by 25%, from 68% to 85%, and enrolment for the 13-19 age group improved by 10%, from 49% to 54%. For the remaining 60 PSUs for which accessibility has stayed same, deteriorated or not improved by more than 15 minutes, enrolment for the age group 6-12 went up by 18%, from 73% to 86%. This is a lesser rate of increase in enrolment than the rate of increase for areas that experienced improvement in accessibility, but not a major difference. For the secondary age children, enrolment increased by 10% for all PSUs whether accessibility improved or not. These results do not signal, particularly for the secondary age level, improvement in road accessibility to be associated with improvement in enrolments. Again we must note here that the above comparisons of enrolments for the two time points are simply a cross sectional age group wise comparison, not the enrolment rates of the same children from the same households or same PSUs over time. In terms of paved roads, areas that have improved accessibility show a lower rate of increase in enrolment for the age group 6-12, but a higher rate for age group 13-19.

Change in change regression (fixed effect): To recall, instead of treating the sample as a household level panel, we have treated this as a 95 village (primary sampling unit) panel sample. Our dependent variable in this case is the change in average village level enrolment rate between 1995/1996 and 2003/2004 which we have transform to the log odds of enrolment. We do this to make our results comparable with cross section results that we have performed at the child level, i.e., constrain the predictions of enrolment to the range 0 to 1. As for our main independent variable, we take the difference of PSU median logged time as the change in accessibility. By this measure, change in half an hour of accessibility to 0 minutes is better improvement compared to one hour to ½ an hour, and one hour to ½ an hour better than 10 hours to 9½ hours. Although in all three cases, the improvement is by 30 minutes, the measure of logged difference is 3.4, 0.70 and 0.05 respectively.

---Table 8.8 about here---

We conduct fixed effect regressions of primary age and secondary age enrolment, measured as log odds of PSU level enrolment, on dirt road accessibility (as well as paved road accessibility, separately) measured as village median of logged distance to roads. We also control for the variable year to take into account the period effects (Shown as Model 2 in Table 8.8). These coefficients obtained in Model 2 by performing fixed effect regressions, controlled for year are exactly the same as when obtained by regressing the change in enrolment on change in accessibility. Given the nature of the fixed effects regression the accessibility coefficients do not change their magnitude or strength when we control for variables that remain fixed over time but may vary by cases such as locations. The results obtained from the PSU level analysis does not provide us with evidence that improvement in access helps improve enrolment.

While the PSU level design allowed us to overcome the age progression problem and design a fixed effect model, it had its own limitations. First, although from the same panel, children were different with differing characteristics. Second, it ignored the considerable within village variation in road access in favor of the village level measure. Third, the number of children eligible to be attending school and/or those actually in school are very small for some villages (PSUs) resulting in unreliable estimates of PSU enrolment rates. Next we proceed with the child level analysis.

Child level analysis

In this section we will first look at the bivariate relationship between accessibility and enrolment in each wave separately at the individual level. We will then examine how the enrolment rates differ for children who have experienced improvement in access and those who have not. We will then perform the regression analysis.

Bivariate relationship in each wave (Table 8.9): For 1995/1996, the association between distance to dirt roads (logged) and primary and secondary enrolment, after controlling for locational factors, is negative and significant, which is the expected outcome. For 2003/2004, the association between primary enrolment and distance to dirt roads after controlling for locational factors is negative, but not statistically significant. For this round the association between secondary enrolment and distance, after controlling for locational factors is negative and statistically significant.

--Table 8.9 about here--

For paved roads, the accessibility-enrolment relationship is negative but not statistically significant for the primary aged as well as secondary aged children in 1995/1996. In 2003/2004, the relationship is negative as well as statistically significant for children of both age groups. The accessibility-enrolment relationship for the panel sample of NLSS-II is consistent with that obtained from the NLSS-II cross sectional sample for both dirt roads and paved roads.

Change vs. change: When disaggregating the children into those that improved accessibility by more than 15 minutes, and those which did not, we find that primary age enrolment has improved at about the same rate (between 23% to 27%) for children who have improved their accessibility and who have not.

--Table 8.10 about here--

However the rate of increase for the enrolment of secondary aged children is much higher in areas where accessibility has improved. Where dirt road accessibility has improved by at least 15 minutes the rate of increase is 24% compared to no increase for areas that did not experience improvements. For paved roads the increase is by 7% in areas where there have been no improvement in accessibility, compared to 12% in areas where accessibility has improved. Improving accessibility has benefited all children, but may have benefited children entering to secondary school age more. This is an interesting finding but, but again we must note that the above comparisons of enrolments for the two time points are simply a cross sectional age group wise comparison, not the enrolment rates of the same children hailing from the same household or same PSU over time. In order to have more confidence in these bivariate relationships between change in accessibility and change in enrolment for the same children, we must examine how their enrolments have altered between the two time points.

To recall, children in 1995/1996 have matured by about 8 years in 2003/2004. We would expect the children who went to primary school in 1995/1996 to be still going to school, but this time at the secondary level. Some of the children cannot be tracked over time, but we do have a sizable sample that we were able to track. Next we look at if the enrolment status of children enrolled in 1995/1996 and who we are able to track, are still in school in 2003/2004 as a function of change in accessibility and their original remoteness.

Child level regression: There are altogether 1074 children who are of the age group 6 to 12 in 1995/1996. However we are unable to track about 34% of them in 2003/2004 because some children died (1.5%), some migrated for work (7%) and some for studies (3%) while some moved due to marriage (14%), and for some, their households got split (6%).

Children who migrated for work, or did so due to marriage are least likely to be enrolled in school and we can assume them not enrolled in school in 2003/2004. Similarly the children who moved for studies can be safely assumed to be enrolled. Assigning these two categories of migrated children (about 24%) respective values for enrolment, the overall sample attrition rate reduces to about 10%.

Our dependent variable for this regression is if the child is enrolled in 2003/2004. We restrict our sample to children who were enrolled in 1995/1996 and whose enrolment status can be tracked in 2003/2004 (n=654). We will also test the models for the sample in which we have not assigned enrolment values for the children who migrated for work, or did so due to marriage and those who moved for studies (n=500). Further we will test the model for a sample that includes all children irrespective of their enrolment status in 1995/1996.

We conduct a series of binary logistic regressions, with appropriate adjustments made for clustering at the PSU level, to model the effect of change in accessibility/ isolation on school enrolment at 2003/2004. The main research objective is to examine whether and to what extent change in geographical accessibility affects change in school enrolment status. For each group we first estimate a model with change in geographical isolation (distance to roads) as the independent variable, controlled for locational variables (results as Model I). We then control for accessibility level at 1995/1996 (results as Model II) to examine if original remoteness affects the chances of the child being in school despite the changes in accessibility.

The model that has both the change in accessibility as well as accessibility level for 1995/1996 as the regressor variables is equivalent of having both accessibility measures of 1995/1996 and of 2003/2004 as the regressors instead. Thus essentially in this model we are suggesting that whether the child continues to stay in school (change in enrolment) is a function not only of the change in accessibility level but also the child's experience with remoteness prior to the when the change occurred. This assumption is acceptable given that the benefits of roads become visible over the years. Also our data for 2003/2004 provides accessibility level for 2003/2004 but does not tell us during which year between 1995 and 2004 accessibility actually changed.

We estimate a third model with controls for time constant variables such as age in 1995/1996 and gender (Model III). Finally we add controls for two time variant variables—the change in poverty level of the household and change in availability of primary schools (Model IV). Poverty change is measured as the difference of logged per capita consumption expressed in Nepal rupees, and school availability change is measured as change in distance to primary school. In brief, we are analyzing 2003/2004 enrolments as a function of 1995/1996 and 2003/2004 variables that are endogenous with 2003/2004 enrolments. To summarize, we will test the following models:

$$Y = \alpha + \beta_G (\Delta G) + \sum \beta_L L + \varepsilon \quad \text{...Model (I)}$$

$$Y = \alpha + \beta\Delta_G (\Delta G) + \sum \beta_L L + \beta_G (G\_1) + \varepsilon \text{...... ....Model (II)}$$

$$Y = \alpha + \beta\Delta_G (\Delta G) + \sum \beta_L L + \beta_G (G\_1) + \beta_A (Age\_1) + \beta_X (Sex) + \varepsilon \text{..............Model (III)}$$

$$Y = \alpha + \beta\Delta_G (\Delta G) + \sum \beta_L L + \beta_G (G\_1) + \beta_A (Age\_1) + \beta_X (Sex) + \beta_P (\Delta Poverty) + \beta_S (\Delta School\ distance) + \varepsilon \text{.................................Model (IV)}$$

Where ΔG is the change in accessibility between 1995-1996 and 2003-2004 and G_1 is the accessibility in 1995-1996.

In the bivariate regressions controlled for locations (presented in Table 8.11, Dirt Road Model 1), we find a positive and statistically significant association between change in dirt road accessibility and 2003/2004 enrolment. This is to say improvement in accessibility increases the child's chance of continuing in school. In the second model in which we control for the original isolation level of the child's household, the relationships between change in accessibility and enrolment at 2003/2004 becomes twice as much stronger (0.116 to 0.226) and retains its statistical significance (Table 8.11, Model II, dirt road). The chances of the child enrolled in school at 1995/1996 of being in school in 2003/2004 increases further with improvement in accessibility once the original accessibility is controlled for. Controlling for other determinants of enrolment, namely, the child's age at 1995/1996 and sex (Model III) and change in household poverty level and change in primary schooling availability (Model IV) on both the samples, does not change the relationship between improved accessibility and change in enrolment further.

--Table 8.11 about here--

As for the results obtained using distance to paved road as the accessibility measure, we found a positive and statistically significant association between change in accessibility and 2003/2004 enrolment only after holding the original accessibility constant. After holding constant the original isolation level of the child's household, the relationships between change in accessibility and enrolment at 2003/2004 became much stronger (0.033 to 0.202) as well as statistically significant at the 10% level (Table 8.11, Model II, paved road).

We tested this model on the sample (n=500) that excluded those who moved due to marriage, and those who moved for work and studies as well. Here again, we found a positive and statistically significant association between change in dirt road accessibility and 2003/2004 enrolment only after holding the original accessibility constant. After holding constant the original isolation level of the child's household, the relationships became stronger by 75% (0.124 to 0.217) as well as statistically significant (Table 8.12 Model II, dirt road).

--Table 8.12 about here--

In case of paved roads, we find a positive and statistically significant association between change in accessibility and 2003/2004 enrolment after holding constant the original remoteness. This association gets stronger after we control for the original isolation level of the child's household, and does not alter after further controls, namely, the child's age at 1995/1996 and sex (Model III) and change in household poverty level and change in primary schooling availability (Model IV).

We also tested the models for all children irrespective of whether they were enrolled in 1995/1996 or not. Again in this case, improvement in road accessibility and enrolment in 2003/2004 became statistically significant after holding constant the accessibility level in 1995/1996 (results not shown). For dirt roads, the significance was only at the 10 percent level.

That the effect of improvement in accessibility is clear and statistically significant after controlling for original remoteness is an indication that the child's original inaccessibility is masking the effect of improved accessibility on continued school enrolment. As we had suspected the original inaccessibility penalizes the chances of a child continuing to be in school.

Discussion

The overall analysis allows us to place additional confidence on the results that we obtained in chapter five, that is accessibility has detrimental impact on the chances of the child being enrolled in school. Although the PSU level analysis did not allow us to infer that improving accessibility has a positive effect on improving school enrolment, the individual level analysis on the enrolment status of children enrolled in 1995/1996 indicated a positive effect of improved accessibility. The effect of improvement in dirt road accessibility was clearly and significantly positive. The relationship between improvement accessibility and continuity in school got stronger after holding the original remoteness constant.

We must note here that constraints imposed by accessibility on school enrolment get removed over time, and the effects are likely not seen immediately. We do not know from the data which year between 1995/1996 and 2003/2004 that the household accessibility actually improved. Thus in some cases the actual improvement in accessibility might not have started to show effects on development outcomes such as school enrolment.

It is quite likely that some national level changes that we are unable to capture in our model are likely at play which is increasing enrolment and access. It is also possible that there is some nationwide phenomenon going on that is positively driving households to send their children to school, independent of the improved accessibility. Nevertheless the results are generally consistent with our cross sectional finding that improvement in accessibility helps increase school enrolment.

Table 8.1. % households by one way time to nearest road from households in 1995/1996 and 2003/2004

Time taken (one way)	1995/1996		2003/2004		Difference (% households/minutes)
	N (unweighted)	Weighted %	N (unweighted)	Weighted %	
Dirt Road					
<=15 minutes	482	47	611	61	14
>15 minutes <=1.5 hour	152	18	119	13	-5
>1.5 hour <=1 day[a]	210	25	173	20	-5
>1 day	95	9	57	5	-4
Total N	939	100	960	100	-
National mean (minutes)		216		129	87
Paved road					
<=15 minutes	244	16	274	19	3
>15 minutes <=1.5 hour	227	28	267	33	5
>1.5 hour <=1 day[a]	320	39	277	32	-7
>1 day	156	17	142	15	-2
Total N	947	100	960	100	-
National mean (minutes)		319		269	50

[a] 8 hours=1 day

Table 8.2. % households in different accessibility zones (1995/1996 and 2003/2004)

Distance to road (1995/1996)	Distance to road (2003/2004)				Total %	N (unweighted)
	<=15 minutes	>15 minutes <=1.5 hour	>1.5 hour <=1 day	>1 day		
Dirt road						
<=15 minutes	43	3	1	0	47	482
>15 minutes <=1.5 hour	14	3	0	0	18	152
>1.5 hour <=1 day	4	7	13	1	25	210
>1 day	0	0	5	4	9	95
Total %	61	13	20	5	100	-
Unweighted N	605	115	164	55	-	939
Paved road						
<=15 minutes	12	2	1	2	17	244
>15 minutes <=1.5 hour	7	18	3	0	28	227
>1.5 hour <=1 day	1	14	22	3	39	320
>1 day	0	0	6	10	16	156
Total %	20	34	32	15	100	-
Unweighted N	273	266	272	136	-	947

Table 8.3. Change in accessibility level between 1995/1996 to 2003/2004

Road type	No. of households	Change in accessibility level				
		Decreased		Stayed same	Improved	
		Total	By 1 hour or more		Total	By 1 hour or more
<u>% Households</u>						
Dirt road	939	14	4	16	69	27
Paved road	947	22	10	22	56	28
<u>Number of PSUs</u>						
Dirt road	95	11	1	10	74	24
Paved road	95	16	6	22	67	27

Table 8.4. Number of PSUs by one way median PSU time to nearest road in 1995/1996 and 2003/2004

Time taken (one way median PSU)	1995/1996		2003/2004		Difference (% PSUs/minutes)
	N	%	N	%	
Dirt Road					
<=15 minutes	52	55	64	67	13
>15 minutes <=1.5 hour	11	12	7	7	-4
>1.5 hour <=1 day[a]	22	23	18	19	-4
>1 day	10	11	6	6	-4
Total N	95	100	95	100	-
National mean (minutes)		217		138	79
Paved road					
<=15 minutes	26	27	30	32	4
>15 minutes <=1.5 hour	19	20	27	28	8
>1.5 hour <=1 day[a]	33	35	23	24	-11
>1 day	17	18	15	16	-2
Total N	95	100	95	100	-
National mean (minutes)		321		267	54

[a] 8 hours=1 day

Table 8.5. Change in various development indicators between 1995/1996 and 2003/2004

Development Outcomes	1995/96	2003/04	Change per year %
Overall road Network (km)*	10724	17280	8
Portion of rural residents having access to dirt roads within 30 minutes	57	67	2
Portion of rural residents having access to paved roads within 30 minutes	14	27	12
Female adult literacy (>15 yrs)	19	34	10
Percentage of fully immunized children	36	6	-10
Couples currently using family planning methods	15	38	19
Net enrolment at primary level	57	72	3
Net enrolment at secondary level	9	15	8

Data source: Central Bureau of Statistics, Nepal (2004a 2004b); *Nepal Road Statistics

Table 8.6. Regression of log odds of PSU school enrolment on road accessibility

Variables	Dirt road				Paved road			
	1995/1996		2003/2004		1995/1996		2003/2004	
	6-12	13-19	6-12	13-19	6-12	13-19	6-12	13-19
Median time to dirt roads (logged)	-0.263**	-0.198*	-0.081	-0.124	-0.107	-0.060	-0.286**	-0.287**
	(0.076)	(0.095)	(0.088)	(0.091)	(0.094)	(0.113)	(0.099)	(0.104)
Development region (Western omitted)								
Eastern	0.497	0.767+	0.255	1.029**	0.399	0.691	0.306	1.068**
	(0.336)	(0.424)	(0.363)	(0.378)	(0.355)	(0.432)	(0.348)	(0.366)
Central	-0.454	-0.108	-0.307	-0.430	-0.353	-0.027	-0.241	-0.354
	(0.315)	(0.396)	(0.338)	(0.352)	(0.333)	(0.404)	(0.324)	(0.341)
Mid Western	-0.422	-0.609	0.440	-0.095	-0.475	-0.630	0.496	-0.022
	(0.412)	(0.519)	(0.446)	(0.465)	(0.445)	(0.540)	(0.427)	(0.449)
Far Western	-0.765	-0.115	0.055	-0.029	-0.803	-0.144	0.201	0.108
	(0.548)	(0.690)	(0.592)	(0.617)	(0.580)	(0.705)	(0.570)	(0.600)
Stratum (Mountain omitted)								
Urban Hills	0.920	0.943	0.153	1.584*	1.658*	1.604+	-1.038	0.634
	(0.582)	(0.726)	(0.668)	(0.699)	(0.688)	(0.827)	(0.723)	(0.761)
Rural Hills	0.785+	0.154	0.276	0.267	1.035*	0.362	0.119	0.172
	(0.411)	(0.518)	(0.448)	(0.467)	(0.432)	(0.525)	(0.423)	(0.445)
Tarai	-1.410**	-0.745	-1.096+	-0.970	-0.627	-0.102	-1.468**	-1.126*
	(0.495)	(0.623)	(0.608)	(0.634)	(0.479)	(0.581)	(0.484)	(0.510)
Constant	2.276**	0.813	2.493**	0.731	1.374+	-0.005	3.813**	1.811*
	(0.644)	(0.810)	(0.682)	(0.711)	(0.788)	(0.954)	(0.764)	(0.804)
Observations	94	95	95	94	94	95	95	94
R-squared	0.52	0.28	0.22	0.41	0.46	0.25	0.28	0.45

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 8.7. Difference in PSU enrolment by change in PSU accessibility level

Access condition	Enrolment for age 6-12 (%)				Enrolment for age 13-19 (%)			
	No of PSUs	1995/1996	2003/2004	% increase	PSUs	1995/1996	2003/2004	% increase
Dirt Road								
Improved by at least 15 minutes	35	68	85	25	35	49	54	10
Did not improve	60	73	86	18	60	57	63	10
Paved Road								
Improved by at least 15 minutes	40	72	85	18	40	50	57	14
Did not improve	55	71	87	22	55	57	61	7

Table 8.8. Village level fixed effect regression on change in log odds of enrolment on dirt road accessibility

Variable	Age 6-12		Age 13-19	
	Model 1	Model 2	Model 1	Model 2
Accessibility (Median logged time to road)	-0.280**	0.018	-0.039	0.123
	(0.092)	(0.104)	(0.083)	(0.100)
Year (1995/1996=0, 2003/2004=1)		0.836**		0.455**
		(0.174)		(0.168)
Constant	2.345**	1.131**	0.473*	-0.187
	(0.258)	(0.343)	(0.233)	(0.332)
Observations	189	189	189	189
Number of Primary sampling Unit id	95	95	95	95
R-squared	0.09	0.27	0.00	0.08

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Results of Model 2 equivalent to regressing change in enrolment on change in change in accessibility

Table 8.9. Logistic regression of school enrolment on road accessibility, 1995/1996 and 2003/2004 separately for Age 6-12 and Age 13-19

Variables	Dirt road				Paved road			
	1995/1996		2003/2004		1995/1996		2003/2004	
	6-12	13-19	6-12	13-19	6-12	13-19	6-12	13-19
Median time to dirt road (logged)	-0.179**	-0.138*	-0.032	-0.139*	-0.093	-0.019	-0.341*	-0.205*
	(0.065)	(0.059)	(0.077)	(0.062)	(0.119)	(0.085)	(0.133)	(0.091)
Development region (Western omitted)								
Eastern	0.450	0.325	0.327	0.853*	0.285	0.247	0.383	0.855**
	(0.317)	(0.313)	(0.463)	(0.331)	(0.332)	(0.330)	(0.487)	(0.325)
Central	-0.492	-0.586	-0.525	-0.560	-0.547	-0.480	-0.371	-0.521
	(0.327)	(0.370)	(0.383)	(0.342)	(0.343)	(0.381)	(0.389)	(0.333)
Mid Western	-0.058	-0.434	1.043*	-0.215	-0.120	-0.445	1.062*	-0.172
	(0.376)	(0.399)	(0.458)	(0.362)	(0.413)	(0.426)	(0.423)	(0.354)
Far Western	-0.317	-0.080	-0.018	0.002	-0.579	-0.186	0.277	0.037
	(0.355)	(0.371)	(0.676)	(0.542)	(0.377)	(0.383)	(0.684)	(0.552)
Stratum (Mountain omitted)								
Urban Hills	2.468**	1.289*	0.698	1.124+	2.840**	1.801**	-0.848	0.724
	(0.736)	(0.570)	(0.941)	(0.645)	(0.880)	(0.639)	(1.069)	(0.736)
Rural Hills	0.832*	0.066	0.668	0.486	0.906*	0.217	0.523	0.442
	(0.381)	(0.440)	(0.484)	(0.384)	(0.365)	(0.418)	(0.424)	(0.400)
Tarai	-0.899*	-0.505	-1.099*	-0.808+	-0.471	-0.107	-1.718**	-0.761
	(0.439)	(0.478)	(0.453)	(0.458)	(0.454)	(0.453)	(0.503)	(0.470)
Constant	1.534**	0.630	2.112**	0.677	1.167	-0.004	3.933**	1.231+
	(0.572)	(0.597)	(0.518)	(0.557)	(0.865)	(0.723)	(0.899)	(0.739)
Observations	1051	681	928	650	1061	687	928	650

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 8.10. Difference in enrolment by change in accessibility level

Change in accessibility	Enrolment for age 6-12 (%)			Enrolment for age 13-19 (%)		
	1995/1996	2003/2004	% increase	1995/1996	2003/2004	% increase
Dirt Road						
Did not improve	65	81	25	54	53	-2
Improved by at least 15 minutes	67	83	24	46	60	24
Paved Road						
Did not improve	64	81	27	47	51	7
Improved by at least 15 minutes	68	84	23	55	62	12

Table 8.11. Logistic regression of 2003-2004 school enrolment of children 6-12 enrolled in 1995-1996 on change in accessibility

Variables	Dirt road accessibility				Paved road accessibility			
	Model1	Model2	Model3	Model4	Model1	Model2	Model3	Model4
Change in distance to road (min. logged)	0.116*	0.226**	0.228**	0.218**	0.033	0.202+	0.212+	0.199+
	(0.053)	(0.071)	(0.076)	(0.078)	(0.088)	(0.109)	(0.114)	(0.114)
Development region (Western omitted)								
Eastern	-0.049	0.086	0.084	0.135	-0.024	0.029	0.002	0.053
	(0.380)	(0.376)	(0.436)	(0.434)	(0.374)	(0.359)	(0.436)	(0.436)
Central	-0.614	-0.644	-0.927+	-0.872+	-0.597	-0.636	-0.951*	-0.892+
	(0.436)	(0.411)	(0.483)	(0.487)	(0.430)	(0.391)	(0.474)	(0.475)
Mid Western	-0.395	-0.498	-0.795	-0.739	-0.283	-0.446	-0.769	-0.714
	(0.417)	(0.420)	(0.514)	(0.531)	(0.415)	(0.411)	(0.523)	(0.540)
Far Western	-0.335	-0.209	-0.376	-0.323	-0.272	-0.202	-0.373	-0.323
	(0.459)	(0.437)	(0.427)	(0.427)	(0.466)	(0.421)	(0.432)	(0.446)
Stratum (Mountain omitted)								
Urban Hills	1.228*	0.349	0.785	0.636	1.188*	-0.129	0.219	0.106
	(0.564)	(0.677)	(0.769)	(0.798)	(0.568)	(0.711)	(0.838)	(0.856)
Rural Hills	-0.133	-0.365	-0.100	-0.127	-0.166	-0.433	-0.200	-0.212
	(0.458)	(0.491)	(0.537)	(0.554)	(0.465)	(0.481)	(0.527)	(0.542)
Tarai	-0.360	-1.111+	-0.809	-0.894	-0.315	-1.009+	-0.754	-0.799
	(0.456)	(0.565)	(0.646)	(0.668)	(0.465)	(0.528)	(0.595)	(0.612)
Median time to dirt road 1995-96 (logged)		-0.195**	-0.199*	-0.215*		-0.267**	-0.280**	-0.292**
		(0.069)	(0.085)	(0.087)		(0.086)	(0.106)	(0.106)
Age of child in 1995-1996 (Age six omitted)								
Seven			-0.351	-0.376			-0.376	-0.402
			(0.491)	(0.518)			(0.478)	(0.501)

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Variables	Dirt road accessibility				Paved road accessibility			
	Model1	Model2	Model3	Model4	Model1	Model2	Model3	Model4
Eight			-0.829+	-0.852+			-0.833+	-0.859+
			(0.457)	(0.482)			(0.449)	(0.475)
Nine			-1.602**	-1.645**			-1.653**	-1.686**
			(0.517)	(0.536)			(0.512)	(0.533)
Ten			-1.984**	-2.011**			-1.983**	-2.022**
			(0.514)	(0.544)			(0.508)	(0.537)
Eleven			-2.080**	-2.147**			-2.094**	-2.152**
			(0.532)	(0.552)			(0.516)	(0.540)
Twelve			-2.598**	-2.679**			-2.653**	-2.733**
			(0.486)	(0.515)			(0.483)	(0.506)
Boys			0.103	0.093			0.175	0.163
			(0.216)	(0.218)			(0.230)	(0.232)
Change in Hh per capita expenditure (NRs. logged)				0.226				0.189
				(0.191)				(0.194)
Change in distance to school (logged minutes)				0.206				0.196
				(0.138)				(0.125)
Constant	0.658	1.659*	2.953**	2.960**	0.724	2.400**	3.777**	3.770**
	(0.560)	(0.711)	(0.986)	(1.005)	(0.557)	(0.785)	(1.030)	(1.025)
Observations	653	653	653	653	654	654	654	654

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Table 8.12. Logistic regression of 2003-2004 school enrolment of children 6-12 enrolled in 1995-1996 on change in accessibility

Variables	Dirt road accessibility				Paved road accessibility			
	Model1	Model2	Model3	Model4	Model1	Model2	Model3	Model4
Change in distance to road (minutes logged)	0.124	0.217*	0.229*	0.221*	0.119	0.269*	0.273*	0.255+
	(0.076)	(0.095)	(0.103)	(0.101)	(0.094)	(0.118)	(0.137)	(0.133)
Development region (Western omitted)								
Eastern	0.064	0.126	0.124	0.183	0.133	0.162	0.136	0.181
	(0.449)	(0.447)	(0.486)	(0.467)	(0.440)	(0.438)	(0.483)	(0.464)
Central	-0.512	-0.593	-1.008*	-0.920+	-0.442	-0.524	-0.944+	-0.861+
	(0.463)	(0.447)	(0.494)	(0.496)	(0.454)	(0.441)	(0.492)	(0.498)
Mid Western	-0.203	-0.277	-0.381	-0.320	0.001	-0.098	-0.205	-0.153
	(0.442)	(0.410)	(0.482)	(0.489)	(0.473)	(0.435)	(0.519)	(0.529)
Far Western	0.087	0.146	0.096	0.140	0.210	0.255	0.163	0.204
	(0.624)	(0.590)	(0.557)	(0.555)	(0.658)	(0.648)	(0.606)	(0.617)
Stratum (Mountain omitted)								
Urban Hills	0.646	-0.062	0.478	0.272	0.544	-0.484	0.030	-0.074
	(0.760)	(0.879)	(1.016)	(1.058)	(0.783)	(0.936)	(1.092)	(1.112)
Rural Hills	-0.187	-0.409	-0.234	-0.254	-0.263	-0.513	-0.332	-0.322
	(0.668)	(0.693)	(0.781)	(0.801)	(0.703)	(0.718)	(0.785)	(0.797)
Tarai	-0.475	-1.110	-0.764	-0.859	-0.469	-1.045	-0.667	-0.680
	(0.662)	(0.756)	(0.887)	(0.913)	(0.694)	(0.747)	(0.841)	(0.857)
Median time to dirt road 1995-96 (logged)		-0.152+	-0.181+	-0.199*		-0.208*	-0.227+	-0.231+
		(0.081)	(0.098)	(0.099)		(0.098)	(0.124)	(0.122)
Age of child in 1995-1996 (Age six omitted)								
Seven			0.060	0.075			-0.008	0.018
			(0.617)	(0.638)			(0.603)	(0.623)

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Variables	Paved road accessibility				Dirt road accessibility			
	Model1	Model2	Model3	Model4	Model1	Model2	Model3	Model4
Eight			-1.022+	-1.004+			-1.059+	-1.033+
			(0.526)	(0.545)			(0.534)	(0.550)
Nine			-1.178+	-1.200*			-1.224*	-1.221*
			(0.602)	(0.601)			(0.601)	(0.603)
Ten			-1.986**	-1.990**			-1.987**	-1.993**
			(0.529)	(0.542)			(0.530)	(0.544)
Eleven			-2.030**	-2.062**			-2.044**	-2.059**
			(0.603)	(0.612)			(0.595)	(0.603)
Twelve			-2.598**	-2.657**			-2.614**	-2.649**
			(0.567)	(0.589)			(0.564)	(0.579)
Boys			-0.488+	-0.499+			-0.438	-0.451
			(0.278)	(0.277)			(0.300)	(0.299)
Change in Hh per capita expenditure (NRs. logged)				0.255				0.174
				(0.262)				(0.275)
Change in distance to school (logged minutes)				0.264+				0.237
				(0.153)				(0.146)
Constant	1.249+	2.093*	3.694**	3.670**	1.308+	2.649*	4.246**	4.144**
	(0.745)	(0.882)	(1.144)	(1.159)	(0.767)	(1.011)	(1.267)	(1.268)
Observations	500	500	500	500	500	500	500	500

Standard errors in parentheses

*+ p< 0.10, * p< .05, ** p< .01*

Chapter IX

Towards a sociology of roads

In November 2006, while this dissertation was in progress, Nepal's development community witnessed a high profile, extempore debate that was directly relevant to the topic of this dissertation. In a program organized to launch a book by the Finance Minister, a former university Vice Chancellor expressed his dissatisfaction that the book emphasized road-building and not education. The Prime Minister who was launching the book, denied the Chancellor's contention that education is more important and remarked, "Education should not be equated with books … roads increase both awareness and opportunities" (Kantipur Dainik 2006). The debate continued in the local press and a popular columnist opined, "The larger issue is not where important personalities stand, but how we create a balance between physical infrastructure and social capability. Thus there is a need to debate the issue publicly" (Lal 2006, original in Nepali). This research hopes to contribute to the literature as well as the public debate on the issue of why roads for social development.

Where we began and what we found

We began this research with some ambivalence regarding what roads, and the associated accessibility, can do to further development in the low income setting. Specifically we wanted to examine accessibility and its effects upon school enrolment chances of school aged children. Our finding showed that that improving accessibility can significantly increase enrolments.

For examining the relationship, we adopted a household level measure of accessibility and recognized the heterogeneity of households on this measure. We then examined in detail how accessibility in Nepal relates to specific household characteristics. Interesting characteristics of inaccessibility emerged. Based on our analysis, we discerned six main characteristics of accessibility in Nepal. First, accessibility in Nepal varied horizontally across locations. Mountains and rural hills lagged behind than the rest of the country. Second, inaccessible areas had higher concentrations of poverty and illiteracy, while accessible areas had a higher concentration of rich and educated people. Third, households from underprivileged caste-ethnic groups, specifically the Dalits and Indigenous Nationalities, and also the privileged Chettri group suffered more access poverty. Fourth, to be in inaccessible areas also meant to be served with distant services. This included transportation, economic facilities, communication services, modern amenities such as the telephone, and educational institutions. Fifth, inaccessible areas were also served by lower quality schools. And sixth, there was substantial intra-village variation in the accessibility level amongst households. The accessibility profile that emerged provided us with additional insights to understand the nature of social inclusion-exclusion in Nepal, as well as to understand the pathways in which accessibility affects educational attainment.

While inaccessible areas suffer from overall low level of resources to better their life chances, it is also the case that inaccessibility itself is detrimental to the chances of the children there to be enrolled in school—the stepping stone for achieving the human capital necessary to increase the child's life chances. By analyzing geographical barriers along with socio-economic and institutional barriers, our research revealed that geographical accessibility had direct and indirect impacts on school enrolment. Our analysis showed that all children from inaccessible areas had a lower chance of entering school. Part of the reason why inaccessibility affected school enrolment was because households in inaccessible areas were poorer, had less educated parents and came from disadvantaged caste ethnic groups. They were unable to overcome the detrimental impact of inaccessibility. Part of the reason was also because schools were distant and low quality in inaccessible areas. So, now we understand better how accessibility can improve school enrolments. Improving accessibility will reduce parents' poverty; provide schools nearby; help expansion of schools, especially the secondary ones; and improve school quality. But there are still other reasons that inaccessibility may be affecting school enrolments, such as expansion of social networks that we have not been able to examine in this research.

Our analysis of the effect of change in accessibility provided us with additional confidence on our cross sectional findings. Improvements in accessibility also improved the chance of the children to continue being enrolled in school but the remoteness they lived through in their childhood affected such chances in later years. Further to this, we analyzed if accessibility had differential impacts on different groups of children. We found that inaccessibility exacerbated gender effects on school enrolment for adolescent girls. While inaccessibility affected all children, adolescent girls were affected more in their chances of attending secondary school. For them inaccessibility continued to be an additional problem by itself regardless of the socio-economic, familial and infrastructural disadvantages.

Although we found inaccessibility to be associated with poverty we did not find evidence that inaccessibility affected the poor children's chances of school enrolment more. We do not have enough evidence to conclude if distance behaves differently for the poor child's enrolment chances than the rich child's. But neither is there evidence that accessibility benefits the rich more. Building roads has a broad based impact.

Finally, we also evaluated the impact of accessibility on school enrolment using both paved road accessibility and dirt road accessibility measures, which allowed us to appreciate the impact of lower quality but cheaper (dirt) roads *vis a vis* the high quality but expensive (paved) roads on school enrolment. That the social effect of lower quality roads is little different, the policy implications would favor building more dirt roads. Each of these findings has relevance for the academics, public and the policy makers who are concerned about the usefulness of roads for a country's development.

Adding to the sociology of roads

Certainly we now know better how accessibility can improve school enrolments. In addition, our study contributes in four meaningful ways towards the sociology of roads. First, it provides a framework for evaluating social outcomes of roads. Second, it provides three useful policy recommendations. Third, it allows us to contemplate on the value of physical roads on expanding social networks. And fourth, it illustrates how roads shape state-society relationships.

Evaluation framework

The overall approach taken in this research provides a framework for evaluating the combined effects of all road projects on social outcomes at a national level. Often evaluations in the roads sector attempt to delineate impact at the project level, which is generally not accurate because a host of wider, beyond-project factors are influencing the outcome. By analyzing large nationally representative cross-sectional and panel household samples, complemented by qualitative insights, researchers can look at accessibility level/change at the household level nationwide, and relate that with the level/change in various social outcomes. Sociologists may use the framework used in this research to assess the impact of roads on a host of socio-economic outcomes such as school enrolment, literacy rates, access to health services, distance to social activities, frequency of social trip-making, etc.

The most obvious finding of this research is that roads assist achieving social outcomes. We analyzed data beyond the simple bivariate association or just the cross sectional data to assert that roads have direct and indirect impacts on increasing school enrolment. We can argue that school enrolment is only one aspect of social benefits that road helps achieve. As noted, there are many other social services such as health access and increased social interaction that are derived from roads. Thus roads need not only be appraised in economically productive vein but also as a factor that helps achieve social development. Sociologists are trained to look into these social outcomes.

Policy implications

We have three specific policy recommendations emerging from this research—the need to shift priority to lower quality but high utility roads, to increase inter and intra-village connections, and to provide pro-poor, pro-women measures in areas connected by roads so that the benefits of accessibility is distributed more equitably. Finally

Priority to lower quality roads: Our research evaluated the impact of accessibility on school enrolment using both paved road accessibility and dirt road accessibility measures, which allowed us to appreciate the impact of lower quality but cheaper roads *vis a vis* the high quality but expensive roads on school enrolment. The policy implication is that for a resource poor country such as Nepal that depends heavily on foreign investment for building its roads, priorities should shift to the less appealing dirt roads. It will be wise first to connect hundreds of villages to the rest of the country, and gradually shift to upgrading them to the 'paved' status.

One reason for this suggestion is that dirt roads are many times cheaper, but there is another compelling reason. By connecting people, the lower grade roads can address the aspirations and reduce the distress of the inaccessible citizens almost immediately, without having to wait for foreign investment for making higher grade roads. Undoubtedly villagers in remote Nepal have long aspired to be connected with the rest of the world and such a shift will also be very consistent with their aspirations. In a number of villages there have been even local donations for road constructions in Nepal (Ministry of Finance 2007). While immediate benefits begin to accrue in the form of increased movement of humans and goods, the community by itself begins to be vocal to demand for more 'development' as it increases its human, social and economic capital through the increased connection availed by roads.

Appraising roads against the standards of higher grade roads is likely to make roads not economically feasible in most of Nepal. A sound approach will be to open low quality roads, and prioritize them later for upgrading the quality. The post Maoist, post Monarchy state of Nepal of 2007 has its best chances to impress its citizens through opening up these lower quality but usable roads countrywide. The sooner Kathmandu lets the local governments decide which routes the roads will take, the better it is.

Priority to increasing intra-village mobility: Our findings reveal there is substantial inter- household level variation within a village in terms of access to roads. Given the difficulty and the costs involved, it may take many years and may not also be practical to expect roads to reach each household in Nepal. Within villages or groups of villages, poor foot paths and rivers that swell during rainy seasons, or rivers without trail bridges provide additional obstructions to the movement of people and goods. This necessitates the focus to shift also to improving inter- and intra-village accessibility by constructing village paths and trail bridges.

Promote newer means of transport: Where accessibility has improved, mobility might not improve automatically due to lack of means of transport. Chances are that it takes additional pro-poor measures and more time before the poor households are able to benefit from improved accessibility. Measures such as promoting non-motorized vehicles such as bicycles in the Tarai and in flatter terrains of the hills, promoting subsidy for operating appropriate types of transport services, offering driving lessons, producing locally trained vehicle mechanics, providing service could help maximize the benefits of improved accessibility.

Road networks and expansion of social networks

One mechanism in which roads help education attainment is through the expansion of social networks by villagers. Roads help break the isolation not only in the material sense that we have discussed thus far but also in the non-material sense. A sense of connection to the rest of the world and the increased social capital due to increased ties and interaction may bring attitudinal changes with them. This includes the increased ability to value the importance of education, awareness about the need to send their children to school and also work towards having more and quality schools in their villages. Parents' values may change because their world has changed. Education now is more important for their children's success than it was before being connected. Also their children have a better chance of using their education to get better jobs. More interaction with the external world means education becomes more important.

Sociologists' interest in infrastructure projects is not new, but their roles are evolving. In small infrastructures such as community drinking water, local hydro projects and small irrigation projects, sociologists have contributed in many stages of projects—from design, implementation, maintenance to evaluation. Sociologists engage in small infrastructure projects because such infrastructure provision demands participation of local people before, during and after construction. However in bigger projects, such as roads, we find sociologists role generally limited to making the conventional social impact assessments. It wouldn't be an exaggeration to say sociologists generally contribute remaining in margins of these projects. The kind of questions sociologists pose may not contribute to the short term efficiency of projects. Questions raised by sociologists such as how would a road projects benefit the poor, or the girls do not integrate well in a field that is driven by the desire to meet rapid disbursement targets in a project setting.

Why do roads, a field that has generally been handled by politicians, economists and engineers, interest sociologists? Politicians are interested because the politics of bringing in road projects—at the international, national and regional levels—entails the possibility of exerting influence on the electorate. Engineers design and supervise the making of roads. Economists are interested to ensure that the roads have enough economic returns so that investors are willing to invest. But why sociologists? Is there any sociology of roads? Is there any scope for such sociology? Do sociologists have any role in road making beyond the conventional socio-economic and environmental impact assessments? In order to answer these questions we must first answer another fundamental question—why roads? What are we trying to achieve by building roads?

People coming from different disciplines may have different set of answers, just as road projects may be different in their stated objectives. Reasons abound, one thing that is unique about all road projects is that roads connect people and communities physically. Roads are an infrastructure of a different kind—unlike other infrastructures such as drinking water, irrigation, or small electricity projects, they link up tens of communities physically, they connect the center and the periphery. They improve accessibility and mobility of people, and potentially shape the social demography. Such uniqueness of roads demands sociologists' regular interest in infrastructures to be modified for roads.

Roads connect people, expand networks and change societal norms. These interconnections are the core of what sociologists study and this is the reason why there is ample space for sociology of roads. Through these interconnections, physical roads become means of social change. With roads, families are not only able to get schools nearby but also be able to value and utilize the education they receive. Moreover, roads affect people and societies in numerous but different ways. Road are not neutral in the way they affect societies and social groups.

State-society relations

This non-neutrality of roads is well reflected in our research. As we saw in chapter four, accessibility derived from having roads is distributed differentially vertically and horizontally. The accessibility profile that emerged presented three forms of imbalance in the state-society relations in Nepal. The first imbalance was obviously regional. The second imbalance was socio-economic reflected mainly through higher concentrations of poverty and illiteracy in inaccessible areas. The third imbalance was in terms of the state's capacity to cater the basic needs of the people in isolated areas. While Nepal has always been understood as a country that has severe accessibility problems, the underlying dimensions of accessibility have rarely been examined.

What became evident from our analysis is that Nepal is a country divided in terms of the level of accessibility its residents enjoy. Moreover, to be a resident of an inaccessible area means to be marginalized in terms of several axes. Not only is one likely to be in a household with very less financial capital, and a low level of human capital, but the person is also likely to be served by very distant and poorer quality services. As a result, his or her chances of accumulating human, social and economic capital is severely limited. Like gender, culture or poverty, accessibility by itself is working as a medium of inclusion-exclusion in Nepal. The access-divide and the imbalance in the state-society relations produced as a result of road expansion are other reasons why sociologists should be drawn to roads. But roads are also of interest to sociologists because the very roads that facilitate social and economic development also have become institutional venues of protesting the state.

In South Asia, however roads have also become venues of protesting against the state. *Chakka jam* (literal meaning jamming the wheels) and *sadak andolan* (protesting from roads) have become synonyms to political protest in most of South Asia. The Nepal of post 1990, in particular during 2002-2006 saw more protest terms—*sadak dabaab* (giving pressure to the state from roads), *sadak tataune* (heating up the roads), *sadak parliament* (parliament in the roads) that were tied to roads. In the political contest between the Maoists, the Parliamentarians and the Monarchy between 1996 to 2006, three venues—the roads, the jungle and the parliament—were where political protests took place against the state (KC 2006). Road centered political activities got more institutionalized and popular. During the period rebels placed deadly ambushes on roads to discourage movement of state personnel and security forces. As a consequence movement on the roads began to be regulated by the state (each passenger of every vehicle was examined) delaying journeys by hours. Hundreds of Nepalese died on the roads not in motor accidents, but the fights that erupted between the state and the protestors. The final turning point in the Nepali politics that ended in a peace accord in 2006—that brought Maoists out of the jungle and that forced the Monarch to give up power to reinstate the Parliament—was arrived by the peaceful protest activities on the roads.

Road as institutional venues of protest is of interest to sociologists, because a closer look reveals the social composition of who actually can exert more pressure on the state. It is not to say that people from remote areas are not able to exert pressure on the state, but the chances of those living near to the roads are higher, just as their chances of accessing state resources, interacting with the state and getting their voices heard are also higher. The diverse combination of all caste-ethnicity groups within 15 minutes of roads in 2003/2004 signals that the decisive mass uprising of 2006 in Nepal had a good participation from all caste-ethnicity groups.

Future directions

Our measures of school quality do not adequately capture various quality dimensions such as teacher presence and several school input factors. Future research may consider having stronger school quality measures. The research does not measure individual level differences in accessibility as well. Individuals in the same household may face a varying degree of accessibility and mobility due to factors such as morbidity and disability. This may be an area worth examining.

We spoke in detail how road networks may affect social networks of households. We would have liked to examine with data how road networks improve and alter social networks and interaction patterns. While this kind of data may not be readily available, one may explore household datasets for measures of social networks, and/or employ qualitative techniques to study the relationship between road network and expansion in social network. This will be an interesting area to explore in future, and a meaningful contribution to sociology of roads.

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