HOLISTIC COMMUNITY DEVELOPMENT AND THE ROLE OF CONTEXTUALIZED & RENEWABLE ENERGY TECHNOLOGIES IN IMPROVING HEALTH CONDITIONS IN RURAL NEPAL

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ABSTRACT

This paper summarizes recent trends in community development schemes aimed at improving health through the improvement of the overall living conditions. Based on our combined 22-years of experience working in holistic community development (HCD) in Nepal, we argue that selective, single pronged approaches to health development are less effective in general in comparison to comprehensive ones. Though selective approaches to development (projects with only single components such as indoor lighting or a village drinking water system) are effective in achieving carefully de-limited goals, selective approaches cannot produce the critical synergistic benefits of the multi-pronged, holistic project framework we have designed and are implementing in Humla District, one of Nepal's remotest and most underdeveloped mountain areas.

Further, we describe why in remote, impoverished communities, it is absolutely essential that projects are sustainable, locally appropriate, and are developed in close partnership with the local community. The availability of elementary energy services is a crucial agent of long-term community development. We argue that tapping locally available renewable energy sources, through applied renewable energy technologies, developed for a defined geographical, cultural and climatic context, is central to project success. These technologies, in concert with the other contextualized project components we describe herein, form the backbone of our holistic approach to community development.

Introduction

At one time, it was axiomatic among community development professionals and theorists of development that projects should be holistic, multi-pronged, and involve the efforts of a multi-disciplinary team, acting in concert with local people. This emphasis fell by the way-side in the 1980s and 1990s, when international funding for development aid came under increasing scrutiny, and the scope of projects narrowed in order to meet ever-tightening control over reporting and transparency, and an overwhelming need to show results – preferably within one fiscal year. In this paper we describe our experience working in the 'trenches' of the community development movement, in the villages of Nepal's far Northwest, far from the rarefied hallways of academic thought and the meeting places of political power and decision making in

Kathmandu and beyond. Humla is the most northern district of the Karnali Zone, which is part of Nepal's western regional development area. This Zone is isolated from the mainstream of Nepal's economic development initiatives due to its remoteness, and because it is the only Zone with no connection to a road (Figure 1). In fact, a 16 day walk from the next road head is required to reach Humla's district center, Simikot. The alternative is to book a one hour flight in an old twin otter from Nepalgunj, in the very south of Nepal at the border to India. This flight lands in Simikot, on a gravel landing strip, but comes irregularly, depending upon the weather and the routine diversion of the air fleet to other parts of the country depending upon politics and business.

According to the UN's Human Development report, the Karnali Zone, with an Human Development Index (HDI) of 0.244 (1996) is the least developed area of Nepal (range 0-1 with Iceland scoring highest at 0.98). The HDI is an index used to make comparisons between living conditions of different populations, based on life expectancy, literacy, educational attainment and GDP per capita. The entire Zone is known for its permanent food shortage, environmental degradation, low productivity, regular disease epidemics among people and livestock, a harsh and unforgiving climate, weak education system, negligible employment opportunities, severe gender inequities in workload, health and education, and a growing trend toward out-migration. These features help explain the living conditions in the villages where our projects are located, where people's lives are marked by poverty and suffering that is almost untouched by the modest but significant development gains experienced elsewhere in Nepal. The authors' extensive experience working and living in the villages in this region of Nepal, in combination with our teaching and reading of the development literature, have convinced us that a return to a holistic community development model is the most likely approach to bring real and sustainable life changes with positive health improvements for local people.

Background

In 1978, the WHO (World Health Organization) and UNICEF sponsored a conference that was attended by representatives from 134 countries. It is referred to as the "Alma Ata Conference", and conference attendees resolved to embark upon a campaign that would bring basic health improvements to the urban and rural poor of the "Third World" in the 21st Century. The now famous declaration of Alma Ata set the tone for most community development projects aimed, like ours, at improving overall health outcomes, and stated:

> *"This conference strongly reaffirms that health is a state of complete physical, mental and social well being and not merely the absence of disease or infirmity…A major social target of governments, international organizations, and the whole world community in the coming decades should be the attainment by all people of the world by the year 2000 of a level of health that will permit them to lead socially and economically productive lives. Primary health care is the key to attaining this target as part of development in the spirit of social justice"* (Excerpted from the Declaration of Alma Ata 1978).

Two powerful themes emerged in the usage of the term "primary health care". Initially, when the concept of "primary health care for all" emerged in the 1970s, primary health care as a concept was integrative and multi-level. WHO gave health the holistic meaning of "the physical, mental and social well being of the individual." With its "Health for All by the Year 2000" initiative, the WHO sought to insure that "as a minimum, all people in all countries should have at least such a level of health that they are capable of working productively and of participating actively in the social life of the community in which they live" (quoted in Rifkin and Walt 1986:561). Projects inspired by this thinking were multi-pronged, aimed at, for example, decreasing diarrheal disease by improving hygiene and sanitation with infrastructural improvements to drinking water supplies. Later, due in large part to shifting economic conditions and a greater emphasis by donor agencies on quantifiable results and outcomes, a more narrow definition of primary health care emerged. This definition is often associated with the somewhat contentious "selective approach", discussed in detail below.

In the 1970s the concept of primary health care began to occupy the world's attention. The WHO published a crucial document in 1973 ("Organizational Study on Methods and promoting the Development of Basic Health Services"), in which it laid out some of the main issues. It identified the fact that the roots of the health services crisis facing the developing world did not lie exclusively in the domain of the health sector. Instead, the authors recognized that health had to be situated in a social and economic context and that political structures and priorities had to be considered as well.

This was the climate out of which the Alma Ata conference developed. Holistic community development as a strategy for improving health outcomes emerged in a period during which there was significant debate about the nature of poverty and the need to understand the structural changes that would be necessary to improve the lives of the impoverished. The foundation of this approach relied upon the idea that improvements in health would always be contingent in part upon changes in the social, political and economic factors that ultimately determine the quality of life of the world's poorest.

Comprehensive approaches to community development

Advocates of comprehensive or holistic approach to improving livelihood and health emphasized the fact that many issues affect health. The focus was on the fact that in most project sites in the rural developing world, the physical infrastructure (lack of roads and bridges), the absence of running water and electricity, the difficulties associated with getting people to accept and use such innovations as latrines, improved cooking/heating stoves, and lack of transport (among many other social and economic factors) all affect health outcomes. According to this assumption, the assistance of a variety of professionals in broad, multi-sectoral programs to improve health status in a target population was considered necessary. Health was viewed not simply as a problem of disease but of all factors contributing to lower the quality of life that the poor experience. Some examples of comprehensive primary health care programs would include projects that improve health awareness and training, community public health education, improved access to affordable energy services, drinking water taps, capacity to grow more nutritious food, improvements in the safety and cleanliness of living areas, building health posts and furnishing them with staff, supplies, and on-going training.

It is important to situate this approach in its appropriate historical context. Until the 1980s there was a strong sense of optimism in discussions and debates about international development. The world economy was growing and the social climate, particularly in the late 1960s and 1970s was favorable for projects that emphasized holism, community, and social equality. Investments in international development were high and expected to continue increasing. Multi-sectoral, broad-based comprehensive primary health care was "in".

Fast forward a few years to the 1980s. The world economy looked very different — economic recession, debt, the oil crisis and an increasingly unfavorable trade climate had taken their toll, and the world economy was not growing as hoped. Development projects across sectors had failed and many people had lost confidence in the process of international development, period. Projects focused on health were particularly concerning to analysts of development, because the possibility that health was not a development sector that was going to be able to be "turned over" to some governments in the developing world any time in the next 50 years was beginning to be understood (LaFond 1995).

Assumptions and Funding Trends

Early on in the development of the idea of comprehensive, holistic community development projects targeting health outcomes, there was an almost unspoken assumption among donor agencies that their support for development was temporary. Implicitly, the expectation was that someday, national governments would take over the projects that had been initiated with the support of external funding. Since the provision of basic hygiene and sanitation to its populace by a national government was (and still is, by most) considered to be a governmental obligation, it was, perhaps, only natural that funders thought that their involvement would be temporary.

As LaFond (1995) notes, weakening public support for overseas assistance in the 1980s strongly affected international donor agencies' budgets to programs that could not show "results". Health-focused UN agencies (e.g., UNICEF) and the WHO were affected by heightening public scrutiny and criticism as well, and were increasingly governed by the need to show results that were simple to display, easy to understand, and obtainable within a defined funding cycle (often only 1 year). This dramatically changed the nature of the projects that were promoted and funded.

Unhealthy Health Systems and Lacking "Results": Donors' Response

As donors became aware of the complexity of the problems associated with affecting health outcomes, they were also realizing that it was difficult to measure immediate health impacts for many of the components of the holistic community development programs that had been initiated in the 1970s. For example, it is difficult to measure the short term health impact of a water tap system, because though it may improve hygiene and sanitation initially, other factors can intervene and depress the benefits of these improvements on health. In response to the perception of these measurement and assessment problems, many agencies started to scale back in the nature and scope of the programs in which they invested.

Thus emerged selective primary health care, an approach that "espoused the mobilization of health services to attack the most prevalent disease problems (Rifkin and Walt 1986:562)." It is centered on short term, single-goal-oriented interventions, and cost effectiveness. Vaccination programs are an example of this approach. These are simple, effective and affordable interventions that prevent devastating, often fatal diseases experienced by many of the rural poor (e.g., measles, pertussis, tetanus, poliomyelitis, diptheria and tuberculosis). The hallmark of the selective primary health care approach is UNICEF's 'GOBI' program. GOBI is an acronym for Growth monitoring, Oral rehydration therapy, Breastfeeding and Immunization. These are four medical interventions that well-exemplify the selective approach: they are simple, low technology, single-sector, quantifiable interventions thought to have a low cost, high impact effect on child survival. GOBI was part of the much-touted 'Child Survival and Development Revolution'. A quote from a UNICEF official illustrates the appeal of Child Survival and the GOBI approach:

> "*The disastrous consequences of the recession prompted UNICEF to re-examine its work with a view to exploring and reordering its priorities at times when*

> *resources are limited amidst increasing demands and needs. This led to the adoption of low-cost, high-impact measures which would contribute to child survival and development…and [are] viewed as the core of a cost-effective and high impact programme"*..(quoted in LaFond 1995:26).

Unger and Killingsworth (1986) assert that in the mid-1980s, selective primary health care was the darling of bilateral co-operation agencies, foundations, academics and research institutions, and international agencies. They suggest that “rather than health factors, the major determinants of this adoption have been political and economical constraints acting upon decision makers (1986:1001).”

Lessons from the field

Comprehensive primary health care is fairly well studied, and available studies allow us to identify the approach’s successes and weaknesses. A review of the impact of a variety of interventions under the comprehensive approach suggested that the evidence for the impact of community based health-care programs in poor countries on the mortality rates of young children is weak (Ewbank and Gribble 1993). More recently, a study was conducted in the Gambia that analyzed the influence of village-level primary health care on mortality rates in children (Hill et al. 2000). The Gambian study compared mortality rates over 15 years among 40 villages. All of the villages had access to maternal and child health programs at and vaccinations from a local health centre, but only some of the villages had primary health care. Primary health care was defined as the presence of one paid community health nurse for about every five villages, in addition to a village health worker and a trained traditional birth attendant. During the 15 years studied, funding and support for the primary health care program grew, was maintained, and then dropped. The authors found that while the primary health care program was well funded and supported, the mortality rates of 1-4 year olds were significantly lower in the villages with primary health care. For infants, the results were less clear cut, though for both age groups, mortality rates rose after support for the primary health care staff weakened.

Other analyses of specific community based interventions aimed at improving hygiene, sanitation and indoor air pollution show positive results, as described below. Many studies of specific interventions show that the introduction of certain technologies can have a strong effect on improvements in health.

Indoor pollution kills one person every 20 seconds in developing countries **(**Warwick 2004), and there is no doubt that indoor air pollution contributes to the incidence of respiratory disease in the villages where we work. Reductions in indoor air pollution (IAP) are known to be very effective in improving the health status of people, particularly among children under the age of five. The many negative health effects of excessive IAP are well understood (see Smith et al 2000 for a review), and the health benefits of transitioning from heating and cooking methods that produce heavy IAP loads to cleaner methods have been documented. Ezzati and Kammen estimate that in their study population in rural Kenya, interventions that reduced IAP caused a reduction in acute respiratory infections by 24-64%, and acute lower respiratory infections by 21-44% (2002). We conducted 24-hour IAP tests in Humli households with traditional, smoky lighting and open fire cooking/heating systems. In homes with the ISIS/RIDS-Nepal solar PV systems and smokeless metal stoves, TSP, PM_{10}, $PM_{2.5}$ and CO values[3] showed that these technologies improved indoor air conditions very significantly. Post solar lighting and smokeless stove installation, households had IAP levels that were 10-25 times lower than the levels we measured in traditional (open fire conditions). This was true for all measured values, including TSP, PM_{10}, $PM_{2.5}$ and CO values. Preliminary analyses of our health data suggest that this reduction in IAP has substantially reduced the incidence of symptoms of respiratory disease.

Interventions improving safe stool disposal have been shown to be effective in reducing diarrheal disease rates. A study of domestic hygiene and diarrhea showed that post-neonatal mortality rates were 68% lower in families with latrines than in those without (Rahaman et al. 1985). Gorter et al. (1998) showed that Nicaraguan families with children whose fecal matter was properly disposed by using diapers were at reduced risk of diarrhea than those families in which children went without diapers.

Hand washing after defecation has been found to be uncommon among many people in the developing world (Han et al. 1986, Huttly et al. 1994). In order to wash effectively enough to prevent disease transmission, one study in Guatemala found that mothers had to wash their hands an average of 32 times per day, using an additional 20 liters of water (Graeff et al. 1993). A review of studies of hand washing suggests that “the promotion of hand washing with soap is an intervention that appears to be both highly effective, reducing diarrheal incidence by between 27-89%, and feasible” (Curtis et al. 2000). The ability of people to wash their hands frequently and effectively depends upon readily available water, which is a significant problem for many poor communities.

Potable water is often thought to be absolutely critical in preventing diarrheal disease. However reviews of 67 studies in 28 countries in 1986 and another 17 studies in 1991 “concluded that improvements in water availability were probably more important than in water quality” (Curtis et al. 2000:27). In fact, it appears that the health effects of having clean (drinking and cooking) water are swamped by the benefits associated with having enough water to increase hygiene and sanitation practices, in particular dishwashing and hand washing.

Flies have been linked to diarrheal incidence in a number of studies. One study of Israeli soldiers demonstrated a significant reduction in diarrhea when yeast-baited fly traps were introduced (Cohen et al. 1991). Another study showed that spraying insecticide effective in killing houseflies reduced the incidence of diarrhea by nearly 25% compared to villages where the insecticide was not sprayed (Emerson et al. 1999). Unfortunately, control of flies in a village setting is extremely expensive and difficult. However, as we have observed in our projects, safe stool disposal is an achievable goal. Preliminary analysis of our data shows a reduction in the incidence of diarrhea, we which believe is at least partly attributable to reductions in the probability that flies are contacting stool, which would limit disease spread.

Many studies have shown some effect of a variety of interventions falling under the umbrella of comprehensive primary health care. However, measuring the effects on health of some of these interventions can be very difficult, particularly on short time scales. This is because the negative effects of other problems that the target community faces can cancel out the health effects of any one of these interventions. Thus measurement of the benefits of comprehensive programs has to be extremely careful and for validity must also be compared with controls.

Comprehensive vs. Selective Approaches: Needs in Humla, Nepal

Our combined practical experience from over 2 decades in the field and in our work with The ISIS Foundation and RIDS-Nepal, has convinced us that a selective approach alone cannot effectively and responsibly improve the livelihood and health outcomes of

Humli people. Currently, it is widely recognized that acute respiratory infections (ARIs), diarrheal diseases and malnutrition are the main problems that need immediate and sustained attention in rural Nepal. These problems cannot be addressed without making deep and significant changes to infrastructure and behavior patterns. While selective projects targeting diseases like polio and measles are critical and do show results that are easily quantified, they cannot be the only approach to tackling the serious health problems facing Humli people in the struggle for improved overall living conditions. We are not alone in this realization, in fact, nor is it new. A study in central Nepal of interventions aimed specifically at reducing ARIs showed a 60% drop in ARIs with education, immunization and antibiotic treatment of children showing signs of pneumonia, but the authors concluded that this reduction was overshadowed by the still unacceptably high rates of mortality from the other killers, primarily diarrhea, and malnutrition (Pandey et al 1989). Despite the fact that this realization may be shared by other people in the development field, project models still tend not to be as holistic as we would recommend.

In our time in the villages, we have seen positive synergistic effects of holistic community development programs, when project components are chosen by villagers based on their needs assessment and when these components dove-tail together to improve the overall hygiene, sanitation, improved access to elementary energy services and health situation in the village. This is what inspires us to continue to improve upon a model we call the "Family of 4" and "Family of 4 PLUS", the outline of which we originally designed nearly 10 years ago after having worked with, and lived among the local communities. Over the years we have developed, improved upon and added new project components, based on participant observation and direct consultation with villagers. We find that the empowerment associated with the teaching/learning, equipment ownership, and project design and implementation uplifts individuals and groups of individuals within the village in a fashion that could never be achieved by a selective approach to improving overall living conditions and thus health outcomes. This experience has convinced us that a return to holistic community development, with projects designed after a detailed needs assessment is conducted in concert with villagers themselves, is not only good and successful; it's imperative.

The Role of Renewable Energy Technologies in HCD

There is a strong relationship between poverty and access to electricity with increasing poverty the more remote and difficult to access the communities live. Approximately 80% of Nepal’s 28 million people live in rural areas, with around half of these so remote that neither a road nor the national grid will likely ever reach them. While Nepal has no fossil fuel resources, it is a country that is rich in renewable energy resources such as hydro power and solar energy. These abundant and locally available renewable energy resources can be tapped into with local developed technologies that the community has helped adapt to the local conditions.

With an annual average water runoff of an estimated 225 billion m^3 from over 6,000 rivers, Nepal’s technical and economically feasible hydro power capacity is estimated 43,000 MW. Additionally, the sun’s free energy presents an applicable and sustainable local renewable energy resource for every Nepali, with an average solar insolation of 5.5 - 6 kWh/m^2 per day (NASA, Zahnd A., 2004). Both generating and storing energy through these rich solar energy resources, as well as powering appropriate and sustainable lights, brings potential health, education, social and economic benefits to the people who have previously lived in homes with excessive indoor air pollution. Nepal is not very windy, as it is landlocked, and due to its unique geographical conditions, it has very few large flat areas of land. But there are various areas where rivers have cut deep north–south valleys into the massive Himalayan mountain range, stretching from the east to the west. While there is no wind speed data map for any location in Nepal, there are many valleys with strong average winds where local people could greatly benefit from using their local wind energy resource.

Poverty has many faces, and cannot be defined simply with economic values and figures, as different standards, ethics and expressions of what poverty means are held in different cultures. Despite this variation, poverty manifests itself across settings in an inability to meet basic human needs such as food, shelter, work, clothing, clean water, fuel, health care and education, within people's cultural context. It denies human beings the chance to live dignified lives, with choices and opportunities for change and development. Additionally, it is well understood that women are much more vulnerable to the suffering and indignities of poverty than men in most societies and cultures. Health outcomes, particularly for women, are notoriously negatively affected by living conditions in which people rely upon open fires for heat, cooking and lighting.

One clear way to improve upon this situation is to work toward providing people living in poverty access to, and control over sustainable energy-producing projects. It is widely accepted that "poverty alleviation and development depend on universal access to energy services that are affordable, reliable and of good quality" (Reddy A.K.N., 2002, Saghir J., 2005). Access to energy services is a key in satisfying the daily needs of human beings, and there are clear linkages between access to energy and reduced infant mortality and fertility rates and increased literacy and life expectancy, as a recent WEA report explicitly illustrates (WEA, 2002). While links between health and access to energy are illustrated in the studies cited above, there is an important gap in household level studies of the role of renewable energy technologies in improving health status. Many authors have described the effect of reducing indoor air pollution for improving respiratory health (see e.g., Ezzati and Kammen 2002), but most if not all of those gains relate to the introduction of smokeless metal stoves. As we describe above, in our work, the very substantial reductions in indoor air pollution we see in the homes in our project villages is attributable to the combined effect of changing both heating/cooking methods (with smokeless metal stoves) and lighting methods (with solar PV systems). The separate contributions of the traditional cooking/heating method (open fires) vs. the traditional lighting method (burning a very smoky, resin rich wood on a stone plate) to indoor air pollution is the subject of a study we will conduct in 2009.

We would argue then, that for those people living in remote areas, far away from mainstream development and the national grid, renewable energy resources present some very promising opportunities. They can make clear and definitive headway towards improved livelihood and health outcomes for the whole family through improved access to energy services, if they are responsibly and sustainably utilized. It is also clear that local universities, such as Kathmandu University, can play a vital part in the development of contextualized renewable energy technologies (RETs), locally developed and adjusted for the geographic, meteorological and cultural conditions in which they will be expected to function. In our estimation, an RET is "contextualized" when its design has emerged after considering the end-users' energy service demands, their living conditions, economic power and ability to learn and apply new technical skills, as well as the long-term sustainability of the system.

Holistic Community Development Redux: The 'Family of 4', 'Family of 4 PLUS'

We began implementing our current model of holistic community development with RIDS-Nepal and The ISIS Foundation in 2002, after baseline studies of the target communities identified the following needs in consultation with members of each household and in group discussions between the local people and the project team. At the baseline, none of the households in these villages have indoor lighting, a smokeless stove for heating/cooking (householders still heat and cook with open fires), a place for human waste disposal other than the fields surrounding the village, or clean drinking water. After our team begins the first 2 year phase of an HCD program-partnership with the village, each household has access to the ‘Family of 4’ program's components, which are (Figure 2):

- A pit latrine.
- A smokeless metal stove with a hot water stainless steel tank.
- A solar PV system for lighting (with three 1-watt white LED lights per household).
- Access to clean drinking water from tap stands, from a community-owned spring.

Once the ‘Family of 4’ program has been running for 2 years, the second phase, the ‘Family of 4 PLUS’ program, can be launched according to the local community's own definition of needs and development. These may include some or all of:

- Access to a greenhouse in the village.
- Access to a solar drier in the village.
- Access to a high-altitude solar water heating bathing center.
- Non-Formal-Education (NFE) classes for mothers and out-of-school children.
- Access to a nutrition program for malnourished children < 5 years of age.

Tapping into locally available renewable energy resources to provide energy services in appropriate, affordable and culturally sensitive ways, in conjunction with projects addressing health, food, hygiene and educational needs, results in real, observable synergistic benefits, as described below. The approach embraced in the collaborative effort between The ISIS Foundation, RIDS-Nepal (Rural Integrated Development Services - Nepal) and the local people, is that the combined effects of these project components together is much greater than the sum of each individual piece. We believe in the synergistic effect of a project such as our 'Family of 4' and ‘Family of 4 PLUS’ because we have seen individuals and groups (e.g., women) rally together in ways they never did before, and take a qualitatively different and new approach to problems facing them. For instance, the NFE classes targeting women bring literacy to members of this community who have never previously been able to read posters or brochures with health messages. Now, not only can women read them, but this ability seems to reinforce their interest in building and maintaining their family latrine, and in the protection of the cleanliness of their water source (just to use two examples). Emboldened by new knowledge and skills, we see women seeking out more information and innovation to improve other elements of their lives in a fashion that is hard to imagine if we had limited our scope to providing, say, latrines alone. With the 'Family of 4' and 'Family of 4 PLUS', approach, we have created project components that both stand alone *and*, especially in combination, energise villagers’ faith in and enthusiasm for making changes in their village as a whole. It is easy for people to appreciate the benefits to themselves, their families, and the larger group from participating.

Sociocultural features of the villages and our field staff team

The partners in this collaborative effort believe that people are the center of each project, and applied technologies serve and support them toward improved living conditions. This approach demands that the local context, language and culture have to be learned and understood in order to comprehend the unspoken and invisible “software” issues of the community. This demands time, compassion and dedication - crucial parts of a project, difficult to identify and judge and even more difficult to budget and “sell” to some donor agencies.

To a very large degree, the success of the ISIS/RIDS-Nepal projects in Humla is based upon the strengths and character of the team members on the ground (RIDS-Nepal). In addition to the authors’ background in anthropology and applied renewable energy technology engineering, we have local team members who work full time, year round on the projects and who come from Humla or the neighboring district, Jumla. The Jumli team members have completed extensive hands-on training as well as certificate programs in sustainable technology at the Karnali Technical School, and each of them is matched by a Humli counterpart whom they personally trained. RIDS-Nepal also has close ties with the Kathmandu University and other international Universities, with whom joint research projects are conducted every year. Our field staff contains both male and female employees who are well trained in the applied technologies, and are articulate, motivated, and of middle and lower castes.

The last point is important. Although Nepal has formally abandoned the caste system, features of the system still prevail in most parts of the country and dictate social discourse and patterns of interaction. In Humla, villages are usually mixed in terms of caste composition, ranging from the lowest to the second highest caste. Humlis tend to be humble people who can be ill-at-ease with high caste urban Nepalis. Our team is composed of approachable individuals, each of whom has a special mix of lower caste position, good education, excellent linguistic skills and all are native to the rural areas of Western Nepal. In addition to the transparency of the project budgets and accounting and the quality of the work, we know that the social skills and capacities of our team make them highly effective on the ground. We also know that we are the only development organization permitted to work in Upper Humla undisturbed by the Maoists during the recent insurrection. This is remarkable, given that during the same period (2001-7) most offices in involved in community development throughout Nepal were shut down, project activities ceased and some offices burned or ransacked.

In the sections below, we describe in short some of the main project components central to our long-term HCD model, as well as some of the “soft” features that distinguish our experience with them. Each of the pieces of equipment that we install is developed locally, bearing in mind the cultural, meteorological, social and economic contexts and the technical limitations to working in this valley. For example, we needed to balance such considerations as the materials available in the villages to build the latrines, accommodating the heating needs and culinary preferences of local people in the design of a smokeless stove, the architecture of the houses in the design of the stove pipe, the amount of solar irradiation available in every household or cluster of households in each village, and so forth.

This level of detailed in research, development and customizing of technologies is part of what we have called "contextualized" technology in this paper, and it demands significant forethought and long-term commitment to working in the villages, “tweaking” the technologies as new demand or behavior patterns evolve, and resources to put into baseline needs assessment and follow up research lasting for at least one generation (~10-15 years).

An example illustrating how important it is to contextualize technologies comes from our experience with smokeless metal stoves in Humla. While most of the local families cook and heat on open fires, there are a variety of types of stoves to be seen around the valley. Some function only as benches or counter space, seeming to have been designed with profit (alone) in mind, as they do not come anywhere close to meeting the energy service demands of the people. What local people told us that they want is a cooking and heating system that allows them to prepare multiple dishes simultaneously, to produce the national dish of *dal bhat tarkari* (lentils, rice and vegetables) twice a day, hot all at the same time, whilst also warming the room in the winter. Humli people also like to eat a type of unleavened bread (*roti*) that has to be toasted against hot coals to produce the desired taste. These demands are tough to manage on a single burner stove or open fire place without an air flow regulation or exhaust damper, in order to control the combustion process according to the meal being prepared or the heating demands of the season.

The RIDS-Nepal smokeless metal stove, by contrast, is designed to meet these preferences, with an easily adjustable air intake and exhaust pipe valve, 3 burners on which food can be simultaneously cooked, and a toaster slot to toast *roti* against the coals. All of these tasks can be accomplished without opening the front of the stove, which is critical, since operating a smokeless stove with the door open allows smoke into the room, and causes the combustion rate to flare out of control, increasing the rate at which firewood is consumed. Each of our stoves has a stainless steel water tank abutting one side, where water can be easily boiled and stored for drinking, washing, or other needs. Further, each stove has a unique number so that we can follow it up for years to come. This has proven important for quality monitoring and trouble-shooting.

In the sections below we describe each of the components in the 'Family of 4' model, and some of the 'Family of 4 PLUS' components in more detail.

The Family of 4

Pit Latrine for a more Hygienic and private Environment (1st in the Family of 4)

Usually, people in these villages defecate wherever a free and private place can be found. Due to lacking awareness of the importance of hygiene and sanitation, a shortage of land, and with no local examples to imitate, the pit latrine is not a traditional part of the infrastructure for a household. In the "Family of 4" model, the pit latrine is the first component to be built. Work on the smokeless stove and the solar PV system does not proceed until the less exciting, lower prestige work of building the latrine has been finished. Because human waste is considered to be ‘polluting’ in the local ideology, few people want to be associated with the building of a latrine or its maintenance. We also know from other studies that women like to go in small groups to guard one another and to use the opportunity to socialize with their peers away from the scrutiny of their mothers in law (Dhakal, personal communication, 2008). Encouraging people to overcome this set of beliefs and associated habits has been one of the largest challenges we face.

An approach that we have found useful is to increase awareness and education about the issues surrounding hygiene and sanitation with posters and brochures we designed as well as with songs written in the local dialect, using images familiar to people from their own valley. We also emphasize these messages using the same materials (and more) in the NFE classes. Gradually, people see the need to use and properly maintain their pit latrine. As a result, the walking paths, the surrounding village fields, and the streams are cleaner than ever before, greatly minimizing the risk of the spread of diarrheal and other disease.

Smokeless Metal Stove for High Altitude (2nd in the Family of 4)

An open fireplace with no chimney and a home full of smoke is "normal" in Humla. The daily firewood consumption is 20kg – 40kg (Zahnd, 1998), and the health of women and children is profoundly affected by indoor air pollution from the fire. Increasing deforestation results in a scarcity of local firewood, forcing women and children to spend 7 - 8 hours daily gathering fuel wood further afield (IEA, 2002; Haddix McKay and Zahnd, 2005) every second day. Women, the primary users and organizers of the household energy, place a high value on improved energy services such as light and an efficient cooking and heating stove.

Now, each household has an efficient smokeless (i.e. with a chimney flue) metal stove, with a firewood consumption rate of nearly half previous levels (Figure 3). As described above, the stove is designed for local culinary preferences and heating needs. The stove is also time efficient, as it allows women to cook *dal bhat tarkari* all at one time, and it provides hot water for drinking and washing in an attached 9 liter stainless steel water tank. The stove ensures a smoke-free, cleaner, and safer home environment, where children are not longer at risk of falling into the open fire.

Solar PV System (3rd in the Family of 4)

Traditionally, every person in these villages uses the fireplace for lighting their home interiors, in addition to cooking and heating (Figure 4). In this culture, women and children are most likely to suffer from the heavy load of indoor smoke pollution (Warwick, 2002), causing respiratory diseases, asthma, blindness and heart disease (IEA, 2002). While the US-EPA (Environment Protection Agency) PM_{10} 24-hour standard is set at 150μg/m^3, not to be exceeded more than once per year on average over 3 years, indoor open fire places create PM_{10} levels ≥ 20,000μg/m^3 (Warwick, 2002, RIDS-Nepal unpublished data) on a daily basis, for hours at a time. Lighting is often the first use of electricity in a developing country, and people are willing to invest in home or village electrification once they understand the potential health improvements, the increased possible education for their children, and the possible financial savings (Mills, 2002) for their families. In order to design a solar PV village system that will reliably light a house over an appropriate life span, the following issues were important for our team to identify and monitor:

- The solar irradiation (kWhm^{-2}day^{-1}) for the location of the solar PV system.
- The village's population, annual growth, its load distribution and growth pattern.
- The sustainability, ease of installation, and maintenance of components.
- Feasibility and reliability of locally developed and manufactured products.
- Trade-off between sustainability/cost vs. high-efficiency.
- Participation of all stakeholders in every project step, including in economic terms.
- Culturally appropriate training, hand-over, operation and maintenance.
- The feasibility of a goal of minimal or no ecological impact during installation and operation.

Elsewhere, we describe in detail the three types of solar PV systems we developed and install in Humla, which are single home, cluster, and centralized village systems (Zahnd and McKay 2007). Here, we will describe a cluster system (Figure 5). Using the checklist described above, 17 clusters of 8 - 12 households were defined in one of our project villages. Each cluster has a central house, chosen by the community, on whose rooftop a 75W_R PV module is mounted on a seasonally adjustable aluminum frame. In that house, usually in the kitchen, is a 12V battery bank. This consists of 2 deep cycle, 12V solar batteries, each with 100 AH capacity. They are in a locally made wooden box, insulated with locally available silver birch tree bark and pine needles. Each household gets three 1-watt WLED (white light emitting diode) lights, connected to the cluster battery bank through armored underground cables. These 1-watt lights, with 42 lumens/watt (consisting of 12 high quality Nichia NSWP510CS WLED diodes with a 50º light angle) have a life expectancy of up to 100,000 hours (Craine, 2002). The lamps are developed and manufactured in Nepal by Pico Power Nepal[4]. They provide enough light to socialize, read, and carry out other daily tasks, thus eliminating the need for an open fire for lighting.

Some of the ‘soft’ factors associated with a project like this are monitored by our team in comparisons made between data collected in our baseline and follow-up studies, in which we ask members of every household about social and attitudinal expectations and changes associated with each project component. For instance, we carefully choose the household in which the battery bank for each cluster system is located. This needs to be the household of an individual who is well-respected, honest, and sociable. We do not advocate cross-caste user systems – each cluster of households drawing power from the same battery system should be comprised of families from the same caste. This cuts down on conflict and disputes over usage load and maintenance duties.

Sophisticated data monitoring and recording systems installed in several typical PV system types in the villages, monitor the daily solar radiation, the energy generated and stored and the consumers’ usage and load over the course of the day, week, month and year. Using the date generated by these systems, we can see what the usage pattern looks like, how the people learn for the first time in their life to live with electrical light inside their home and whether villagers are splicing other electricity-using devices (other than the lights) into the wires. Further, they provide important data to understand the long-term performance of a PV system under real conditions. These data are crucial for the ongoing development of our projects, and help us make improvements to the solar PV systems (Figure 6). Our team is in and out of the households year-round, troubleshooting and training/re-training and helping address issues that arise until the glitches smooth themselves out.

Clean Drinking Water from a Community owned Spring (4th in the Family of 4)

The main rivers in Humla, contaminated by upstream villages, human waste, washing and disposal of dead animals, used to be the daily drinking water supply for most of the villages where we work. Now, in our project villages, water flows from tap stands that deliver clean water from the community-owned springs high on the slopes above the villages. From the springs, water is brought to the villages through 90cm underground polyethylene pipes to cemented tap stands, providing clean and fresh drinking water to clusters of households in each village.

This is often a very technically challenging project component, since the terrain is steep, rocky, covered with snow during the winters and dangerous in the areas where the springs originate. Additionally, there can be some social tension associated with the location of the tap stands, and the users of each one. Members of higher castes prefer not to draw water from the same tap as members of the lowest castes. They make these preferences known to our team members in a way that, given some of our team members’ own lower caste positions, can be hurtful and discouraging. This is a feature of a caste-bound society like Nepal’s that can factor into projects in ways that can be damaging to team spirit and the ability of groups of people to work together. Despite the experience of frequent frustrations such as these, we have been able to successfully navigate these difficult issues to date with commitment and diplomacy – mainly because we are aware of the issues and invest the time and effort to confront and address them.

Family of 4, Plus (examples)

Greenhousing and Solar Driers

With 199 days frost in a year (NASA, Zahnd 2004), only 3-4 months (District Development Plan, 2003) of agricultural work is possible. Thus many Humlis suffer permanent food shortages with high levels of malnutrition, especially in children. A low-cost greenhouse prototype, constructed using local stones, wood beams and UV stabilised plastic from Kathmandu, was built at the ISIS/RIDS-Nepal High Altitude Research Station (HARS) in Simikot, Humla in 2005 (Figure 7). The greenhouse produced vegetables for 10 months of its first year. This is absolutely critical as our data show that an astonishing 67% of Upper Humli children under the age of five show stunted growth, a sign of serious long term malnutrition (Haddix McKay and Zahnd, 2005). Further, in order to store the greenhouse's product yields in clean and hygienic ways, a solar drier was developed in tandem with our colleagues at Kathmandu University. These driers are wildly popular in Humla, and allow families to efficiently and properly dry and preserve their precious foods for consumption in times of food shortage.

Non-Formal-Education Classes for Mothers and Out-of-School Children

With a literacy rate for women as low as 4.8% in Humla (Jumla, 2002), booklets and brochures purchased in the distant cities are not appropriate for awareness raising and education, at least not initially. Thus we developed a novel, Humla-specific NFE program for mothers and out-of-school children, with topics that support the projects described above, including solar lighting, cooking stoves, safe drinking water, pit latrine usage, greenhousing and improved hygiene. These themes are taught in evening classes initially through our pictorially-based posters, games and songs. As students’ literacy increases, other locally relevant reading materials are introduced and used under the guidance of the RIDS-Nepal trained NFE facilitator (Figure 8). In this way, the participants are immediately involved with subjects relating to the other project components which have been or are being implemented in their village, at a level appropriate to their educational experience, leading them to discover the wonder of functional literacy, and ultimately to participate in the development of their own teaching materials.

Nutrition for < 5 years of age malnourished children

As indicated above, a very high number (67%) of children under age 5 are malnourished in our project villages. This reality, staggering in the 21st century, is the result of unproductive land, the harsh environment, unpredictable, recurring natural calamities like landslides and droughts, remoteness and lacking knowledge of how to utilize the minimal available foods to maximum nutritional benefit. To begin to help this situation, we developed a nutrition program for the most malnourished children < 5 years of age and their mothers, in the project villages. Up to 15 mothers per village are instructed in basic nutrition, and trained how to mix and prepare a super porridge called "*sarbotham pitho*". This is made from locally grown lentils, wheat, soya beans and corn. This is added to the diet of the most severely malnourished children in the village. Weekly, the mothers of these children are visited by one of our team members, for counseling and to answer questions and help with problems. On a monthly basis, each child is weighed and measured, and data are recorded so that each child's growth and health condition can be tracked.

Solar Heated Bathing Center

The rivers in this high elevation area have been found to be warmest from June – August, measured as 12°C - 16°C. The rest of the year they are between 4°C - 12°C. Thus water for bathing needs to be heated by wood fires, when wood collection is already a huge burden for women. Thus, a commonly owned high elevation solar heated bathing center for women and men has been designed and is being built (Zahnd & Malla 2006). The solar water heaters, from another collaborative research project with colleagues at Kathmandu University, are designed and manufactured in Nepal, with hot water storage tanks and insulation to protect the system from freezing in the winter. One bathing center unit, consisting of four flat plate solar absorbers and one hot water storage tank, allows up to 300 people to enjoy hot showers (calculated at 10 liters, 50°C water per person) once every two weeks, addressing the pressing need to improve local hygiene. The population of a village defines the amount of units needed. A "village bathing center committee" is responsible to keep track of and to maintain the infrastructure. A data monitoring system, recording the incoming solar irradiation, the intake water, the absorber, the hot water storage tank temperatures and the daily hot water consumption, installed in the first prototype high altitude bathing center in Simikot in October 2005, provides valuable feedback for future improvements.

Conclusions

Our experience in the field compels us to argue that only a long-term HCD approach can sustainably and responsibly bring about serious change in terms of health outcomes and livelihoods improvement for people living in remote impoverished conditions such as in Humla. We would like to see a wide scale paradigm shift, back to long-term, holistic, multi-pronged projects that are reliant upon villager-led needs assessment and rigorous, annual, household-level studies of the social, attitudinal, technical and health outcomes associated with the studies. Ideally, projects should have long-term donor commitment to the follow-up and maintenance of projects. Projects need not be large scale, as in the case of the exemplary Millenium Village Project, but the commitment needs to be long-term, because the positive effects to be experienced as a result of this kind of effort will not be tangible in the short term. Donors and project staff members also need to be aware of the fact that by and large this type of work is not generally profit-making in the short term. At some point, small shops and businesses may, and should, indigenously emerge to service the long-term equipment needs to maintain and improve different project components. This can represent an important development for local people to help them to engage, if they wish, with the cash economy. Finally, we would like to remind our readers that change in behavior may be slow, and may take up to two generations to occur. This is especially true for project components such as latrines, which are so heavily laden with symbolic meaning that may, at first, be invisible to new comers to the cultural and social system. Working with local people with patience, compassion, and a shared understanding of the commitment each side has made to tackling the challenges that will inevitably arise, is necessary and will, we are confident, bear fruit that will nourish all participants, in perpetuity.

Notes:

1. The ISIS Foundation is an internationally registered INGO, www.isis.bm.
2. RIDS-Nepal, a registered Nepali non-profit NGO, www.rids-nepal.com.
3. TSP is total suspended particle. PM_{10}, $PM_{2.5}$ are particular matters of < 10 or <2.5 micrometer, and thus able to enter the respiratory system. CO is carbon monoxide.
4. Pico Power Nepal (PPN) can be contacted through Mr. Muni Raja Upadhaya, at: muniraj@wlink.com.np.

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Appendix

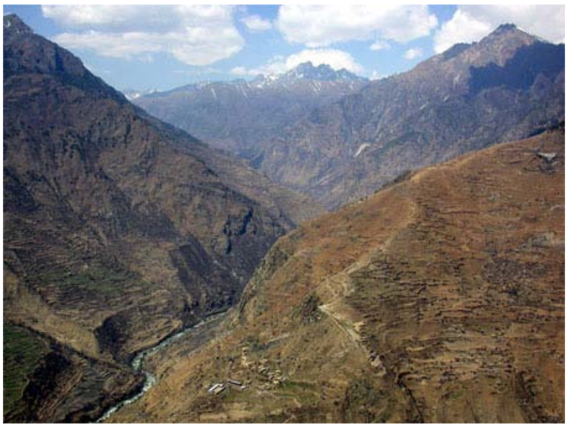

Figure 1: The Upper Humla region is 16 days walk away from the next roadhead, thus very remote and hard to get to.

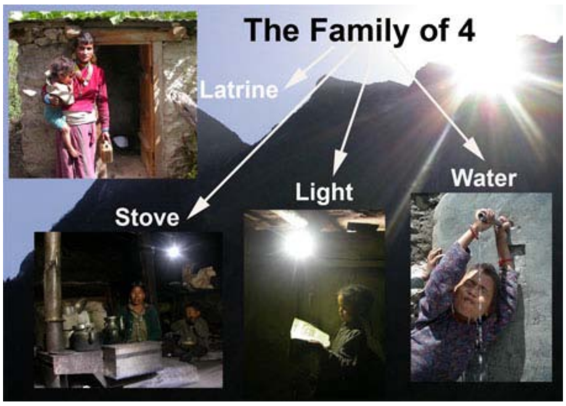

Figure 2: 'The Family of 4' consists of a pit latrine, a smokeless metal stove, elementary indoor lighting for each household and access for each family to clean drinking water.

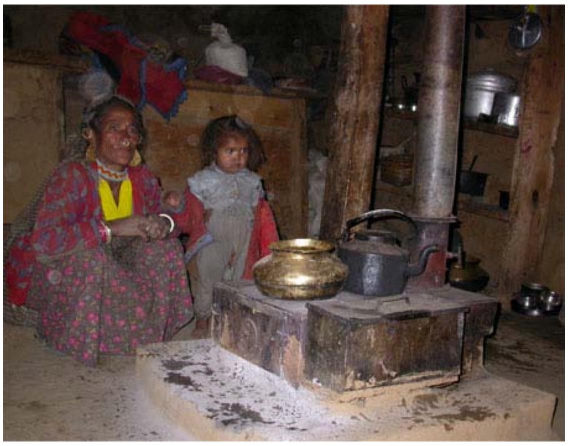

Figure 3: With our smokeless metal stove, up to half the firewood can be saved, food is cooked all at one time and the indoor air is

Figure 4: Previous to the elementary indoor lighting the use of "jharro" (a resin soaked pine wood tree stick) was the traditional way of generating a dim, smoky indoor light.

clean.

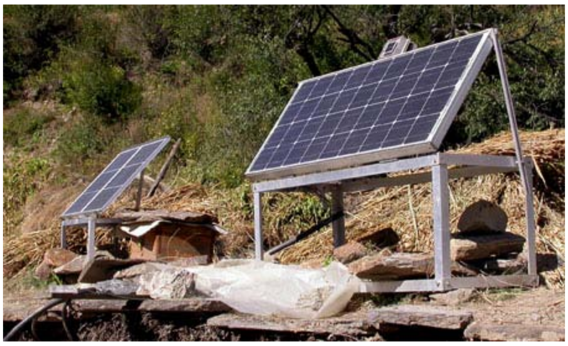

Figure 5: A solar PV cluster system for up to 12 homes. One $75W_R$ PV module (right) generates power which is stored in the battery bank installed inside the home. All other cluster homes are connected through underground cables to the battery bank, which provides up to 3 days of power without sunshine.

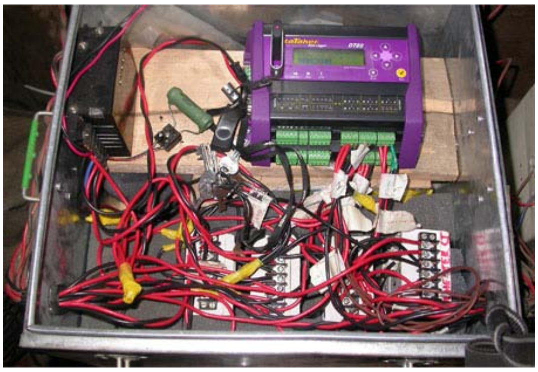

Figure 6: A sophisticated dataTaker DT80 data logger monitors and records 22 different parameters for one of each of the three types of solar PV village systems RDIS-Nepal developed. This provides us with detailed data for long-term performance.

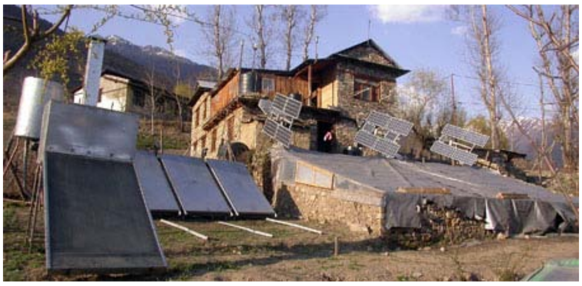

Figure 7: The High Altitude Research Station (HARS) which is also the ISIS/RIDS-Nepal Simikot field office. Here the newly developed RETs, often emerging out of collaborative projects between RIDS-Nepal and universities around the world, are field tested. Problems can be identified and technologies improved here at the Station, before they are considered ready to be implemented in the project villages. This is important for developing contextualized technologies and long-term sustainable HCD.

Figure 8: Women enrolled in the NFE evening classes meet 6 times a week to learn how to read, write and communicate. Teaching material is developed locally and the main themes are the 'Family of 4' / 'Family of 4 PLUS' village project components.

Brief Biography of Presenters

HADDIX MCKAY, Kimber is a cultural anthropologist who specializes in demography, health and human behavioral ecology. Dr. McKay has worked both full time and as a consulting anthropologist designing studies of health and treatment of illness in remote areas of Nepal and Uganda. She has lived and worked in Nepal frequently from 1994 to the present, and assisted in the design of locally appropriate development schemes aimed at improving health conditions, particularly in the use of sustainable energy technologies and in public health-related interventions such as latrine design, improved/smokeless cook stoves, lighting schemes, community based health training, and drama programs with specific health-related messages. She works with The ISIS Foundation as Manager, Humla and Research, and is an associate professor of Anthropology at the University of Montana, Missoula, MT, USA.

ZAHND, Alex has a mechanical engineering degree from Switzerland, and a Masters in Renewable Energy from Murdoch Australia. He has been in Nepal since 1983 and works in holistic community development projects since 1996 in the remotest and poorest mountain communities in the Himalayas. Since 2001 he has also been a member of expatriate staff of Kathmandu University, involved in teaching Renewable Energy courses as well as in applied research of renewable energy technologies. Since 2002 he combined his extensive field experience and applied academic research projects by developing and leading a long-term HCD project and a High Altitude Research Station, in the very remote and impoverished north western district of Humla, through the established non-profit NGO RIDS-Nepal (www.rids-nepal.org). He is also working on his PhD on the role of renewable energy technology in holistic community development, with practical applications in Himalayan villages in Nepal.