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Nepal, Factor 16: Infrastructure

Nepal: Improving Nepal's Rural Infrastructure

In the United States, we live in an interconnected society. Distance and location have little impact on what is possible. However, the same cannot be said for Nepal. The transportation sector in this country is practically nonexistent, which means that people's potential is hindered by their physical location. This isolation has extreme implications on food security in Nepal.

Nepal is located in Asia and is surrounded by China to the north and India to all other sides. Its government was recently restructured to a multi-party republic after a 10 year civil war. It is nestled in the midst of the Himalayas and is home to Mount Everest. The northern part of the country is extremely mountainous, the southern part is a flat plain, and the middle ground is hilly. As a result of its location on a tectonic plate border, Nepal is highly prone to earthquakes. Nepal has a varying climate between regions and seasons. Temperature highs range from 37°C to 23°C in the south and 20°C to 0°C in the northern mountains. Nepal also experiences monsoons. Roughly 19% of the country's 148,000 sq km is arable, the majority of which is located in the Terai plain. All arable land is being farmed extensively. Nepal's major exports include carpets, clothing, leather and grains (Every Culture).

The total population of Nepal is 29,384,297 people. A quarter of the people live below the poverty line. The population is clustered around the capital, Kathmandu, and along the Terai plain. Thirty-eight percent of the people live in an urban setting, and Kathmandu is growing quickly. The majority of people live in a rural environment. Seventy percent of people work as farmers, but almost all are subsistence farmers. The average wage in Nepal is $288 US per year (World Factbook). The typical rural family lives on a ten acre plot of land and farms just enough food to sustain themselves. Farming is done by hand or using extremely primitive tools. They use a mixed crop system in which they plant several different crops within the same plot. Farmers grow crops such as potatoes, corn, millet, buckwheat, and beans. The land

is typically terraced because of the steeply sloped landscape (Canada Foundation for Nepal, 2012). A family unit consists of multiple generations; brothers live together with their parents, wives, and children in one house. The fertility rate is roughly two kids per woman. Housing is typically stone or mud-brick huts with thatched roofing. Typically, families consume two meals per day. Rice and vegetables are dietary staples along with grains used for roti (Every Culture).

Access to healthcare is extremely limited as the only hospitals are found in Kathmandu and Pokhara. Families must travel days to reach the nearest hospital, and often by foot. Hospitals are extremely understaffed and poorly equipped. Educational access varies by family. Free schooling is offered through the government, but it is so extremely underfunded and understaffed that most families deem it impractical. Private school costs roughly $350 per year, which is too high for most families to afford. Access to education depends on the distance from a school to the family. Modern technologies such as electricity, telephones, and transportation systems are uncommon in rural Nepalese communities (Every Culture).

The sector of infrastructure that most impacts food security is transportation. Currently, Nepal has a road network that is only found in the southern part of the country. There are roughly 42,000 kilometers of roadway. Only 11,890 kilometers are paved. There is also a railroad system that stretches 53 kilometers (World Factbook). The geographic landscape provides many challenges with constructing roads, especially into the Himalayas. There, extreme altitude changes cause issues. Most goods are transported to rural Himalayan villages by pack mule, human foot travel, or helicopter. This causes transportation costs to be double the value of the actual food. Despite the challenges of the terrain, greater setbacks stem from the country's struggles with natural disasters. Nepal is prone to earthquakes. These can cause the roads to be torn apart, and landslides to occur. Nepal is susceptible to flooding during monsoon season. The frequency and intensity of these natural disasters will continue to increase as climate change continues. As a result, roads require immense amounts of upkeep to continue functioning. This makes expansion and growth very slow and expensive (Every Culture).

Despite the challenges, improving transportation infrastructure is critical to improving food security within Nepal. In the southern regions, infrastructure is needed to move food produced at farms to the markets that supply thousands of people with food. If transportation methods don't exist, people are unable to have access to the food grown in remote areas. Increasing the ease of transportation helps to lower transportation costs, which lowers the overall price of food; more families will then have access to it. Access to markets is needed in order to provide food to people in agriculturally unproductive lands, or areas that are unable to cope with the high demand of food, especially Kathmandu. Improving market connections will help to stimulate trade. Nepal's largest trade allies are India and China. Nepal's agricultural products could be important in helping provide nutrition for the people of these growing countries, and to provide economic growth for Nepal. Trading food creates nutritional variety. Increasing trade gives people more options for their food which results in a healthy, balanced diet. Lastly, connections with other agricultural providers helps reduces the risk of a catastrophe if a disaster strikes. If an earthquake affects a rural, isolated subsistence farmer, then there are no options if their crops are totally destroyed. Interconnected agricultural communities help to distribute risk potential and create a safety net in case of disaster.

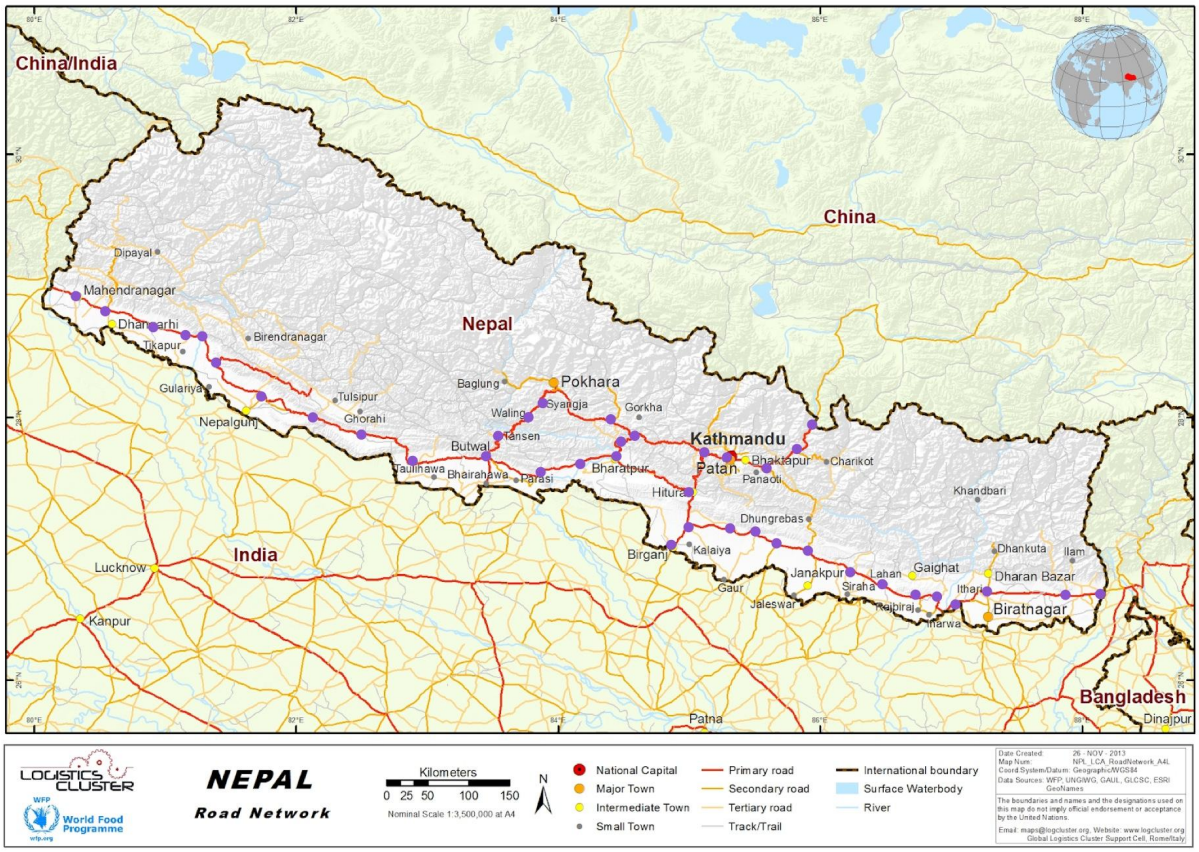
Nepal recognizes the importance of improving their country's infrastructure, and as a result, it is currently improving. Notable advances include the construction of a major highway stretching out from Kathmandu (World Highways, 2014). The population, growing at 1.16% per year, will soon demand larger quantities of food (World Factbook). Infrastructure will need to be developed in order to connect the food to the people needing it. Several different approaches have been launched by a variety of organizations. Many of the funding sources are nonprofit organizations due to the fact that the government is still struggling to recover from the civil war and earthquake.

Nepal's geography presents challenges in finding a solution, because it has so much variation. As a result,

two plans are suitable: one for the Southern Terai plains, and one for the mountainous north.

The southern sector has less challenges associated with creating infrastructure. This region is the primary producer of agriculture, so providing transportation pathways for the food is extremely important in distributing it. Because of the strong presence of agriculture and population, the majority of projects focus their efforts in this region. The landscape is fairly manageable, so the best option is to continue expanding and improving the existing road network. Many communities lack access to this network simply because of the shortage of roads. It is important to create quality roads that will be able to withstand natural disasters. The World Bank's current project does just that. They have been working in Nepal since the 1970s to try and improve infrastructure. The World Bank has funded 42 bridges and many roads. Their focus has primarily been on creating roads that are all-weather proof; they have created 1700 kilometers worth. These projects have placed maintenance as their top priority in order to prevent the deterioration of existing roads. They also utilize a community approach that helps for job creation. Teams of 5 - 6 locals are recruited and paid to maintain their roads. Each district is required to complete an annual maintenance plan in order to continue receiving funding. The roads are designed to withstand environmental disasters (World Bank, 2016). This program is conscious of the unique challenges of this region by creating roads that adapt to all weather forms and by prioritizing maintenance. This ensures that the infrastructure is permanent and sustainable, while involving locals to increase community involvement in bettering their homes. This current program is already making great advancements in improving infrastructure in the southern parts of Nepal.

In addition to the existing program, this project could benefit from a few alterations. One is requiring landslide prevention methods to be installed into areas with high degrees of risk. This would drastically reduce the chance of road blockage. Another possibility is including earthquake resistant features in all bridges. This is done by allowing the bridge to have the flexibility needed to absorb and distribute some of the shock but making it sturdy enough to hold together. Typically, the bridge is made out of flexible concrete composite, but using nickel or titanium support rods (Materia.nl, 2016). In order to ensure that the money and time invested in constructing these figures is a long term installment, it is critical to design them with the highest degree of technology and sturdiness possible. This feature is necessary in regions that are susceptible to earthquakes. The final element to include is to design roads to converge into regional hubs. It would be most logical for all roads to lead towards the primary road system, because it runs directly through the middle of the agricultural sector. Rather than simply having all roads have individual outlets onto the primary road, clustering them into groups promotes regional trade hubs. Concentrating goods into several areas creates local economies that distribute food. The locations for these central hubs are most logically placed at existing cities or existing intersections of secondary road systems with the primary road. However, it is important to include local leaders in all stages, especially planning, in order to ensure success. See below for possible convergence points.



In order to implement the remaining improvements, there are several different possible methods. For funding, the World Bank would be a likely ally given their current level of involvement and investment. Their current priority is the quality of their projects, so they will likely support these additional aspects. The design plans for bridges and landslide prevention systems can be modeled after existing ones in Japan and San Francisco, and can be formulated by either government or private sector engineers. An option is collaborating with an engineering firm and requesting a donation of their services to design free blueprints. Other possible sources include Engineers Without Borders or graduate engineering students. Locals could then be hired to complete the plans for both elements. Regarding the network hubs, construction simply needs to be carefully monitored by locals to ensure that roads converge at natural points. Creating a flow of goods is critical in helping to distribute food to all who need it. Local involvement helps to ensure that the infrastructure created will be as useful as it possibly can be.

The second phase in building Nepal's infrastructure is addressing the rural mountainous communities. This task is a lot more challenging given the sudden elevation changes, flooding, and frequency of earthquakes and landslides. Because of the elevation changes, roads need to be designed as switchbacks; this is not an efficient method because of the small amount of distance travelled compared to the amount of road laid. In addition, the people are isolated in clusters as opposed to dispersed over a wide range. Roads are not needed in the spaces in between villages. Because of these two main reasons, roads are not the best system of infrastructure. The two best possible solutions are either drones or gondolas.

Using drones is an option for connecting isolated, mountainous communities with outside markets and food. Griff Aviation is a company that specializes in creating drones with high-load capacities. One of their most recent creations is the Griff 350. This drone can hold up to 350 kilograms and travel for 20 minutes at full capacity. The motor is waterproof. This technology would be extremely useful because it is completely independent of the landscape. Earthquakes, landslides, or other natural disasters would have

no impact upon it. It can be sent as often or rarely as needed and to any location. There is no construction needed; the drones are purchased and are immediately ready for use. The largest drawbacks are the cost, load limit, and that the people have no way of being transported. Each individual drone is priced at $250,000. While this may be less expensive than installing roads, it still has an extremely high price that would be unreasonable for creating a fleet of the size needed. The second limitation is the load limit. The drone can only hold a maximum of 350 kilograms and travel a maximum of 20 minutes at full capacity (Griff Aviation, 2018). The flight time needed to operate from a central location would be much longer than 20 minutes. In addition, the amount of food and goods that would be transported back and forth in a healthy market setting would be much higher than 350 kilograms per trip. The local people would have no way of traveling either. Combining this information with the cost makes this option not cost effective. The drone technology would also be completely out of place compared to the current technologies of the villages, which are extremely basic. Using this technology on a regular basis is not realistic. However, drones would be ideal for disaster relief in the sense that they can transport goods regardless of the landscape below them. Because these communities are self sustaining, the most critical times for connectivity are following a disaster. Aid organizations would have to closely coordinate drone usage with the government as drones are currently prohibited in Nepal. In addition to the positive potential of distasteful relief, the drone technologies are advancing at a rapid rate; this possibly could become more realistic and efficient once the technology reaches a certain capacity, for a variety of tasks in many different locations.

The other top option for northern Nepal's infrastructure is a gondola system. Gondolas are typically used for transporting people up ski mountains, however, their potential extends much farther. They have proven to be able to travel over large distances with elevation changes with relative ease. They offer enclosed capsules that can be used for transporting people or goods in either direction. In addition to their typical design, a few additional changes could maximize the potential of this system. The structure would have to be fashioned to cope with the natural challenges of the environment. The engineering techniques that are used to design other elevated, supporting structures, such as bridges or skyscrapers, can be translated to apply to gondola supports. The priority is combining flexibility of structure with durability of materials. If strong, metal poles are used in combination with flex points, then the gondola is much more likely to survive natural disasters. The other possible alteration is its energy source. One of the possibilities is to use gravity as a source of power, because of the intense elevation changes. This could be done by adding weights to the descending cable in order to propel the opposite cable up the hill. The second option is to utilize hydropower. Nepal has an enormous potential for hydropower; of the 40,000MW of potential energy, only 600 MW is currently being used (Nepal Development). This energy source is especially useful because many of the rivers run along the valley deep into the mountains. These are both viable options for clean energy sources. Both sources are sustainable and could each be more suitable depending on the terrain. However, they cost $15 million per mile (New England Ski Database). The possible drawbacks to this solution are the time needed for construction and the cost. Because this project will hopefully create a widespread web of gondola lines, many lines will be needed. The additional precautions for the environment will also increase the cost. However, this option provides the most direct line of transportation and connectivity for the people in the rural villages. It also is a long-lasting solution. Another possible issue is that many of the rural communities prefer to be somewhat isolated. Again, coordination with the local people's wishes must be ensured. The World Bank would be a likely source of funding due to their current commitment to improving Nepal's infrastructure. A simple, self-sustaining gondola system would be most useful for creating a basic web in key areas that is needing a consistent, long term solution.

Expanding and maximizing the World Bank's current project in southern Nepal and implementing a gondola system in northern Nepal will work to create connectivity not only among Nepalis, but also with their surrounding nations. By improving transportation options, people will have easier access to a variety of food, which improves nutrition, and larger quantities of it, which ensures that everyone has access to an

adequate amount. Creating infrastructure helps to stimulate economy and trade, which helps the country to develop. Lastly, it reduces the risk of natural disasters destroying people's sole source of food. Following these steps with the help and guidance of the local people will create the best possible recipe for success. It is crucial for Nepal to support infrastructure development.

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