# Demystifying the Possibilities of ICT4D in the Mountain Regions of Nepal

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## Abstract

*Despite the substantial investments in ICT4D projects in developing countries, the benefits are yet to be realised by the majority of remote communities. Inaccessibility to ICT has widened educational, healthcare, information, and communication gaps between urban and remote communities. This paper focuses on an interpretive case study in Nepal to widen our understanding of how locally-initiated ICT4D projects may help to narrow these gaps. The study utilises the Assets Pentagon Model to identify the strengths and challenges of the Nepal Wireless Networking Project in the mountain areas, and to identify implications for research and practice based on insights from the case.*

## 1. Introduction

Remote communities of mountain regions in developing countries are among the poorest, most inaccessible and most excluded in the world, though they are rich in natural resources [1, 2]. They are facing social, political, and economic exclusion from the key systems of development [1]. The current global information explosion has little impact on development activities and access to practical information for remote communities in developing countries [3]. Despite the massive rate of telecom penetration in the urban areas, IT services still remain far short of meeting total demand and serving these areas. For instance, there are more than 1000 Internet access points all over Nepal, with around 90% of these located in urban areas, whereas only around 15% of the total population lives in such areas[4]. The distribution of ICT services in terms of geographical dispersion has been heavily skewed in favour of urban areas[4, 5].

The availability of Information and Communication Technology ICT in a remote community is significant to facilitate the flow of information and knowledge that provide an opportunity to connect them with the main streamline of development. The implementation of ICT4D projects can facilitate these communities to undertake development activities [6-9]. The reduced cost of installing ICT infrastructure has enhanced the possibility of technology diffusion in these areas. Studies show that ICT intervention can serve community development needs [10, 11]. It is broadly agreed that ICT can play an important role in the development of remote communities [1, 5, 10]. Some of the examples are the Kothmale project in Sri Lanka, the ERTIC project in Peru, and the InfoDes project in northern Peru. The Kothmale project through ICT is helping remote communities to connect with urban communities[3]. Similarly, the ERTIC project in the mountain region of Peru shows that ICT projects can be instrumental in overcoming remoteness and social exclusion problems[1]. Furthermore, Diaz and Urquhart argue that ICT projects such as InfoDes, can be helpful in creating social capital vis-à-vis human capital in remote communities[12].

In the absence of systematic research in these remote places, the actual outcomes of ICT4D projects are unidentified [1, 12]. Few studies have addressed the issues of the opportunities and challenges of ICT4D projects in mountain areas [1, 5, 10, 12]. There is a need to understand the multidimensional opportunities created by the ICT projects [13, 14]. We need to explore both within the communities which are directly affected by the intervention, and within an expanding context surrounding those communities[15]. To contribute to this research context, we conducted an interpretive case study [16, 17] to explore the multidimensional challenges and perspectives of the ICT4D project in the mountain region of Nepal. We deployed the analytical lens of the Assets Pentagon Model [18] to understand the multidimensional possibilities of the Nepal Wireless Networking Project (NWNP) in the Myagdi district of Nepal. This Pentagon model is also useful to explore the inter-relationships between different assets.

The organisation of this paper is as follows: section 2 discusses the theoretical framework; section 3 illustrates the research background, context and methodology; section 4 & 5 discuss the research findings and challenges of the NWNP respectively; and

1

section 6 concludes the paper with a discussion and implications.

## 2. Theoretical Framework

In order to understand the multidimensional potential of the ICT4D project in the Myagdi district of Nepal, we deployed the Assets Pentagon Model[18, 19]. The Assets Pentagon is a core component of the Sustainable Livelihoods Framework [18]. It is composed of five capitals: *financial capital, human capital, physical capital, social capital,* and *political capital* [18, 19]. Research shows that the implementation of ICT4D projects creates multiple opportunities[11, 18, 19]. These opportunities are intertwined and interdependent. Any of the single capital of the Assets Pentagon Model can be a necessary condition for development; however, not a sufficient condition. Therefore, to achieve overall socio-economic development, contribution from the five capitals is a prerequisite. The assets pentagon is also useful to illustrate the inter-relationships between the various assets. Our findings show that political capital, such as government support, political stability, and social inclusion, are core challenges of ICT4D projects. Therefore, we explore the perspective of *political capital* rather than natural capital, in keeping with the argument made by Heeks and Shoba [19].

**Social capital** is the genre of social resources upon which community people draw in pursuit of their livelihood objectives; mainly conceived as *networks* and relationships based on *trust, reciprocity* and *exchanges*[19, 20]. Social capital influences the other four capitals, for example, by improving the efficiency of economic relations. Social capital can also help increase people's incomes and rates of saving (financial capital). Likewise, by creating bridging social capital, it can facilitate social inclusion, and assist in accessing the collective resources (political capital). It can help community people to maintain shared ICT infrastructure (physical capital). Furthermore, social networks facilitate innovation, the development of knowledge and the sharing of that knowledge. There is, therefore, a close relationship between social and human capital[18].

**Physical capital** comprises the basic infrastructure and producer goods needed to support livelihoods. Access to information or communication is one essential of physical capital. The opportunity costs associated with poor infrastructure can preclude education, access to health services, and income generation. For example, providing telecom infrastructure can enable the remote communities to access information and communication services; likewise, telemedicine services can provide cheap and time-saving healthcare opportunities. Physical capital can provide the accessibility and shareability choice to create social and human capital.

**Human capital** represents the skills, knowledge, ability to labour, and good health that together enhance people's capability to pursue different livelihood strategies and achieve their livelihood objectives. For example, improved access to education and training through distance learning programmes, and the potential to transfer digital content to remote locations easily in the form of text, images, video, and radio can help community people in the process of relevant knowledge generation[11]. Human capital is one of the core components of the assets pentagon as it is required to make use of four other capitals[18].

**Financial capital** denotes the financial resources that community people use to achieve their livelihood; for example, revenue generation through selling agricultural products, eco-Tourism, and remittances using ICT services and at the same time save transaction costs by buying agro products, and getting immediate medical services using the ICT platform. Financial capital is important for the long-term sustainability of ICT4D projects.

**Political capital** represents the political stability, government support, and pro-poor IT policies for remote community development. Political capital can be formed by including women and marginalised groups in the villages[19]. ICT services such as eGovernment, eCommerce, and telemedicine projects can help to form political capital. The political capital assists the macro-level policies and their effective implementation for development.

## 3. Research Background, Context, and Methodology

### 3.1. Nepal

Nepal is a landlocked country situated in South Asia, on the southern slopes of the Himalayan mountain range, between the two giants India and China. The territory comprises three main geographical regions; the Terai (flat river plain of the Ganges, 17%), the central mountain region (64%), and the Himalayan region (19%). Nepal, with its 27 million inhabitants, is divided into five development regions, 14 zones, and 75 districts. Around 4000 village development committees (VDCs) comprise the administrative unit below district. About one third of the total population lives in rural and remote areas. Agriculture and tourism are the key economic sectors of Nepal. About 42% of the population lives below the national poverty line. The literacy rate in Nepal is around 55% in which,

Nepali (national language) is 82% and English is approximately 18%. Computer ownership per 100 inhabitants is 2.80, and telephone lines per 100 inhabitants are 3.5 [21].

## 3.2 ICT Profile of Nepal

Most of the Internet Service Providers' subscribers and users are concentrated in Kathmandu (capital city). Likewise, tele-density data are less than one per hundred in rural areas, while it is around 15 per hundred in urban areas. Around two-thirds of the telephones are in the Kathmandu valley [22].

The Nepal government formulated an IT policy in 2000, which has been renewed in 2010. The policy offers a vision of putting Nepal onto the global IT map within the next five years[4]. The Nepal government has installed around 300 telecentres all over Nepal as part of the ICT4D projects. However, they are mostly concentrated in the city areas and district headquarters. They are more focused in the eastern and southern parts of Nepal where the density of the population is much higher in comparison to the population density of the north-western part of the country. Most of the remote communities have no internet, email, or IP telephony services. Some remote communities are using internet services; however, they are operated by community initiatives using local VSAT technologies. Even remote places just outside of capital cities are not connected through internet services[23].

## 3.3. Nepal Wireless Networking Project

The NWNP was initiated in 1997 by educationist and social activist Mahabir Pun. Since 2003, this project has been in full-fledged operation. It is situated in the Myagdi district of Nepal. Despite difficult circumstances, such as lack of government support, lack of funding, lack of technical knowledge, and an unstable political system (Nepal was in fact involved in a civil war between the government and the Maoists when the project started), the project succeeded in providing internet service with minimal wireless technology (meant for private networks), home-made antennas, and relay stations, that had to be hidden in trees at an altitude of 2,700 meters.

The project was initiated to reduce migration from remote areas to urban areas and abroad. After several years working as a social worker in the Myagdi district, Pun identified two major reasons for the migration. First, the health care system is really poor (or non-existent); uneducated "village ladies" are responsible for providing health services in the villages, and there might be several days of walking to get to the nearest doctor. Second, there is no education offered in the mountain areas, and a lack of work for well-educated candidates. Due to lack of decent roads in the mountain areas, lack of trained personnel (such as doctors and nurses) in Nepal, and low status and salaries in the villages, Pun argues that you cannot bring teachers and doctors to villages. Thus, the only opportunity from his point of view is to empower the villages by introducing communication opportunities, to "get service to the people, not people to the services".

The NWNP is working with Open Learning Exchange (OLE) Nepal, an NGO based in the US and Kathmandu, as a partner to develop educational contents for the school children. The contents are based on the government curriculum from grade one through ten. In addition, the NWNP is in the testing phase of using the network for online-based learning. The objective is to provide further education for youngsters living in the villages.

To address the challenges of bringing specialist doctors into the mountain villages, the NWNP has initiated telemedicine services in some villages of the Myagdi district. Every morning, the village ladies (being responsible for health care services in the villages) consult doctors from main hospitals using videoconferencing services, to discuss patients, common diseases or to learn from doctors and village ladies from other communities.

Studies show that for the sustainability of any ICT4D project, income generation activities are important [1, 24]. To generate employment opportunities, the NWNP is working on developing an eCommerce platform in collaboration with Gandaki Software Engineering College, Pokhara. In addition, it is planning to start a remittance service in the remote area because most of the family members from remote communities go to work abroad. Moreover, virtual ATM machine services are being piloted in Ghore Pani (a famous trekking route for tourist), which will be further distributed to other tourist areas.

Pun received the Magsaysay Award in 2007 for implementing this wireless project in the mountain region of Nepal. Currently, the NWNP has built networks in 42 villages of Myagdi and other districts, and has been partially provided financial support by the World Bank and Nepal Telecommunication Authority. The NWNP's vision is to provide all remote villages of Nepal with Internet services to help to contribute to socio-economic development.

## 3.4. Research Site

The chosen location for this research was the Nangi and Tikot villages in the Myagdi district, located

in western Nepal on the southern flank of the Annapurna and Dhaulagiri ranges of the Himalayas. The total population of these villages is around 2,000 people and the elevation is over 2,000 meters. People have to go to urban areas to procure employment, education, and healthcare services. Tikot is not accessible by road. From Nangi, it takes about four hours by jeep or one day walking to the nearest town of Beni. From Beni, there is another seven-hour bus ride to reach the capital city where there are hospitals and universities. These villages are inhabited predominantly by Magar ethnic communities including other minority castes and social groups [25], and the community people in these villages still practice shamanistic rituals. They are respected as traditional doctors and healers. Most of the villagers are farmers who grow mainly potatoes and other agricultural products. One common employment opportunity is to join the military service in India or the UK because the army service does not require a high level of education. Furthermore, youngsters go abroad to work in, for example, the construction business in neighbouring countries. Thus, the main source of revenue is remittance from family members working outside the villages. Sometimes they also sell agricultural produce such as milk products and potatoes.

## 3.5. Data Collection

The explorative nature of this research consider that "Research is a continuous process of data collection, followed by analysis and memo writing leading to questions that leads to more data collection"[26]. The research data was collected through interviews, focus group, workshop, note taking, observations, web information, and still and video pictures. Secondary sources of data, such as various reports, were also included. To obtain the primary data, a sample of 40 community people was interviewed from two villages. We interviewed ICT service users, such as teachers (aged 30-40, males), social activists (aged 30-60, males, and females), health workers (aged 30-40, women), students (Standard 11-12, aged 16-18, girls and boys), and non-users, such as drivers, SME workers, retired army personnel, and farmers.

A semi-structured guide was used for the individual interviews, each of which lasted from 15 to 55 minutes and was tape-recorded. Individual interviews helped this study to understand the individual perspective of ICT4D prospects and challenges, at the same time, to understand the collective views, we conducted focus group interviews with teachers, activists, and experts, such as Director of Nepal Telecommunication Authority, Joint Secretary of High Level Commission of Information Technology, and Directors of

Borderland Travels and tours, ENRD, OLE Nepal, and Thamel.com. The observation of ICT usage was conducted in schools, telecentres, and village telemedicine clinics. The objective of observation was to understand the pattern of usage and the technical performance of ICT devices, such as wireless services and telemedicine equipments. Pictures and videos were used to portray the socio-cultural context. In addition, supplementary data were obtained from different relevant Internet sites, informal discussions, email exchanges, social networking sites, different websites of ICT4D projects, and a ICT4D workshop in Kathmandu.

The ICT4D workshop attracted around 30 participants, composed by researchers, practitioners, experts, medical doctors, government officials, telecom director, teachers, students, and members of the Nepal Wireless Networking Project. The idea of the workshop was to collect more data and understand the ICT4D possibilities and challenges through the experiences shared by different stakeholders in general, and to synthesize and triangulate our findings from the two villages.

## 3.6. Data Analysis

We analysed the data collected through interviews, observations, note taking, and workshops. All the interviews were transcribed, summarised, coded and categorised [27] using the nVivo tool with respect to the multidimensional prospects and challenges of the ICT4D project in mountain areas. The analysis started with open coding and categorizing the data. All the coding done by two authors were verified, invalidated and synthesized. Thereafter, based on the relevance of the concepts we created the sub-categories keeping Asset Pentagon as a guiding framework. Furthermore, two core-categorise opportunities and challenges added. The categorization process was based on the iterative process of moving around data, concept, and categories as Klein and Myers suggested[28] in their principle of evaluating interpretive field study.

Finally, we made connection between data and sub-categories, vis-à-vis sub-categories and core-categories. Regular discussions with other researchers and practitioners were attempted throughout the project to check the reliability and validity of interviews and interpretation. Different background of researchers as one of the researchers was from a remote community of Nepal, their knowledge and experience as an insider and outsider helped with understanding the reality of the research context based on critical perspectives.

## 4. Research Findings

Both the Nangi and Tikot villages have started to use computers actively in schools, and to provide Internet access to other citizens in the afternoons. Further, they are using telemedicine services, and have initiated some income-generating projects utilising the potential brought to them by being connected. We will use the Assets Pentagon Model to further illustrate the potentials of the NWNP in the Nangi and Tikot villages.

## 4.1. Social Capital

The notion of social capital is to extend the network and relationships based on trust, reciprocity, and exchanges[20, 29]. The NWNP has provided an opportunity to extend their social network. At present, villagers are using the internet for communication purposes. People from the villages who are working abroad are using e-mails to communicate with their families who remain in the villages. Students and teachers are offered web mail accounts through the project, while others are using free web mail accounts such as Yahoo and Gmail. There is a bulletin board for local news, local advertisements, announcements, and urgent messages. While interviewing a school principal, he said:

*It [NWNP] has increased the dimension of communication. For non-students, the communication patterns have been somewhat changed, for example, by providing faster communication opportunities. But in the case of students it has been drastically changed. They are using social networking services to make a lot of friends. Likewise, we have a lot of volunteers from other countries with different nationalities and cultures. We can have cultural exchanges, building friendships with them. The dimension of communication has been altered.*

Teachers and students are getting access to some educational materials that the NWNP has put on the intranet. Students from high schools are using the network to write e-mails to each other and to their pen-pals abroad. In the past, the students used to send letters to their pe n-pals through "snail mail" which used to take months. Now they can communicate in real time no matter where they are located. A village activist explained:

*Regarding the social impact, we are not in a position to say that it has a solid role in development; however, the perspective of the village people regarding the computer and its usage is changing. They are at least using email and chat for sending and receiving message to/from their relatives in foreign countries.*

The community people of Nangi are running a cross-breeding project between Yak and Cow. It is situated at the higher altitude of 3,200m from the Nangi village. Due to the internet connection, the management committee of the projects can communicate with each other through NetMeeting in order to make appropriate decisions for the projects.

The health workers from the Nangi and Tikot villages argue that telemedicine assists in the development of trust among village people due to the virtual presence of doctors. A doctor associated with this project said:

*Particularly in the villages, people are afraid of diseases. When they see a doctor in front of the camera prescribing them medicines, they feel confident, they feel psychologically confident.*

## 4.2. Physical Capital

The NWNP has facilitated the development of physical capital in these villages, such as Wi-Fi stations, telemedicine centres, and telecentres. Many people living in these villages, including all school children, are able to use computers and, to some extent, utilise online opportunities. Such competence is currently rare in most remote communities in Nepal. One of the teachers expressed his feelings on the matter:

*There are a lot of benefits to using computers in this village. There are many places in which children have not seen computers, but in this remote village, children are able to use and feel the new technologies. They are able to read updated news, and some are busy playing games. To enjoy playing games on computer is also a breakthrough achievement for them.*

Besides providing communication facilities, the NWNP has set up a telemedicine centre in these villages. Local health workers are communicating with medical doctors in Pokhara or Kathmandu for medical assistance. The village health workers facilitate communication between the doctor and the patient and provide the medicine prescribed by the doctor. A health worker in the Nangi telemedicine centre said that:

*Here we have a small clinic where two sisters are working. If they face any difficulties or emergencies, then they connect directly to Kathmandu or four to five other main hospitals and consult with the doctors there.*

The team leader of the NWNP project explained about the telemedicine project that:

*It is difficult to get specialist doctors to go to remote areas. Thus, we are using telemedicine to get access to hospital doctors for remote places. The people who have not seen doctors can see the doctors*

*through this technology. These are the main focuses of our project. Whenever we are connecting villages, we are connecting schools and health post stations.*

### 4.3. Human Capital

The NWNP helps school children to utilise online educational resources, as stated by one student:

*It helps us in our study. For example, to understand the history the course book is not enough. Now we may download additional information to know more. It's helping me to receive external information related to my studies.*

School children and teachers are more motivated to study and learn. One of the teachers expressed his excitement as follows:

*It was clearly exciting to get this new technology. Therefore, when the computer arrived in the village, we used to learn computer until midnight. Gradually, the interest to work on the computers was cultivated.*

Young people from the village are procuring employment in the project, enhancing their knowledge and skill through the use of ICT. One technician said:

*Mahabir Sir taught us at the beginning, [lessons] such as checking radios, operating computers. Later on, I learned through my own experience.*

The project facilitated a network between remote and urban hospitals and schools. Local manpower is generated by developing competence for IT teachers, clinic health workers, and network technicians.

### 4.4. Financial Capital

Some income-generating activities are being initiated but are still in the piloting phase. Examples include the Haat Bazaar initiative and remittance services. On the Haat Baazar websites, villagers may advertise their local products for sale, such as cows, buffaloes, goats, chickens, and cheese. The team leader of the NWNP project explained:

*They can use it (*Haat Baazar) *for advertisements in the village. Thanks to the Internet, we can promote local products such as Doko, Namlo, Nepali spices, mushrooms, and cattles. If anyone wants to sell their products, they may use services like Haat Bazzar on the net. They contact the Internet operator who will put the information online for other people to see and buy that product.*

Remittance services, which are in the testing phase, may become important in the future:

*...Remittance services are going to be started soon in this village. By using this service, family and friends in foreign countries and the big cities may transfer money easily, which is clearly beneficial for the community.*

By offering cheap communication opportunities, the NWNP facilitates reduced transaction costs. One of the village farmers said:

*When there was no internet here, communication was very difficult because we used to go to Beni or Pokhara just to make a phone call. Furthermore, we had to wait for months, not days, to receive our letters from the central offices in Kathmandu. It took many days to send letters abroad. Now communication is very easy and convenient since village people are using the Internet for communication. People here chat and send e-mails to relatives in foreign countries on a daily basis, instead of sending letters. They do chatting [online] instead of telephone calls.*

The NWNP is planning to develop e-commerce services related to eco-tourism, and to provide ATM virtual machines. The team leader of the project said:

*To make this technology sustainable, we need to introduce eCommerce, so that we can get some economic sustainability.*

### 4.5. Political Capital

One of the notions of political capital is inclusion of marginalised people so that they can access key resources and services. The Myagdi district is found in a very remote area of Nepal. Most of the villagers are still socially, politically, and economically excluded from mainstream development in the cities. The NWNP has provided an opportunity to access information and communication services without any discrimination. One of the interviewees from Tikot village stated the following:

*Nangi and this village are pretty similar. There are Magars, Damais, and Kamis (marginalised groups). And, Bahuns (a so-called benefitted group) came from other districts. However, there is no discrimination among these castes. They are using computers equally.*

A teacher replied with the following, commenting on technology and the inclusiveness of marginalised groups:

*This technology is not meant for just a particular caste. I hope it [ICT] will definitely solve this problem (the differences between various castes) because it is not meant for any particular caste.*

Another element of political capital is empowerment of women. The NWNP provides an opportunity to empower local women and encourage them to participate in the development process. For example, in the telemedicine centre of the Nangi and Tikot villages, local women are given preference with respect to receiving training.

The NWNP has drafted a future plan to introduce eGovernment services in these areas. It will assist in providing government information and services in

remote places via the Internet. The team leader of this project has lobbied the government to put the remote communities on the priority list of IT policy in 2010.

## 5. Challenges

There are still a number of challenges that need to be addressed in order to realise the benefits of ICT4D projects in remote places. The director of Nepal Telecom Authority articulated the main challenges as follows:

*Rural means no affordability, lower literacy rate, everything is below average, and poverty incidence is high. Moreover, the supporting infrastructure, such as electricity, road network, and other supporting infrastructure, is not yet developed in the rural areas.*

The Assets Pentagon Model is also useful to identify challenges and obstacles for the NWNP in the Nangi and Tikot villages.

### 5.1. Social Capital

A main challenge is the literacy rate, which restricts participation, especially of the elderly. A majority of the villagers are using ICT services for communicating with their relatives and friends. It may be helpful to maintain the bonding social capital[30]; however, for the creation of macro level socio-economic development, they need to extend their social network[20]. As mentioned in section 3.2, only 18% of the educated population is English literate. The majority of the people in the Nangi and Tikot villages are lacking with respect to English-oriented ICT services. As previously mentioned, the NWNP has initiated several projects focusing on developing online context based on the Nepalese language.

The participation of the community people is also important for creating social capital. The participation of farmers (the majority of people living in these villages) is still a challenge due to their lack of education, illiteracy rate, and lack of time to participate in training to increase their ICT competence. The VDC chairman of Nangi village, who learned to use computers and the Internet, explains:

*In this village, around 50% are retired personnel from the UK's or India's armies. I told them this is an Internet age; we used to send letters using the post office but now, because of the Internet and telecommunication, we can send information to different places easily. Therefore, I asked village elders to come and take computer education, but still, they are not able to understand it.*

### 5.2. Physical Capital

Shortages of power combined with poor infrastructure are still major obstacles for the NWNP. For example, the lack of sophisticated devices has hampered the quality of telemedicine services in the Nangi and Tikot villages. Similarly, the team leader of the NWNP told us that better Internet bandwidth is needed to further generate local content and promote it to outside markets:

*The only constraint to making Voice over IP telephone calls to the villages from abroad using the extension number is that they don't have enough Internet bandwidth from the ISP. People are using Skype and Yahoo Voice Chat in the morning or evening when acceptable Internet bandwidth is available.*

The poor physical capital in these villages hindered health workers in the use of their capability in the telemedicine project, as expressed by one of the local health workers:

*When I went to Kathmandu Model Hospital last time for training, I could use a lot of lab facilities, which are not yet available here. Thus, I'm not able to make full use of my new competence [here].*

There is shortage of power in most parts of Nepal in which people face twelve-hour power cuts even in Kathmandu city. In most parts of the country, the power supply is very unreliable. Moreover, due to the mountainous terrain, the NWNP had to locate critical parts of its equipment, for instance, all its relay stations, up in the mountains. Consequently, the NWNP is highly dependent on solar power systems. Solar power is still very expensive (typically amounting to half of overall expenses) and does not function satisfactorily in the rainy seasons.

### 5.3. Human Capital

A main challenge is the lack of skilled manpower to maintain and further develop the NWNP. For example, in Nangi, there are trained technicians who can solve really basic technical problems. However, most of the technicians are not certified engineers; they are local young people who learned through experience. One technician in Nangi village described this situation:

*We are not using the computers for complex tasks; therefore, we don't have problems. But we will face difficulties if we start using them for more complex tasks.*

In Tikot, there is tremendous dependence on one technician. One of the teaching staff of the Tikot School said:

*If the computers become out of order, there is no one to give support. We have just one technician and he is not perfect. He works according to the*

*instructions given by Mahabir Pun* (the initiator of the NWNP) *by phone. Otherwise, if the problem gets bigger, then Mahabir needs to come.*

Although the NWNP has the support of community members, they are very much dependent on Mahabir Pun, team leader for funding, planning, development, maintenance and action. An involved citizen in Nangi said:

*Mahabir has done this entire thing. He is the one who brought the computer and Internet to this village. All the credit goes to him. As long as Mahabir is with us, there is no fear. However, in his absence we are a little doubtful.*

One of members of the teaching staff in Tikot village expressed his worries as follows:

*It was not possible without him; still, I didn't find any other person who came here to work like Mahabir. For example, there are many people who came from foreign countries to observe the project, but there was no one who said "I will work with Mahabir". Therefore, as long as Mahabir is here, it will function properly; however, in his absence, we need another person like him for the sustainability of this project. Without his presence, this project will not function properly. I am bit worried about it.*

### 5.4. Financial Capital

The NWNP has started different small-scale industries for income generation. So far, most of the income-generating projects are in the testing phase. Sustainable business models should be developed for further extension of the project in order to realise macro level socio-economic benefits. According to the director of the Nepal Telecommunication Authority, private sectors are not interested in remote places because they find no business opportunities there:

*The major challenge for the private sector is the lack of a business model in remote places. In the liberal economic system, a business model is very important; we are not able to design the correct sustainable business model.*

The lack of financial capital makes it difficult for the NWNP to develop sophisticated devices. Financial capital is required to further develop the network into new villages in other regions. Upgrades and purchases of new devices are difficult due to poor economic conditions. The headmaster of the Tikot school discussed his experience:

*There is a lot of development every day. There might be a time when our old computers will not work properly… Therefore, we need to look for funding to buy new equipment, otherwise we will have a problem.*

### 5.5. Political Capital

The NWNP is facing political instability and lack of government support. Ten years of Maoist insurgency, the massacre of the king's family, and the contemporary fragile government are some of the reasons for the unstable political situation. Although the government has embraced liberal policies since 1997, it has drafted IT policies which are still not being implemented in practice. Despite the allocation of an enormous amount of money to the Rural Telecom Development Fund (RTDF), the funds have not been distributed and utilised due to political instability and delayed bureaucratic processes.

Decades of political instability in Nepal have hampered overall socio-economic growth. The head teacher of the Tikot Middle School gave one example of the practical difficulties due to the tense political situation:

*We sent our computer teacher to Kathmandu for one month of training in hardware. Due to the Nepal Banda [strike] and other political movements, he got just 15 days of training instead of one month.*

Similarly, there is a lack of government support for these kinds of community-based ICT4D projects. A villager from Tikot expressed that:

*The District Education Office is not helping us directly, but the education ministry provides around 40-50000 rupies to fund Internet provision to the schools. They sometimes offer us a programme to provide an equal amount of money from the community and from the District Education Office… but that small amount is not enough to contribute to the big change.*

## 6. Discussion

As mentioned in Section 1, remote communities in the mountain regions of developing countries are deprived of socio-economic and political advantages [1, 5, 10]. In this study, we have described the Nepal Wireless Networking Project and explored how this project may help to overcome these shortages. There is a great deal of optimism, exemplified by one villager from Tikot who stated that:

*The Internet cannot help us with plowing, sowing, and harvesting. But by using the Internet, we can engage in a lot of other educational and financial development, I believe.*

We argue that the NWNP provides a promising opportunity to create social, human, physical, financial, and political capital. People may access data resources and they are offered training to improve their competence. Social networking may also be facilitated. Now they no longer have to travel long hours to make a phone call to their relatives. Due to the NWNP, people living in the villages have better access to

medical competence. Transaction costs are reduced and there are some promising opportunities to empower marginalised groups, especially women, through training programmes.

The NWNP has provided several opportunities to the Nangi and Tikot communities. However, in order to realise the macro level socio-economic impact, the community people should not only be able to access and assess the information; they should also be able to convert it into relevant knowledge, and to make decisions. At the same time, they should be able to generate local content that can be used for revenue generation activities[19].

In the content development and revenue generation programme, this project is still in its infancy. They need to work on local content generation. Although they started local bulletin and eCommerce services, this information is still not exported to the outside community. Access to local data and information by external market is important in order to generate revenue and long-term sustainability [1].

The findings from our NWNP case allow us to identify some implications for practice.

First, there is a need to really understand the context to be able to achieve results by introducing ICT in remote areas of the developing world. Several researchers have identified the lack of contextual understanding as a major explanation for why ICT4D projects have not succeeded (see [14] for a discussion of such issues). Our contribution here is to identify the importance of contextual understanding in a so-far successful ICT4D project in a remote area. The NWNP was initiated without external funding, with only some rare international contacts (a few international students volunteered in the initial phase) and with some clear, community-based objectives on what to achieve, which were clearly not technology-oriented. The objective was (and is) to avoid migration from remote areas by developing health care services, improving education, and developing business opportunities. Everyone interviewed shared exactly the same vision and objectives.

Second, it is important to focus on localised content and develop content providers. The NWNP has initiated collaboration with several content providers in Kathmandu to develop online materials for schools, telemedicine systems, and e-commerce opportunities. It is also of critical importance to develop online content based on the Nepalese language. Mahabir Pun argues that no technology should be distributed before there is a joint understanding of the needs and opportunities, and before there is some content available with which to start up.

Third, the NWNP case study illustrated the critical importance of a champion. Mahabir Pun initiated the project from his uncle's house. The project was illegal, and had to be localised in mountain areas dominated by the Maoists. Pun's importance cannot be overestimated, and based on what he has done with the NWNP, he is currently well-respected at all levels in Nepalese society, which gives him access to all offices, including ministry offices in Kathmandu city. Thus, his network is of critical importance. The importance of one man is a double-edged sword. The project would not exist without him, but the project will also fail if he can no longer manage it. Therefore, the project may face the challenge of being developed from an initial phase in which the champion is of critical importance, to a more mature phase in which it is less dependent on one (or very few) contributor(s).

## 6.1 Implications for future research

Based on the NWNP case study, we will suggest some implications for future research.

First, the asset pentagon model introduces a holistic view on the Nepal Wireless Networking Project. More research is needed to increase our knowledge of the inter-relationship between the various assets, but our work represents an attempt to start with a holistic view of the implications of introducing ICT4D projects. The holistic view is even more important as long as the project is initiated to overcome social, and not technical, challenges in the Myagdi district.

Second, more research should be done to understand how the contextual characteristics influence the technical design of the NWNP as well as its online content. The NWNP is an excellent candidate for understanding how the design of technology is influenced and influences local societies in remote areas of the developing world. Such knowledge is necessary in order to fully understand how ICT4D projects can succeed under such circumstances.

Third, there is a clear need for more research to develop sustainable business models. So far, the NWNP is highly dependent on donors and some restricted income from the village development committees. Business models should be developed not only to make the NWNP sustainable, but also to generate income for these very poor villages.

The NWNP has created a positive wave in the Nangi and Tikot villages. The extension from what were initially two villages to currently more than forty indicates its importance. Despite some challenges, the NWNP is an important example of an ICT4D project in remote areas in a country which is rarely (if ever) discussed in the ICT4D literature. Conducive government policies, infrastructure development, and public-private partnerships may support the replication of the NWNP across other mountain villages in Nepal.

Further development of business models to attract eco-tourism and to sell cultural and agricultural products through the Internet may generate revenues and further add to the socio-economic development in the long run.

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