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Remoteness, Exclusion and Telecentres in Mountain Regions: *Analysing ICT-Based "Information Chains" in Pazos, Peru*

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Abstract

Communities in developing country mountain areas, in part due to their remoteness, find themselves excluded from social, political and economic systems; and excluded from access to resources. This paper researches the impact on remoteness and exclusion of information and communication technologies (ICTs). It utilises two models – the resource movement framework, and "information chains" – to analyse a telecentre in one district of mountainous Huancavelica, Peru's poorest region, set in the high Andes.

It finds ICTs enabling new and positive resource flows for the two key user groups: teenaged school students and young farmers. These help to maintain social networks. They also support information searches that have improved agricultural practice where other information chain resources have been available. But non-use and ineffective use of the telecentre are found where information chain resources are lacking. ICTs have some impact on intangible elements of remoteness. In this particular example, they also offer access to some previously-excluded resources. But they have not really addressed the systemic exclusions faced by mountain communities. And they so far appear to be a technology of inequality; favouring those residents who begin with better resource endowments.

The paper concludes by offering some recommendations for mountain ICT project practice.

Introduction

Mountain regions in developing countries are among the poorest, most-remote and most-excluded in the world. Information and communication technologies (ICTs) bring with them a promise of addressing poverty, remoteness, exclusion and other developmental problems. Yet, to date, little has been written about the application of ICTs in mountain regions.

In part, this is hardly surprising. Mountainous areas in developing countries are literal "last places on earth", and many have been cut off from digital communications. However, in the past few years, this has been changing as connectivity programmes reach out into remote regions. As a result, we are increasingly in a position to start filling the knowledge gap about ICTs' role in the development of mountain regions with both conceptualisation and field data.

This paper makes a small contribution to the "gap-filling" process. Specifically, it asks, "What role can ICTs play in overcoming the remoteness and exclusion of mountain regions?".

It begins, in Section A by reviewing characteristics of these regions, and by highlighting conceptual means for understanding the impact of ICTs on those characteristics, based around resource movement and "Information Chain" models. The following section explains the selection of Peru as a research site, and provides more specific details on the research project – "ERTIC" – which set up a telecentre in the research location; Pazos. Research data-gathering methods are also described. Section C explains how ERTIC was implemented in Pazos and then presents an analysis of both use and non-use of the telecentre. Finally, conclusions are drawn on the basis of the resource movement and Information Chain models about the extent to which ICTs are addressing remoteness and exclusion.

A. Understanding Mountain Regions and ICTs

Beyond "I'd know one if I saw one", actually defining a mountain runs from the subjective (it's a mountain if that's what local people call it) to the objective (land >2,500m or 1500-2499m if slope is >2 degrees or 1000-1499m if slope is >5 degrees and local (radius 7km) elevation is >300m or 300-999m if local (radius 7km) elevation is >300m or "isolated inner basins and plateaus less than 25 km^2 in extent that are surrounded by mountains" (Blyth et al 2002:74)). Here we will use the latter, defining mountain communities as those living in a mountain area as per the Blyth et al definition.

In a simple sense, mountain regions are important because they cover more than one-fifth of the Earth's surface and are home to one-tenth of the world's population (Byers et al 1999). But they are also important for other reasons. We can characterise these in various ways. In a positive sense, these regions are vital sources of natural resources – minerals, timber, fresh water – and they are also sources of cultural (leisure, spiritual) and knowledge resources (Panos 2002).

In a negative sense, mountain regions suffer important challenges. Some of these lie at the intersection of the human and the environmental: deforestation, soil erosion, landslides (Byers et al 1999). In recent years, mountain regions are seen to be on the front line of climate change and climate adaptation (Panos 2002). Other challenges are characterised in more solely-human terms: chronic poverty, poor quality of life, out-migration and conflict (Panos 2002, CPRC 2004).

Mountain regions have an additional importance because of the impact both their resource supply and their challenges have on those living outside these regions. Issues range from more than half the world's population relying on mountain-origin fresh water, to 10-20% of global tourism being mountain-based, to mountain areas being key sites for everything from local insurgencies into lowland areas to regional drugs cartels to global terrorism training (Panos 2002).

This connectedness of mountain and non-mountain regions is ironic, because a number of the problems faced by mountain communities can be laid at the door of disconnection and exclusion (*ibid.*). We can characterise exclusion in a number of different ways. For the poor generally, including those living in mountain regions, there are various forms of *systemic exclusion*: that is, exclusions from the key systems of development. These would include:

- Social exclusion: e.g. from public service systems such as the health system and the education system (Carver 1999).
- Political exclusion: e.g. from political systems including political parties, from political agendas, and from policy priorities and the rights of citizenship (Altamirano et al 2004, Palin 2005).
- Economic exclusion: e.g. from economic value chains, both input systems such as banking and credit; and from output systems such as traders and customers (Altamirano et al 2004, Pringle et al 2004, Lightfoot et al 2008).

Underlying all these forms of exclusion is a foundation of *resource exclusion*. We can understand this as an exclusion from the six resource capitals that make up livelihood assets (DFID 1999, Heeks & Arun forthcoming):

- Human: information, knowledge, health, skills
- Natural: land, water, forest
- Financial: money, financial assets
- Physical: transport, housing, energy, raw materials, tools, equipment
- Social: networks, relationships, group membership
- Political: power, status

The term "exclusion" suggests that the poor in mountain communities are prevented from accessing systems and resources. Of course, this is not really true. It would be better, then, to understand exclusion to mean either that systems and resources cannot be accessed (true exclusion or disconnection) and/or that they can be accessed but only at disproportionately high cost (costly inclusion) and/or that they can be accessed but with other negative consequences for the community member (adverse inclusion) (Panos 2002, Bird et al 2002).

We should also understand that exclusion is self-reinforcing. In other words, that exclusion is both a consequence of earlier exclusion and a cause of later exclusion. For example, a mountain community member who lacks financial resources may be

unable to access the health system; that may lead to a lack of good health, which may in turn lead to an ongoing lack of financial resources.

For the poor in mountain regions, we need to add in one further factor: their remoteness. Their physical remoteness – their distance from main centres of population and their high/steep landscape – means, for example, that physical infrastructure – transport, energy, telephony, etc – does not reach them, or that it only does so intermittently, or at high cost. This in turn makes it either impossible or high cost to access the systems and resources listed under the two exclusions above. Physical remoteness means the same thing for the socio-economic infrastructure: health centres, schools, markets, government offices, and so on are absent in mountain areas or cost more to access.

We could also characterise remoteness in less tangible ways. Mountain communities are remote from centres of knowledge; remote from centres of political power; remote from centres of economic activity; and so on. This brings us pretty much back to where we started, indicating the overlapping and mutually-reinforcing nature of systemic exclusion, resource exclusion and remoteness.

A1. Relevant Conceptual Frameworks

Because exclusion means disconnection from systems and resources, there has been an ongoing interest in what technologies of connection have to offer mountain communities; particularly what they have to offer to resource exclusion by their impact in reducing remoteness. For many years, this interest spotlighted roads. We can summarise views about road connectivity using the resource movement framework shown in Table 1, which includes some examples of those views.

	Resources Brought In	***Resources Taken Out***
Positive	Greater access to resources such as bottled gas (Parish 2002) Easier access to agricultural inputs and construction materials (Panos 2003)	Easier to take those with health problems to local clinics (Panos 2003) Easier and cheaper to sell local agricultural produce in external markets (Somuncu & Inci 2004)
Negative	The influx of HIV/AIDS (Karumuna 2004) Influx of urban second-homers leading to "over-crowding, noise, exhaust emissions, littering" (Özden et al 2004)	Natural resource extraction by "plains people", leading to depletion and without income benefit to mountain communities (Carver 1999) Outmigration and brain drain from mountain communities (Kohler et al 2002)

Table 1: Views on Resource Movement Impact of Road Connections to Mountain Communities

Some analysts also go further than impact analysis to identify the need for complementary inputs on road projects beyond just tarmac and laterite (e.g.

Karumuna 2004). Developmental connectivity means "more than the usual engineering solutions"; it means providing inputs such as awareness, skills and money for the local community.

More recently, there has been some interest in the role that information and communication technologies can play (defined here as technologies that process or communicate digital data). This interest has been slow-growing because there are significant resource barriers to ICT implementation in mountain areas, such as lack of power and telecommunications networks, lack of literacy and ICT skills, and lack of money (Aitken 2002).

As with roads, so with ICTs, it is not the technology that matters so much as what it carries in and carries out: in this case data. And, as with roads, we can see a variety of views about resource movement as summarised in Table 2.

	Resources Brought In	***Resources Taken Out***
Positive	Information to assist with remittance payments (Aitken 2002) Health information and online education (Helmersen 2001)	Promotion of area to tourists, and contact with distant government officials (Panos 2002)
	Information on market prices leading to …	… greater sales of agricultural produce in external markets (Lightfoot et al 2008)
Negative	Downloading of pornography (Montgomery 2002)	
	Information on lifestyles in urban areas leading to …	… loss of local youth through out-migration (Byers et al 1999)

Table 2: Views on Resource Movement Impact of ICT Connections to Mountain Communities

However, some of these views have been based on conjecture rather than evidence and there is a recognised need for more impact studies of ICTs in mountain areas (Helmersen 2001, Kohler et al 2002). With a specific view to the impact of ICTs on the lives of the poor in mountain regions, we can model these into a framework to analyse exclusion. We start with the main way in which ICTs are conceived: as a tool of consumption that brings data into poor communities. The "Information Inflow Chain" is summarised in Figure 1.

The model is a development of Heeks (2005) that has three main origins. It draws from the information systems discipline, which has analysed how raw data comes to be transformed into organisational value (Ward & Peppard 2002). It draws from development studies' sustainable livelihoods framework – used already above in discussing resource exclusion – to incorporate the notion that resources are a key component in producing development results (DFID 1999). And it draws from ideas about ICT literacy that move beyond the basic notions of "computer skills" (Warschauer 2002).

It also fits with the literature on mountain communities and connectivity just mentioned: that the impact of any type of connectivity – be it road or ICT – is more about what is carried by the connection than the nature of the connection; and that connectivity requires complementary inputs to be effective for mountain communities.

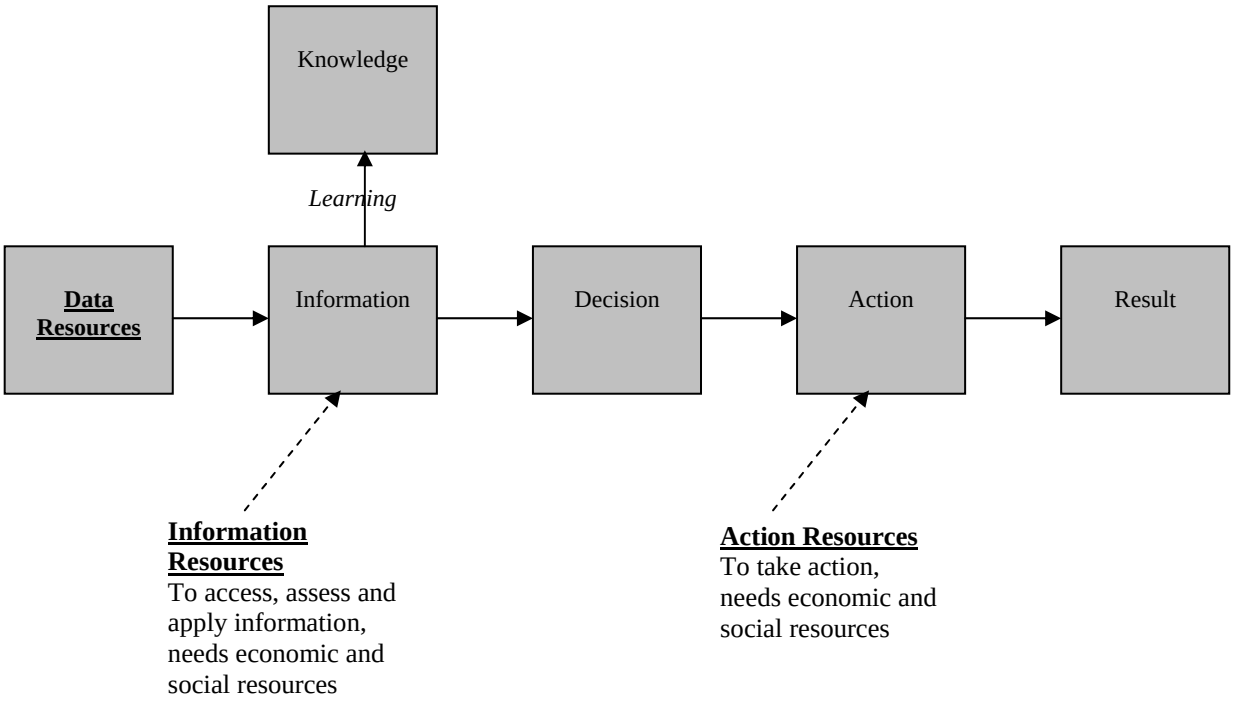

Figure 1: The Information Inflow Chain

The information inflow chain (summarised by the DIKDAR acronym) begins when and if data resources are delivered via the ICT channel. The mere presence of data is not enough. The mountain community user must be able to access the data, assess its qualities, and apply it to their own particular needs. Data access requires availability of ICTs, skills like computer literacy and (often) literacy, and the time, money and motivation in order to make use of ICTs. Data assessment and application will require the user to have enough knowledge to judge the accuracy and completeness of the data, and its relevance to their own specific learning or actions needs.

But this only turns the ICT-based data into new knowledge or decisions. To deliver development results, a set of action resources is needed. These will vary depending on the actions but can include things like money and raw materials that the action requires, like skills in order to undertake the action, like power and motivation to make the action happen, and like social or business contacts to make the action create an effective result.

The inflow chain, though, is only half the picture. Like roads, ICTs do not just bring resources into mountain communities; they also allow resources to flow out. In this mode, ICTs are a tool of production, allowing community members to create their own data. This might be a simple chat message sent to a distant relative, or a

contribution to a blog, or creation of a participatory video. We can model this as shown in Figure 2.

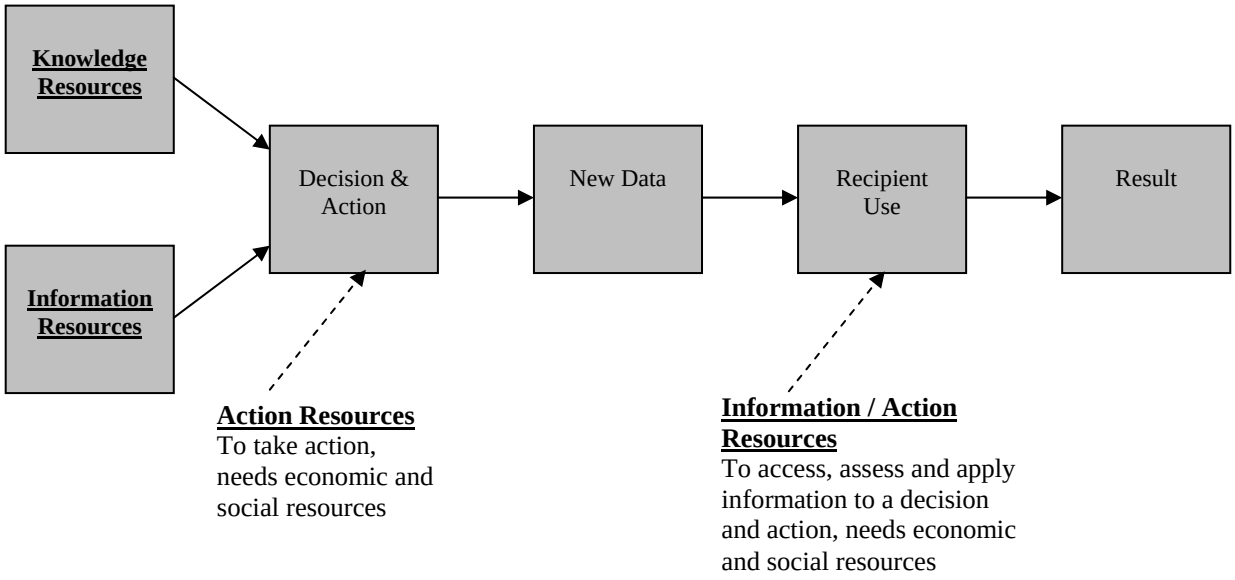

Figure 2: The Information Outflow Chain

For this use of ICTs, mountain community members need resources of information and knowledge about a particular aspect of their lives, which they then decide to turn into new data. The resources required for this action vary depending on data format. They could be fairly basic IT skills (e.g. email) and knowledge (e.g. the recipient's email address). Or they could be much more complex (e.g. those required to create and disseminate a video, or to create a community web portal).

Once the mountain community member has created this new data resource, this will have some developmental result of itself. For example, there is evidence that the mere act of content creation can be empowering (Heeks 2008). However, a fuller result will be achieved only once the data is received and used by a recipient. This, in other words, requires the "inflow" chain steps to be worked through by the data recipients (who may not, of course, reside in a mountain area).

In all, then, we can say that the arrival of ICTs in a mountain community has little or no impact of itself. To impact development, a raft of complementary resources must be present. Figures 1 and 2 categorise these in terms of the links in the chain as data, information, knowledge and action resources. Or we could categorise these resources as:

- Tangible: technology, money, raw materials.
- Semi-tangible: data, knowledge, skills, time, contacts.
- Intangible: information, power, motivation.

Or we could categorise them according to the six resource capitals model used above: human, natural, financial, physical, social and political.

Having conceptualised the relation between ICTs and development, we now move on to describe the research that applied these models to use of ICTs in one particular mountain location.

B. Research Context, Setting and Methods

The chosen location for this research was Peru. Peru was selected firstly because it is a very mountainous country, including regions and communities that are particularly remote and excluded (Altamirano et al 2004). Peru was also selected because ICTs have been diffusing relatively rapidly in the country (see Table 3).

Year	***Internet Subscribers***	***Subscribers per 100 population***	***Internet Users***	***Users per 100 population***
2000	138,000	0.53	800,000	3.08
2006	1,028,000	3.62	6,500,000	22.89
Average Annual Growth Rate	40%	38%	42%	40%

Source: ITU (2009)

Table 3: Internet Diffusion in Peru

Two features of this diffusion are noteworthy, and typical of Internet access in developing countries (Kenny 2006). At least initial access is rarely via the model typical of the global North: private connections in the home. Instead, it is estimated that more than 80% of Peruvian users have initially connected to the Internet via public access points (*cabinas públicas de Internet*) (Bossio 2002).

In addition, diffusion has been uneven. The growth in Internet access has been concentrated in Lima and other urban areas, leaving rural – including mountain – areas relatively poorly served (INEI 2006). This reflects a longer-term Peruvian pattern of a negative relation between altitude and provision of public infrastructure, and a broader pattern of the infrastructural marginalisation of mountain communities (Panos 2002, Escobal & Torero 2003). As a result, the Peruvian government has stepped in to try to ameliorate some of the emergent inequalities. Since 2001, it had recognised the developmental importance of the Internet, and the need for interventions to address digital divide challenges (PCM 2001).

Some interventions have been sector-specific, such as the Huascaran Project that has focused on providing Internet connectivity to schools. Other interventions have targeted rural areas; hence including Peru's mountain regions. One such initiative was ERTIC (*Establecimientos Rurales de Tecnologías de la Información y Comunicación*: rural ICT establishments), which was implemented by INICTEL (*Instituto Nacional de Investigación y Capacitación de Telecomunicaciones*: National Institute for Telecommunications Research and Training).

ERTIC developed from an earlier project, based in Huancavelica region, to strengthen the network of rural libraries (ERTIC 2006). ERTIC's aim was to set up telecentres in ten districts of the region; telecentres being seen as a space within an existing public

library in which computing and Internet capabilities could be accessed. Each telecentre consisted of five PCs, a server, a printer and a scanner. These PCs ran open source software, and were linked to the Internet using an antenna-based VSAT (very small aperture terminal) satellite connection.

The ERTIC project was begun in 2004 but it was only in early 2006 that the telecentres were opened. INICTEL paid for set-up costs of the hardware and software; it also paid for two telecentre staff and Internet connection costs for the first six months. After that time, responsibility for each telecentre was transferred from INICTEL to the local municipality government, including responsibility for operational costs but also the ability to charge usage-related fees.

B1. The Research Site: Pazos

Huancavelica region is located to the south-east of the Peruvian capital, Lima (see Figure 3).

Source: peru.com (2007)

Figure 3: Peru and its Regions

Huancavelica lies fully within the Andean uplands, with a minimum and maximum elevation of 1,950m and more than 5,000m respectively, and a population of just over 450,000 (*Wikipedia* 2009). There is a clear negative relationship between altitude and income in Peru and it is thus no particular surprise that Huancavelica is Peru's poorest region, with more than 85% of the population living on less than US$1 per day (Escobal & Torero 2003, INEI 2008).

The chosen focus for this research is the telecentre installed in Pazos district, which lies at the northern end of Huancavelica region. The district's main town – called Pazos (see Figure 4) – lies at 3,840m though the district overall encompasses 13 other smaller villages between 2,600m and 4,400m, with a total population of just under 8,000 people (ERTIC 2007). It thus fully meets the definition of a mountain community.

Figure 4: Pazos Town

87% of the population has access to electricity and 80% are literate. There are sixteen primary and four secondary schools in the district, plus an outreach centre for the provincial Agricultural Technical Institute (ATI). The condition of school buildings, equipment and materials is generally reported as poor and, overall, just under 60% of school-age children are enrolled. Pazos has one health centre and four clinics. Among main causes of death are poisoning due to careless handling of agricultural chemicals (*ibid.*).

Livelihoods in Pazos are almost entirely focused on agriculture, dominated by peasant farming, with potatoes being the principal crop. Farming is mainly manual with some mix of ox- and tractor-drawn ploughs. There is some limited livestock (mainly sheep), dairy and textile production. Most production is for subsistence. Beyond that, most surplus is sold in the weekly market in Pazos town. Analysis of agriculture in Pazos notes a potential for expansion but a lack of knowledge and a lack of technical assistance from agricultural extension services (*ibid.*).

In terms of communications, Pazos' roads are in a generally poor condition – only 10% are formally maintained. However, it is only one hour by motorised transport from Huancayo (the capital of neighbouring Junin region, with more than 300,000 inhabitants) and four hours from its own regional capital, Huancavelica (with a population of around 40,000). There are only two public telephones in Pazos town, and six – offering a poor service quality – in outlying villages; there is no mobile coverage. TV reception is only available in the main town but there are two radio stations, one from regional, one from provincial level, plus a radio communications network used by health workers (*ibid.*).

In reviewing Pazos as a mountain location, we can say that it is typical in many respects: its altitude; its poverty; its reliance on agriculture; the relatively poor state of its infrastructure. In other ways, though, Pazos does not represent an extreme of exclusion – it has schools, electricity, a health network and, perhaps most critically, is only one hour from a major urban centre. This is not unexpected for current research on ICTs in mountain areas: the world's remotest, most-excluded areas are not yet connected; we must therefore steer the tradeoff between exclusion and ICT availability.

In order to research the Pazos telecentre, a three-month study was conducted in 2007. This looked particularly at the two primary user groups of the telecentre – secondary school students and young peasant farmers – but it also covered non-users as well. Three research methods were used:

- Observation of ICT usage conducted within the telecentre. Five of these observational sessions were open: just recording whatever usage was undertaken. One session was directed: testing out the abilities of users to complete a set of word processing and online communication tasks.
- Four focus group sessions conducted with small numbers of primary user group members to talk about their usage of ICTs.
- Twenty-nine individual interviews. The interviews covered both users and non-users of the telecentre; based both in Pazos town and in outlying villages.

C. Telecentre Users, Usage and Non-Users in Pazos

The ERTIC project's telecentres were seen as different from Peru's *cabinas publicas*. They were to be developmental; encompassing a specific (top-down) conception of development. Thus, where the *cabinas publicas* were seen as leisure centres used by youngsters for entertainment and chat, ERTIC telecentres were intended to drive cultural, economic and social development (INICTEL 2006). The planning document notably leaves unspoken how exactly this development is to be achieved via use of

ICTs. However, in implementation, the project tried to shape ICT usage towards its intended goals.

The ERTIC telecentres charged US$0.30 per hour for Internet access but farmers looking for agricultural information were allowed one hour free. Access to pornographic websites was prohibited, as was the playing of computer games. Internet searches for educational, commercial or "professional" purposes were, by contrast, deemed to be high priority (*ibid.*).

Two further elements were incorporated with the intention of enhancing the developmental role of the telecentres.

The first was training. The two local network managers were given technical training on topics like Linux, network management, and web design. But they were also given training in user relations, such as promotion of Internet use. The network managers in turn gave training to potential users; both general IT training on computing basics and document production, but also an awareness-raising exercise on potentially-interesting uses of the Internet such as finding cooking recipes, or researching domestic violence. In Pazos, during the six-month initial period of INICTEL support, 547 people were trained (about 7% of the district's population).

The second was local content production for the ERTIC project web portal. One element of this was quasi-bottom-up: a network of local "correspondents" was created to produce news for the web portal. The other element was top-down. INICTEL produced videos for tourism promotion and agricultural training, and set up *Plataforma Rural de Huancavelica* (Huancavelica Rural Platform). The latter was a separate web portal through which INICTEL intended to provide distance learning materials (including its videos) on improving agricultural practices in crop and livestock farming; a virtual library of documents on agriculture and post-farm production; and a commerce portal through which farmers could offer specialist produce, handicrafts and services.

Taken together, these elements of the ERTIC project provided a set of key resources, each of which addresses aspects of the resource exclusion of populations in mountain regions:

- Technology: specifically technology intended to leapfrog geography to move from a situation of physical remoteness to virtual connectedness.
- Skills: in making use of the technology.
- Information: about key aspects of the livelihoods of mountain region inhabitants; particularly upland agriculture.

In addition, through the commerce portal, there was potential for inclusion in previously-inaccessible markets.

From this foundation, what actual uses of the telecentre were found?

As noted above, two main user groups were identified from the observational work: secondary school students (see Figure 5), and young peasant farmers (see Figure 6). For both groups, the project had provided information chain resources in practice: beyond the technology, interviewees mentioned the value of the skills and knowledge they had gained from the telecentre managers. It emerged, though, that this built on a

pre-existing foundation: almost all users had already used one of the *cabinas publicas* in nearby Huancayo (usually encouraged by a friend or relative in the city who took them to look at the Internet or to set up an email account), and received some ICT introduction in their school or college.

Figure 5: Teenaged Telecentre Users

The teenaged school students (aged 15-17, both boys and girls) who lived near to the telecentre were regular users, going two or three times per week for around one hour a day from 5pm. For them the physical space of the telecentre was also a social space: one would find a group of six or seven together gathered around one or two computer users; typically discussing what they were seeing on screen but also socialising more generally with each other. This is, therefore, collective consumption of the new medium, and one can see that collective as building its own information chain resources – particularly ICT skills and knowledge, and knowledge about accessing and assessing data. Less analytically, it was also notable that the telecentre provided a space for teenagers of the opposite sex to meet together, and that all activities were undertaken to the constant beat of reggaeton.

The farmers represented a smaller group. They were aged in their 20s, and were all either students or graduates of the Agricultural Technical Institute. Usage was focused on Saturday when the farmers came into Pazos town for market day. Like the teenagers, farmers would often talk together about their computer-based activity.

On the basis of observation, two main categories of use – social and informational – can be seen. We will also comment on two other issues: creation of local content, and non-use.

Social Use

The teenagers' telecentre usage centred on, and was motivated by, communicating with distant relatives or friends who had migrated to live in cities such as Huancayo, Huancavelica or Lima. The same was true – though to a lesser extent – of the young farmers. They used email or MSN (Windows Live) Messenger and the main information flow was outward: informing the migrant "*pazinos*" about village news and about events such as local festivals that the migrants could return to attend. Local users' skills in these applications were relatively deep, including the ability to use emoticons, attach pictures, and make use of the telecentre webcam. The fact that migrants did, indeed, return for the events suggests that this information outflow chain was working.

One stereotype of ICT usage is that it reinforces existing social networks for poor users, rather than extending those networks (e.g. Williams 2004, Ureta 2008). This did appear true of the farmers but it was not the whole story in Pazos. Almost all of the teenagers interviewed would chat online with unknown respondents who in some mysterious way just "appeared" on their Messenger contact lists. Although they assumed these to be teenagers, they were also well aware that people could make up identities, and about the dangers of meeting up; something their contacts sometimes proposed:

> "[*My contact*] he is from Huancayo city; he says that, but I do not know. He has been asking me several times to go out in Huancayo, I have accepted but I have never really gone … I do not know him, how might he be?" (Teenager, Pazos, female user)

Mainly through discussions with their real friends, this group had therefore developed the information inflow chain resources necessary to make a relatively discriminating assessment of this particular data.

Information Searches

Farmers' telecentre usage was dominated by searches related to agriculture: for information on new products, technologies and techniques; for information on events and training courses; and for information on markets and prices. Their searches were often focused on sites from public sector organisations like the National Agricultural Research Institute and the National Agriculture University. Their searches notably never involved the project's own Huancavelica Rural Platform. (This was perhaps not surprising given that the Platform – http://pallasca2.inictel.net – does not seem to have lived up to its ambitions: at the time of writing, it seemed that no new content had been added to most parts for about one year, and content was very limited; only the section on educational courses still appeared active.)

Slightly strangely, the ERTIC project did not include training in Internet information searches, but the telecentre managers had given enough individual support to get users started. There had also been encouragement from the educational institutions. Those

few school students who used the web to find information for their homework did so in a couple of subjects where their teacher had specifically referred them to web-based sources. The same was true of the Agricultural Technical Institute – lecturers had specifically given assignments motivating the student-farmers to make use of the web.

Through experience and/or training, the farmers had a good understanding of the limitations of web-based, externally-sourced information. In part, this was encouraged by the experimental and evidence-based approach taught by the ATI:

> "For me, the results [*from a web search*] are given only in the field. In some cases it worked and in other cases it did not. We cannot know from the website because they are from another 'system'". (Young farmer, Tongos, male user)

> "I also use it to be updated: livestock, pork and guinea pig farming in other places is different. Then we talk to other technicians to discuss if it can be implemented here in this area, because if we plant here seeds from other places, maybe it will not work." (Young farmer, Pazos, male user)

Farmers therefore made use of their own and others' knowledge in order to run the first steps of the information inflow chain effectively. In some cases, the "others" used are farmers in Pazos. In other cases, though, these are colleagues in different regions of Peru met during the internship in a different agriculture institute required as part of agricultural technical training. The farmers all used email and Messenger to maintain the combined social and productive value of this contact network.

As an example of this in action, one of the farmers from Aymará village needed help to protect his crop from weevils. He got in touch with a technical contact at a distant agricultural research centre who suggested use of plastic barriers. He then searched the web for further information. Having motivation, money, and the ability to source the plastic, he then applied it to a portion of his field, later adopting it for his whole crop once it had been shown to work.

Farmers also integrated the knowledge they gained from their internships with web-based information. Two had been in Cuzco (a region some distance from Pazos but in the mountains) where they saw farmers growing crops traditionally regarded as coastal like tomatoes, melons and pickles. Wondering if this would be possible in Pazos, they used web searches to find out about methods of cultivation, soil types, pests, etc; applying their collective knowledge in order to assess the validity and application of this data. Having – like the previous farmer – the motivation, money and ability to source necessary inputs, they set up a greenhouse which duly produced a good crop, and motivated other farmers to follow suit.

In other cases, though, farmers were not able to make effective use of the information they found. Some had found information about potato wholesalers to whom, in theory, they might sell their crops. But they lacked the resources (particularly raw materials, skills and knowledge) to produce a crop of a quality high-enough to meet wholesaler requirements. Even had they done that, they probably lacked the resources (particularly skills, knowledge and confidence) to set up and fulfil contracts with wholesalers.

Local Content Creation

As noted above, local content creation was one of the aims of the ERTIC project and also one of the interests of local users:

> "Yes, I would like to learn [*to publish information*] in order to put information about our school, how it is, what we are working on … this is to be seen by other schools in Huancavelica." (Teenager, Pazos, female user)

> "I would like to have my reports about agriculture and livestock farming to be seen by others and help them." (Young farmer, Tongos, male user)

These users no doubt had the information and knowledge resources necessary to begin the information outflow chain. As their statements suggest, they also had the motivation. But the chain did not materialise because users here were not involved in the "correspondents" project; nor did they receive any training on how to publish local content. Thus none of those interviewed knew how to create and publish their own data.

As a result, the farmers' aspiration (and the project's promise) of finding new markets for their produce had not been achieved:

> "The idea was that the Internet would solve problems of commerce and trade … they said our products would be offered [*online*] but … it has been a year and nothing has been solved." (Young farmer, Mullaca, male user)

(As another result, local content for the ERTIC web portal was provided only by telecentre staff, not by ordinary users, and it could only be uploaded by INICTEL staff in Lima, not by anyone in the telecentres.)

Non-Use

Non-users were included as interviewees. They did not lack awareness: all interviewees, whether users or not, were aware of the telecentre and had some idea about use of the Internet for communication and information. Indeed, most had been trained as part of the project.

Nor did non-users lack general motivation: all the farmers appeared equally interested in improving their crop yields, increasing their incomes, and introducing new technologies. Most – user and non-user alike – were enrolled in the FONCODES project that was aiming to reduce dependency on potato cultivation.

However, non-users did lack a number of important information chain resources. Even if trained, their IT skills had atrophied since training, contrasting with the users who had steadily built on the skills foundation provided by the course. The absence of Internet information search skills training had left an important gap, and non-users lacked the social or educational institution networks that had helped fill this gap for others. Hence, alongside the IT skills, they also lacked information skills, e.g. the ability to find information online and then filter it by assessing what had good data quality and what did not.

More fundamentally, non-users were found to be less proficient in literacy in Spanish than the user population. This, in turn, was mutually reinforcing with their expressed preference for face-to-face communication. They therefore found the web to be too text-based, too static, and insufficiently interactive. They also wanted a practical demonstration of results before they would be willing to change their agricultural practices. We could put this down to issues of risk aversion, but it more seemed to reflect a distinction between the concrete and the abstract. Users were willing and able to take the abstract – data found on the Internet – and turn it into the concrete through experimentation. Non-users were not.

This also seemed to relate to self-efficacy: "the belief that one is capable of performing in a certain manner to attain certain goals" (Heeks 2009). Low self-efficacy has been particularly noted with women in ICT-for-development projects, and the same was found here – a belief among some of the female farmers that they were not good at using the telecentre:

> "I do not know how does it work and I am embarrassed because sometimes I do not understand and I need them to repeat to me." (Older farmer, Pazos, female non-user)

Beyond gender, there were other demographic aspects to non-use of the telecentre. For example, older community members were hardly present. In part, this reflected ERTIC project goals, which saw beneficiaries as those "aged 39 or less" (MEF 2005). Older members lacked some of the basic information chain resources, such as IT skills, appropriate knowledge, and motivation.

There were also geographic aspects of non-use, with some negative relationship between distance from telecentre and level of use (something found in other ICT projects: Alampay 2006, Jagun et al 2008). For the school students, this was often a matter of time/opportunity – they had to walk some distance to and from their homes, and that precluded them attending the telecentre. As a result, despite motivation, they also lacked the kind of IT skills and confidence that their more proximal classmates had picked up. By contrast, some farmers from outlying districts did use the telecentre because they came by it every Saturday.

Finally, there were aspects to non-use that were user-independent because they related to the data resources that begin the information inflow chain. We can identify five main qualities of data resources, under the CARTA acronym: completeness, accuracy, relevance, timeliness, and appropriateness of presentation (Heeks 2006). In two ways, data was qualitatively deficient and so led to non-use in specific circumstances.

Sometimes, farmers were unable to find relevant data. For example, one of the farmers had tried searching for data relevant to local needs of growing artichokes, and marketing guinea pigs. He had been unable to find such data and, more generally, project staff reported this as a problem suggesting it was an issue of data availability rather than deficient search skills.

In other cases, data was not appropriately presented. There were technical databases of agricultural information that farmers were unable to use. Other information could be accessed but was in such technical language that it could not be understood.

Again, project managers corroborated the problem, suggesting it should be seen as a data not user issue.

D. Analysis, Conclusions and Recommendations

Mountain regions are developmentally-important but also developmentally-challenged. Those challenges include an exclusion from social, political and economic systems that is founded on an exclusion from human, natural, financial, physical, social and political resources. These exclusions are self-reinforcing but also based on remoteness of mountain communities that is physical, but which can also be thought of in less material terms.

As information and communication technologies start to diffuse into these communities, it was therefore appropriate for this research to ask "What role can ICTs play in overcoming the remoteness and exclusion of mountain regions?". It did this through study of a single telecentre set up in one of the poorest upland areas of Peru.

The chosen district – Pazos – is in some ways untypical of mountain regions, and our study was not an extensive one. Nonetheless, we have some foundation for providing a response based around two conceptual models, for both of which we find some "proof of concept" from this research.

Applying the resource movement framework to Pazos' experience, we can see the current evidence falls mainly into the positive category. In particular, new information brought into the community had led to improvements in agricultural practices. Information flowing out (or, more accurately, exchanged to and fro) had helped to cement social/productive contacts. The only question mark lay over some of the new contacts that teenagers were making.

The effectiveness of these new information flows was founded on the presence of necessary information chain resources, as summarised by the inflow and outflow models: skills, knowledge, money, motivation, self-confidence, etc. To some extent, these additional resources had been deliberately provided by the ERTIC project. But it is probably fair to say that, in large part, they had not.

We might say that the ERTIC project was attuned to (only) one early part of the information inflow chain: other than providing the technology "road" it just offered some relevant skills. Beyond that, though, the effective functioning of the information chains relied on:

- Institutions: the pre-existence of relevant data resources from public institutions since those provided by the project did not connect to the users in Pazos; skills and knowledge provided by educational institutions and, in the case of ATI, a particular attitude – almost a philosophy – towards the assessment and use of information.
- Informal actions: although an integral part of what the ERTIC project provides, the telecentre managers seem to have had at least as much impact through their informal activity as through the formal training they provided. They were the rock on which ICT activity, at least for the less-confident users, was based;

providing guidance on how to use the technology, where to search, sometimes even how to interpret and use data.

- Social networks: the urban contacts in Huancayo who provided initial ICT knowledge and skills; the more distant farming contacts who provided information-related skills and knowledge; and – a combination of the social and the informal – the resource-building activities of the groups who gathered around telecentre users.

And the functioning of the chains finally relied on factors that are at once more individual and yet also, in their origins, more contextual: the fact that some mountain community members have knowledge, motivation, money and other information chain resources that other residents lack.

The presence or creation of information chain resources lay behind the effective use of the telecentre. Conversely, the absence of such resources underpinned its non-use and ineffectiveness. This was the story told in the inability of farmers to make use of information on wholesalers; in the deficiencies of some online data resources; in the absence of important ICT and informational skills for some tasks or within some community members; and in the psychological profiles of some residents that suggested a lack of abstract reasoning or self-efficacy.

Returning to our question, then, what do ICTs do to remoteness? Pazos doesn't get physically closer to anywhere thanks to a telecentre. But it does get virtually closer and help overcome some constraints of geography. It has helped Pazos residents be and feel more connected with distant social contacts. It has helped Pazos residents be and feel more connected with distant sources of information. While physical remoteness may remain, then, virtual and psychological remoteness are reduced.

But this is not the death of geography. In other ways, the physicality of space keeps asserting itself. The telecentre provides a physical space for socialisation, and its levels of usage and its perceived value derive in part from this. Distance to the telecentre is a partial determinant of use and non-use. And the proximity of a sizeable city, Huancayo, has affected telecentre usage; quite possibly in ways that one may not find in more remote mountain locations.

In terms of resource exclusion, the ERTIC project overall has led residents in this mountain community to access resources from which they were previously excluded: data, skills, knowledge, technology. Perhaps for some also empowerment and motivation. Set against this, though, adding a telecentre in this way notably fails to provide access to other important resources; not just those relating to non-functioning of some information chains, but also others in each of the resource categories of exclusion noted earlier.

And we can see signs of the reproduction of both inclusion and exclusion. Many key information chain resources are built thanks to inclusion in external systems: basic IT skills and confidence from visits to the nearby city; knowledge and contacts from enrolment in the Agricultural Technical Institute. These in turn enable more effective use of ICTs when the technology arrives in the mountain community. And that more effective use reinforces or enables further inclusion: supporting geographically-dispersed contacts and networks; providing access to distant information. By contrast, those who began as more excluded – older inhabitants, students living in the

poorer districts further from the telecentre, perhaps female farmers – found it harder to make effective use of ICTs, and this reinforced their exclusion.

Looking more systemically at the impact of ICTs on exclusions, we have seen an inclusion in circuits of information and knowledge about economic activity. But we have not yet seen inclusion in new economic institutional systems, such as distant markets. Nor did we yet find any evidence of inclusion in formal social or political systems.

What, finally, about inclusion in less formal social systems? The general message seems to be one of continued more than new inclusion. All mountain community users employed ICTs to reinforce their existing social networks. Some seemed to be expanding their social networks but so far with uncertain results.

More generally, we can see the important interaction between social and digital networks. Just as ICTs support social networks, so social networks support use of ICTs. We are thus far from any notion of the atomised individual in cyberspace. The ICT users in this mountain community are surrounded both virtually and physically by human beings: the friends and relatives who introduce the Internet; the telecentre managers who provide skills, knowledge and support; the friends who group around and discuss when they use a PC; the contacts who help in locating, assessing and applying online agricultural information. Because of this, those who begin with stronger social networks are likely to derive more benefits from the insertion of ICTs into a mountain community, and to strengthen those networks further through use of ICTs.

Put these last few points another way, those who already have some of the necessary information chain resources – resources which social networks clearly help to provide – will of course gain more from the arrival of ICTs in mountain communities than those who lack such resources. We therefore have the basis for the entirely-predictable finding that ICTs will exacerbate inequalities within mountain communities. This inequality of impact is predictable in two ways. It has already been seen with other connectivity infrastructure in mountain areas: "the main benefits of improved roads tend to go to richer groups" (Karumuna 2004:286). And it has already been seen with ICTs more generally (Heeks & Kenny 2002).

We can conclude by saying that ICTs cannot alter physical remoteness, but do address less tangible aspects of mountain community remoteness. They do provide access, or reduce cost of access, to some resources. But at least in this project, ICTs fail to improve access to many other resources, and fail to address most forms of systemic exclusion. Indeed, because of the importance of initial resource endowments in making effective use of ICTs, digital technology can help reinforce patterns of inclusion and exclusion.

Some of these findings relate to the approach taken in this particular project. We can end, then, with some recommendations for projects.

Recommendations for Practice

The analysis here is firstly an argument for an "info-centric" perspective on the use of ICTs in mountain areas. Looking at a different technology of connection, we would argue that roads are less important than the vehicles that travel on them, and that those vehicles are in turn less important than the people and goods they carry. So likewise with ICTs. The telecommunications and computing hardware is less important than the applications software it supports; and those applications are in turn less important than the data they carry.

So projects must pay attention to the technology. But to get development results, they need to pay more attention to the data that technology brings into and takes out of mountain communities. Unless project members understand the role that data (when turned into information) can and could play in those communities, they will have no strategic direction for their projects. This understanding could go as far as a formal information needs and mapping exercise prior to the ICT project (Bossio et al 2005).

For a road, the people and goods carried are only important if they have some developmental result for the mountain community. So, too, the data that ICTs carry. Projects should therefore be "chain-centric": attuned to the additional resources – over and above technology and data – that are required in order to turn digital data into development results. Most mountain ICT projects are likely to recognise some part of this; for example they may offer training that provides skills and some knowledge. But how many are like ERTIC in relying for provision of information chain resources on other institutions, on informal activities, on social networks, or on the pre-existing resource endowments of individuals? It seems at least some other projects are like ERTIC: they provide individual resources – local language data content (Alcántara-Ayala et al 2004), or sources of finance (Pringle et al 2004) – but do not take responsibility for any other elements of the chains.

A fully "chain-centric" approach would look at the developmental results a mountain ICT project was seeking to deliver, and then track through the key information chain resources required to turn the ICT-borne data into those results. It would then analyse where those chain resources would come from; and seek to facilitate their supply. For many projects, this may involve more work on information literacy: building the information resources necessary to effectively find, assess and apply data that has been found online. It may also involve more work building specific skills around creation and dissemination of local data content. Taking the specific example of a productive project, being "chain-centric" could mean facilitating supply of financial credit, raw materials and transportation; finding evidence about demand; and facilitating links to traders and markets.

Mountain ICT projects can seek to directly enable supply of individual information chain resources. But they can also be "socio-centric"; recognising – as in the ERTIC project – that new chain resources are mainly provided by individuals' social contact networks. Other than the project managers, the Pazos telecentre initiative relied largely on the residents' existing social networks. But other – arguably more effective – mountain ICT projects build in the formation of new social contacts that can in turn

provide new resources (Lightfoot et al 2008); something that can therefore be recommended as a good practice.

Finally, we recommend that mountain ICT projects are "econo-centric". Broadly, and building from the Pazos experience, we can identify four main uses of ICTs in mountain areas, though they overlap in practice:

- Social: maintaining contacts with friends and family; building new social contacts.
- Welfare: information flow relating to the consumption of services like health, education, governance.
- Political: information flow relating to rights and political awareness and action.
- Economic: information flow relating to productive, income-generating activity like agriculture or micro-enterprise.

All uses are important but arguably the economic is the most important, and the one that mountain ICT projects should attend to the most. The no.1 difference between the poor and everyone else is – obviously! – money; so finding ways to help users earn more money will be a top priority. Sustainability of projects often requires that they generate income, and users are most likely to pay where they see a direct, positive financial impact.

Final Word

We should, naturally, be a little measured about conclusions drawn from one relatively-young mountain ICT project in one district; a district that is only partly-typical of mountain areas. We call for more research – particularly well-conceptualised research – on good practices and impacts of such projects. Such research can build on the two frameworks presented here: the resource movement framework, and the two information chain models. Work using other impact assessment frameworks (see Heeks & Molla 2009), would also be welcome.

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