GRAVITY GOODS ROPEWAYS: A SUSTAINABLE SOLUTION FOR RURAL TRANSPORTATION IN HILLY AND MOUNTAINOUS REGIONS OF NEPAL

by

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THESIS ABSTRACT

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In Nepal, the harsh mountainous topography hinders a viable transport infrastructure, including roads, making trails and mule tracks the only available option for a majority of the population. This isolates communities and compels them to face an exhausting, time consuming and often dangerous journey to get their agricultural products to the nearest markets. This study investigates the potential of gravity goods ropeway as a viable means of transportation to serve these isolated communities. This research looks at *Hiklung* village to explore the significance of gravity good ropeways in linking farmers to markets, its socio-economic impact, and its effectiveness in improving food security and livelihoods of project beneficiaries. The findings of this study, based on participant observation and interactions with project beneficiaries, suggest that an alternative means of transportation like gravity goods ropeway can be a sustainable transport solution to these isolated communities and increase their participation in the local economy.

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CHAPTER I

INTRODUCTION

In Nepal, the harsh topography of hilly and mountainous areas hinders the construction of a transport infrastructure, including roads, making trails and mule tracks the only available option for a majority of the population. Furthermore, majority of these tracks lack modern bridges over the rivers. This isolates communities and compels them to face an exhausting, time consuming, and often dangerous journey to get their agricultural products to the nearest markets. During the rainy season, the journey to the markets becomes more dangerous due to slippery mountain tracks and natural disasters like landslides and floods and sometimes it is completely impossible to take products to market and vice-versa. The rural economy is largely based on subsistence agriculture. The lack of access to market, due to the absence of proper and reliable means of transportation, has been a great hindrance of commercialization of agriculture in hills and mountains. Each year substantial quantities of surplus agricultural produces perish due to the lack of access to markets.

Nepal is one of the poorest countries, and is the most rural country of South Asia (Portnov, Adhikari, & Schwartz, 2007). Hills and mountains in Nepal cover 83% of the area of the country. With such geographical condition, the steep and complex terrains accompanied by heavy monsoon rains create conditions of severe natural instability in Nepal. These conditions make development of transport infrastructure challenging and costly (Devkota, Dudycha, & Andrey, 2012, p. 283). Due to the lack of proper transportation infrastructure, movement is slow, difficult, and dangerous in the hilly and mountainous regions that dominate Nepal (Devkota et al., 2012, p. 283).

Statement of the problem and research objective

In developing countries, lack of rural transportation system is a major problem and hindrance in the sustainable development of the region. In absence of proper transportation network, more than 40% rural population is bound to live in isolation and is highly food insecure (World Bank, 2014). Moreover, the lack of rural transportation networks is rooted in two inter related conditions that is lack of accessibility to basic socio-economic needs and absence of reliable transportation infrastructure and services to facilitate mobility(Haynes, Lovett, & Sunnengerg, 2003).

To solve the rural transportation problem, both issues of accessibility and mobility needs to be addressed (Devkota et al., 2012, p. 282). In Nepal, the topography of the country is the greatest hindrance to the improvement of access to market and basic services. The rugged mountains pose an obstacle to the mobility of the people and transport of goods and services. The Department of Local infrastructure Development and Agricultural Roads (DoLIDAR) Nepal estimates "36 per cent of Nepal's population live at least two hour walk from the nearest all season road, 50 per cent live at least four hours walk from the nearest all season road, 50 per cent live at least four hours walk from the nearest dry season road where a bus or jeep may transit: and only about 30 per cent have access to all season transportation services"(p.v). Therefore, improving accessibility through appropriate means of transportation has been one of the major development challenges in Nepal. Roadways and airways are the major modes of transportation in Nepal. Though Nepal has made impressive progress in road infrastructure development, it cannot keep up with the demands of an ever-increasing population in scattered settlements living in hilly and mountainous areas. Construction of roads is generally very

capital-intensive, massive construction and time consuming. Hence, universal connection to the all-weather road is an illusive dream in Nepal. The populations living in the remote mountains of Nepal are likely to languish in the vicious circle of poverty and isolation unless some alternatives are provided (Singh, 2010, p 3-4).

The harsh topography hinders construction of a transport infrastructure, including roadways, making trails and mule tracks the only available option for majority of population, and forces people to transport goods physically. This isolates farmers from markets, stretches duration of travel, and deteriorates the quality by the time their produce reaches to the final market. Consequently, farmers are bound to exercise low bargaining power despite having marketable agricultural products (K.C, 2015). Furthermore, farmers become dependent on the market intermediaries like traders, and intermediaries who purchase crops at farm gate and sell them to the buyers at urban center in the expectation of appropriate price. These market agents dictate the price negotiation process, offer lower price and seize largest share of profit subsequently reducing the price, profit share, and income of farmers. Hence, small-scale farmers are unlikely to experience any significant financial improvement.

To deal with this situation, sustained intervention is required that will help diversify sources of income, increase household level income and enhance food security for the long term.

"Strong links to markets for poor rural producers are essential to increasing agricultural production, generating economic growth in rural areas, and reducing hunger and poverty"(International Fund for Agriculture Development[IFAD], 2013). Better access by small producers to markets means that they can reliably sell more produce at

higher prices. This in turn encourages farmers to invest in their own businesses and increase the quantity, quality and diversity of the goods they produce (Wickramasinghe & Weinberger, 2013). Moreover, they can gradually save and accumulate assets, increasing not only their prosperity, but also their capacity to deal with risks and shocks (Aliguma, Magala, & Lwasa, 2007). Finding good market opportunities to make agriculture a remunerative business is of major importance for smallholders as it can enable farming households to commercialize their production systems and focus on market oriented crops and livestock products, which can increase and secure their cash income and reduce the need for self-sufficiency (IFAD, 2011).

To address the problem, some International Non-Government Organizations (INGOs) including government institutions have introduced Gravity Goods Ropeway as an alternative and complementary means of transportation in Nepal (Baral, 2012). They claim this system helps to connect farmers directly to market in shortest time retaining the quality of the product and enhance their bargaining power. It is inexpensive, has low operational cost, and can reduce the transportation cost further increasing the profit share of farmers.

This study aims to investigate the advantages of gravity goods ropeways as mode of transportation in Nepal, its significance in linking farmers to market, its socio-economic impact on rural population, and its effectiveness in improving food security and livelihood of rural population of Nepal without access to transportation facilities.

Research Methodology

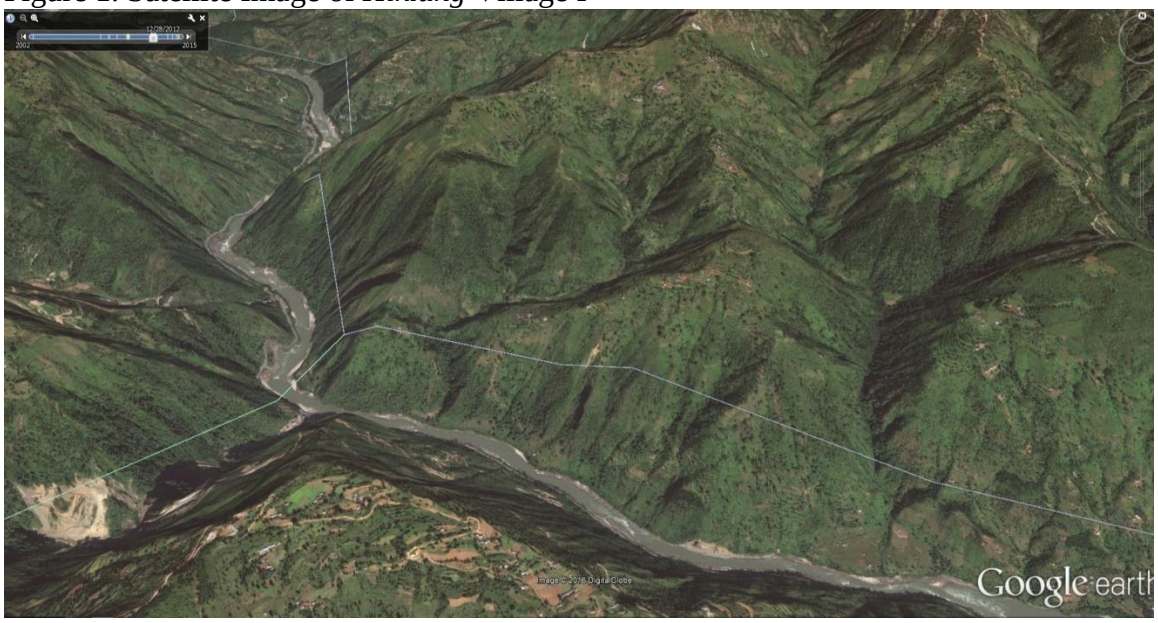
I have collected my primary data through participant observation and interaction with farmers, local stakeholders, and other experts from government and non-government agencies during my field visit.I have used data from my preliminary field visit during winter break of 2014. My research site was affected by the April 2015 Nepal earthquake. I could not conduct the detail quantitative study as intended due to the vulnerability of the situation.

I have collected secondary data from research papers and journals, websites of concerned organization and interviews of experts regarding Gravity Goods Ropeway and its impact. Along with this, I have reviewed literature on sustainable transportation, market access, poverty reduction and transportation challenges in mountainous areas.

Research site

Hiklung village is located in Bhumichowk VDC of Gorkha District of Nepal. Gorkha District lies in the Central Development Region of Nepal. Hiklung Village is situated in the hilly region of Nepal. The site is rich in forests and lies at an altitude of 2460 feet from the sea level. The site has a moderate type of climate. It is neither too cold, nor too hot. It receives heavy rainfall from June to September (Monsoon season). It also receives some amount of winter rain.

Figure 1. Satellite Image of *Hiklung* Village I



Source: Google Earth, 2016

Figure 2. Satellite Image of *Hiklung* Village II

Source: Google Earth, 2016

It is just around 2 Kilometers (1.24 miles) off the national highway. In spite of being so close to the highway, no paved road network connects this village to the highway, as it is located in the steep hilltop. The villagers have to walk around 2 hours on the steep foot trail to reach the nearest road. Moreover, they have to cross a fast flowing river without any modern bridge to reach the next side. There is a suspension footbridge to across river but they have to walk extra 2 kilometers (1.24 miles) to get there. The lack of road had isolated the farmers from market, stretched duration of travel, and deteriorated the quality by the time their produce reached the final market. The villages had to carry their goods on their back for around 2 hours and walk up and down the steep hill foot trails up to the riverbank. Then, they had to use boat to transport their produce across the river. Now, the villagers use improved wired bridges to travel across river and gravity goods ropeway to transport their goods. Now, after the installation of the gravity goods ropeway, they are able to transport their goods directly to the station located near the road within 2 minutes.

I chose *Hiklung* Village as my research site for number of reasons. Firstly, the villagers did not have proper access to market prior to the installation of the Gravity Goods Ropeway even being so close to one of the busiest highways in Nepal. Villagers were not able to take advantage of the highway in spite of being physically close to highway. I also chose this village as it is inhabited by Chepang people, one of the marginalized communities in Nepal (Aryal, Berg & Ogle, 2009).

The other reason for choosing this village was for the successful operation of Gravity Goods Ropeway for more than 6 years by the community. Finally, due to the recent massive earthquake, climatic condition (Rainy season), and frequent political

strikes, I could not travel far from Kathmandu city and go to other probable sites. This site is around 70 kilometers (43.49 miles) from Kathmandu city and I had gone for preliminary field visit in this site during the winter break of 2014.

People:

Chepang people inhabit this village. Traditionally, *Chepang* used to live as semi-nomads depending on slash and burn shifting cultivation farming systems, fishing and hunting and gathering of uncultivated foods (Aryal et al., 2009). Over the past two or three generations, they have slowly shifted from more settled way of life (Sharma, 2011). In this village as well, they are permanent residents with legal land documents and have been living there for generations. Hiklung Village has 75 households and they all are of *Chepang* people.

Socio-economy

The primary occupation of the villagers is agriculture. The village economy used to be subsistence based before the introduction of the Gravity Goods Ropeway. They traditionally cultivate maize, millet, banana, Nepali Butter Tree (*Diploknema butyracea*) etc. Their traditional diet included wild yams, tubers, fish, chicken, pig, bats, wild birds, and wild deer (now law in Nepal protects wild animals).Now, they cultivate seasonal vegetables such as cucumber, radish, green leafy vegetables, tomatoes, cabbage, cauliflower and some varieties of bean as cash crop in their terraced land. Some farmers have also started off-seasonal vegetables using plastic green house. They cultivate

tomatoes in those plastic green houses. Only few households have little paddy. Due to the lack of irrigation facility, they have to depend on rain to cultivate their paddy fields.

Animal husbandry is also common in their village. The main domestic animals in the village are cow, ox, buffalo, pig, and goat. Most of the households have few chickens. They rear cow and buffalo for milk and manure. Buffaloes are either consumed as meat or sold in the market after they stop producing milk. Pig, goat, and chicken are reared for meat and are sold for cash as well. They use oxen to plough their field. Ox and cow are not used as meat because beef is socially and legal restricted in Nepal. Animal husbandry constitutes vital source of income in their domestic economy.

Youths and men usually go to seek for employment in the nearby cities and Kathmandu. In recent years, in this village as well there has been trend of going aboard particularly to Gulf countries to find work as migrant workers.

Limitations of the study

I recognize that several factors have affected the quality and scope of my research. I had previously planned to conduct 20 qualitative interviews, focus group discussions, and participatory rural appraisal. However, I had to conduct my research during the aftermath of a massive earthquake in Nepal. I was completely unaware about the condition of my research site and was not sure whether the ropeway still existed after the earthquake as my research site is very close to epicenter. Due to these conditions, my research was based on the participant direct observation and unstructured interactions

with farmers, local stakeholders, and experts from government and non-government agencies during my field visit.

Chapter II

INTRODUCTION TO NEPAL

Nepal is a landlocked country located in South Asia and has a total area of 147,181square kilometers with an average width and length of 193 kilometers and 885 kilometers respectively. Nepal shares borders with China in the North and India in the east, the west, and the south. Kathmandu is the capital city of Nepal (Central Bureau of Statistics, 2014).

The country has a central government system with a multiparty system. The Head of State is the President. However, the President's role is largely ceremonial and does not have substantive executive power. The Prime Minister is the chief executive of the Government of Nepal who manages the functioning of the government (The Asia Foundation , 2012).

Figure 3. Map of Nepal

Source: Maps of world. Retrieved from http://www.mapsofworld.com/nepal/

Administratively, Nepal is divided into five north-south development regions; Eastern Development Region, Central Development Region, Western Development Region, Mid-Western Development Region and Far- Western Development Region. These development regions consist of 14 zones and 75 administrative districts. The districts are further devolved into 191 Municipalities that are considered as urban and 3276 Village Development Committees (VDCs) which are mostly rural areas. The VDC has nine wards. However, a municipality can have more than nine wards since the wards are demarcated on the basis of population (Central Bureau of Statistics, 2014).

In the district level, the local governance of Nepal is represented through the District Development Committees (DDCs). They are the frontier institutions in the process of decentralization (Joshi, 2011). District offices are the key administrative field units headed by the chief district officer (CDO). Furthermore, each district has a local development officer (LDO) who is responsible for local development programs supported by the central government and the DDC. The LDO is the district level officer of the Ministry of Local Development (MoLD) (The Asia Foundation, 2012). Administratively, VDCs and municipalities fall under the jurisdiction of DDCs but the Local Self-Governance Act, 1999 has recognized them as statutory independent entities. However due to the weak institutional capacity, VDCs are usually unable to fully utilize their power and prefer to work under the direct control of DDCs from the resource coordination and oversight point of view.

Geography

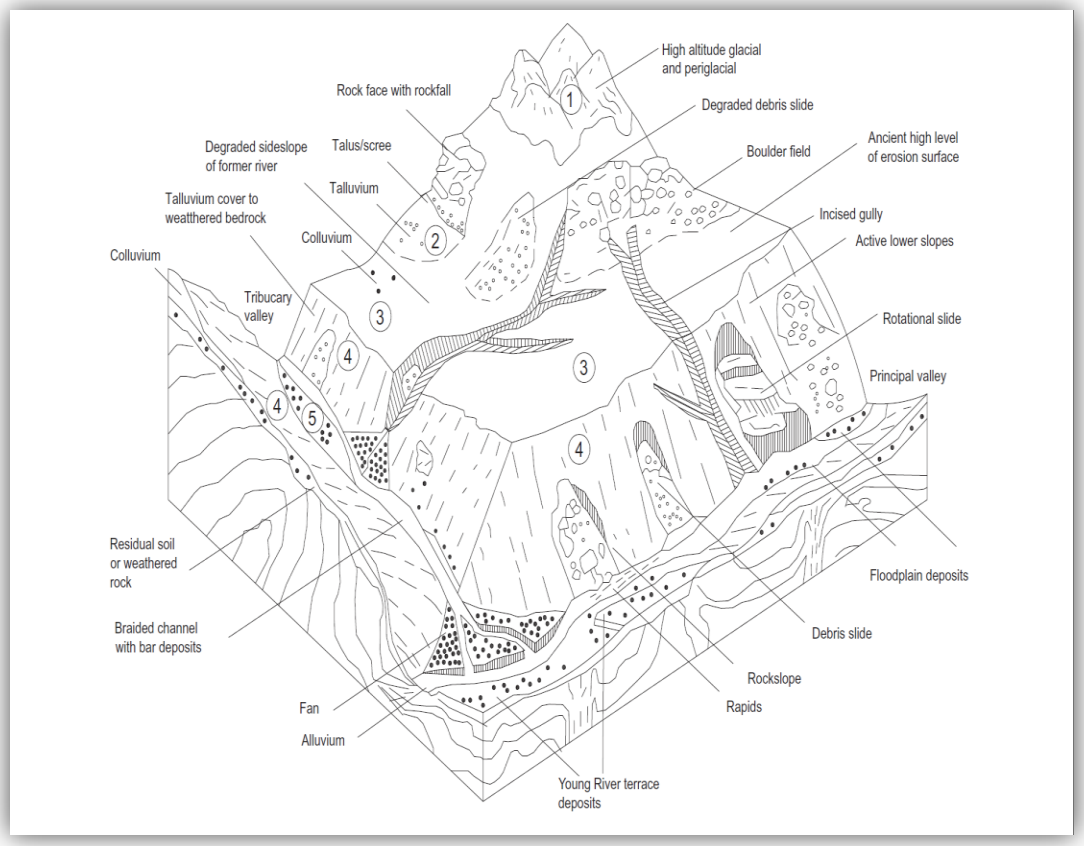
Nepal occupies 0.03% and 0.3% of total land area of world and Asia respectively (Central Bureau of Statistics, 2014). Nepal extends between longitudes 80° 04'East and 88° 12'East and latitudes 26° 22' North and 30° 27'North. Nepal altitude varies from the Gangatic plains in Terai at 70 m above sea level to the world's highest peak (Mount Everest at 8850 m). The geography of Nepal can be divided into three bands: the Terai (Southern plains), the Mid- Hills and the Mountains. The plains cover 17% of the total land of the country. The Mid- Hills(Hilly region) cover 68% of the total land of the country and altitude varies from 700 to 3,000 meters (2,000 to 10,000 ft.). The Mountain region covers 15% of the total area and altitude ranges from 3,000 to 8,848 meters (10,000 to 29,209 ft.) (Central Bureau of Statistics, 2011). Hills and mountains in Nepal cover 83% of the area of the country. With such geographical condition, the steep and complex terrains accompanied by heavy monsoon rains create conditions of severe natural instability in Nepal. These conditions make development of transport infrastructure challenging and costly (Devkota et al., 2012, p. 283).

Fookes et al. (1985) described the features of land forms of Nepal in terms of Five zones as shown in figure 4 :

Zone 1 - glacial and peri glacial topography (typical of High Himalaya) containing rock and ice terrain of the high peaks.
Zone 2 – free rock faces and associated debris slopes (typical of the High Himalaya and highest elevations of the Middle Himalayas), being composed of rock fragments and coarse debris covered slopes.
Zone 3- degraded middle slopes and ancient valley floors (typical of parts of the Mahabharat Lekh and the lower elevations of the Middle Himalaya). With lower average slope angles, when compared to zone 2 and zone 4, has cultivated lands and scattered inhabited areas in hilly regions.
Zone 4- active lower slopes (typical of many parts of the Mahabharat Lekh and some of the more confined slopes adjacent to the major rivers in the Middle Himalaya). Steeply sloping valley and gully side slopes dominate the topography.

Zone 5- valley floors (typical of the Low Himalaya and, to lesser extent, the Middle Himalaya). The main features of this zone are the tributary stream and gully crossing at the point where they flow into the major river valley.

Figure 4. Five zone mountain model for Nepal Himalayas



Source: Fookes et al., 1985,p. 18

Socio-economy

Nepal is a multiethnic, multilingual, multi-religious, and multicultural country. The National Population Census (2011) reveals that there 125 caste[1] and ethnic groups in Nepal who speaks 123 different languages (Central Bureau of Statistics, 2011).

[1] each of the hereditary classes of Hindu society, distinguished by relative degrees of ritual purity

According to the National Population Census (2011), the total population of Nepal is 26.5 million with 5,427,302 individual households (Central Bureau of Statistics, 2011). The annual growth rate of population is 1.35 percent per annum. The census report shows that the geographical distribution of population is uneven in Nepal as 6.7, 43.0, and 50.3 per cent of total population is living respectively in the Mountain, Hill, and Terai. Similarly, the population density in the year 2011 was 180 people per square kilometer. There is also huge gap in the literacy rate in Nepal. The literacy rates of male and female are 75.1 and 57.4 percent with the average literate rate of 65.9 percent.

Nepal is one of the least developed countries with agriculture as the main livelihoods base for 81% of its population living in rural areas (Central Bureau of Statistics, 2011). According to UN Human Development Index, Nepal ranks 174th poorest country in the world (United Nations Development Programme [UNDP], 2014). Nepal's HDI value for 2014 was 0.548 that ranks Nepal 145th out of 188 countries and territories (UNDP, 2015). It indicates that Nepal falls under low human development category. The decade long civil conflict that ended in 2006 presented the major obstacles for human development and caused loss of thousands of lives (Basnett, Henley, Howell, Jones, Lemma, & Pandey, 2014). It destroyed local infrastructure, local governments, halted major infrastructural development projects, and adversely affected rural livelihoods causing huge out-migration.

Despite those unfavorable conditions, Nepal has made progress in each of the HDI indicators from 1980 to 2013 (UNDP, 2014). As shown in the table 1, Nepal's life expectancy at birth increased by 20.7 years, mean years of schooling increased by 2.6

years and expected years of schooling increased by 7.6 years between 1980 and 2013 (UNDP, 2014).

Table 1. Nepal's HDI trends based on consistent time series data and new goal post

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP$)	HDI value
1980	47.7	4.8	0.6	1,067	0.286
1985	51.2	5.9	1.2	1,125	0.330
1990	55.1	7.8	2.0	1,255	0.388
1995	58.8	8.4	2.2	1,442	0.419
2000	62.1	9.3	2.4	1,572	0.449
2005	64.8	9.9	2.7	1,722	0.477
2010	67.1	12.1	3.2	2,026	0.527
2011	67.6	12.4	3.2	2,067	0.533
2012	68.0	12.4	3.2	2,151	0.537
2013	68.4	12.4	3.2	2,194	0.540

Source: *Nepal Human Development Report 2014*

Lack of sustained economy growth, political instability, and decade of civil conflicts has caused extreme poverty in Nepal. Still about 25 % of the population is living below the poverty line and bound to live in low quality of life[2]. Similarly, Gini

[2] The World Bank. (2010). Nepal. Retrieved on Nov 25, 2015 from http://data.worldbank.org/country/nepal

Coefficient of Nepal is 0.328, which indicates that there is high inequality and non-uniform distribution of income between the rich and poor (Central Bureau of Statistics, 2014). The annual growth rate of Gross Domestic Product (GDP) in 2013/2014 was 5.15% and the per capita GDP was about 703 USD, which is very low.

Meanwhile, the 2013 female HDI value for Nepal is 0.514 in contrast with 0.564 for males, resulting in a Gender Development Index (GDI) value of 0.912 (UNDP, 2014). Traditional socio-cultural structures, patriarchal society, lack of opportunities, and limited access to resources and control over them have been responsible for unequal gender relations in Nepal. There have been considerable disparities between urban and rural areas in Nepal as well. Lack of proper transportation facilities has kept the rural population away from economic activities. This has caused high rural underemployment (47%) and poverty remains at 34%. In the meantime, the poverty incidence for urban area was estimated to be only 9 %(Central Bureau of Statistics, 2014).

Even though agriculture is the main livelihoods base for 81% of its rural population, food insecurity is pervasive. According to Word Food Program (2014), 41% of the population is under-nourished while 30 out of 75 districts are reported to be food insecure in Nepal.

Asian Development Bank (2014) reported that agriculture was largely based on low value cereals with produced under subsistence agriculture with a mere 13% of output traded in markets. Agriculture in Nepal, especially in hilly and mountain region, was dominated by the small-scale farmers where average land holding size is about 0.5 hectare (Karki & Karki, 2011). Small landholding and lack of proper access to market have made many subsistence farmers unable to sustain for whole year with their own

produce and are bound to suffer from food and nutritional insecurity. Moreover, political uncertainly, and the poor state of Nepal's transportation infrastructure have constrained growth in agricultural sector keeping transportation costs high, and making farmers' involvement in markets expensive (Basnett et al., 2014).

Transport

There are two major modes of transportation in Nepal; roadways and airways. There is a small sector of railway in Nepal. However, despite having high potential ropeways have not been given high priority by Government of Nepal. Road construction has been top priority of government. In the districts that have not been connected with road network, air transportation is the only one option for travel other than walking.
In the early stage of road construction in Nepal, government focused on buildings road to connect boarders of neighboring countries; India and China (Pokharel & Acharya, 2015). Only during 10^{th} five-year plan (2002-2007), government prioritized connecting all 75-district headquarters by road; however, it is still in implementation still this day (Pokharel & Acharya, 2015).

Low quality and limited transport infrastructure have been critical constraints to economic growth and the expansion of productive capacity in Nepal. Inadequate and unbalanced transport infrastructures have hindrance development activities and in some cases, it has increased the regional disparity (Pokharel & Acharya, 2015). Due to geographical complexity, disperse settlement pattern, and inadequate transport infrastructure, majority of the country's population is struggling to achieve the minimum access to basic services and economic activities.

Basneett et al. (2014) highlight that lack of proper and adequate transportation infrastructure has undermined the political, administrative, and social integration of the country, the delivery of basic services, and the competitiveness of the economy (p. vi). They suggest that both institutional capacity development as well as infrastructure development would reduce transportation related costs, and empower the government to meet its economic growth target.

Chapter III

LITERATURE REVIEW

Transportation and economic growth

Accessibility and proper transportation facilities are the most for economic development of any region throughout the world. The efficient and reliable transport infrastructure increases mobility, which helps people to have more social and economic opportunities. It may lead to faster economic growth and improve the quality of life. There has been no debate on the importance of transport infrastructure for balanced economic growth and development. However, some regions are given more priority for enhancement of transport infrastructure and some are neglected due to various regions. Low population density, geographical constraints, and lack of adequate resources might be the demotivating factors for government towards investing in enhancement of transportation in those regions. Absence of transport infrastructure keeps those remote populations away from economic opportunities, and faster and safer access to basic needs and services. This creates huge income disparity between those population and population having access to transport facilities. Growth starts to concentrate on the regions with proper transport facilities, which attracts more qualified work force and investments. Those regions then emerge and enter into a virtuous cycle whereas lagging region enters into a vicious cycle in the absence of investments and economic opportunities (Pokharel & Acharya, 2015).

Barro (1990) highlights that economic development is closely related to enhancement in transportation infrastructure. Better transport infrastructure facilitates the mobility of people and goods, which helps to stimulate trade and make economic activities (Li & DaCosta, 2013, p. 56). It promotes territorial accessibility and connects people with markets, health, social services, and educational institutions. Easier and faster access to goods and services helps to improve the quality of life and ease the societal inequality (Li & DaCosta, 2013, p. 57). According to Li & DaCosta (2013), "A better transport alignment and network connectivity may successfully improve the business investment climate, lift up the national competitiveness, and boost economic development in a country" (p. 57). Thus, an efficient and extensive transportation network is vital for economic growth.

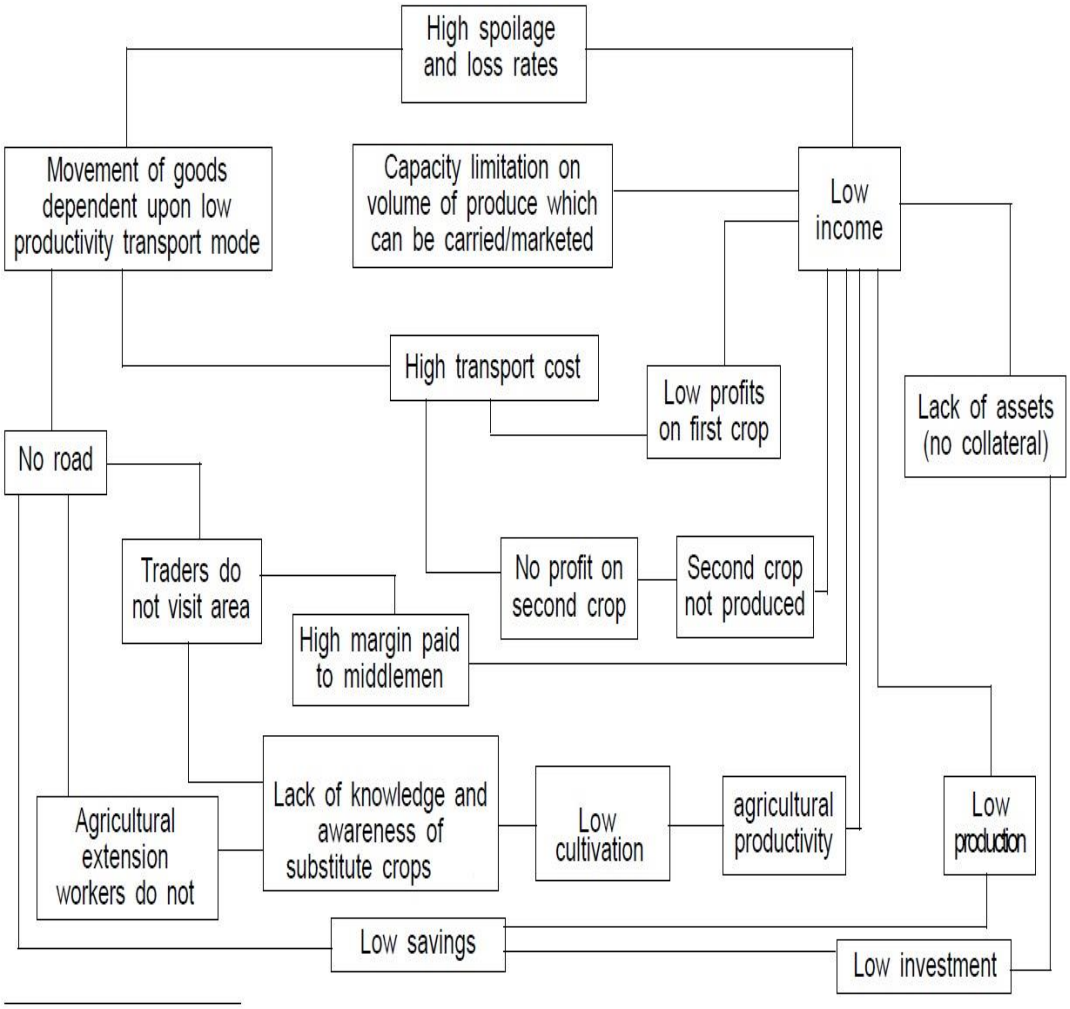
Li & DaCosta's (2013) study found direct link between income inequality and access to transport infrastructure. They stated, "The alignment, connectivity, functioning, and performance of the transport system are closely linked with economic, social, and environmental development" (p.70).

For enhancement, proper functioning, effectiveness and performance of the transport system proper transport planning and policy are a critical components. Li & DaCosta's (2013) suggests that for economic, social, and environmental development of underdeveloped areas and disadvantaged groups of people, government should pay more attention on planning and formulating policies that pay more attention to income distributive effects of transport infrastructures and services (p. 70).

Transportation and poverty reduction

Many factors drive development of remote rural areas. Among them, the access of people to living in remote areas to transportation infrastructure and services is crucial. Mobility is a key element in the economic and social development of rural and remote areas. Rural development involves agricultural production, economic utilization of these products and the provision of basic social and economic services (Schmid, Bartholdi, Moosmann, Czeh, & Engelskirchen, 2013). Agricultural development alone cannot solve the problem of rural poverty; it should be supported by appropriate sales opportunities, and supply chain to gain maximum profit from sales of agricultural produce. However, in the absence of appropriate transport infrastructure, agricultural produce might not reach market on time and could perish on the way. In such scenario, higher yields will not be sufficient condition for farmer to gain profit from agriculture. According to Balla (2000), lack of access to transport facilities and services perpetuates the vicious circle of poverty and low income operating in rural areas in developing countries. Lack of transport facilities results in low agricultural productivity, high transport costs, low profit margins, higher spoilage and loss of goods during transportation and, hence, lower levels of income and increased poverty (p. 33).

Figure 5. Vicious circle of lack of access to transport facilities and services



Source: Balla, 2000, p. 44

Development of the transport sector like other infrastructure sectors leads to increase in factor productivity in various sectors by increasing accessibility and reducing transport costs and time (Balla, 2000, p. 32). Unlike programs for agriculture development, transportation infrastructure does not directly increase agricultural output, but can make a significant contribution towards its growth by increasing the factor productivity of land, labor and capital in the production process (Balla, 2000, p.29).

Investment in the transportation infrastructure generates income-earning opportunities for the rural people by creating jobs and access to market and other facilities. Moreover, investment in rural transport results in transport induced lower prices of consumer goods that bring relief to rural population. In addition, it may also help farmers to modernize their production pattern by creating better access to seeds, fertilizers, tools, and technologies. Reduction in transportation cost and time automatically lowers the prices of agricultural inputs and leads to higher realized price for farmer's output. Higher income through sale of agricultural produce makes important contribution to poverty reduction in rural and remote areas.

Sustainable transport

The concept of sustainability has been gaining a synonymous status to the idea of development over the past decades. Sustainability is the major concern during planning and implementation of the development projects.

The most popular and commonly used definition of Sustainable Development given by the landmark publication Our Common Future (or the Brundtland report) is "Development that meets the needs of current generations without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 45). It asserts that humanity should make development sustainable without causing any ecological imbalance and environmental degradation by over utilization of natural resources.

According to Asian Development Bank (2010), the concept of sustainability is more relevant in the transport sector as development and enhancement of the transport

infrastructure as well as means of transportation may cause multiple adverse effects on human life and the natural and physical environment. Concept of Sustainable transport came into existence to find a balance that will enable people's transportation needs to be met without causing harm or depletion of natural and physical environment and resources (Asian Development Bank [ADB], 2010, p. 4).

Different agencies have come up with different definitions and explanations of sustainable transport based on how they see it. Emphasis has been given on accessibility, safety, environmental friendly, and affordability. For example, Sustainable transport Initiative (ADB, 2010, p.4) explains sustainable transport system as the transport system that promotes economy, regional development, and equity through affordable fare and minimum harm to environment.

> Sustainable transport supports a competitive economy and balanced regional development, and promotes equity, including gender equity, within and between successive generations. Environmentally, a sustainable transport system minimizes the use of land and emissions, waste, and noise. It uses renewable resources at or below their rates of generation, uses nonrenewable resources at or below the rates of development of renewable substitutes, and limits emissions and waste within the planet's ability to absorb them. In terms of cost, a sustainable transport system is one that is affordable and operates efficiently, taking into account requirements for investment in capacity and the need for maintenance. A sustainable transport system as one that is accessible, safe, environment-friendly, and affordable. This incorporates multiple overlapping dimension of sustainability (ADB, 2010, p.4).

Canadian Center for Sustainable Transportation's explanation of sustainable transport system is more or less similar to that of Sustainable Transport Initiative. It also emphasizes that sustainable transport should promote equity within and between generations, limit emissions and use of non-renewable resources, and should be

affordable and efficient. Canadian Center for Sustainable Transportation explains sustainable transportation,

- allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations;
- is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; and
- limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise. (TCST, 2005)

Market Access

"Markets are of fundamental importance in the livelihood strategy of most rural households, rich and poor alike" (International Fund for Agricultural Development [IFAD], 2003, p. 3). Rural population, as producers, buy their agricultural inputs and sell their products in market and they, as consumers, spend their income from the sale of crops or form their non-agricultural activities, to buy their food requirements and other consumption goods (IFAD, 2003, p.3). Usually in rural areas, almost all the households are both producers and consumers as they sell their agricultural produce and buy their food and other necessary items at different times of year. According to IFAD (2003), rural population in many parts of the world are unable to improve their living standards because they face serious difficulties in accessing markets to meet their need as both producers and consumers (p. 3). Remote location, geographical constraints, low population densities and high transportation cost and time present physical difficulties in accessing market. Along this limited access to market, the rural population is often constrained by their lack of understanding of market conditions, their limited business,

and negotiation skills, and their lack of an organization. Due to these conditions, they lack the bargaining power required to interact on equal terms with other, larger and stronger market intermediaries (IFAD, 2003, p. 3). This often leads to low profit margin and exploitation from market intermediaries. They are often obliged to sell their produce in low price and buy agricultural inputs and other necessities in high price. To solve this problem, easier access and strong links to markets for rural population are essential. Better access and links to markets enables rural farmers to have more bargaining power with intermediaries or even bypass them and can reliably sell more produce at higher prices making more profit (IFAD, 2013). Higher profit encourages farmers to invest in their own businesses and increase the quantity, quality and diversity of the goods they produce (IFAD, 2013). Moreover, they can gradually save and accumulate assets, increasing not only their prosperity, but also their capacity to deal with risks and shocks (Aliguma, Magala, & Lwasa, 2007).

Rural road networks challenges in hilly and mountainous regions of Nepal

For the economic development and prosperity of rural population, road network construction and upgrading in the rural areas of Nepal is one of the major concerns of the country's government. In the absence of roads or their improper condition, access to goods and services is hampered, resulting in less economic opportunities and lower quality of life of rural residents (Shrestha, Benta, Lopes & Lopes, 2014, p. 43). However, due to financial and technical constraints, it is difficult to construct road networks in hilly and mountains regions of Nepal. Along with technical issues resulting from geographical constraints, a shortage of construction machinery construction of roads in hilly and

mountainous regions of Nepal can be an expensive and slow process. There are many cases of landslides during the construction and even after completion of hilly road constructions as soon as wet season[3] starts. In Nepal, technical constraints are more difficult to overcome due to its unique topography (Shrestha et al., 2014, p. 43). Moreover, areas with low population densities are often of less priority to Nepalese government. Even in the rural areas where they are road networks, they are mostly earthen. An earthen road surface is usually natural soil with little or no gravel or permanent surfacing (Shrestha et al., 2014, p. 43). Due to their surface conditions, many rural roads are not functional throughout the year and remain closed during wet seasons in Nepal.

In Nepal, bridges are crucial part of road networks in the hilly and mountainous areas as these areas feature many deep gorges and rivers. Construction and maintenance of these bridges are expensive task for government as these bridges suffer intense wear both from natural conditions like seasonal rainfall and earthquakes and from frequent vehicle overloading (Woof, 2014).

Food security in Nepal

Food security prevails when all people at all times have access to sufficient, safe and nutritious food to maintain a healthy and active life (Food and Agriculture Organization of United Nations, 2003). Basically, food availability, food access and food use are considered the three pillars of food security. Nepal is predominantly an agrarian country. Even though agriculture is the main livelihoods base for 81% of its rural population, food insecurity is pervasive. According to Word Food Programme (2014),

[3] Wet seasons: The monsoon season, which usually goes from June to October in Nepal.

41% of the population is under-nourished while 30 out of 75 districts are reported to be food insecure in Nepal. Around 16.4 % of the population was at risk of severe food insecurity in 2009 (World Food Programme [WFP], 2009). Asian Development Bank (2014) reported that agriculture was largely based on low value cereals with produced under subsistence agriculture with a mere 13% of output traded in markets. Food insecurity persists mostly in the mountainous and the hilly regions of Nepal. World Food Programme (2009) estimated that out of 75 districts, 40 were food deficit in 2008/09 and among them, 13 districts were in hills, and mountains were most severe. Agriculture in Nepal, especially in hilly and mountain region, was dominated by the small-scale farmers where average land holding size is about 0.5 hectare (Karki & Karki, 2011). Small landholding and lack of proper access to market have made many subsistence farmers unable to sustain for whole year with their own produce and are bound to suffer from food and nutritional insecurity. Moreover, political uncertainly, and the poor state of Nepal's transportation infrastructure have constrained growth in agricultural sector keeping transportation costs high, and making farmers' involvement in markets expensive (Basnett et al., 2014).

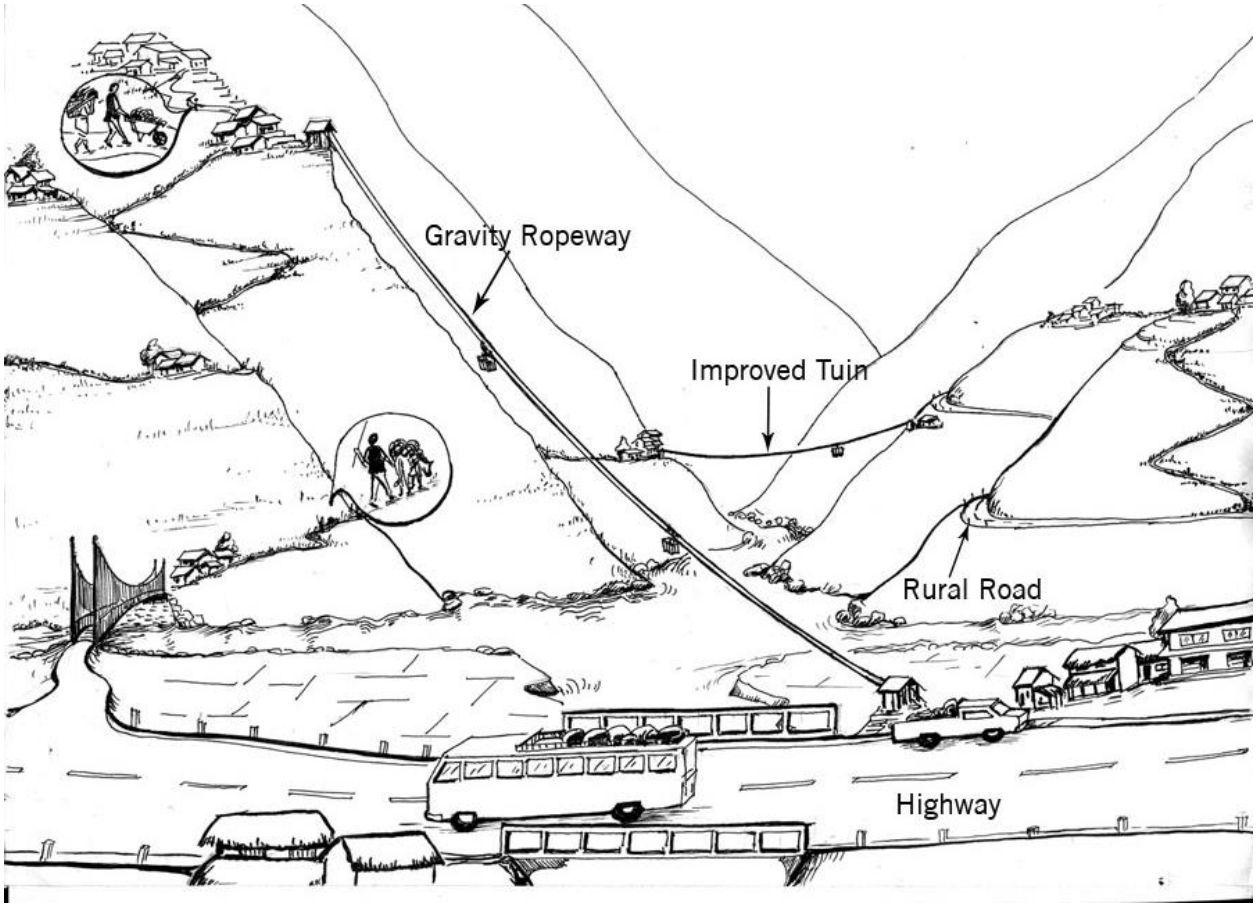
Chapter IV

GRAVITY GOODS ROPEWAYS

History of Gravity Goods Ropeways in Nepal:

The ropeway is one of the oldest means of transportation system. This technology has been use for goods and human transportation since early 250 B.C. However, modern ropeways started in Europe, particularly during early 1600s (Gyawali, Dixit, & Upadhya, 2004). The first ropeway in Nepal was constructed in 1924 to carry stones from the mines for the construction of palaces. After that, various motorized ropeways have been constructed in various parts of Nepal. Gravity goods ropeway have been used for timber and minerals transportation in various European countries specially Switzerland (Gyawali et al., 2004). They have been operational at many places in mountainous regions of India for transportation of local produces to markets and road head. However, first gravity goods ropeway had been constructed only during 1998 by a micro-hydro power plant. The fatal accident caused due to the operation negligence resulted in dismissal of that project and it's no longer in operation. The first successful operation of Gravity goods ropeway started in early 2000s that was used for apple transportation directly from the orchards to the trailheads (Singh, 2010, p. 1). After its success, more studies were conducted to increase its safety and technical efficiency in accordance to the terrains and needs of Nepal.

Figure 6. Niche of ropeway on overall rural transportation scenario



Source: DoLIDAR, 2010.

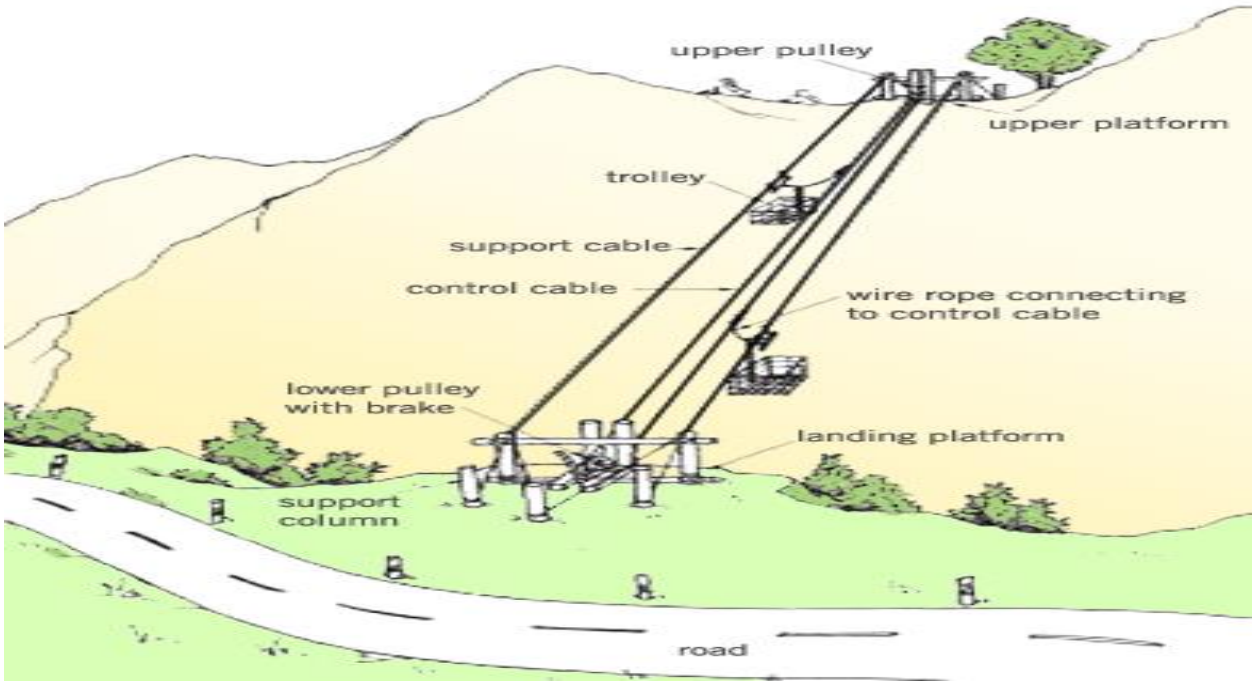
"The Local Infrastructure Development Policy 2061 and Agriculture and Local Level Road Implementation Guidelines 2063 devised by Government of Nepal Ministry of Local Development has recognized gravity goods ropeway as one of the local means of access and is categorized under class "E" " (Department of Local Infrastructure Development and Agriculture Roads [DoLIDAR], 2010, p. v). Even though the government has recognized the importance of gravity goods ropeway, still government of Nepal has not formulated any specific policy for the sustainable operation and up scaling of gravity goods ropeway. Department of Local Infrastructure Development and

Agriculture Roads (DoLIDAR) the technical department of Ministry of Federal Affairs and Local Development, Government of Nepal, which oversees all the infrastructure development works at the local level, has recommended central government for formulating policy regarding gravity goods ropeway in Nepal (DoLIDAR, 2010).

DoLIDAR has also started to replicate the technology in Nepal. To support and sustain the wider replication of the technology, Gravity Goods Ropeway technology has been included in the curriculum of civil engineering in Nepal. The colleges have started running elective class on it for Bachelor of Civil Engineering final year students (Singh, 2013).

Gravity Goods Ropeway

Figure 7. Gravity goods ropeway



Source: DoLIDAR, 2010.

Gravity goods ropeway is non-motorized means of transportation that uses earth's gravity to transport goods. They are short- haul ropeways created for the steepest section of the hills.

It works solely on gravitational force without using fossil fuels, electricity, or any other external power. It works two ways- while one carrier is transporting agricultural produce or goods downhill, its weight pull the other carrier up the hill. However, the carrier going uphill should only have one third of the weight of the goods coming downhill. For instance: if the weight of goods coming downhill is 90 kg, goods going uphill must not exceed 30kg (one third). The weight ratio of downward to upward moving load should be 3:1 for this system to work properly (DoLIDAR, 2010). A wooden drum brake, with bearing and bracket, controls the speed of trolleys.

Benefits of Gravity Goods Ropeways

Gravity goods ropeway has strong potential in hills and mountainous region of Nepal to increase the accessibility of rural population to their nearest market. The general benefits of the gravity goods ropes are as follows:

- **Cost effectiveness:** It is very efficient and cost effective means of transportation. Its construction cost is negligible in compared to other conventional means of transport. DoLIDAR(2010) estimates the approximate cost of the gravity ropeway to be NPR 1,400,000 ($ 13461.53)[4] whereas per kilometer construction cost of a four meter wide earthen road in the hills is approximately NPR 3,000,000($ 28,846.15).

[4] $1= NPR 104 (Central Bank of Nepal, December 24, 2015)

- **Time saving:** It is the fast means to transport goods in hilly and mountainous region. As the rope is suspended in the air, alignment is straight and short. Goods can be transported through gravity ropeway within few minutes. It saves time and energy of villagers and reduces drudgery. The time that used to be spent on carrying agricultural produce to market, now can be utilized for other income generating activities and family care.
- **Short route:** In case of roads and railways, alignments are usually winding to acquire required gradient which makes the route longer and costlier (DoLIDAR, 2010). Since, the rope of gravity goods ropeway is suspended in the air, the alignment is straight and it results in a short route.
- **Energy efficient:** It does not required electricity, fossil fuel or any other external power to operate as it operates solely on the earth's gravity. This is very important for a country like Nepal that needs to import all of its required fossil fuels.
- **Environment friendly**: As it a non-motorized transport system, it does not pollute environment by emission of carbon dioxide or any other gases. It causes neither air nor sound pollution. If proper mitigation measure is taken during its construction, there will be negligible impact on the environment and the ecological system during its construction and operation. Therefore, it does not disturb ambient environment and the ecology. In comparison to other transportation project like road and motorable bridge, it has negligible adverse impact to the surrounding environment due to its less occupancy, as it required only around 55 square meters for each station (KC, 2009, p. 2). It also does not

require cuts and fills[5] as in case of building motorable roads and the alignments are worked out very carefully in order to avoid the clearance of trees and vegetation. The Initial Environmental Examination (IEE)/Environmental Impact Assessment (EIA)[6] for gravity ropeway installation is not required as it is a low cost technology (DoLIDAR, 2010).

- **Simple technology:** It employs very simple but robust technology which can be operated and maintained by local communities. Local engineers and technicians can design and construct this system without any assistance of foreign expert.
- **Nominal operation and maintenance cost:** The community does not need to spend for any fuel or highly skilled work force for its operation and maintenance. The cost of operation and maintenance is minimal.
- **Market Access:** Most importantly, it increases access to market for rural communities. It can play a major role in poverty reduction by improving the economic condition of the villagers.
- **Income opportunities:** It may create various income generating opportunities to the people in their own village. The two operators get employment in their own village. The two operators can operate this system throughout the year.

[5] In earthmoving, cut and fill is the process of constructing a railway, road or canal whereby the amount of material from cuts roughly matches the amount of fill needed to make nearby embankments, so minimizing the amount of construction labor.

[6] EIA: Detailed study based on environmental assessment (EA) to determine the type and level of effects an existing facility is having, or a proposed project would have, on its natural environment.

Limitations of Gravity Goods Ropeway

In spite of its several benefits, gravity goods ropeway has some limitations like all other technologies.

- **Span:** According to DoLIDAR (2010), "when the span exceeds over 1500 meters, the tension due to the self load of the wire rope increases as it is suspended between two points only. In addition, the energy loss due to the friction will be more in longer span ropeways. Therefore, for safety and efficiency, the span of gravity goods ropeway is recommended to the limit of 1500 meters only" (p.6).
- **Slope:** According to Practical Action Nepal, gravity ropeway cannot be operated in a gentle slope. Their experience shows that it requires at least 15 degrees of slope to operate smoothly. "The upper limit can go as high as 40 degree if proper loading ratio is maintained and an arrangement to prevent derailing of the trolleys from the track ropes is placed. However, according to the current practice, preferable slope for gravity ropeway is form 20 to 30 degree" (DoLIDAR, 2010, p. 6).
- **Hauling Capacity:** Like other means of transportation such as trucks, it cannot carry heavy loads at the same time. It is mainly used for transporting agricultural produce from village to nearby road or trail and three times less amount of goods from road to village at the top.
- **Loading ratio:** The operators needs to be fully trained to make proper load balance between two trolleys and they should be very careful about the weight of the load at both stations while operating the gravity goods ropeways (DoLIDAR, 2010). Measuring/weighing equipment is essential to weigh the load and they

should functional every time they operate gravity goods ropeways. They should also regularly service the brakes and lubricate the pulleys and wire ropes for smooth operation and longevity of the system.

- **Safety issue:** The two operators should be very careful during the operation as well as during the time while the system is not in operation. They should be careful about their own safety and other villagers specially the children. Effective communication between upper and lower station operators is essential for preventing accidents. They should strictly restrict other people to be near the system at any time. Station should be properly locked when they are not present. Any negligence could result in fatal accident.
- **Goods only:** There are inevitable limitations of gravity ropeways to fully address the transportation needs of Nepalese hilly and mountain communities. They only facilitate goods transport but not the movement of people.

Chapter V

CASE STUDY OF THE HIKLUNG VILLAGE

Introduction of Gravity Goods Ropeway in *Hiklung* village

The European Union, Rotary Club and Foundation Jose Entrecanales Ibarra co-funded the Gravity Goods Ropeway in *Hiklung* Village under the joint collaboration and technical support of Practical Action Nepal and Nepal's Center for Community Development and Research (CCODER) Nepal. The total cost of construct was NPR. 1,195,534 ($ 11,495.51)[7]. Out of total NPR. 1,195,534 ($ 11,495.51), NPR. 9,59,534 ($ 9226.28) was co-funded by above mentioned donors and community contributed as labor support worth NPR. 236,000 ($ 2,269.23). The construction of Hiklung Gravity Ropeway Project was completed on March, 2010. The total length of the ropeway is 612 meters (0.38 miles). Estimated life span of the wire rope is 15 years. Idea of constructing Gravity Goods Ropeway in *Hiklung* village was initiated by Nepal Chepang Association. After recognizing the advantages of Gravity Goods Ropeway, officials of Nepal Chepang Association proposed Practical Action Nepal for feasibility study of this technology in Hiklung Village. Realizing the need of Gravity Goods Ropeway in *Hiklung* village, Practical Action Nepal conducted the site survey in the area. Their site survey revealed that construction of Gravity Goods Ropeway was technically feasible and socially, economically and environmental viable in that area. As, there needs to be organization registered under government agency, the villagers formed an agricultural cooperative under the name *Jaldevi Chepang* Agricultural Cooperative Limited.

[7] $1= NPR 104 (Central Bank of Nepal, December 24, 2015)

Figure 8. Supporting pillar with name board

After the completion of the project, they trained the local two operators while they were also testing the system. The operators were nominated by the cooperative. Practical Action asked the cooperative to select promising local as operators who does not plan to leave village in near future. During the test operation, engineers were able to find the actual loading ratio for this particular gravity ropeway. They recommended the downward moving load to be 90 kilograms and the upward moving load to be 40 kilograms. The operators were trained to maintain this weight ratio. The loading ratio should be well maintained so that the trolleys approach the respective stations with minimum speed but will not stop in between. If the loading ratio is not properly maintained, the trolley moving downward may approach with excessive speed or the trolleys do not move with required speed. Excessive speed may have a ramming impact

at the bottom station and may risk the safety of the haulage rope and other accessories and even endanger the life of the operator. If the trolleys do not move with required speed, the operator need to manually pull of the hauling rope (DoLIDAR, 2010). Weighing equipment was also installed on the both upper and bottom stations.

After the successful test operation of the gravity ropeway, the Hiklung Gravity Ropeway was handed over to the Jaldevi Chepang Agricultural Cooperative on April 4, 2010.

Operation of *Hiklung* Gravity Goods Ropeway

The operation of the Hiklung Gravity Goods Ropeway is managed by *Jaldevi Chepang* Agricultural Cooperative Limited. They have hired the two local operators trained by Practical Action Nepal. These two trained operators control the whole system. They are stationed in upper and lower stations. Since, the two stations are not visible by naked eyes; they initially used cell phones for effective communication and operation of the system. Effective communication between upper and lower station is essential for preventing accidents. However, due to the high tariff, they stopped using cell phones. Now, they hit the rope to transmit the signal. This method has been effective so far over there. When the rope is hit once, it means the loads are ready above. When the operator at the upper station hits rope twice the load comes down. Same response is given from the bottom station after the goods are unloaded. The bottom station operators control the speed of the trolley with the help of brake installed in the bottom station. Due to this, the bottom operator needs to be extra careful. The bottom station operator is also responsible for monitoring the wear and tear of brake shoes. The brake shoes are the only element for

decelerating the sliding down of the loaded trolley from upper station to lower station. In this ropeway as well, there was a set of spare brake shoes ready available in case of emergency.

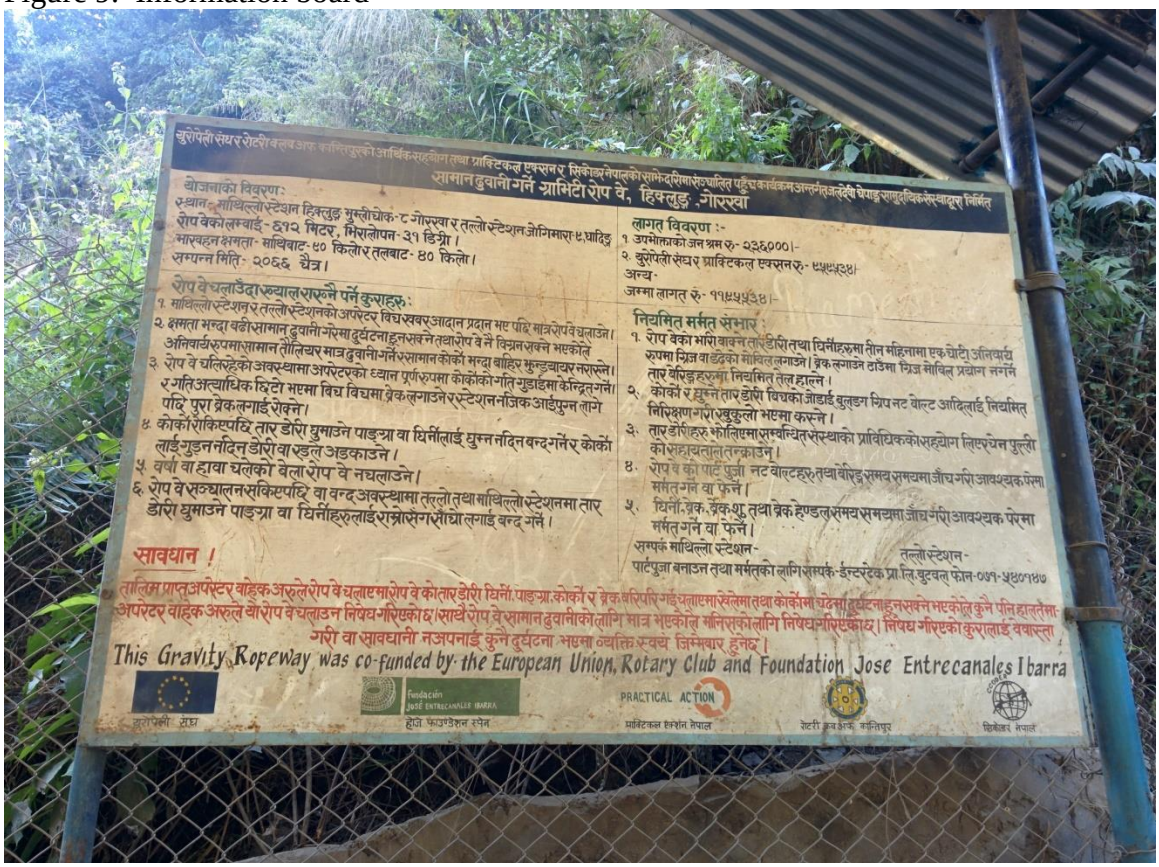
Before the lower station operator gets ready to walk for his job, both operators plan for their day's work. They discuss about the nature of the load for that day and the hours they will be working. This meeting helps them to plan the activities like transferring, storing, trading, and marketing of the goods. Another helper who helps him to load and unload the load accompanies the operator at the bottom station. This helper is responsible for managing and storing of goods before they are transferred to vehicles that take their agricultural produce to nearby market. Sometime, the traders themselves come to pick the produce at the bottom station.

The price of the agricultural produce is determined by the cooperative with regard to market conditions. If the cooperative gets proper price, they may sell their produce to the traders from the bottom station. Otherwise, they themselves take the collected produce to the nearby market for better price. Working hours of the operators and helpers depend on the amount of agricultural produce collected for that very day.

Even though the ropeway can be operated throughout the year, weather conditions like visibility, wind, rain, storm, fog etc., and the amount of agricultural produce collected restrict its operation. Due to the safety reason, they never operate ropeway during rainfalls, strong wind, and very poor visibility. According to the operators, there has never been any accident in this ropeway as they follow the proper guidelines given to them. There is a notice board in each station that contains general information about ropeway, span and capacity of ropeway; points to remember(dos and don'ts) while

operating a ropeway; cautions and safety precautions; warning and danger; minor repair and maintenance tips; contact details of manufactures, repair and maintenance service providers; and the ways to deal with emergencies. The information has been written in simple Nepali language so that non-professional can understand them easily.

Figure 9. Information board



The operators are very careful about the weight and size of the load. Each station has weighing machine and each time they weigh the load properly before loading to the trolleys. For this ropeway, the recommended downward moving load is 90 kilograms and the upward moving load is 40 kilograms. As I have mentioned earlier, the load should be as recommended for smooth operations and prevention of any mechanical damage to the

ropeway. Sometimes, the weight of agricultural produce going downward or of the load coming upward may fall short. In this situation, they use rocks to balance the weight.

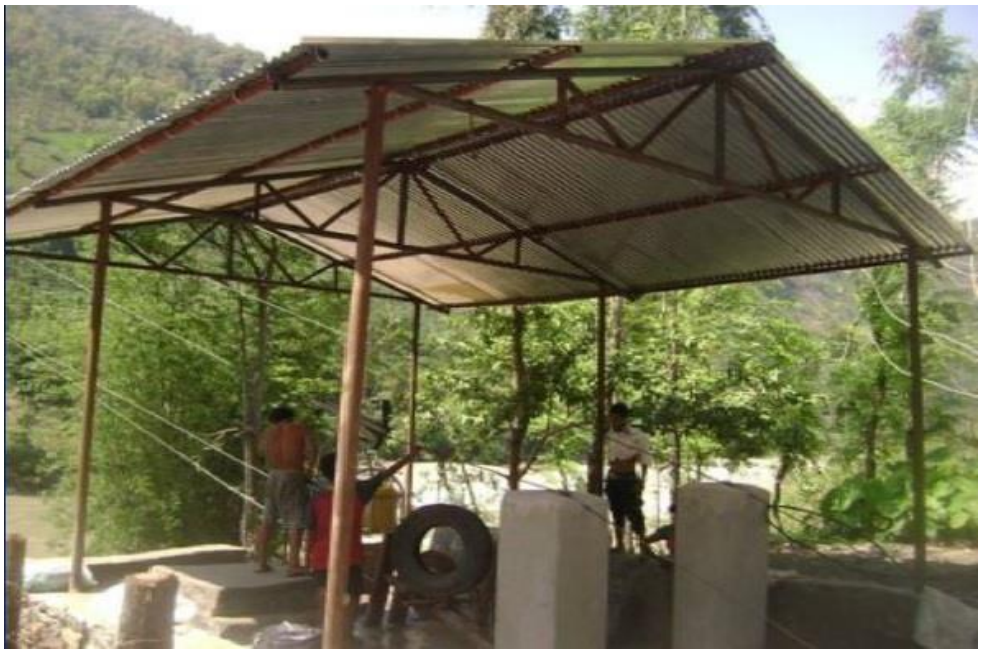
Figure 10. Brake at lower station

The operators are also responsible for regular maintenance and minor repair. They regularly lubricate the rope to avoid deterioration and inspect the wire ropes for any abnormal signs. Along with it, they periodically inspect the sheave[8]. They have been trained to figure out the wear and tear of the wire ropes and the sheaves. In case of any suspicion, they immediately suspend the operation of ropeway and contact the concerned management committee. Then, the management committee contacts the repair and maintenance service provider. This maintenance service provider periodically inspects

[8] A sheave is a pulley with a grooved wheel for holding a belt, wire rope, or rope. The grooved wheel spins inside the frame of the sheave.

the wire ropes and the sheaves as well. Another major component of the gravity ropeway is a brake. They regular check the brake shoes and can repair themselves when needed. As mentioned earlier, they have a set of spare brake shoes readily available in case of emergency. Apart from this, they periodically check the whole system and repair minor wear and tear by themselves.

Figure 11: Bottom Station



Agricultural cooperative collects NPR 0.5 per kilogram for both up and downwards load. The operator at the upper station keeps the record of the daily transaction in the ropeway logbook. At the close of the business that day, the cooperative's marketing members make payment to the farmer deducting the per kilogram charges. The collected amount is used to pay wages to operators and helpers and pay for regular maintenance of the ropeway mechanisms. Remaining amount is saved for future replacement of parts and wire ropes.

The practice of collecting user fees has ensured a revolving maintenance fund for long-term sustainability of the ropeway project.

Market Access

Due to the geographical constraints and the lack of road and bridge, people of *Hiklung* village faced serious difficulties in accessing markets to meet their needs as both producers and consumers. In spite of being so close to a highway, no road network connects this village to the highway, as it is located in the steep hilltop. They had to walk around 2 hours on the steep foot trail with agriculture produce on their back if they wanted to sell their produce in nearby market. Moreover, they have to cross a fast flowing river without any modern bridge to reach the highway on other side. The lack of road had isolated the farmers from the market, stretched the travel duration, and deteriorated the quality by the time their produce reached the final market. In the past, they relied on subsistence agriculture and cultivated crops and vegetables for their personal consumption only. Incomes from the cash crops were negligible. There were very few incentives for cultivation of vegetables for purpose of selling in the market, as they had to travel a long distance and they had no control over the price. As the vegetables and other agricultural produce are perishable, they had no option other than selling them to local traders accepting whatever price they offer or sell them to individual buyers staying in the market a whole day instead of taking them back.

The situation has changes after the installation of Gravity Goods Ropeway in their village. Even though, they themselves could not travel in this ropeway, they can now easily send their produce to the market and goods from the market to their village in

negligible amount of time. They no longer have to carry heavy loads on their back and walk in the steep mountain path to take their produce to the market. The travel time of agricultural produce has been reduced from 2 hours to 2 minutes. They now have better access to the market than before. They no longer face difficulties in accessing their access to the markets to meet their need as both producers and consumers. They do not need to carry loads on their back from market and to market any more. The ropeway takes their agriculture produce from village to highway and brings daily consumer goods from highway to their village. Villagers were happy that they are now relieved from walking uphill in the steep path carrying heavy loads on their back while bringing goods from the market.

Figure 12. Upper Station

Changes in agricultural patterns and condition of food security

In the past, the villagers used to take their agricultural produce to the market individually. Whenever they had any surplus agricultural produce, they would immediately take them to the market and sell them either to traders or stay for a whole day in the market until they were able to sell them completely. Moreover, they used to

buy needed agricultural input like chemical fertilizers, seeds, tools etc. individually. However, they formed *Jaldevi Chepang* Agricultural Cooperative Limited to have collective benefit from farming and it was a necessary condition for initiating a ropeway project in their village as well. The donor agency requires a community based organization with their own constitution to handover the ropeway project to local community.

The Gravity Goods Ropeway created better access to the market for the people of *Hiklung* Village. Formation of Agriculture Cooperative and presence of Gravity Goods Ropeway have been beneficial for the villagers. Their agricultural patterns have changed. They have been able to get maximum price for their produce and make more profit through collective effort. Cooperative manages the collection and sell of their agricultural produce. The cooperative has increased their bargaining power with the traders and facilitated the resource sharing among the farmers. They communicate with the market representative through cell phones to get immediate update of the market rate for their agricultural produce. Once they are able to get best value for their produce, they send their produce to the market or to the traders. This has discouraged the role of intermediaries and has created direct link to the market. They are able to make more profit by sending their fresh produce in the market when they get maximum price for their agricultural produce. Now, they can wait to harvest their vegetables until they get maximum price. However, since waiting could affect the quality and they do not have cold storage facilities, they usually wait only until the time that does not affect the quality of vegetables.

The average production of the vegetable was 600-800 kilograms from 1 Ropani(0.05 Ha) in 1 year. Individual farmers harvested different quantity of vegetables in a day. Cooperative collects the harvested vegetables from the individual farmers and keeps record of their harvest quantity for that very day under their individual account. According to the villagers, they harvest highest quantity of the vegetables during rainy season and lowest quantity during winter season due to the lack of sufficient water for irrigation. According to the villagers, the quantity of vegetable farming has drastically increased after the installation of ropeway in the village. In the past, they were not motivated for investing their time and resources in vegetable farming due to the lack of proper access to market. IFAD (2013) states that higher profit encourages farmers to invest in their own businesses and increase the quantity, quality, and diversity of the goods they produce. In case of *Hiklung* village as well, access to the market has increased their income. Some farmers have also started off-seasonal vegetables using plastic green house. They cultivate tomatoes in those plastic green houses. Through their agricultural cooperative, the villagers now get their agricultural inputs like seeds, fertilizers, and tools in subsidized rate from the government or in lower prices than the market.

With the increase in the market access and the income, the villagers have been able to access variety of foods that are not produced or available in their own village. According to one of the respondents, meat consumption has increased, as they are now able to afford and have access to broiler chicken meat from market. In the past, they used to eat their home reared chicken and other animals only during the festivals or the special occasions. Consumption of rice has also increased in the households and it has started to be the part of their daily diet. In the past, they ate maize and millet as staple food. Their

consumption of the vegetables has also increased with increased in the production. The junk foods like biscuits and instant noodles have also started being the part of their daily diet. Specially, the children are attracted towards these junk foods due to the taste enhancer included in the packet of instant noodles.

Figure 13. Collection of tomatoes at bottom station

Socio-economic impacts

After the introduction of Gravity Goods Ropeway in Hiklung Village, their activities have been more organized in terms of farming, harvesting and marketing of their agricultural produce especially vegetable through their membership in agricultural cooperative. Agricultural cooperative has encouraged villagers to rear improved breed of animals specially pigs. The villagers had started growing vegetables and other crops on

their previously uncultivated land as well. The time that used to be spent on carrying the agricultural produce to the market and bringing the necessary goods from the market, now can be utilized on farming, family care, and other income generating activities. Villagers were happy that they are now relieved from walking uphill and downhill in the steep path carrying heavy loads on their back for 2 hours while taking their agriculture produce to the market and bringing the consumer goods from the market. It used to take them the whole day to take the agricultural produce to the market and get back home. As the parents do not have to travel long distance, the children can devote more their time on study and go to school regularly without concerning about their household works.

It has caused positive impact on their health as well. They have been relieved from back pain. According to the President of the agriculture cooperative, "operation of Gravity Goods Ropeway have improved health conditions through a reduction in heavy load carrying" (Parja, 2015). Particularly the women and the children of households whose male members have migrated to cities in Nepal or to the Middle East as laborers are benefitted much in terms of improved health conditions. In absence of the male members, women need to undertake both domestic and income generating activities.

Villagers have developed savings habit. They have established savings and credit cooperative in their village as a sister organization of their agricultural cooperative. Members of the cooperative save NPR 100 ($ 0.96) each month. Members can get low interest loans from this savings and credit cooperative in the time of need. Members usually borrow money for buying agricultural inputs and for paying expenses required for the foreign employment.

Increased purchasing power has resulted in improvements in the quality of life and better access to food. They have been able to purchase a better quality of food grains, pay for education and healthcare, and invest in other income generating activities.

Community development projects

Agricultural cooperative collects NPR 100 ($ 0.96) each month from its members as membership fee. The collected amount is used to cover the administrative expenses, trainings, and community development projects. Agricultural cooperative has successfully completed a drinking water project in their village. Each household has water tap in front of their own home. They also use surplus water to irrigate their farmland. Access to drinking water at their doorsteps has eased their lives and availability of extra water for irrigation has helped them to achieve maximum agricultural yields.

The community members have developed management skills and transferable skills like bookkeeping. The management and other skills, which they have learned from training provided by the funding organizations of ropeway, have been beneficial for them to initial their own community development activities.

Examples from other ropeways sites

Pharityal(2006) had studied the gravity ropeways installed in Uttaranchal of India. Uttaranchal is a state in the northern part of India and its geographical features are similar to that of hilly and mountainous regions of Nepal. These ropeways has been installed by The Government of India under the alternative marketing system component of 'Integrated Development of Horticulture in Tribal/Hilly areas' in 2000 (p. 13). According to the researcher, he received mixed responses from the different sites. He found that in

one of the research sites the villagers made negligible use of the four spans of installed ropeway. He believes distance of ropeway from village, incompetence of management committee to set proper operating system and high user fee could be the reason and behind this minimal use. However, in Gyandhura Village, the community was taking maximum benefit from gravity ropeways. The ropeway transported vegetables, construction materials, and food grains. It has decreased the transportation cost to half. Prior to ropeway, manual transportation of 50 kilogram from the village to the road head costed IRs. 10 and through ropeways it costs IRs. 5 (p. 15). The transport time was reduced from 1 hour to 2 minutes. Ropeways had encouraged the production of vegetables and floriculture. Researcher found some challenges such as bulk transportation of goods to a village from the lower terminal was not very feasible and some marginalized farmers preferred to carry their produce themselves to save money due to the user chargers.

Banskota, Sharma, Malla & Bijukuchhay (2007) had conducted cost benefit analysis of gravity ropeways in *Janaguan* and *Godavari* villages of Nepal. The authors collected data required for their calculation during the feasibility study of these proposed sites. From Janaguan, it takes about three hours to reach road head carrying a 50 kg load and the porters charge NPR. 1.75 per kg. Similarly, from Godavari, it takes one and half-hours to reach nearest market carrying a 50 kg load and porters charge NPR. 65 per trip. The authors have based their calculation on the assumption that a ropeway will decrease the transport time to less than 10 minutes at both sites and the transport cost to NPR. 0.18 per trip at Janagaun and NPR. 0.26 per trip at Godavari. They assume that these estimated

minimum user charge would be able to meet the full annual operating and maintenance costs as well as the replacement cost and would make them financially sustainable.

Table 2. Summary results of an economic cost-benefit analysis of gravity ropeways in Janagaun and Chapakharak villages

Scenarios	PRESENT VALUE (NRs)		NPV @ 12% discount rate (NRs/km)	EIRR	BC ratio	Switching Values*	
	Cost	Benefit				% Increase in cost**	% Decrease in benefits**
Base Results							
• Janagaun	1,004,263	3,298,765	2,294,502	55.89%	3.28	228%	-70%
• Godavari#	894,918	1,584,573	689,655	27.35%	1.77	77%	-44%
Sensitivity Results							
Total project cost increase by 20%							
• Jangaun	1,205,116	3,298,765	2,093,649	45.76%	2.74	174%	-63%
• Godavari#	1,073,902	1,584,573	510,671	21.72%	1.48	48%	-32%
Total project benefits decrease by 20%							
• Jangaun	1,004,263	2,639,012	1,634,749	43.73%	2.63	163%	-62%
• Godavari#	894,918	1,267,658	372,740	20.57%	1.42	42%	-29%
Total cost increase and benefits decrease by 20% each							
• Jangaun	1,205,116	2,639,012	1,433,896	35.57%	2.19	119%	-54%
• Godavari#	1,073,902	1,267,658	193,756	15.84%	1.18	18%	-15%

* Switching value to bring EIRR to 12% (i.e., discount rate)
** Negative values imply decrease in cost/benefits
# Preliminary result from cost-benefit analysis

Source: Enchancing Market Access And livelihood Options in the Himalayan Region through Gravity Ropeways (Banskota, Sharma, Malla & Bijukuchhay, 2007,p.18)

As shown in the table above, the results indicate that a ropeway at both sites is beneficial on economic ground. The table above shows the cost benefit ratio of both ropeways showing their estimated economic internal rate of return (EIRR), net present value (NPV) per km, and the benefit-cost (BC) ratio along with a switching values to understand the sensitivity of the results under different scenarios (Banskota et al., 2007).

CHAPTER VI

DISCUSSION

Even though there are several benefits of gravity goods ropeway to the local community, we cannot totally neglect its adverse impact. There could be several environmental impacts of gravity goods ropeways —such as loss of agricultural land, encroachment of the local forest, land dispute, proximity electric transmission line, soil erosion, landslides, and disturbance to the wildlife and their habitat. Likewise, the possible negative social impacts are loss of jobs of local porters, social conflict on benefit sharing and change in land use and land values (DoLIDAR, 2010). The Girnar Ropeway project in Gujarat could be taken as an example. Initially the project was not approved by government due its possible impact on Long-billed vulture (one of the 20 most endangered birds in the world). This project was aaproved only after some technical changes to eliminate its adverse effect on the bird (Sarkar, 2011).

DoLIDAR has come up with recommendation for mitigating these possible negative impacts. They have recommended for the involvement and the participation of local communities throughout the project cycle. According to their report, every gravity goods ropeway project should conduct an environment impact assessment to identify the likelihood of any adverse impact due to the installation/operation, and adequate and satisfactory mitigation measure should be taken.

Despite the several known benefits of gravity goods ropeways, questions can be raised about its relevance in the 21st century. Local people, planners, and even policymakers who are unaware of its benefits might consider gravity goods ropeways as an outdated and an inferior technology in the age of modern motorized ropeways and

other modes of transportation. To underscore this concern, Nepal's transportation policy is heavily inclined towards development and more than 80% of the total outlay in the transportation sector was directed to the road development in 2010 (Shrestha, Benta, Lopes & Lopes, 2014).

A local community might question why outsiders are trying to withhold better modes of transportation and make them adopt inferior technology like gravity goods ropeways. Policy makers and government stakeholders might think why people of Nepal should depend on inferior technology when there has been lots of advancement in modern modes of transportation (Singh, 2010, p.2). City dwellers and urban professionals who are non-users of the technology or who might have never closely witnessed the rural Nepal and its topographical challenges usually make these comments. Before doing research on this subject, I too had similar perception as them when I first came to know about this technology. I had limited knowledge of its benefits to the rural population living in the remote mountains. To understand its importance, firstly one needs to know about the geography of Nepal and the rural settlements. There is no doubt that there is no alternative to roads for increasing accessibility of the rural population to the market centers. However, there are many scattered settlements in hilltop of Nepal and it might take several decades for Nepalese government to connect these places with all-weather road networks. Many rural roads are only accessible during the dry seasons. In such scenario, gravity goods ropeways can be a viable means to transport goods from the hilltops that are not connected with road networks and vice versa. In the hilltops that are already connected with the road networks, it can serve as an alternate means during the monsoon season as well.

According to Gyawali et al. (2004), the ropeways are most appropriate technology for a mountainous country like Nepal. They have cited the examples of another mountainous and landlocked country, Switzerland that has made tremendous development in the ropeway technology. Their study has revealed that the aerial ropeways are even three times cheaper than the equivalent road construction in Nepal because of its geographical condition. According to DoLIDAR(2010), the approximate total cost of the gravity ropeway construction is NPR 1,400,000 ($ 13461.53)[9] whereas per kilometer construction cost of a four meter wide earthen road in the hills is approximately NPR 3,000,000($ 28,846.15).

Despite the huge potential, the policymakers of Nepal have given ropeway technology less importance. They consider it as a temporary alternative only before the areas are connected with road networks. Moreover, they think it is not justifiable to spend the scare resources on such short-term projects (Singh, 2010, p. 3). Singh (2010) argues that ropeway meant to neither compete with roads nor be presented as a short-term relief. It has the potential to reach and serve remote places before a road network reach their villages. Unlike mountain road that needs costly periodic maintenance, the maintenance cost of Gravity goods ropeway is negligible. With negligible maintenance cost, gravity goods ropeway's major component wire rope last for 15 years and the replacement cost of this wire rope is also negligible in comparison to a mountain road maintenance cost.

Gyawali et al. (2004) highlight that in many cases the local community fear that the installation of the ropeways in their communities will affect future chances of road construction in their village. Moreover, government will not prioritize their area for road construction if they already have ropeways in their community. Same ideology might be

[9] $1= NPR 104 (Central Bank of Nepal, December 24, 2015)

a hindrance in the construction of gravity goods ropeway in some communities as well. Even though it might be an outdated and an inferior technology for some, it is still a sophisticated technology for the people living in the remote hilltops.

Some people might argue that this technology might hamper local porters, and horse and mule owners who transport goods for their livelihood. Their argument might be induced by the case of Manakamana Cable Car[10] that negatively affected the local porters and business owners on that trail (Gyawali et al., 2004, p. 181). This might be true in case of a large ropeway project that has adverse impact on a livelihood of some groups in a way similar to what road construction has. However, in the case of gravity goods ropeway instead of taking jobs, every gravity goods ropeway site provides employment to two local operators and brings the market closer to the villages. It opens numerous opportunities for villagers by connecting them to the market.

There is also a safety concern related to the operation of the gravity goods ropeway. Gravity goods ropeway is a safe technology. However, the two operators responsible for operating the system should be properly trained before they are allowed to operate this system. They need be very careful throughout the operation period. Simple negligence can result in fatality as the carriers might drag down anyone near it. Therefore, the operator should not let anyone except them to be near the carrier after it is ready to go towards the lower station. Proper communication between two operators is vital. The operators need to secure the area and lock the entrance of station after their shifts are over.

[10] Manakamana Cable Car is the only mono-cable car in Nepal which connects the popular Hindu temple Manakamana with Prithvi Highway. It is installed by a private company.

In Nepal, Gravity Goods Ropeway was first introduced at 2001. Even though this technology was introduced more than a decade ago, the government of Nepal still has not formulated specific policies for the promotion of this technology in Nepal. However, the Department of Local Infrastructure Development and Agricultural Roads(DoLIDAR) of Ministry of Local Development, Nepal has been actively supporting the promotion of this technology in Nepal. DoLIDAR in collaboration with Practical Action Nepal has published a book named "Technical Guidelines for Gravity Goods Ropeway". I have used this book as one the major secondary sources for my study.

The findings of this study suggest that Gravity Goods ropeways have huge potential to connect the remote mountain villages with the nearest road networks or the market places in low cost compared to construction of roads. However, Gravity Goods Ropeways should not be compared with the roads in terms of advantages as gravity ropeways only facilitate goods transportation and not the movement of people. It can occupy an important position between the conventional and the modern mode of transports. Furthermore, it does not overlap with any of them but fills the gap in between them (Singh, 2010). It could act as both alternative and complementary mode of transport in the hilly and the mountainous areas. In one hand, it connects the villages to market that have not been connected by roads and in the other hand, it can reduce the transportation cost and the time where roads already exist. In the places already connect with single-lane gravel or green roads, this technology still can be of a huge benefit during the rainy season, road blockage due to landslides and petroleum shortages when movement of vehicles are halted. It does not have potential to replace the road but will help to take maximum benefit from it by increasing traffic to and from the remote villages. As it is

environmentally friendly technology, the promotion of this technology could lower the petroleum imports associated with a road construction. Thus, gravity goods ropeways provide an economically and environmentally friendly transport solution.

My findings suggest that this technology has a positive impact on the socio-economic condition of the users. Gravity Ropeways enables users to take advantage of the market by supplying their agricultural produce. Saving in the transport costs makes this system economically viable to the farmers. It definitely increases their bargaining power and enables them to get better prices of their goods. They benefit more if they sell their produce through collaborative effort establishing cooperative than selling them individually. In case of my research site as well, the villagers would have been less benefitted if they were to sell their produce individually. Increase in income will encourage savings and will induce further investments in diversification of the agricultural products and other profitable sectors. In *Hiklung* village as well, the cooperative has been able to invest in drinking water project which have further improved their livelihood. My findings suggest that ropeways increases food security in terms of access to the food. With increased pursing power and access to market, villagers have access to the food throughout year. However, improved access to market has also lead to increase in consumption of junk foods like instant noodles and biscuits with low nutritional value. As gravity goods ropeways reduce the transport time of goods, this saved time could be utilized in other income generating activities. Income generated through sales of agricultural produce has helped the villagers to come out of vicious of poverty and improved their livelihoods.

CHAPTER VII

CONCLUSION

This study investigates the advantages of the gravity goods ropeways as a mode of commercial transportation in Nepal, its significance in linking farmers to the market, its socio-economic impact on the rural population, and its effectiveness in improving food security and the livelihood of the rural population of Nepal without access to transportation facilities. I have investigated the changes brought in the lives of people of *Hiklung* village after the installation of gravity goods ropeway in their villages. My study also includes research done by others regarding gravity goods ropeways on other sites. I have used their findings as secondary data in this research. The following summary of findings is organized in a manner that addresses each of the research questions guiding this research.

Research question 1: What are the advantages of gravity goods ropeways as a mode of commercial transportation in Nepal especially in hilly and mountainous regions?

Hills and mountains in Nepal cover 83% of the area of the country. With such geographical condition, the steep and complex terrains accompanied by heavy monsoon rains create conditions of severe natural instability in Nepal. These conditions make development of transport infrastructure, including roads and bridges, challenging and costly (Devkota et al., 2012, p. 283). Due to the lack of proper transportation infrastructure, movement is slow, difficult, and dangerous in the hilly and mountainous regions that dominate Nepal (Devkota et al., 2012, p. 283). My findings suggest that gravity goods ropeways have huge potentiality to overcome these challenges. The gravity goods ropeway can be constructed in about NPR 1,400,000 (($ 13461.53)[11] . In contrary,

[11] $1= NPR 104 (Central Bank of Nepal, December 24, 2015)

per kilometer construction cost of a four meter wide earthen road in the hills of Nepal is approximately NPR 3,000,000($ 28,846.15) (DoLIDAR,2010). Once the ropeway is constructed, it can last for about 15 years with minimal regular maintenance. Furthermore, there is no extra cost for electricity, fossil fuel or any other external power to operate it because it operates solely on the earth's gravity. The study done by Banskota et al. (2007) in two villages of Nepal revealed that transporting goods via gravity goods ropeway is more economically viable than transporting them through porters. In *Hiklung* village, I found that the transport time was reduced from 2 hours to 2 minutes. Pharityal(2006) found that the transportation cost was decreased to half while transporting goods via ropeway in *Gyandhura* village. Furthermore, usually a porter in Nepal, can transport up to 50 kilograms of load on their back whereas a gravity goods ropeway can transport around 90 kilograms of load at once. Despite gravity goods ropeways' various advantages, they should not be compared with the roads as they only facilitate goods transportation, not the movement of people.

During rainy season, vehicular movement in majority of hilly and mountain roads are disrupted by landslides and floods. At that time of year, gravity goods ropeway can keep on serving as an alternative means of transport until mountain villages are connected with all-weather roads.

Gravity Goods Ropeway fulfills most of the criteria of sustainable transport if we do not consider movement of people. It promotes economy, regional development, and equity through affordable fare and minimum harm to environment. It is emission free and environmental-friendly. It helps isolated population to participate in the local economy.

Research question 2: What is the significance of gravity goods ropeway in linking mountain farmers to the markets?

In Nepal, mountain farmers are compelled to face an exhausting, time consuming, and often dangerous journey to get their agricultural products to the nearest markets. Long duration of travel, without any refrigerating facilities, deteriorates the quality of agricultural products by the time they reach the final market. Furthermore, long travel time and low volume of freight that people and animals can transport make their agricultural and other natural products uneconomical. My findings suggest that these problems can be solved through installation of a gravity goods ropeway to connect mountain village with nearest road or market. Farmers, in *Hiklung* village, have quick access to their nearest market. They can send their fresh vegetable to markets in no time. They don't have to worry about the quality of their products deteriorating due to long hours of transport like in the past. They communicate with the market representative through cell phones to get immediate update of the market rate for their agricultural produce. Once they are able to get best value for their vegetables, they send them to the market or to the traders quickly. This has discouraged the role of intermediaries and has created direct link to the market. They are able to make more profit by sending their fresh produce to the market when the price for their vegetables is higher.

The gravity goods ropeway has made transportation of chemical fertilizers and other agricultural inputs easier as well. Farmers do not have to carry them on their back and walk on the steep mountain tracks.

Research question 3: What are the socio-economic impacts of gravity goods ropeways?

This research reveals that the gravity goods ropeway has positive socio-economic impacts to the project beneficiaries. Presence of a gravity goods ropeway in the village encourages farmers to diversify their crops and increase the scale of farming. Better access to market encourages farmer to invest more time and resources in farming. Pharityal(2006) found that ropeway encouraged the production of vegetables and floriculture in *Gyandhura* village, India. In *Hiklung* village, farmers started growing more cash crops like seasonal vegetables. IFAD (2013) states that higher profit encourages farmers to invest in their own businesses and increase the quantity, quality, and diversity of the goods they produce. In case of *Hiklung* village as well, access to the market and the increment in production have increased their income. This led to the formation of the savings and credit cooperative as a sister organization to their agricultural cooperative. Presence of gravity ropeway also had direct positive impact in the health, education, and livelihoods of the community in the *Hiklung Village.*

Research question 4: How effective is gravity goods ropeway in improving food security and the livelihood of the project beneficiaries?

Even though agriculture is the main livelihood base for 81% of its rural population, food insecurity is pervasive in mostly hilly and mountain areas of Nepal. Agriculture in Nepal, especially in hilly and mountain region, was dominated by the small-scale farmers where average land holding size is about 0.5 hectare (Karki & Karki, 2011). In the *Hiklung* village as well, farmers had small land holdings and were subsistence farmers. Whenever they had any surplus agricultural produce, they would immediately take them to the market and sell them either to traders or stay for whole day in the market until they were able to sell them completely. Only few farmer grew

vegetable for commercial purpose. Now, after the installation of gravity goods ropeway in their village, majority of them started growing vegetables as cash crops. Access to the market and the increment in production of cash crops has increased their income. With their savings, they were able to buy chemical fertilizers and improved seeds to increase and diversify their crops. Presence of the ropeway had direct positive impact on availability and access to food. Due to increment in their purchasing power, the villagers now have access to better food and other necessary items. Collective savings in the agricultural cooperative led to successfully completion of community development projects in this village like piped drinking water project. This research reveals that the gravity goods ropeway is effective in improving food security and the livelihood of the project beneficiaries.

Inaccessibility due to the lack of a proper transportation facility is still one of the major concerns of various rural and remote villages in Nepal. Moreover, the lack of rural transportation networks is rooted in two inter related conditions that is lack of accessibility to basic socio-economic needs and absence of reliable transportation infrastructure and services to facilitate mobility(Haynes et al., 2003). The harsh topography hinders construction of a transport infrastructure, including roads, making trails and mule tracks as the only available option for majority of population and forcing people to transport goods physically. Isolation has forced the population living in the remote mountains of Nepal to languish in the vicious circle of poverty. Government of Nepal cannot keep up with the demands of an ever-increasing population in scattered settlements living in hilly and mountainous areas due to financial and geographical constraints. Due to this condition, majorities of the settlements are still not linked with

road network and will be bound to remain isolated for decades to come. To address this problem, Gravity Goods Ropeways have emerged as a sustainable solution for rural transportation in Hilly and Mountainous regions of Nepal.

Gravity Goods Ropeway has a high potential to become a replicable model of sustainable development practice in Nepal and benefit a large number of rural population living in isolation to come out of vicious circle of poverty. This technology encourages policy makers and development agencies to re-think rural development in terms of accessibility rather than just in terms of roads built (Gyawali & Dixit, 2004). This technology has potential to connect farmers' of mountainous areas with markets throughout the world.

Recommendations:

My study suggests that for gaining maximum benefits from a Gravity Goods Ropeway a strong user committee is vital. Sustainability of the Gravity Goods Ropeway completely depends on community participation and a sense of ownership backed by responsible user committee. If the operators follow guidelines properly, carry out regular maintenance of these gravity ropeways, and appropriately manage user fees, the ropeways will sustain and benefit communities for years to come.

Marketing and trading of agricultural produce should be done through collective effort by establishment of agricultural cooperative to gain higher profit. This helps for effective collection, storing, management, and sale of their agricultural product; increases bargaining power with the traders; and facilities the resource sharing among the farmers.

The gravity goods ropeways should be promoted only in the areas where it significantly saves time for the transportation of goods. If the time saved is not significant, the villagers prefer to carry their agriculture produce one their own to save user fees.

Villagers should be given proper training in operation and management of ropeways. They should be given training on bookkeeping and committee management skills.

Government of Nepal should formulate appropriate policy for the promotion of this technology and promote it through its agencies. Government should make proper institutional arrangements defining clear roles and responsibilities of the central government, local government, private sectors, non-government organizations, and the beneficiary community for smooth implementation and sustainable operation of gravity goods ropeways. Project planning for gravity goods ropeway should follow bottom up approach with equal participation and involvement of the beneficiary communities.

I recommend promotion of gravity goods ropeways in all the mountainous developing countries whose government cannot invest sufficiently in their roadway. Government of these countries should collaborate with donor agencies to invest on gravity goods ropeways and increase participation of isolated communities in country's economy.

Future Research

Considering the importance of gravity goods ropeways in the economic development of isolated settlements in hilly and mountainous areas, this topic is seriously understudied. Further research is required to learn more about viability of gravity goods

ropeways in the remote mountain areas of Nepal or other similar mountainous countries and the role they play in the socio-economic development of those areas. As this research was limited to *Hiklung* village, I would suggest that future research should be carried out on other villages as well. Emphasis should be given to; i) villages where gravity goods ropeway has been in operation for around 2 years, ii) villages where gravity goods ropeway has been in operation for more than 5 years, ii) villages with gravity goods ropeway that has recently been connected with road, and iv) villages that have stopped using gravity goods ropeways.

The findings of this research are highly encouraging, in terms of socio-economic impacts of gravity goods ropeways and its effectiveness in linking isolated farmers with the nearest market. These findings suggest that gravity goods ropeway can be a replicable model of development intervention in hilly and mountainous areas of Nepal and other mountainous countries having similar economy.

I hope the government of Nepal will soon formulate policies related to gravity goods ropeways and have them established at the national infrastructure for transport sector development policy and plans. These policies will definitely pave the way for the promotion and construction of gravity goods ropeways in the isolated hilly and mountain villages that are in dire need of some sort of transportation facility. Gravity goods ropeways will play a vital role in efforts to end their sufferings and increase their participation in the local economy.

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