A Solar Cooking Case Study:

Investigating Appropriate Information and Communication Technologies (ICTs) for Development in Nigeria

Carole St. Laurent

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Table of Contents

Table of Figures

Table of Tables

1 Foreword

The focus of this study is appropriate digital information and communication technologies (ICTs) for development in Africa. For the last several years, I have contemplated, researched, and tested how these technologies can be of practical benefit to impoverished communities in rural Africa. Numerous needs and possibilities exist. As a result of my literature review, interviews with those involved in this field in Africa, and field research in Nigeria in April 2004, I chose to focus my major project on evaluating the effectiveness of video as tool for informal adult learning and community development. My research question was whether video was more effective than print-based materials for community development. This question arose from my experience that CD-ROMs, and emails containing textual information, were under-utilized at a community Information Centre in Nigeria with which I was in close contact. My project aimed to investigate whether videos can more appropriately share information with communities in rural Nigeria. This was researched through a case study, which developed and tested videos in Nigeria about how to build and use solar cookers.

The context in which this research was conducted is important. It is my view that ICTs are means to various ends, rather than ends unto themselves. Therefore, I sought to develop a project that would use ICTs as tools for a specific development goal. The topic of solar cooking was requested by people from Ago-Are, one Nigerian community in which I conducted field research. With their support and involvement, I was able to do a preliminary assessment of how ICTs could support training for a specific development goal. Video, as a visual medium, was used to introduce a cooking technology that has the potential to greatly improve the workloads of rural women, while reducing poverty, increasing health, and protecting the environment. I could not have asked for a richer learning experience than that of having the opportunity to design and implement this project in Nigeria. I worked with two existing, diverse, computer-focused, non-governmental organizations (NGOs) in rural Nigeria, to develop their capacity to make their own training videos, and to build and use solar cookers. The outputs of this project include two locally made videos about solar cooking in two local languages, nine locally made solar cookers testing

five different designs, new capacities at these centres to make and use solar cookers, and new skills to produce edited videos about any topic of interest to these communities. The research question asked whether locally made videos were effective training tools for transferring knowledge about solar cooking to people who had not previously heard of it. This project situated my master's research within natural development settings, with established NGOs as partners. This real-life, start-to-finish grassroots project provided a valuable learning environment for someone interested in pursuing international development work as a career.

This paper shares the story of this project – its motivation, conception, development and implementation, and particularly the light it shed on the use of locally created videos as training tools for community development. It also provides background information on the fields of ICTs for development, the diffusion of innovations, and participatory action research, all of which were integral project components, and important areas of learning within my master's program. I am grateful to the Commonwealth of Learning, whose financial support made this project possible. While the fieldwork in Nigeria was finished in June 2005, I will continue to support this project from Canada via ICTs until it formally ends in December 2005. I hope that sufficient local and external support will be garnered to speed its continuation and multiply its fruition well beyond the project's formal end date.

2 Introduction

The focus of my studies is the appropriate application of information and communication technologies (ICTs) towards international development in Africa. ICTs are technologies that help people communicate and share information, via old technologies such as radio and TV, and new technologies such as computers, software such as email, and the Internet (European Commission 2001). The application of ICTs to international development is often expressed as "ICTs for development," or "ICT4D." They are especially helpful for communication, knowledge sharing, and collaboration across geographical distances. My focus is how modern ICTs can be best applied in rural, economically disadvantaged, resource-limited, language-diverse and partially-literate areas. I am interested in ICTs' place within existing communication channels, and new communication methods that ICTs enable. Which methods and tools work better, and why?

I am an Internet consultant by profession, and have a strong interest in the use of computer technologies for international development. This master's major project researched the effectiveness of amateur video as an educational tool in rural Nigeria. Therefore the ICTs concentrated on in this paper are digital video, computers for video editing and communication, and the Internet. Email was the main communication tool that I used to develop this project with my African partners. We rely on it extensively to collaborate now that I am back in Canada. One output of this project was the creation of an online group to help interested parties in Nigeria to communicate about solar cooking.

My geographical focus is sub-Saharan Africa. I have long been interested in Africa, and in the field of international development as a means of addressing the great inequities that it faces in comparison with standards of living elsewhere in the world. This led me to study the work of The Sharing Way, and to visit some of their relief and development work in Kenya in the 1990's. I narrowed my geographic focus to rural Africa, where the majority of the population lives. Rural areas face more challenges for the adoption and use of ICTs than urban areas do, as will be discussed further in section *6.2 ICTs in Africa,* below.

An effective way to learn about the use of ICT4D in Africa is to visit communities on the continent. I wanted to talk to people who used ICTs in this context, and to others about their own needs and priorities apart from ICTs. I hoped that creative sparks would fly, and that together we would envision applications of ICTs that were relevant to the community, but perhaps not immediately apparent until we "rubbed minds" together. I first heard this expression in Nigeria while I was having just such a conversation, and it captures exactly what I mean.

In April 2004, I visited the founders, staff and volunteers of a grassroots community information centre started by the local Nigerian non-profit organization, Oke-Ogun Community Development Network (OCDN). Such centres are frequently called telecentres, which is the term I will use in this paper. A telecentre may provide a variety of services, such as computer training and access, Internet access, browsing of CD-ROMs about topics of interest (usually these are published by development agencies), perhaps a pay phone service, fax service, or printing and photocopying. A telecentre differs from a cyber café or telephone service because it has a mandate of serving the community, and offers more assistance and training to its clients. It may charge fees for its services, which are often required to keep such centres sustainable (Colle 2005:2).

In visiting this Nigerian telecentre, I experienced firsthand the frustrations, limitations, and benefits of digital ICTs in rural Nigeria. OCDN operates an Information Centre, providing access to the only four computers that I am aware of in the town of Ago-Are, in Oyo State, Nigeria. Home to 10,000 people in southwest Nigeria, Ago-Are is three hours' drive north of the major city of Ibadan. Red brick homes made from local clay are set closely together within the town. In the surrounding fields virtually every family has a farm to grow cassava, yam, maize, or other produce. There are four schools, and approximately thirty churches and thirty mosques of varying sizes. The major language is Yoruba, and English, the national language of Nigeria, is prevalent. The town has three paved roads linking it to the larger surrounding towns, and dirt roads servicing other areas. Restaurants and clapboard shops line the main road. Bread and a few staples are available daily, but the major food and cattle markets occur every five days. Taxis congregate at the motor park to take passengers to nearby towns and cities. Motorcycle taxis serve passengers

needing rides within town. My research has led me to believe that their situation is representative of many parts of rural Nigeria, and other African countries as well.

When I visited in 2004, Ago-Are had no land-based or cellular telephone service. At that time, the closest telephone and Internet access were both in Saki, a larger town thirty minutes away by car. Using public transport, one could expect a round trip for one hour of Internet surfing to take at least three hours. However, the occasional interruption of electricity, Internet, or telephone service would make the trip fruitless. The Internet service was so slow that in one hour, I could barely manage to open ten emails to copy and paste them to diskette for later reading. On one occasion we could not complete the sign up procedures for a Yahoo! email account within thirty minutes, and were too frustrated to keep trying that day.

While Ago-Are is a typical town in south-western Nigeria, for its size, its computer-based Information Centre is an unusual feature. The uniqueness of this centre relates to the state of ICTs in sub-Saharan Africa. This will be discussed in section *6.2 ICTs in Africa*, below.

In 2004, OCDN did not have Internet access, so their computers were used for training (mostly in MS Office), information sharing via CD-ROMs (sent by volunteers from the UK), and paid secretarial services. In 2004, one email exchange with them would take one month, as they needed to travel to the nearby town of Saki to visit the Internet café to download their emails, and they might return at a later date to respond to it if it asked detailed questions. Email access came at a significant expense for their travel and connection fees compared to the Centre's income ($1.40 CAD for roundtrip taxi fare, and $2.20 per hour for Internet access), but it provided a vast improvement over the previous means of communication – telephone calls with an intermediary who had a phone, could understand English and Yoruba, and who could relay messages through contacts to bring it from the city of Ibadan to the town of Ago-Are, and receive answers back. This is the communication process that Pam McLean, an OCDN supporter from the UK, used to communicate with them before email became available in Saki in 2003.

Communication was made significantly easier for OCDN when they installed a satellite Internet connection in October 2004. The fact that staff must pay for Internet access ($1.20 CAD

per hour), and that customers are frequently using the computers, mean that Internet access is still intermittent for them. But this is a vast improvement since an email exchange now takes days, not weeks. And occasionally we find ourselves online at the same time and can "chat" online using an Internet-based program that works like instant email. (Yahoo! Messenger and MSN Messenger are examples of popular chat programs.)

One of OCDN's requests was that I help them learn about solar cooking. They became interested in this technology after Pam McLean introduced it to them. Pam brought them a book about solar cooking in 2003, plus a video of herself using an Anahat curved cooker over a flame in the UK (the weather did not permit a demonstration using sunshine). OCDN did not experiment with solar cooking based on this book and video. They would have had to procure sheet aluminium and construct a simple stove to implement this idea. In 2004, Pam brought them a demonstration-sized Anahat solar cooker, but by then the book was lost. With Pam's help, they experimented with the cooker and successfully baked muffin-sized cakes over a flame with it. However, no one tried to make a larger cooker, or to cook traditional foods with it, since Pam left in April 2004.

People were still excited about the idea and requested that I find more information for them. They could not easily find this information themselves, as they did not have any telephone service in the town (cellular or land based), nor Internet access, their friends and family from the city did not know about solar cooking, and there were no libraries, universities or bookstores available to conduct research in. After returning to Canada, I researched solar cookers, and in August 2004 I emailed OCDN instructions on how to build and use the CooKit cardboard panel cooker. I requested feedback about the usefulness of the information and what kind of problems they faced, but their responses were minimal. They only mentioned one issue, the fact that they did not have a black pot, but a more common aluminium pot. I emailed two potential methods to blacken a pot – using fire, or using a homemade ash paint that I downloaded a recipe for. I do not believe these ideas were tried. From August 2004 until my return in June 2005, OCDN did not succeed in implementing the solar cooking instructions. Pastor David Adesokan, the OCDN Information Centre manager, wrote, "Your effort on the issue of solar cooker is a good one and I

wish we are able to come up with something good at the end. Please keep trying and help us with all information and guide lines that could get us the right answer" (Adesokan 2004). Mujidat Lawal, the Centre's trainer at the time, wrote (Lawal 2004):

> I am ready to support you with all my effort to make this project (Solar Cooker) to be a success and women interest groups are eager to hear from somebody that will come and eradicate poverty for them and since we have been seeing somebody like you we are ready to support you, we have been hearing about one author Hannah that she wrote a book about **SOLAR COOKER** and Pam also brought Video of it to Infocentre. Which Maria and Mrs. Ilubiyi are watching it but we are unable to do it at Ago-Are but if we are seeing somebody that will come and train us, we are ready to cooperate with him or her with full participation.

The video Mujidat mentioned was the one of Pam McLean using the Anahat solar cooker in the UK. Pam was cooking with it over a stove instead of in the sun, because the weather was not appropriate for solar cooking in the UK. According to Everett Rogers' extensive research into the transfer of technology, there are sufficient limitations in the video's content to explain why the video did not effectively teach solar cooking, without assuming that the video format itself was a poor means of communication. Rogers' research is reviewed in detail in section *6.5 Diffusion of Innovations,* below.

As well as sharing the solar cooking information with OCDN, I also sent it to Fantsuam Foundation, a larger ICT training centre in north-central Nigeria. David Mutua, the former manager of the OCDN Information Centre, began working with Fantsuam Foundation (FF) in 2004, and OCDN and Fantsuam Foundation have strong ties, particularly through David. They were enthusiastic about the idea of solar cooking, and felt it would be of practical help for their community. They had previously been interested in solar cooking but could not implement it

because of a lack of training. It is noteworthy that a mature telecentre that provides a large ICT training program, whose staff are well educated and speak English fluently, which expressed a historical, independent motivation to try solar cooking, did not make and test the CooKit based on the online instructions I sent them.[1] These were four pages long, and included a diagram, measurements, and instructions on how to build the stove. The only required materials were cardboard, tinfoil, glue, a black pot, and a clear plastic bag. Other links on the website provided background information, health and safety tips, recipes, and testimonials. I extracted the most important information and emailed it to OCDN and FF.

I am very curious about why two communities with which I am in strong personal contact, which expressed great interest in solar cooking, did not succeed in implementing a simple cardboard cooker based on Solar Cooking International's Internet-based information. I successfully made the same cooker based on the same information in September 2004, without any prior solar cooking experience. I confirmed that the necessary materials were available (cardboard, tinfoil, glue, paint and scissors). I offered to help them overcome obstacles. This intrigues me. And it sobers me. If literate, educated people like Pastor Adesokan and Mujidat Lawal cannot successfully use print-based material to implement solar cooking in Nigeria, when the materials are available and inexpensive, what can help them better? I began wondering if a video would be more effective. My exploration of that question resulted in the development of the solar cooking and video training project documented within this paper.

[1] See http://www.solarcooking.org/cookit.htm

3 The Research Question, and its Significance

Why are relevant and important knowledge resources, which are available on the Internet and via CDs at the OCDN Information Centre, not being used by community members? Even people with tertiary education, including teachers and nurses, seldom take advantage of the available materials such as how to prevent malaria, although malaria is a perennial problem in Ago-Are. Research on the use of ICTs for development shows that even information that communities request do not get used (Thione 2003:66). If this information was communicated audiovisually, would it be better used and more effective than printed materials?

Research on the impact of ICTs for development suggests that this would be true (Spence 2003:76; Fraser and Villet 1994); so do the personal opinions of some people I spoke with who are involved in community development. John Dada, the Programs Director at Fantsuam Foundation, believes that since Nigerians are largely oral and visual in their communication habit (as the popularity of home videos and Nigerian and foreign movies show), video may prove to be a more effective communication tool in Nigeria than print. “Speak, speak, in the language the people understand.” These words of OCDN’s late founder, Peter Adetunji Oyawale, still direct its mission. To see and hear is universally more powerful than to read. Studies show that “we retain 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we hear and see, 70% of what we say, and 90% of what we say and do” (Pike 1989:61).

Of those who heard it, who can forget Neil Armstrong saying, “That's one small step for man but one giant leap for mankind” (BBC 1969)? Of those who saw it, who can forget the image of the collapsing World Trade Centre towers on September 11, 2001? But can you remember a headline you read about either event? I cannot. I believe that the benefit of audiovisual materials over text is especially strong in Africa, where oral arts and history form rich parts of the culture, and where significant numbers of people are functionally illiterate in major world languages. This argument is supported by the work of Walter Ong (1984) of the Toronto School in Communication Studies. Ong showed that literacy, the technology of reading alphanumeric text, structures the

thought process and thus orally-dominated cultures, which rely on face to face or visual communication, differ in their mode of understanding from that of a literate culture. On my second day at Fantsuam Foundation, while greeting the mechanic, Emmanuel, I asked about his farm. He said, “I will show you. Seeing is better than hearing. Seeing is believing.” I noticed people saying “seeing is believing” on several other occasions in Nigeria, including during one of our solar cooking training workshops. Seeing was a key socio-cultural factor in this research, especially when describing solar cooking, which was new to virtually everyone in Ago-Are and Kafanchan. Seeing is much better than hearing, or reading, only.

If English, text-based materials are ineffective development communication tools at OCDN and FF, where the staff are literate in English, in ICT usage, and well educated, it is likely that megabytes of important information about agriculture, health, HIV/AIDS, etc., are much less effective than they could be, here and in many other developing areas. If this information can be made more accessible to its intended users by changing its language and/or format, it can become much more effective in serving its purpose. Which format will work better than English text is a very important question for development practitioners to ask, since it impacts most current development information, which is published in text format in major world languages. This is particularly relevant for ICT-delivered information that is not available locally, and would be difficult to get through other means (e.g., by inviting a trainer, or travelling to attend training). One of the key criticisms of the use of the Internet for international development, is that most online development resources are Western-based, in major world languages such as English (Mijumbi 2002:5; Huyer and Sikoska 2003:19-22). That is why “**local** or appropriately localised content” is the third key principle of the “Information and Communication for Development in Support of Rural Livelihoods” plan, introduced by the Department for International Development (DFID), UN Food and Agriculture Organization (FAO), and the World Bank (WB) in 2004 (FAO/WB/DFID 2004, emphasis theirs).

An audiovisual format inherently communicates more effectively than text because it allows people to see and hear information, rather than just read it (Pike 1989:61; Fraser and Villet 1994). This eliminates the constraint of illiteracy, and it adds rich audiovisual data that print lacks.

Since the text instructions that I sent to FF and OCDN about solar cooking were not used, I wanted to explore with them whether a video about solar cooking would be a better communication tool. This project is the result. The general research question that it explored was:

> Is video an effective medium for distance learning for people in Nigeria – in particular, for the local change agents who are best suited to sharing this information with others?

My specific research question, using solar cooking as the learning topic, was:

> Is a simple video of someone in Nigeria building a solar cooker with locally available materials, and modeling its use, an effective means of teaching local change agents how to successfully build and use a solar cooker?

My expectation was that complex activities, such as building a solar stove, and using a significantly different cooking method such as solar cooking, would be more thoroughly communicated through video than print. Communicating simpler topics may also be easier with the audiovisual qualities that video provides. After using the videos we created together in Nigeria for training workshops, I am convinced that they do communicate more effectively than print. Everyone who saw the solar cooking video wanted to try solar cooking himself or herself, although most had no prior knowledge of it. However, the printed materials I brought about solar cooking were not well used by even the project leaders, not unlike the text I had emailed previously. I recommended that they photocopy parts that I found particularly relevant and helpful for the current project, but they did not, nor did they spend much time reading or discussing the material. While time constraints for the project leader at FF, and financial constraints at OCDN were probably factors in these decisions, they could have been overcome by soliciting the help of a volunteer at FF, and by being scanned at OCDN.

If indeed audiovisual materials are more effective educational materials than printed text, a wonderful opportunity exists to increase the impact of a great deal of existing development knowledge by supplementing text-based communications with video-based communications. Thousands of development documents in major world languages exist on the Internet, including the solar cooking information that OCDN and FF did not use. Creating and disseminating audiovisual training materials could allow professional knowledge producers, such as development organizations and Solar Cookers International (SCI), and grassroots organizations such as FF and OCDN, to make important information more accessible to the neediest audiences, including illiterate people and women (who suffer from the highest rates of poverty and the lowest rates of education). This could multiply the impact of organizations such as Solar Cookers International. SCI has been sharing solar cooking information in developing countries since the 1970's. They have few staff and limited resources, and only two physical offices (in California and Kenya). Their training materials consist of books and websites including textual instructions supplemented with diagrams and pictures. If effective audiovisual training materials were developed in multiple languages, Solar Cookers International might achieve significantly higher solar cooking adoption rates than they currently do. This would allow solar cooking to reach people who cannot effectively use SCI's existing print-based training materials, due to language, literacy, or learning styles that rely on demonstration and oral communication over reading.

4 Solar Cooking

It seems appropriate at this point to briefly describe solar cooking as background information to this project. Solar cooking is a proven technology that was invented over one hundred years ago, and has been widely adopted in India in the last thirty years. It has the potential to reduce poverty, increase health, increase productivity, and reduce environmental degradation and pollution – with as little as a foil-lined cardboard box. It was an important means of helping refugees cook their food rations in the Kakuma refugee camp in Kenya since 1995, where desert conditions, poverty, and isolation made it very difficult to cook using combustible fuels (Solar Cookers International 2004). Former residents of the refugee camp have launched a cooperative business called SOCOCO, which profitably uses solar cookers to cook food at their hotel restaurant (SCI (EA) 2004).

These solar cooking successes offer examples of how Nigerian people can harness the free energy of the sun to cook food and pasteurize milk and drinking water, while reducing the harmful effects of using traditional cooking fuels. These include deforestation due to firewood collection and charcoal production, the physical hardships of collecting and chopping firewood, and suffering and early death due to smoke-related illnesses (primarily affecting women and children; African Development Bank Group 2004). As firewood becomes scarce, dependence on fossil fuels such as kerosene and gas increases. And as the expense of fossil fuels increases, so do poverty levels.

Quick Facts:

~ 70% of Nigerians live on less than US$1 per day.

* "In some locations, many families are said to spend nearly a quarter of their income on firewood."

The sun is free.

Sources:
~ *Environment and Energy for Poverty Reduction Programme,* Government of the Federal Republic of Nigeria and UNDP, May 20, 2004.

* *Renewable Energy for Rural Industrialization and Development in Nigeria,* UNIDO, 2003.

4.1 The Problems Addressed, and Their Importance

Sobering Statistics:

~ Nigeria will be completely deforested in 2020 at current depletion rates.

~ More than 35 million m^3/year of firewood is burned in the savannah region alone.

~ UNDP predicts 70% of fuel wood consumption can be replaced by renewable energies like the sun.

Sources:
~ *Environment and Energy for Poverty Reduction Programme,* Government of the Federal Republic of Nigeria and UNDP, May 20, 2004.

Nigeria faces a huge environmental problem due to the depletion of its forests caused by mining, increasing rural populations, and increased farming on previously forested land. If current trends are not reversed, Nigeria will have no remaining forests within the next twenty years. Not only is this an environmental crisis – it is a cooking fuel wood crisis which will lead to increased poverty levels as firewood becomes scarce and expensive, and as families are forced to switch to other fuels. If reforestation plans are combined with solar stove programmes that provide an affordable, renewable energy alternative, people will not need to cut down trees to cook with, and reforestation efforts can be allowed to take root.

Furthermore, there are significant health costs from cooking with firewood. When cooking fires are inside the home, tended by women with their youngest children on their backs or nearby within the room, the smoke can cause emphysema, other respiratory illnesses, and eye problems. An estimated one thousand and one hundred people die per day in sub-Saharan Africa due to cooking smoke-related diseases, particularly women and children (AFRO-NETS 2004). Therefore the potential health benefits of solar cooking are literally life saving.

Over **1,100** people **die each day** in sub-Saharan Africa due to illness caused by cooking **smoke**.

It is clear that for environmental, economic, and health reasons, reducing dependence on fuel wood and conventional fuels, and increasing the use of free and renewable solar energy, are important goals.

4.2 Benefits of Solar Cooking

Food cooked from solar energy is more nutritious because the lower cooking temperatures preserve more of the food's vitamins and enzymes. Solar energy can be used to pasteurize water and milk, thereby preventing diseases such as diarrhoea and typhoid fever. Solar cooking also provides economic benefits. As Chief Gbade Adejumo, the Chair of Oke-Ogun Community Development Network, said (Adejumo 2004), "The reality in Nigeria now is that all conventional methods of cooking such as firewood, kerosene, gas, etc., are becoming too expensive for the various strata of African women. And since solar power is available and virtually free all the year round, all of us should embrace it not only for affordability but for convenience." For families that purchase cooking fuel, adopting solar cooking in conjunction with traditional methods will reduce household expenses. This may positively impact females, who often suffer the most when there are insufficient funds for adequate food or school fees for children.

Health Facts:

~ 46% of Nigerians lack clean water.

* 80% of Nigerians are carriers of typhoid fever, which is spread through unsafe drinking water.

+ Solar cookers can pasteurize water and prevent diseases and untimely deaths.

Sources:
~ *Environment and Energy for Poverty Reduction Programme,* Government of the Federal Republic of Nigeria and UNDP, May 20, 2004.

* Dr. Chris Azukaeme, Kafanchan, Nigeria

+ Solar Cookers International (see www.solarcooking.org)

In Nigeria, women and girls are responsible for collecting firewood and cooking. They are the ones who suffer the negative impacts of deforestation with respect to ever-increasing distances required to travel for firewood, and most of the health problems associated with smoke inhalation. They will therefore be significant beneficiaries of cleaner, cheaper and easier solar energy. If solar cooking is adopted in the home through mothers,

daughters will learn these methods as well, one generation of women role modelling for the next. Creating the foundation for this first generation of women to solar cook is the challenge of adaptation, as it affects socio-cultural norms. The next generation of women in charge of cooking for their families will help integrate solar cooking into their communities' practices.

4.3 What Has Already Been Done

The efforts of other solar cooking researchers inspired and informed this project. Solar Cookers International, and its extensive website of solar cooking information, is a particularly rich source of information, inspiration, and lessons learned from other projects.[2] Several Nigerian citizens and organizations are already using and promoting solar cooking, but the untapped potential for greater adoption of solar cooking in Nigeria is tremendous. Where solar cooking is currently researched and practiced, it is done so in isolation, as there seems to be no networks or knowledge-sharing opportunities for Nigerian solar cookers. Greater collaboration would increase the impact and effectiveness of solar cooking efforts in Nigeria. The sharing of solar cooking successes, outreach programs, training materials, and mutual encouragement are important ways to accelerate the adoption of solar cooking in Nigeria.

There are also lessons to be learned from previous solar cooking projects that had disappointing results. Pastor Caleb learned about solar cooking from the Christian Rural and Urban Development Association of Nigeria (CRUDAN) years ago, and has been trying to integrate it into his work at the Centre for Research and Development in Appropriate and Educational Technology (CEREDAET), a research organization in Jos. He attributes the poor adoption rates to the required lifestyle changes to use solar cookers, inconvenience due to slower cooking times, and lack of promotion. Therefore, this project chose to emphasize training, encouragement and support among solar cookers in Nigeria, and wide dissemination via video and online resources.

4.4 Types of Solar Cookers

There are three main types of solar cookers: panel cookers, box cookers, and parabolic (or curved concentrator) cookers. Within these types there are many variations on designs. This project used all three types of solar cookers, which are shown below. Many other designs are available on Solar Cooker International's website.[3] The principle is similar to a greenhouse – the sun's rays pass through a glass or plastic cover, hit the black pot, get converted to heat, and the glass or plastic insulates the pot to retain the heat. A black pot gets much hotter than pots of other colours, particularly silver. In marginal weather, the more insulation the solar cooker has, the more it retains heat. A black metal tray in the bottom of the cooker is very effective at increasing the heat being transferred to the pot. My favourite solar cooker was a large cardboard box cooker with a glass lid, a black metal tray bottom, and 3" walls filled with crushed newspapers as insulation. An extra panel to reflect more sunlight into the box may be a way to make it even hotter (as long as it did not interfere with unattended cooking by casting shadows as the sun moved).

Figure 1: Rashid Adesiyan checking water in CooKit Panel Solar Cooker, Ago-Are, Nigeria

(Note: the pot must be put in a clear plastic bag for effective solar cooking)

[2] See www.solarcooking.org, www.solarcookers.org

Figure 2: Box Solar Cooker with Glass Lid, Ago-Are, Nigeria (with Rukayat Adewumi, front, and Grace, back)

Figure 3: Parabolic Solar Cooker, BayanLoco, Nigeria (left to right: Maria Ajayi, Pastor David Adesokan, Ezekiel Kyari)

[3] See http://solarcooking.org/plans.htm

5 The Research Context

The research context in which I explored video as a training tool can be addressed at several levels. This research occurred in rural Nigeria, in organizations that have been using computers for only a few years – since 2003 in the case of OCDN, and since 2000 for FF. To better understand these organizations and their settings, it is helpful to review the state of computing in Africa. There are many impacts upon it, including electrical supply, technical skills, climatic conditions that impact the longevity of computers, and communications infrastructure for Internet connections. The broader context within which ICTs in Africa fall is the development discourse of ICT4D around the world. Of particular interest to this project is the historical use of audiovisual materials in development. Section *6 Theoretical Foundations* outlines these below, including my own approach and philosophical affiliations on ICT4D.

The research methodology was participatory action research (PAR). Its theory and historical background are discussed in section *6.4 Participatory Action Research*. The long, rich research into the diffusion of innovations has particular relevance to the sharing of solar cooking, so it is discussed at some length in section *6.5 Diffusion of Innovations.*

At a narrower level, the experiential context in which the research questions were explored was within a development project to introduce solar cooking to the communities in which OCDN and FF work. The project included capacity building to give these NGOs the technical skills to develop these videos, as well as to train them in solar cooking. This project is described in section *7 The Research Project*, below. While the research questions explored in this paper comprised only a small component of the whole development project, the opportunity to conduct this research within a real development context was very important to the research methodology, output, and findings. In fact, inexperienced volunteers developed the video, rather than telecentre staff, who did not have enough time to devote to this. We faced budget shortfalls and serious time constraints – but these are the realities faced in most development projects. Because this research occurred within a participatory development project that incorporated these constraints, the results may differ from those that a positivist research project would have found by

circumventing these constraints. My hope is that that having conducted the research within a development project will make its findings more valuable to ICT4D practitioners who are considering using video-based training materials in their own work.

5.1 Research Limitations

Due to delays in obtaining a travel visa, my time in the field was reduced from six to three months, yet the scope of the project was not reduced. The resultant time pressures precluded the opportunity to use the videos as a "train the trainer" tool for change agents who had not participated in the solar cooking project. Instead, we used the video as a training tool for community members who had no prior experience solar cooking. Community members are the target audience for the solar cooking project, but we had intended to test the videos' effectiveness for those who would teach others how to solar cook, such as development workers and teachers. The opportunities I had to test this video with this audience leads me to hypothesize that solar cooking might have been better understood and more successfully practiced by members of these groups, than by the general population. During the training workshops, a home economics teacher from the local College of Education, and a nurse with experience in community health work, were the quickest to grasp solar cooking. They asked detailed questions about the principles involved in solar cooking, to understand why and how the stoves worked. This would have allowed them to experiment with solar stove designs, and make them more conscious of properly aiming the stoves. Both of those women would make excellent trainers and promoters of solar stoves. If the home economics teacher at the College of Education trains future teachers to solar cook, and these teachers teach students in the public schools how to solar cook, the practice could quickly spread throughout Nigeria. It is my hope that FF will nurture this opportunity. The nurse, Paulina Sheyin, has already joined our informal Kafanchan Solar Cooking Group.

Additional limitations included the fact that the participants were new to solar cooking as well as to videography. They were practicing both new skills at the same time,

while trying to develop high quality training materials about the topic they were still learning about themselves. The project members who participated most in the solar cooking training and video production were volunteers struggling to balance their time on this project with their other commitments. The NGO staff lacked the freedom to devote as much time to this project as did the volunteers. These factors are explained in more detail in section *7 The Research Project*, below.

6 Theoretical Foundations

Three main bodies of knowledge inform this research project: ICT4D, participatory action research (PAR), and diffusion of innovations (DOI). Each is presented in its own section within this chapter. Applications from the history of participatory video have been incorporated into the sections on ICT4D and participatory action research, since video is a key component of this research. Reflections on how these theories were applied within this research project are elaborated in section *7 The Research Project,* below.

6.1 Historical Context of Digital ICTs for Development

The role of digital ICTs in support of international development has been a major field of debate and practice since the 1990's. This field has been termed "ICTs for development" (ICT4D). ICT4D is defined as (TechTarget):

> an initiative aimed at bridging the digital divide (the disparity between technological "have" and "have not" geographic locations or demographic groups) and aiding economic development by ensuring equitable access to up-to-date communications technologies. Information and communication technologies (ICTs) include any communication device -- encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. The United Nations, through its UN Development Programme, actively promotes ICT4D as a powerful tool for economic and social development around the world.

ICT4D has matured over the years. Narrowing our scope to computers and the related digital ICTs that support the Internet revolution, the focus of the 1990's was building

infrastructure rather than applications, but this is just the foundation. In order for ICTs to benefit a community, they need to be used in locally valuable, relevant ways by local people. This began to be recognized in the late 1990's when it was realized that the provision of digital technology alone did not necessarily improve development success, and that there were many factors to effective ICT use. This has led me to view digital ICTs for development as a pyramid that shows the changing foci over time, from the bottom up. Each layer depends upon the strength of the foundation of the lower layer(s):

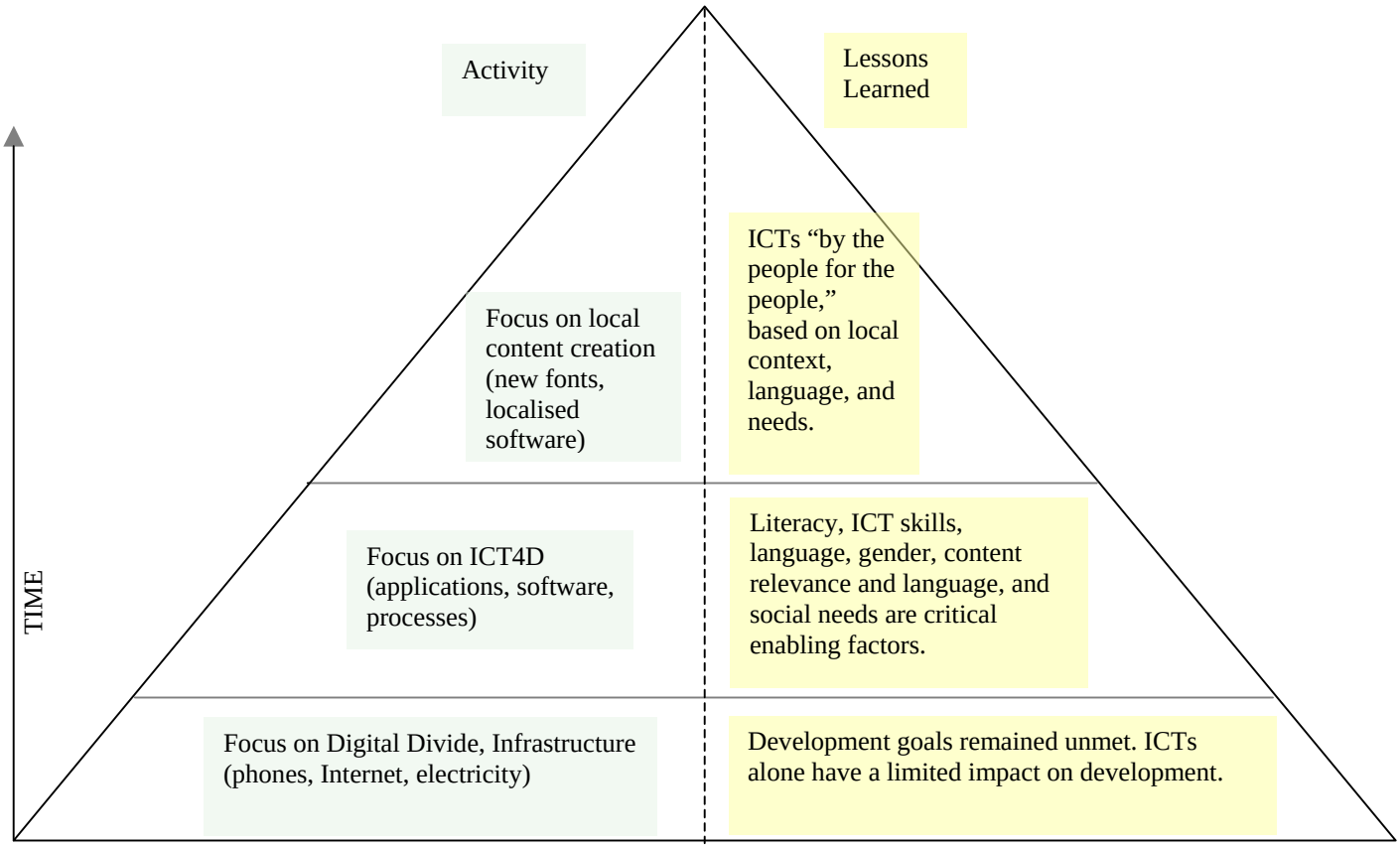


Figure 4: Digital ICT4D Historical Development Pyramid

The base of the pyramid, tier one, represents building the infrastructure necessary for the use of digital ICTs. Significant attention has been devoted to the "digital divide," the phrase coined to describe the gap between the availability of ICTs in the North and South

(and within communities in the North and South). Efforts to bridge the digital divide continue, and include national and international areas of concern, such as telecommunications policy. Mobile telephony is a key technology with its economical alternative to land-based telephony, and is expanding into rural areas. However, it is currently inadequate for Internet connections, so satellite and even radio communications are used as alternatives. Some African initiatives for infrastructure development include The African Connection and the Ministerial Oversight Committee, The African Telecommunications Union, The African Advisory Group on ICT, and the African Information Society Initiative (Chetty 2003:7-10). In addition, ICT development is a priority for the New Partnership for Africa's Development (NEPAD) (Chetty 2003:10-12). These efforts are important to the diffusion of digital ICTs throughout Africa, and should continue to be a priority. At the same time, alternative energy sources such as solar power, and more appropriate hardware for the heat, dust, and low energy requirements in Africa should be pursued.

I see the second tier of the ICT development pyramid as creating appropriate applications for users, with "applications" encompassing software, databases, and communications networks such as online communities. For example, software needs to be converted to local languages to be most applicable for development. Open source software, because it allows people to change it and share their changes, offers more opportunities for language conversions than are available in commercial software. Translate.org.za is an organization dedicated to translating software such as Open Office (a free alternative to Microsoft Office), web browsers, and Google into South African languages.[4] Similar software has just been translated into Hindi and Tamil.[5] Mozilla, the producer of the popular open source Mozilla and Firefox web browsers, supports localization projects [6] (the industry term for converting software, games, or books into other

[4] See http://translate.org.za/ (accessed Aug. 21, 2005)

[5] See http://www.ildc.gov.in/ (accessed Aug. 25, 2005)

[6] See http://www.mozilla.org/projects/l10n/mlp.html (accessed Aug. 21, 2005)

languages is called “localization,” because often products require other changes than just language to become culturally appropriate, including attention to colours, images, etc.). Sometimes a font must be developed before computers can support a new language. The organization, Bisharat, supports the development of African language fonts, and provides information about similar efforts. For example, a Yoruba font can be downloaded from http://www.learnyoruba.com/.

The third tier in the ICTs for development pyramid is creating and customizing information, beyond just using it. A lack of locally relevant, local-language content is one of the missing pieces that have limited the impact of telecentres such as OCDN and FF to date (Colle 2005:5-6; Huyer and Sikoska 2003:16-17). Content can be irrelevant due to its language (e.g., English), its format (e.g., written versus audiovisual), its cultural and contextual assumptions (e.g., that the reader is a native of North America), or its subject. The lack of relevant content can be addressed in two ways: by authors such as development organizations creating such content, and by communities developing their own content (White 2003a:41). This solar cooking video project takes the second approach by creating videos in Nigeria about solar cooking, in Nigerian languages. Where literacy is not an issue, a strength of computers is the ability to make content very easy to type, edit, manipulate and share, and this is what people usually first learn: word processing, spreadsheets, then perhaps desktop publishing or databases. Imaging and video editing software are the logical next steps in content creation, especially when addressing the need for local content in areas where literacy levels are varied, and oral cultures predominate.

I believe that the ability to easily publish ideas is one of the most powerful aspects of the Internet. In the late 1990’s, this was noted as an important future focus by the IDRC African ICT branch, Acacia. They saw the applicability of ICTs for local knowledge dissemination through both online (email and Internet) and offline methods (print, audiovisuals). They even suggested the development of a website for all projects so that

local knowledge would not get subsumed by newly available international knowledge (Graham 1997).

The strength of the World Wide Web is that it allows one to share information and exchange ideas with the world. However, this remains primarily text-based, and could be expanded with some strategic attention to audiovisual training and extending the current interest in home videos. The most popular online application by far is email, which is a tool that allows people to share their own content with family, friends, or associates (Thione 2003:42-43, 47-48). Beyond email, online groups and websites make it easy to share information with broader, even global, audiences. The cost and ease of publishing websites is dramatically better than it used to be even a few years ago. With free tools such as Yahoo! Groups and Blogger, one can collaborate with groups and publish websites. One can even publish audio blogs by telephoning in the entries, which will be published as audio links on your weblog. Blogger offers a free audioblog service,[7] but the access number is in the United States, requiring a long distance telephone call to use it.

The usefulness of the Internet is growing for people in the South. It is much more feasible for people to be *content creators,* rather than just *content browsers,* today than ever before. If the infrastructure and availability of good computers and access to them exists, members of developing countries could enjoy this rapid improvement, including the growing maturity of open source software. These tools let people choose their own content, language, dialect, and format, circumventing the problems of irrelevant content. The information can remain local to one computer, one community centre, be shared with small numbers via email or online groups, or with the world via the Internet. Colle (2005) suggests that universities, who are researching agriculture and other important fields, link with telecentres to develop local content, distribute it to communities, and encourage interaction between universities and communities. Collaborations can also be developed between telecentres and research institutes. In 2004, for example, OCDN and the

[7] See http://www.audioblogger.com/

International Institute of Tropical Agriculture (IITA) implemented a joint project to help farmers in Ago-Are interact with researchers at IITA and the University of Ibadan via ICTs. This project was the impetus that brought Internet connectivity and developed the Community Television Viewing Centre in Ago-Are via OCDN, for the showing of educational videos (as well as for entertainment). This facility was used to share our solar cooking video.

An excellent example of how ICTs can address current infrastructure constraints and address various community development goals, is a multi-faceted project developed in Laos by the Jhai Foundation.[8] Based on local needs and conditions, it includes components such as low-wattage computers able to survive harsh physical environments, pedal-powered wireless communications systems, capacity building, and economic projects such as selling locally grown coffee over the Internet. Through this experience they developed a 6W, alternative-powered, $900 Jhai PC and Communication System that is in a proof of concept stage, and has attracted interest from 80 countries (Jhai Foundation).

While the digital divide discourse focused on technology infrastructure, the ICT4D discourse has matured to include a great deal of attention to enabling factors which help people to use ICTs, including education, literacy, ICT literacy, supportive environments, and attention to gender and social needs. This deepening awareness arose after projects that focused primarily on technical issues had disappointing results (Murdock and Golding 2004; Huyer and Sikoska 2003). Also, it has become recognized that ICTs are of no value in and of themselves. They must be appropriately used before they provide benefits. Ethan Zuckerman (2004), the founder of GeekCorps, an organization that sends tech-savvy volunteers to help organizations in the developing world, explains:

> "For Development" is an interesting clause. It asserts that we're not bringing ICT into developing nations because it's important in and of

[8] See Jhai Foundation, http://www.jhai.org/ (accessed Aug. 10, 2005)

> itself. We're doing it because it's got some sort of impact on human development – it will help people get health information, or grow more crops, or make money selling handicrafts to the rest of the world.

Zuckerman summed it up well: ICT4D means the use of information and communication technologies, old and new, to improve the quality of lives and livelihoods of the poor in developing regions of the world. In an effort to refocus on the information and communication being shared, rather than on the means by which they are shared, a new term has arisen: information and communication for development (ICD). DFID, FAO, and the World Bank have recently announced a five-year process to apply ICD to rural livelihoods (FAO/WB/DFID: 2004).

Currently, many development organizations are focusing on the United Nations Millennium Development Goals (MDGs), which define targets for improving the lives and prospects of the poor in many ways, including making the benefits of new ICTs globally available (UN). Not only is ICT4D an MDG itself; it is also an important means to realize the other goals. As an IT specialist, I can propose a myriad of ways that ICTs can help to reach all of the MDGs – poverty reduction, education, infant mortality, gender equality, etc. The UN ICT Task Force believes that the use of ICTs to address the MDGs is critically important, and they have documented recommendations of how to do so (2003:7-21). Many other development organizations agree, and have specific projects and policies about the use of ICTs for development (for example, the Canadian International Development Agency, International Development Research Centre, The World Bank, UN Development Program, UN Educational Scientific and Cultural Organization, The UK Department for International Development (DFID), UN Food and Agriculture Organization (FAO), etc.).

The ICT4D discourse has become extremely specialized, so that one can follow discussions about their impact on poverty reduction (sometimes called ICT4P), education (ICT4Ed), health (through the field of telemedicine, which uses online communications for diagnosis and/or treatment, or more generally through knowledge sharing), as well as gender, and numerous other areas. The ICT4D portal on http://www.DevelopmentGateway.org currently links to twenty-five key sub-topics within ICT4D. Browsing them will demonstrate the wide variety of areas in which the impact of ICTs are being discussed. The number of areas in which ICTs are being applied is much greater than this.

6.2 ICTs in Africa

To understand the environments in which OCDN and FF operate, as well as to critically consider how to apply ICT4D in Africa, it is necessary to understand the state of digital ICTs in sub-Saharan Africa. While “there is unanimous agreement among Africa's leaders and pan-African structures on the benefits that ICT can bring and the impact it can have on a wide range of development issues” (Bridges.org 2003:13), they are not a panacea for development (Huyer and Sikoska 2003:1).

But digital ICTs are not very accessible yet in Africa. Most people in the developing world do not yet have telephone access, let alone the electricity, telecommunications, computers, or Internet access to participate in the information society. In 2001, of the approximately 816 million people in Africa, it was estimated that (Jensen 2002):

- 1 in 4 had a radio (205m)
- 1 in 13 had a TV (62m)
- 1 in 35 had a mobile phone (24m)
- 1 in 40 had a fixed line (20m)
- 1 in 130 had a PC (5.9m)
- 1 in 160 used the Internet (5m)

The *Networked Readiness Index 2001-2002*, a ranking of the 75 countries most capable of participation in the Internet, showed that Africa has extremely undeveloped ICT networks and low capacity to use them, as judged by factors including infrastructure, ICT use, network access, policy, capabilities and ecommerce (Kirkman et al. 2002:11-13). Only four sub-Saharan African countries were included in this index. The other forty-three countries were not ranked due to difficulties collecting data about them. Ironically, this is partially due to the digital divide. Of the four countries included in the study, South Africa ranked 40th, Mauritius 51st, Zimbabwe 70th and Nigeria in last place at 75th (Kirkman et al. 2002:12). And these represent the African countries with the best ICT capabilities!

A further difficulty lies in the distribution of ICTs. South Africa and northern Africa have the highest rates of ICT development on the continent. Furthermore, within all African countries, the vast majority of telephone lines, electrical resources, and Internet service are located in their largest cities. These are inadequate to serve the urban populations, which represent a mere twenty to thirty percent of the population. The majority of Africans live in rural areas, which are even more poorly served (Chetty 2003:6). Even so, in the cities, telephones and Internet cafés and telecentres are available. The sharing of facilities broadens their reach substantially. On the other hand, many rural areas either do not have electricity, or it is unreliable, with generators providing a backup supply where possible. There is also a lack of rural telephone infrastructure. Cellular phones are increasing service to rural areas due to their cost effectiveness and lower physical infrastructure requirements compared to landlines. However, Internet connections often rely on landline telephone access, which is more reliable than cellular telephony. Satellite and radio Internet services provide alternatives to phone-based Internet access. Nor is it easy to find the financial capacity or human resource skills to invest in ICT capacity development. Furthermore, where the services are available, lower economic classes are sometimes still excluded from them due to costs, lack of training, language or illiteracy issues.

The digital divide was recognized as a major factor hindering the South's participation in the increasingly global economy, especially after the Internet, online marketing, and ecommerce became significant components of global business in the 1990's. It is recognized that the global information economy is forging ahead, whether or not Africa keeps up with it. There are great risks in further marginalization for Africa if it does not invest in ICTs (Mansell and Wehn 1998:103).

6.2.1 ICTs for Development in Africa

In addition to enabling participation in the global economy, ICTs are important enablers that can be used immediately by all sectors of society to improve relief and development efforts, governance, healthcare, and education. Indeed, they already do so (Chetty 2002:2-4). And when appropriately designed and delivered, they offer practical help to the most disadvantaged citizens to increase their farming and small business incomes – including elderly illiterate women, who are arguably at the farthest end of the digital divide (Mijumbi 2002).

Critics of ICT4D sometimes set up a false dichotomy between meeting basic needs versus providing ICTs (UN ICT Task Force 2003:5). With appropriate interventions, ICTs can reduce poverty, for example by giving farmers access to distant market prices to get fairer prices for their produce. I believe that if a portion of all development budgets went into appropriate ICT use, it would result in better needs analysis, stakeholder participation, transparency, monitoring and evaluation, and knowledge sharing – all of which can improve future interventions. For example, a Nigerian micro-credit organization called Rural Searchlight invested in one computer to manage their financial records. Its founder, Victoria Adetona, said that this reduced the time devoted to accounting, keeps their records more accurate, and allows them to train youth in the use of computers, which they see as a critical component of education today – and one that is not provided in Nigerian public schools (Adetona 2004).

In other instances, the ability to use email to send project reports, questions, and answers almost instantaneously can create much better decision-making and avoid months of delays that “snail mail” has imposed on projects. People who have worked in international development have told me that it is not unusual to receive information that is six months old because of how slowly it is gathered and transcribed by hand, and the manual effort takes field staff away from providing other valuable services. At other times, those urgent, valuable services preclude field staff from doing data collecting at all, and reporting, if it is required for external agencies, is done quickly and inaccurately.

The benefits that human rights lawyer Mbuthi Gathenji could gain by the use of computers are substantial. In 2003 we spoke at length about his work, and the impact that ICTs could have on it. As the Director of the Dispute Management Centre in Nairobi, Kenya, he has documented approximately one million paper records of property lost by Kenyans in the 1992 Rift Valley displacement. He wishes to verify these with the government records that are available, and the testimonies of village chiefs and others who may also be displaced, and therefore difficult to locate. His goal is to secure property restitutions for displaced Kenyans. The appropriate use of computers could dramatically assist his work. Field researchers could use laptops to record testimonies directly to a database, eliminating the time consuming effort of transcribing paper records. A database could be used to manage each record and change its details over time. Data could be gathered together from multiple laptops via diskettes or other storage media, or online synchronizations, and records could be found within seconds. Gathenji was a quick convert to the concept of computerized record keeping, and hoped to find funding to invest in computerization. This is important not only for efficiency, but for security. This was demonstrated dramatically when Kenyan officials attempted to confiscate his records (Gathenji avoided their confiscation at the time). There is a great risk of loss because his years of work are documented in a single paper copy.

The leap from a traditional, oral society to one that integrates Internet-based resources is much bigger than the step from a book society into the Internet revolution was

in the North. O'Farrell et al recommend giving attention to this leap to make the introduction of ICTs into previously oral cultures more successful. Whereas known and trusted elders are the knowledge repositories in a traditional oral society, external information comes from unknown and distrusted sources. The failure of one telecentre in Mexico was partially attributed to inattention to the role of elders as community knowledge brokers, failing to involve them in the project design, and failing to demonstrate the usefulness of this competing information source to them. To make other projects more successful, ICT-based information should be integrated into existing local information systems (O'Farrell et al 2000).

6.2.2 Audiovisual ICTs for Development

One of the ICT capabilities that I have most wanted to explore is the use of audiovisual communications. Compared to text (the primary communication method of the Internet and computer-based data, as well as in formal education), audio replaces written words with spoken words, and introduces music and other sounds into the sensory experience. Visual mediums introduce diagrams, blueprints, photographs, visual art, and moving pictures. If a picture is worth one thousand words, video is worth ten thousand. Audiovisual content is recalled four or five times better than material heard in a lecture, and nine times better than written material (Fraser and Villet 1994). When the audiovisuals are developed in the field rather than somewhere very remote from it, the sounds and pictures include local change agents, local languages, landscapes, and songs. This is very different from words written in a foreign language, or in one's national language but using a foreign writing style (e.g., I find it difficult to read Nigerian newspapers because the writing style is so unfamiliar to me). Audiovisual communications are very different from even a letter from your most intimate friend in your mother tongue.

If a picture is worth one thousand words, a video is worth ten thousand.

A picture is worth a thousand words – especially if they are in a foreign language.

They are inherently richer than text. Nigerians have a strong affinity to videos and movies for entertainment, with a budding movie industry. This is beginning to be extended quite naturally to information sharing and educational activities, with groups such as Communications for Change developing audiovisual materials for social causes.[9]

Radio is by far the most widely available and accessible audiovisual communication technology in Africa. The book, *The One To Watch* (Girard 2003), promotes the combination of radio with the Internet and other technologies to strengthen the impact of both. For example, listeners to agricultural radio shows could communicate their questions to the radio show producers in person, by phone, mail, and perhaps email. Researchers could find the answers online or in data stored on their computers. Some of this data may have been received by mail on CDs, a method of sharing information with telecentres that are not connected to the Internet. The answers could then be broadcast on future radio shows. This takes advantage of the reach of radio to the largest audience, and adds the abilities of computing and the Internet for access to global information sources, strengthening both.

Recently, a promising old approach has become much more affordable and feasible to use: developing locally created videos to share information. Don Snowden pioneered the use of participatory communications in the 1960's through the sharing of filmed messages on Fogo Island in Canada. He used video as a tool of self-reflection, communication and empowerment among island communities, and between the communities and the government. It led to the revitalization of the communities, and prevented their relocation by the Newfoundland provincial government (Quarry 1994). The resulting Fogo Process spread around the world as its efficacy was shared. The documentary video and companion manual, called *Eyes See; Ears Hear* (Snowden 1984), document how one project successfully implemented this process in India.

[9] See http://www.cfcnigeria.org/

Audiovisual materials have also been used very successfully in development for education. Educational television programs have been used for rural education in India with excellent results since the 1970's, and include two-way audio conferencing for interactive training (Joshi 1999). One thousand videos were made for primarily illiterate farmers in Peru in the 1970's and 1980's as part of training packages including guidebooks, trainers' guides, and practical application of the lessons. Ninety-two per cent of the farmers liked the video component because "it was like 'actually being in the field'" (Fraser and Villet 1994). This supports the theory that audiovisual training materials are effective. This success spurred the development of a video training program in Mali in 1988, called *Centre de Services de Production Audiovisuelle* (CESPA). CESPA has grown into an income-generating video production house that serves NGOs and others, with almost two hundred productions completed by 1999. Its video training programmes were based on culturally adapted visual pedagogy principles developed by Manuel Calvelo in Latin America. Over two hundred and forty people have been trained to use the videos for community outreach. It is significant that in addition to the videos, they develop multi-faceted outreach and intervention programs, and train community workers to facilitate their use. In Nigeria, the organization Communication for Change has a library of four hundred development audiovisual materials that form part of their outreach programs for improved health. Some of the videos are developed in-house, along with radio dramas and theatre. One of their outreach programs is to show educational videos on intercity buses.[10]

Silvia Balit (2003:11) believes that the key challenge within participatory communication today may be how to combine the new ICTs with the benefits of small, local participatory media. "What is important is to apply the same principles, criteria, and lessons learned from use of other technologies and participatory approaches in the past, to the selection and use of new information and communication technologies. This is a complex challenge" (Balit 2003:12). In other words, we should not reinvent the wheel, but rather treat the introduction of new ICTs as adding radial tires, snow tires, or inner tubes to the

[10] See http://www.cfcnigeria.org/

inventory. Participatory videos are excellent enablers of communication, reflection, and action planning within communities. When used for this purpose, the video content becomes secondary to the participatory communication process (FAO 1998). In other applications, they are important for the protection of human rights and the publicizing of human rights abuses, as discussed in section *6.4 Participatory Action Research,* below.

In 1994, Colin Fraser and Jonathan Villet recommended the development of telecommunications learning centres for rural villages to give them Internet access to interactive audiovisual training programmes (Fraser and Villet 1994). Modern telecentres partially fulfill that vision today, but the majority of information that is downloaded at a telecentre is textual or graphical, but not audiovisual. Moving images are too large to download on the low speed modems that most rural telecentres in Africa use. Videos and other large files are sometimes mailed to them on CD or VHS tapes if the producer has the resources to duplicate and mail out copies (a telecentre that relies on refurbished computers is not likely to have a DVD player yet).

Due in part to these technical problems, I believe that video is underused as an information-sharing tool within current ICT4D practice in Africa. Other limitations are that older computers do not have adequate power to edit video and lack built in speakers. In addition, in the North, where most ICT4D projects are initiated, text is a much more popular working medium than video. But text does not address issues of illiteracy, or illiteracy in major world languages, or the fact that African cultures are more oral rather than written (Spence 2003:76). Therefore I believe that video will prove to be a better communication medium in Africa than text has been to date for development purposes. It is much more powerful to see and hear someone speaking in your own language than to decipher megabytes of text in your second (or third, fourth or fifth) language. Educational studies, traditional wisdom, and the deep experience of development communicators concur. As the farmer's proverb from Peru says, "What I hear, I forget. What I see, I remember. What I do, I know" (Fraser and Villet 1994).

The combination of digital video, computers, and the Internet allow for exciting communication and training possibilities that may increase the effectiveness of many development efforts. And not just videos, but audiovisuals, such as photos or other visuals with companion sound files. These are smaller files, and therefore will be more accessible for online access. They are also simpler to create: all one needs are a built in laptop microphone or headset, free software, and a scan or digital photograph. The visuals can be printed for offline use, and the audio can be played on a windup tape recorder or battery operated CD player. Videos can be brought to marketplaces via battery-operated DVD players (one of the future outreach plans we intend to use in the solar cooking project), or on battery-operated laptops. Generators projecting a video onto a wall or sheet can be used for larger audiences.

Audiovisual ICTs are exciting because they will allow megabytes of currently under-used but valuable and relevant textual information, to have more powerful impacts by converting them to audiovisual formats. More than that, the ability for rural Africans to share their own knowledge in a means that is comfortable to them – orally – will allow much richer dialogues about future development, in both the North and the South. In Ago-Are and Kafanchan, home videos are very popular. It is common to hire someone to videotape weddings and other important events. Two staff people at FF have digital camcorders, and sell video services for weddings and events. The Nigerian municipal and federal governments frequently use video to record meetings. The most common video format is VHS, which is left unedited, or is edited using old technologies. One of the video trainees in Ago-Are was a fulltime cameraman for the local government, and used VHS and analogue editing equipment. He is excited about the ease of editing on a computer. The rich history of film for community development is being revived by the portability, affordability, and ease of making digital home videos today.

Participatory video has been used creatively and diversely to empower communities and facilitate development. Shirley White (2003) edited an excellent book called *Participatory Video* that shares many case studies, and recommendations for future

applications of video in development. White (2003b:392-397) recommends that telecentres evolve into Community Communication Centres that serve as a hub for the local development of a geographical region. These centres would not only provide access to ICTs and training, but would serve as communication environments that actively use participatory development methods to advance community well-being. They would help local leaders, groups, and citizens work together, and enable networking across villages through the Internet, and potentially via a regional group of satellite centres. They could also "facilitate community research, planning, action and evaluation" (White 2003b:396), and initiate resource acquisitions to further local human and economic development. Since ICTs are tools which require the input of multiple actors to be applied appropriately to a community – e.g., technicians, farmers, women, men, leaders, youth – this community mandate would help telecentres become more than sources of technology, but to be sources of shared vision, goals, and projects. This is the manner in which to shift Nigerian communities from the focus on tiers one and two of the ICT development pyramid, into tier three (see *Figure 4: Digital ICT4D Historical Development Pyramid,* above). It is here that the most self-direction and creativity can come to the fore and allow people to guide their own learning and communication activities in support of their own development goals.

In summary, one important critique of the Internet's applicability to development is the dearth of relevant content (Colle 2005:5-6). One of the best means of increasing relevant content is for the people in the South to create their own content. Computers make content very easy to create, edit, manipulate and share. Beyond the basics of creating text-based data, it is becoming increasingly easy and affordable to create audiovisual data, including still images, sound, and video. Audiovisual content has lagged behind text content, but it has important benefits as a communication tool, and is becoming ever more accessible and affordable. It should therefore be considered for more applications at the local level, as well as to be shared more widely, whether via offline or online methods. However, it seems doubtful that this leap to the upper tier in the ICT pyramid could take place without face-to-face, hands on training, if potential users in

developing areas do not tend to use printed materials such as instruction manuals. Thinking "outside of the box" is necessary, as most rural Nigerians will never get to take these types of ICT courses in formal educational programs. Hands-on experience and training better meets the needs of those steeped in an oral communication tradition, and those whose level of literacy may preclude self-directed or formal learning methods. It is dangerous to view these simply as "extras" or "extravagances." The excitement and freedom that can be felt when you place a digital video camera into the hands of a first-time user, where illiteracy is inconsequential, is amazing. Perhaps the support to use these exciting new tools will need to be as creative as the potential offered by these tools themselves.

6.3 My Personal Perspectives on ICT4D

My desire is to support the increasing well-being of people in rural Africa, whom I seek to serve through the appropriate application of technology, knowledge, and methodologies for improving their standards of living. My ICT expertise led me to concentrate on how digital tools, including computers, the Internet, and audiovisual mediums, could help meet this goal. I see ICTs as means to an end, whether that end is improved health, education, governance, or another goal. I enjoy adding other technologies into the "tool sets" that I am proficient in, such as solar cooking and indigenous methods of refrigeration and food preservation. In the solar cooking project I experimented with solar cooking, solar food drying, and clay pot refrigeration: a variety of ways to improve food security, improve the economic situations of families, reduce deforestation, and save labour. Digital ICTs significantly helped me to research, collaborate, train, and provide ongoing support for this project, and can provide similar support for other pursuits.

With respect to the various specialties within ICT4D, my interests lie in applications and content creation, the middle and upper tiers of the *Digital ICT4D Historical Development Pyramid* (see *Figure 4,* above). These can be viewed at the macro level, for example, as applied to egovernance and other broad areas. My focus is at the community

level, particularly, to explore and empower community development through participatory communication methods. This is not to say that the boundaries of the communication must remain within a community; rather, I wish to work with communities on local priorities, and empower them to use digital ICTs to tap into, and contribute to, global discussions which will further the community's goals. In the field of development communication, I fall within the communitarianism school, which is also referred to as participatory communication (Nulens and van Audenhove 1999: 6). Nulens and van Audenhove (1999:4) summarize the main schools of thought as follows:

TABLE 1
Relation Development Theories and Dichotomies

	Dominant school		Critical school	
	Neoliberalism	Modernization	Dependista	Communitarianism
ICT and society	ICT causes development	ICT causes development	ICT causes dependence	Appropriate ICT can cause development
ICT and power	Extreme technophilia	Technophilia	Technophobia	Technostructuralism
ICT and regulation	Market	Market State	State	Community

Table 1: Relation Development Theories and Dichotomies (Source: Nulens and van Audenhove 1999:4)

"In contrast to the liberals and Marxists, whose central emphases are respectively on freedom and equality, the communitarians' primary concern is with fraternity and community" (Tehranian 1990:65). Communitarianism focuses on local communities, emphasizing the need for locally appropriate and culturally sensitive communications. Initially, it rejected the use of ICTs in favour of traditional communication means. Later research, however, has emphasized the possibilities that ICTs offer for interactive, participatory communications. As Nulens and van Audenhove explain (1999:6), "These new technologies possess the possibility to transfer the control over technology from

powerful agents to the people themselves." The communitarian school emphasizes "self-management, self-reliance, the right to communicate, indigenous knowledge and people's participation in decision-making and change (Nair and White, 1993:16)" (Nulens and Van Audenhove 1999:6).

Shirley White, an expert in the use of participatory video, believes that locally centred communication seem to provide better results for behavioural change than larger communication strategies have shown (White 2003a:41). The possibilities for locally controlled, democratic, and community and individual based communications are much greater for the new ICTs than they were for TV and radio. This is because the cost of entry into publishing and broadcasting on the Internet is vastly lower than the cost of TV broadcasts, and significantly lower than radio. It is possible for an individual to own the equipment and learn the skills to publish print and audiovisual materials on the Internet independently. This gives me greater hope in the possibilities for locally directed development to occur with the help of modern ICTs, in contrast to the disappointing impact of the mass media on development (Melkote and Steeves 2001:206-222). While it would be nice if public media and broadcasting became more democratic, accessible, and applicable to development, the good news is that we do not have to wait for that. The Internet can be used for radio broadcasts, audiovisual archives, audio or text blogs, and interactive communications, which are already more responsive communication tools than mass media.

For an ICT4D practitioner, one's definition of "development" has an important impact on the choices one makes. The historical macro-level approach that prioritized economic growth was modelled on the industrialized countries' experience and has grossly failed. I seek to support development that is communitarian, participatory, and ecologically sustainable. It is based on improving individuals' and communities' well-being at no one's expense, nor at the environment's expense. ICTs are tools, methods to reach specific goals, and are very adaptable to local means and ends, as the solar cooking video project demonstrates. However, they can also be applied to negative effect, or cause unintentional

negative consequences; the technologies are neither inherently beneficial nor detrimental. Discernment and care must be taken in their use, because many non-technical factors impact their appropriateness and sustainability for particular situations. For example, it is bad economics to invest in computers for schools that do not have electricity. It is unsustainable to invest in computers without simultaneous investment in training and maintenance. In addition, there are potential negative impacts from the rapid socio-cultural changes that ICTs trigger. Majid Tehranian (1990:180) provides an interesting perspective on this:

> As *bits* and *watts* (the indicators of information and energy units) increase in mass production and consumption, life is impoverished under a system of modernized poverty. Whereas poverty in traditional societies is made tolerable by relative equality, ethics of self-denial, and mutual obligation, and strong bonds of community, modernized poverty is characterized by the ethics of relentless acquisition, conspicuous consumption, and unabashed self-gratification. Modernized poverty thus breeds atomistic mobility, status anxiety, social envy, rising expectations, frustrations, and regression. The negative *internalities* of dualistic modernity (such as time-consuming acceleration, sick-making health care, stupefying education, countercommunicative mass communication, and information-void news) thus outpace the positive *externalities* of growth and development.

While this statement is extreme, the underlying message is poignant. No longer should we be blasé enough to assume that "good development" means copying exactly what has happened in more developed parts of the world – the "developed" countries have many flaws that should be avoided rather than duplicated. Attention is needed, therefore,

to promote a definition and practice of "development" that minimizes the transference of "modernized poverty" in the guise of increased uninformative information, and meaningless communication. Helping new ICT users to discern, create and share information based on their own needs, and to participate in meaningful, interactive communication based on their priorities, can mitigate this. This is the exciting possibility inherent in enabling African communities to reach the top of the ICT pyramid – and finding their own way to do so.

Especially interesting, at this point in time, is a new program of information and communication for development (ICD) initiated by DFID, FAO and the World Bank. According to Guy Mustard from DFID, changing the terminology from ICT4D to ICD intentionally seeks to move the focus from "technology" to "development," with poverty alleviation as the key priority (CTO 2004). In late 2004, these partners created a five-year plan called "ICD in Support of Rural Livelihoods," which outlines the following "key principles for ICD" (FAO/WB/DFID 2004):[11]

- **Determine who should pay**: A new consensus is needed on who should pay for communication and information services for poor rural communities.
- **Ensure equitable access:** New systems must deliver the right kind of information in the right format, for poor people to ensure that existing inequalities are not exacerbated.
- **Promote local content:** It may be more useful to promote more information sharing between local institutions than bring in new information from outside.
- **Strengthen existing policies and systems:** Further work is needed to strengthen communication policies, and new systems should seek to build on existing systems.

[11] See also http://www.fao.org/waicent/portal/outreach/livelihoods/en/index-en.html

- **Build Capacity:** Capacity building is needed at all levels, to equip people with the new skills necessary to develop and manage new systems.

- **Use realistic technologies:** The most effective systems use realistic technologies that enhance and add value to existing systems.

- **Build knowledge partnerships:** New technologies provide enormous opportunities to build knowledge partnerships that cross national, ethnic and social boundaries.

These principles are based on the partners' research into effective ICT4D praxis. Their goal, rural livelihoods, is similar to the goal of sustainable livelihoods. The sustainable livelihoods approach, which began in the 1980's, promotes an integrated approach to livelihoods. It recognizes that poverty, food security, access to assets and opportunities encompass both micro and macro level factors. It therefore seeks to bring individuals, communities, development agencies, and multiple government departments together to strengthen their interdependent work, including through the use of ICTs (Singh and Gilman, 1999:54).

I resonate with the goals of sustainable livelihoods, and with the principles of ICD outlined above. Six of the seven recommendations were directly addressed by the solar cooking project, as discussed in section *7.2*

Reflections on ICT4D Theory in Practice, below. The project also supports sustainable livelihoods through its goal of training local entrepreneurs to build and sell solar cookers. Another future economic opportunity is for trainers to be hired by other development groups to train more trainers in solar cooking, although I hope that solar cooking training will remain free of cost for the partners' local communities. The broadest economic benefit of solar cooking is for the families who adopt solar cooking. The families which buy fuel will reduce their expenses, and those which collect firewood will increase the time they have available for more profitable pursuits.

In summary, I believe that ICTs are useful tools. But unlike hammers, they are not "one size fits all." ICTs need appropriate contextualization to be useful, and three aspects stand out. One aspect of contextualization is redesigning hardware for African conditions including less available electricity, heat, and dust. Examples of this include the Jhai PC and Communications System described above, research and development efforts into the Solo Computer[12] at Fantsuam Foundation, and an MIT project to develop a $100 laptop for use in developing countries.[13]

The second aspect of contextualization is redesigning software. This includes such things as translating software interfaces, particularly of open source software, into African languages.[14] Language is a key aspect of accessibility to African populations. An example of a more radical redesign of software is to make the operating system audiovisual. For example, it could become more graphics-based than usual, and "speak" the name of the action it triggers. This was the intention for the Indian-designed handheld computer called the Simputer in 2001. The first commercially available Simputers were launched in India in 2004 (Wikipedia 2005).[15] Text-to-speech programs that audibly "read" words on a screen, whether they are documents or web pages, provide another opportunity to serve populations with limited reading abilities. So are speech-to-text programs that type words

[12] See http://www.explan.co.uk/hardware/solo.shtml

[13] See http://laptop.media.mit.edu/

[14] See http://www.translate.org.za/

that one speaks, and obeys spoken commands such as “File, New,” or “Close.” As far as I am aware, they are currently only available in major languages.

The third important contextualization is designing audiovisual content in a manner that is easy for illiterate people to use. Video is one example of this; another is the CD-ROM, “Rural Women in Africa: Ideas for Earning Money.” It is in Luganda, a major language in Uganda. One clicks on images to navigate through it, and all of the text is audibly “spoken” when clicked on. Illiterate women, who had never used a computer before, used it with enthusiasm at the Nakaseke Telecentre (Mijumbi 2002). Sound files, photographs, graphics, and MS PowerPoint presentations, or videos that combine them, are other examples. A video does not need to be created from moving images; it can be created from still photographs and other graphics. Motion effects can be applied to these so that the result is more like a movie than a slide show. Audio files can be used alone, or in conjunction with printed materials (whether textual, graphical, or both). Finally, games provide very exciting learning opportunities that address more elements of learning, such as interactivity, decision-making, instant feedback, motivation and stimulation.

6.4 Participatory Action Research

My key method of inquiry is participatory action research (PAR). PAR gives control of the research agenda, methodology, and implementation to the local stakeholders to ensure their needs and values are met. It is an empowering and capacity building approach that redefines the researcher as a facilitator and co-researcher *with* a community, rather than an expert who comes to study a community, and who may, as an outsider, inadvertently impose his or her own viewpoints and assumptions through this position. Simone Arsenault-May (2003) provides a good overview of PAR, and other research methods that are similar to or have influenced PAR (such as action research, participatory research, and popular education). French and Bell, quoted in Arsenault-May (2003:44), define action research (AR) as “research with a purpose, that is, to guide

[15] See http://www.simputer.org/ and http://amidasimputer.com/

present and future action." Action research is associated with organizational change in Western countries, although the term was also used in Latin America by Fals-Borda in the 1970's (Hall 1992:17). In organizations, corporate agendas limit the actions that action research can investigate or recommend (Arsenault-May 2003:44-45). Action research has also been applied in community contexts in North America, as demonstrated by Stringer's handbook on community-based action research (1996), and Kemmis and McTaggart's book for action research in educational contexts (1988).

Stringer's historical review of AR led him to distinguish that AR processes (1996:xvi):

1. are rigorously empirical and reflective (or interpretive);
2. engage people who have traditionally been called 'subjects' as active participants in the research process; and
3. result in some practical outcome related to the lives or work of the participants.

This coincides with Barnsley and Ellis' definition of PAR (1992:9, emphasis theirs), that "Research is the systematic collection and analysis of information. We define **action research** as the systematic collection and analysis of information **for the purpose of taking action** and **making change.** Our approach to action research emphasizes **participation."**

The terminology and definitions of action research, participatory research, and participatory action research overlap. Barnsley and Ellis explicitly state that they combine action research and participatory research into participatory action research, and that they usually call it action research "because it's a simpler term" (1992:9). Fals-Borda changed the term he applied to his work from participatory research to participatory action research

when he joined Vio Grossi's Latin American participatory research network (Hall 1992:17). Fals-Borda cannot distinguish any differences between participatory research and participatory action research, but prefers the term PAR because "we want to make the point that 'we are talking about action-research that is participatory, and participatory research that unites with action (for transforming reality)'" (Fals-Borda 1992:14, footnote 1). He explains that from its small community-based beginnings, PAR achieved recognition, including self-recognition, as a theoretical foundation for "complex, urban, economic and regional" applications when it was formally presented at the 20th World Congress of Sociology in Mexico City in 1982 (Fals-Borda 1992:16).

Fals-Borda emphasizes the strong link of PAR to social and political action, and either warns, or celebrates, that PAR is a lifelong commitment. I cannot do justice to his ideas without including them here in his own words (1992:18):

> It is well to remind ourselves and others at this challenging moment that a rather permanent existential choice is made when one decides to live and work with Participatory Action-Research. Our proposal has not been, nor is, a finished product, and easy blueprint, or a panacea. We should recall that Participatory Action-Research, while emphasizing a rigorous search for knowledge, is an open-ended process of life-and-work, or *vivencia*; a progressive evolution toward overall, structural transformation of society and culture; a process that requires ever renewed commitment; an ethical stand, self-critique, and persistence at all levels. In short, it is a philosophy of life as much as a method. This philosophical, ethical and methodological choice is a permanent obligation. Moreover, it should be made more general: a committed Participatory Action-Research researcher/activist, now or in the future, would not want to help oligarchical classes that have accumulated capital, power and knowledge illegitimately and through the efforts of the working

> class… Therefore what is at issue for Participatory Action-Research now and in the future is to increase the input to and control over the process of production of knowledge, its storage and its use of enlightened common people – the subordinate classes, the poor, the peripheral, the voiceless, the untrained, the exploited grassroots in general. Its purpose is to break up and/or transform the present power monopoly on science and culture by elitist, oppressive groups. The end-result will be a science geared for the defence of life.

I see a strong link between increasing "the input to and control over the process of production of knowledge, its storage and its use" (Fals-Borda 1992:18) and the use of participatory video. The solar cooking video in this project directly achieves these goals because the video was made by local producers about local actors, and their adoption of an external technology.

In his book entitled *Participatory Action Research*, William Foote Whyte (1991) provides another interpretation of participatory action research. This definition arose from the background of organizational development, and "portrays a depoliticized process of collaborative labour management reflection. Power and its relationship to knowledge in such a process is not central" (Hall 1992:17). That is not the meaning that I intend when I speak of PAR; I fall within what Hall distinguishes at the "libratory tradition of participatory research" (Hall 1992:17); the one Fals-Borda described so well.

Hall wrote of the controversy of whether PAR could remain undistorted when taught, implemented, and written about within academies of higher education, or whether it was doomed to cooptation because of the pressures of the academic structure. He believes that PAR "deserves to be taught in universities," that academics deserve to be challenged by and to discuss it, and that academics are no less community members than

others – all of which imply that despite the challenges, it belongs within the walls of academe as well as in communities (Hall 1992:24-26). But PAR goes against the history of academe by its core principle that knowledge is local and lived, and not limited to that which is approved and published in peer-reviewed journals. The onus is on the academy to let PAR be PAR without codifying it into a theory and language that make it other than PAR. I witnessed this tension in the York University master's course, Popular Education. It sought to teach PAR using participatory methods, and the professor and students struggled to balance the university's educational process, particularly its evaluation requirements, with a truly participatory experience and ethic. I believe that we succeeded because the major course work was participation in a PAR-focused conference.

In practice, because PAR is by definition participatory and responsive to the changing needs and information of the participants, the researcher becomes a co-researcher with the participants; they are all co-researchers. However, someone must direct the process. This person becomes a facilitator and catalyst, rather than the primary investigator and interpreter of data. The facilitator may come from within or without the community, as long as the community remains in control of the process through consensus. PAR facilitators must carefully ensure that they remain in a supportive role rather than a directive role. Through participatory development training and other experiences, I have learned that the facilitator may feel more comfortable in a leadership role than the other participants do, and the facilitator may have to resist assuming leadership even when the group asks him or her to do so. Awareness of "passing the pen" and "passing the floor" is important, especially while group dynamics are being shaped. This will nurture local ownership that will grow into dynamic participation as people learn of their own competencies.

Leaving control with a group is especially difficult when one is working towards a goal, or "end product," or within a definitive timeline. The dilemma of whether the product or the process should take priority will influence one's actions, whether one is the facilitator or a participant. If one values the product over the process, one may be tempted to

sacrifice some democratic participation for a perceived increase in outcome. The motive for this can be for the group's good; it is not necessarily power seeking. On the other hand, if one values the process over the product, one would value a democratic process more than a better product, and would believe that the process will benefit the group more than a better product would. When some group members emphasize process, and others emphasize product, there is potential conflict. Please note that I am speaking in hypothetical terms of situations where there is a perceived sacrifice in outcome by practicing democratic PAR; this opposition may not always exist or be perceived to exist.

PAR methods and processes are self-reflexive and flexible by definition. Therefore it is difficult to predict and plan a PAR project in advance. Arsenault-May (2003:56) says, "There is the nagging feeling that if one person plans any part of the process, it will no longer be 'participatory enough'. While these concerns are valid, there is a point at which someone needs to plan something on their own or in a very small group, or there will be no space for others to participate!" I agree, and experienced this feeling when I developed the proposal for the solar cooking project. I resolved the tension by holding the plans for my project in "open hands": open to critique, suggestions, revision or rejection by those who collaborated with me on the proposal, and with the communities in which we implemented it. A very important characteristic of all PAR co-researchers is to hold ideas, plans and assumptions "out there" in front of yourself, rather than so close to yourself that a critique of them feels personal. We all need to put our ideas on the table, so to speak, and walk around them, look at them from various angles, leaving lots of imaginary room on the table for others' ideas and contributions, and have fun in the process of building together (Kaner et al 1996).

Advance planning should include thinking through the questions to be asked, the stakeholders to be included, and a review of which tools can help achieve which tasks, such as brainstorming, investigating root causes, or making decisions. However, these plans and ideas must be reviewed with the participants, and adjusted as required based on feedback and emerging needs. In this way PAR goes beyond top-down methods of

development to generate enthusiasm, and to increase commitment to sustainable community action plans that were developed jointly. Some of the tools PAR uses include community maps, transect walks, Venn diagrams, timelines, and matrices; there are many others. These tools can be used pictorially rather than textually to make them accessible to illiterate participants.

Hall says, "The literature on participatory research has always been vague on the question of method," (1992:20), and explains it is because of its social and group emphasis, philosophy, and attention to participatory practice. "This means that for participatory research there are no methodological orthodoxies, no cookbook approaches to follow. The principle is that both issues and ways of working should flow from those involved and their context" (Hall 1992:20). He lists "community meetings, video documentaries, community drama, camps for the landless in India, use of drawings and murals, photo-novels, sharing of oral histories, community surveys, story telling, shared testimonies and many more. Even questionnaires…" (Hall 1992:21). The lack of a cookbook approach is not a disadvantage, though it is more challenging. Arsenault-May (2003:56) advises, "It is important to avoid following what other PAR researchers have done too closely, despite the fact that this may appear to make the question of definition easier to answer. This is because these 'second-generation' processes, while so neatly described, would no longer fit within the definition of praxis – not to mention the fact that they would likely be less effective than an emergent and participatory process."

I like Stringer's simple steps of "look, think, act" as a guiding framework (Stringer 1996:16-17). These three steps are complex activities, each requiring research, cooperation, reflection, analysis, action planning and evaluation. They are cyclical, and do not occur within neat boundaries. However, they can help the facilitator and participants reorganize their thoughts if confusion or "analysis paralysis" occurs. Another good way to visualize the PAR process is through Paolo Freire's (1970) process of "action-reflection-action" (White 2003a:54-55). While Stringer and Freire prescribe very similar processes, I like the way Freire's description explicitly highlights the cyclical nature of the process, and I

like how Stringer's description draws attention to a fresh look and analysis of the present before taking action.

While flexibility is good with respect to the methods used, questions asked, and the participants' goals, PAR must remain grounded in the principles of democracy, equality, liberation, and the enhancement of all of the affected people's lives, both in the process, and in the outcomes (Stringer 1996:10). Stringer reminds us that people's control, pride, dignity, unity, and responsibility are important values to ensure (1996:21-22).

External research facilitators must remember that they are catalysts and enablers whose role is to help a group define its own problems, analyse their own situations, evaluate options that meet their own needs (without negatively impacting others, now or in the future), and implement their own solution. The PAR process is as important as the outcome, and people's self-development is as important as a solution to the defined problem (Stringer 1996:23). This is a very different belief than that in the corporate and commercial worlds, where profit and power seem to be all that matters. Profit is emphasized as a corporate service and responsibility to shareholders, which takes precedence over responsibility to employees, customers, and the environment. Emerging emphasis on corporate responsibility and the triple bottom line call this emphasis on profit into question, but it remains the most prevalent business driver today. A focus on outcomes rather than process appears to also be true in the government and NGOs. In fact, I see this almost everywhere: within the educational system, where in class projects the grade is more important than care for group members, or even within family, where, for example, having a successful event can cause severe family stress (that is why movies about family weddings and major holidays can be so funny, albeit it because of their exposure of family dysfunction). I believe that it is difficult for people from Western cultures to remember to put people and process above outcomes (or at least to assign them equal importance).

One may debate whether it is true that the process is always more important than the outcome. What about the responsibility to those who have invested financial or other resources to support a quality output? What about responsibilities to a larger community, which might rely on a smaller group's output for the common good? How do you balance group versus individual needs? How do you balance opposing ideas within a group when consensus does not occur? How could friendly differences about group goals and beliefs be resolved to the mutual satisfaction of all parties? Is it counter-PAR to recommend a less participatory process that one believes will result in a stronger outcome? Stringer's view says yes. However, if the group blesses this less-participatory approach in certain circumstances, does it become "good" PAR? Kaner et al (1996) provide more guidance by admitting that not all decisions require total group input, namely "Business as Usual" decisions, whereby the leader or person responsible can safely make a decision without affecting participatory goals. These are difficult questions that largely fall outside of the scope of this project, but they are helpful in stimulating deeper thinking. While the statement that the process is always more important than the outcome may appear to be valid, especially to an audience that practices PAR, Stringer did not substantiate it enough to resolve these questions for me. Putting process over product does not necessarily satisfy a wide-angle view on the issues that PAR is used to address, particularly political action against injustice.

It is interesting that Kickett, McCauley and Stringer (1986) believe the facilitator "is not an advocate for the group for which he or she works" (as cited in Stringer 1996:23). I tried to discern why the authors rejected an advocacy role for the facilitator, and believe it is because enabling people to do their own advocacy develops the skills of the group, gives them control, reduces their dependence on outsiders, and leaves the responsibility for the action with them. It also maintains the facilitator as an objective party, able to mediate all views for the consideration of the group.

PAR and participatory video can make a great combination. This approach offers advantages for small projects with a small stakeholder group, such as within this project.

However, PAR can also be used as a powerful tool for political resistance and change. If activists choose to use PAR to confront inequity and injustice, they must be aware of the conflict that could be triggered at several levels – within families, among classes, and with powerful political and economic opponents. In instances where participants seek to change power structures, or to stop abuses of power, it can trigger strong opposition, even death threats, to activists making these challenges.

The Nakamata community in the Philippines provides an excellent example of the convergence of ICTs to fight for human rights, including film, home video, Global Positioning Systems, weblogs, email, websites, cellular phones, Short Message Service (SMS) text messages, print and TV broadcasting. Their story is well told at http://www.seeingisbelieving.ca/. Participatory video has been a powerful tool for documenting human rights issues, screening them on TV and elsewhere (often in non-mainstream venues), raising awareness of issues and support, and also to provide a measure of physical security by deterring violence. *Seeing is Believing,* a powerful documentary about the struggles of indigenous peoples of the Philippines to protect their land – and their lives – from those who illegally profit from them, has demonstrated all of these possibilities for video (Lozano 2003b). After the community experienced violent repression, with no support from police or government, a New York-based NGO called Witness[16] gave the protestors the equipment and training to record home videos for their work. Joey Lozano, the leader of the resistance movement, believes that the cameras have protected community members, because when an activist is armed with a camera and has a means of getting images to the press and groups like Witness, the one armed with a gun hesitates more to use it (Lozano 2002, 2003a). And when he does, the videos can document the human rights abuses that the local police neglect to investigate, to apply domestic and international pressure on them. On the other hand, the camera poses increased threats to oppressors, and may incite further repression (Lozano 2003b). A camera cannot ensure security.

6.5 Diffusion of Innovations

Everett Rogers defines the diffusion of innovations as the "process in which an innovation is communicated through certain channels over time among the members of a social system" (2003: 5). It has four component parts: "the innovation, communication channels, time, and the social system" (Rogers 2003:11).

The innovation is an idea or a technology that is new to its audience (Rogers 2003:11). The characteristics of an innovation that impact its adoption include its perceived relative advantage, its compatibility with current practice and beliefs, its ability to be tested on a trial basis, its observability, and its complexity (Rogers 2003:15-6). Wolfe identified a different set of characteristics, which affected adoption: "adaptability; centrality to the day-to-day work of the organisation; technical vs. administrative focus; pervasiveness (the proportion of total behaviours expected to be affected by the innovation); radicalness; and uncertainty about outcome" (Nutley et al, 2002:17). It is very interesting that the efficacy of the innovation seems less important than the above factors in predicting its adoption (Nutley et al, 2002:19). Rogers did not cite any evidence that the relative improvement of the innovation was more important than other characteristics in predicting adoption rates, and he recommended that studies define their own innovation characteristics to study rather than using a prescribed list. Therefore it appears that an innovation's effectiveness is a necessary, but insufficient reason for its adoption.

The communication process about the innovation usually has different channels and objectives at different points in the diffusion process. For example, mass media may be involved in the introduction of the innovation to a population. The promoter of the innovation, called the "change agent" (Rogers 2003:473), may have several interactive dialogues with people about the innovation over time. And peers are often involved in sharing their experiences and opinions of the innovation with each other (Rogers 2003:5-6,

[16] See http://www.witness.org

18-19). The more similar a change agent is to his or her audience, the more effective their communication will be. Since in reality change agents often differ substantially from their audiences, a more similar, or homophilous, communications aide is often used to reach target audiences (Rogers 2003:19-20, 28).

Because an innovation is new, those learning about it regard it with uncertainty. Providing more information about it reduces the uncertainty about it, especially if the method of sharing that information is geared to the group. When a respected leader, called an "opinion leader" in diffusion of innovations literature, shares the information, its impact increases. Since communities are not homogeneous, its various sub-groups may have their own opinion leaders. Adoption is strengthened when the appropriate opinion leader is used for the appropriate audience (Rogers 2003:26-27).

Adoption or rejection of the innovation will occur when an individual's knowledge is sufficient to reduce his or her uncertainty to a tolerable level, and allows a decision to occur (Rogers 2003:14). Rogers conceptualizes this innovation-decision process in five stages: "(1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation" (2003:20). While there are other models with different numbers of stages, they tend to be "variations on the above, with greater or lesser gradations between stages" (Nutley et al, 2002:10-11). Rogers' is the most commonly cited model (Nutley et al, 2002:10).

Progressing through these stages takes time. Time can also be used to characterize a person as an earlier or later adopter, compared to others in the affected group. Diffusion researchers categorize people's "innovativeness" by their position on a bell curve, divided into the categories of innovators, early adopters, early majority, late majority, and laggards (Rogers 2003:22). Earlier adopters tend to have more years of formal education, are more often literate, have higher social status, more upward social mobility, and larger farms, etc., than later adopters (Rogers 2003:298). This implies that these people may be more confident in making a decision and taking risks to apply

something new, before it is proven. However, no age difference has been shown (Rogers 2003:298).

The rate of adoption of an innovation is of great interest in diffusion research, and varies a great deal (Rogers 2003:20). Often it takes years for an innovation to become widely adopted. Usually the rate of adoption of an innovation is graphed as an S-curve, with the steepness of the slope indicating the speed of adoption within a social system (Rogers 2003:23).

A particular time point named the take-off point occurs when a "critical mass" of people have adopted an innovation (Rogers 2003:11, 343-363). After this point, the diffusion of the innovation becomes self-sustaining. The time to take-off can vary tremendously, and is generally measured in years (Rogers 2003:351). After time, an innovation's use may be discontinued, which is called discontinuance (Rogers 2003:21).

Diffusion occurs within a social structure, in which the units may be "individuals, informal groups, organizations, and/or sub-systems" (Rogers 2003:23). The social structure, communication structure, and system norms exert influence on diffusion within a system. However, these system effects are complicated, and therefore not well researched (Rogers 2003:24-26). More widely studied are opinion leaders who exert influence on the system (Rogers 2003:26-27). Change agents often work with opinion leaders to accelerate the rate of adoption of an innovation (Rogers 2003:27).

In a participatory project, discovering the "movers and shakers," the influential people in a group, is extremely important. Often, if these people are not on board, the project will not easily succeed. While many despair that participatory processes require too much time and energy, it may mean the difference between success and sustainability versus failure. Devoting too little time and money to a project may make the time and financial investments that are made, unproductive. For complex changes, such as the widespread adoption of solar cooking in rural Nigeria, a timeline of years is necessary.

Communications research in the 1940's and 1950's began with the hypodermic needle model, which "postulated that the mass media had direct, immediate, and powerful effects on a mass audience" (Rogers 2003:303). This was later replaced with the two-step flow hypothesis, which "suggested that communication messages flow from a source, via mass media channels, to opinion leaders, who in turn pass them on to followers" (Rogers 2003:304). This model was more accurate than the hypodermic needle model, and shed important light on the complexity of communications, the role of opinion leaders, and subtleties such as the communication of knowledge versus acts of persuasion (Rogers 2003:304-305). However, it has been shown to be too simplistic to explain this complexity (Rogers 2003:304-305).

Social learning theory provides important insights into diffusion networks, which influence the adoption of innovations (Rogers 2003:341). Professor Albert Bandura at Stanford University is an important leader in this field (Rogers 2003:341). Social learning theory states that people learn from others by observing them, whether the observation is in person or via media, especially visual media such as television. Common examples of this include parents modeling for their children, teachers modeling for students, or children imitating their favourite television characters. Even as adults, we continue to learn in this manner, such as through television do-it-yourself programs. When the modeling is done in person, the observer may or may not talk to the model about the modeled behaviour. The learner then engages in similar behaviour (Rogers 2003:242). This theory may explain the positive impact that exemplary demonstrations have been shown to have on the adoption of an innovation, particularly when an opinion leader in the community conducts the demonstration (Rogers 2003:389-90).

One key issue raised by Röling et al (1976:156-157, 160-164) is that of equality in the diffusion of innovations. Because of the lack of attention given to the consequences of diffusions of innovations, they have tended to increase socioeconomic gaps in social systems (Rogers 2003:130), helping the rich get richer, but leaving the poor no better off. One reason for this is that change agents tend to follow strategies of least resistance, e.g.,

concentrating on the “early adopters” who tend to be socio-economically advantaged, rather than the path of most resistance, e.g., concentrating on those from lower socio-economic backgrounds, who tend to be innovation “laggards” (Röling et al 1976:157-159). However, this need not be the case. Interventions that appropriately targeted lower socioeconomic clients have been shown to decrease the socioeconomic gaps within target communities (Rogers 2003:134). Rogers thoroughly addresses this by discussing case studies which have had positive and negative impacts on socioeconomic gaps, and suggests strategies to reduce gaps: forecasting the impact of an intervention, targeting clients from lower economic strata, and providing enabling social conditions such as cooperatives and credit to enable disadvantaged clients better access to innovations (Rogers 2003:456-469). The change agent can increase equity by following a diffusion strategy of greatest resistance, rather than least resistance, by focusing on clients from lower economic and educational backgrounds, thereby reversing the paradox that those most in need of an intervention are often its least frequent adopters (Rogers 2003:295-296).

The consequences of the innovation are another key consideration. This has been traditionally ignored in diffusion studies, sometimes because the change agency assumed that the affects would be positive, sometimes because they are hard to discern and research. Rogers suggests that panel studies in which respondents are interviewed about consequences after adopting an innovation, and quantitative field experiments be conducted to determine recurrent consequences of an innovation (2003:440-441). It is important to recognize desirable and undesirable consequences, direct and indirect consequences, and anticipated and unanticipated consequences (Rogers 2003:450). PAR-based projects differ in that these aspects are built in to the process. Ongoing evaluation is built-in to the open process, feedback loops are created, and self-monitoring occurs and changes are made as required. This may increase PAR projects’ success and sustainability.

Röling et al (1976:162) provide another important critique to the diffusion of innovations model: the fact that information is distorted as it passes from its recipients, to those whom they tell this information to (the secondary audience). In one experiment, only 14% of the information with the first generation of learners reached the second generation of learners. In another study, farmers with small farms received only the new seeds being introduced in a package of innovations, but no additional information that was critical to successfully growing these seeds. In a third case, the information reaching 25% of second-generation hearers was distorted (Röling et al 1976:162). These factors severely limit the ability of second-generation learners to implement an innovation, because they do not have all of the information that they need to successfully implement it, they are unaware of the existence of this missing information, and they sometimes have misinformation (again, without awareness of this). Presumably, the third generation of learners will be even more disadvantaged.

The strengths of diffusion of innovation research are its longevity, wide applicability (from marketing to health interventions), depth of research, and international relevance; it is held in high regard (Rogers 2003:59, 93-94, 102-105). One of its weaknesses is its pro-innovation bias (Rogers 2003:106). The impact of this bias is that most research is conducted on successful diffusions, rather than on unsuccessful ones (Rogers 2003:107). Researchers also under-emphasize rejection, discontinuance, and re-invention of innovations (Rogers 2003:107, 111). There is a tendency to assign the blame for rejecting a technology with the laggards, rather than with the system, change agency, or developer of the innovation (Rogers 2003:118-119). Instead, researchers must carefully remain alert to other reasons, including systemic reasons (e.g., lack of credit to acquire the innovation), the inappropriateness of the innovation for some people (e.g., those with small farms), or the change agent's interactions with the laggards (or the lack thereof) (Rogers 2003:118-125). Additionally, when diffusion research occurs later than the adoption decision, research results may be affected because respondents can forget details (Rogers 2003:126-128).

Studies of the process of innovation by the Minnesota Innovation Research Programme (MIRP) show that innovation is an unpredictable journey, not a linear process, as Rogers and others suggest. Nutley et al (2002:13-14) have summarized this journey as follows:

Box 1: The innovation journey

A non-linear dynamic process in which the following is commonly observed:

1. The innovation journey consists of the accretion of numerous events performed by many people over an extended time. Innovation cannot be attributed to the discrete acts of a single person on a particular date and at a particular time.

2. Concentrated actions to allocate resources and initiate innovation development are triggered by 'shocks', not mere persuasion. When people reach a threshold of sufficient dissatisfaction with existing conditions, they initiate action to resolve their dissatisfaction.

3. When innovation development work begins, the process does not unfold in a simple linear sequence of stages and sub-stages. Instead, it proliferates into complex bundles of innovation ideas and divergent paths of activities by different organisational units.

4. Setbacks are frequently encountered during the innovation process because plans go awry or unanticipated environment events significantly alter the ground assumptions of the innovation. These setbacks signal rejection of the innovation or opportunities for learning through reinvention.

5. Innovation receptiveness, learning, and adoption speed are facilitated when the innovation is initially developed within the user organisation and inhibited when end users are provided no opportunities to reinvent, or modify, innovations developed elsewhere.

6. Management cannot ensure innovation success but can influence its odds. The odds of success increase with experience and learning from past trials at innovation and decrease with the novelty, size, and temporal duration of an innovation venture. **Source: abstracted from Van de Ven et al, 1999, pp10-11**

Table 2: The Innovation Journey (Source: Nutley et al 2002:13-14)

Diffusion of innovations research contributes significantly to projects introducing new knowledge or technologies to an area. For example, applying DOI principles could help to increase the awareness of, and use of, solar cooking in rural Nigeria. The DOI model could also explain why some projects do not have lasting impacts and are not always sustained. It is important to support the innovation until it is safely passed the take-off point Rogers mentions, which may be years after its initial introduction.

There are several ways that video can contribute to the diffusion of innovations. For example, seeing is a more effective communications method than only reading or hearing (Fraser and Villet 1994). Videos can show people things that are difficult to show in person. They overcome geographical and time barriers, and can show the effects of an innovation (or the lack of change) over time. They can be tailored to show different opinion leaders and change agents to different audiences, and vastly broaden the number of people who can see the presentation, as compared to in-person visits. They can be shown at times that are convenient to the audience, and can be watched multiple times. They can increase the impact of training programs that are delivered in person, and be available for individual or group use beyond them.

One type of diffusion research that interests me is communication channel usage. Communication channels include media such as radio, television, the Internet, and videos, as well as people, including both formal project members and members of the public. Of particular interest to this project is the value of videos as a communication method, and in a manner of speaking, a communication channel, for the diffusion of solar cooking to areas

where no other information sources about solar cooking exist. Bandura's social modeling theory is also pertinent, and a future project could test the effectiveness of modeling via video alone, versus only in-person modeling, versus both in-person and video modeling on the learning of solar cooking. These communication methods would be interesting to compare in future phases of the solar cooking project.

7 The Research Project

I explored the research question of whether amateur video was an effective training medium for people in Nigeria, by developing a proposal to create and evaluate locally made videos at two NGOs in rural Nigeria: Fantsuam Foundation (FF) in Kafanchan, Kaduna State, in north-central Nigeria, and Oke-Ogun Community Development Network (OCDN) in Ago-Are, Oyo State, in the southwest. I had previously visited OCDN in April 2004 to get firsthand experience of the operations of a rural telecentre, and to discuss their needs and possible ways that ICTs could address these needs. Please refer to section *2 Introduction,* above, for more details about Ago-Are and OCDN. The solar cooking project arose out of this visit, plus subsequent email discussions after my return to Canada.

OCDN works with FF from time to time, and one of OCDN's supporters, Pam McLean, suggested that I work with FF on the solar cooking project. This proved to be very helpful, since they are better established than OCDN, and could offer better support in the development and execution of the project. FF is a non-governmental organization located in BayanLoco, a rural community adjacent to the larger city of Kafanchan in Kaduna State, Nigeria. Kafanchan's main roads are paved. It is a two-hour drive from the capital, Abuja, has a large daily market, and is much larger than Ago-Are. BayanLoco is a farming community with dirt roads, and a large proportion of the population is employed by the state railroad. As of July 2005, the railroad had not been operational for ten months, and the workers have been laid off without pay. This caused a lot of financial hardship in the community. People survive through farming, petty trading, or other sources of income.

FF started as a micro-finance service for women, and now runs three ICT training programs with approximately fifty computers. They first invested in computers to manage records for their micro-finance program. To do so, they had to provide basic computer training to their staff. A community member asked to be trained as well, and he is now an instructor in their training school. They offer basic computer courses, advanced courses, a Cisco Networking Academy that teaches advanced computer networking, and computer maintenance training. FF

has high speed satellite Internet access, runs a generator as needed to provide electricity during working hours, and its Program Director, John Dada, remained in good contact with me while we developed the proposal. They import donated used computers, which they fix, sell to others, and service when they break down. A private Internet café is operated on their premises, using their generator and Internet connection.

In contrast, OCDN has two operational offline computers for their software training program, and two more computers that are dedicated to their Internet café. They have low speed Internet access that staff must pay to use, and save money by only using the generator when there are paying customers, if the public electricity supply is unavailable. OCDN is smaller, has little external funding, and only employs one trainer, apart from the security guard. The manager is a volunteer. They remain in contact through brief, infrequent emails. They did not offer any input to the proposal during its development, although I requested them to. I see this as based on their lack of time and money for Internet use, rather than a lack of enthusiasm or dedication on their part, but it also appears to demonstrate the self-conception of a recipient, rather than an initiator, in the solar cooking project.

Video production was new to both telecentres, so the project had to include training on how to use video cameras and how to edit videos on the computer. The project purchased camcorders and Macintosh computers for both telecentres. The choice of Macintosh computers proved very helpful, and is further discussed in section *7.1.2 Technical Preparations,* below.

Neither organization had ever successfully used solar cookers, although Pam McLean had brought one to OCDN in 2004. At that time she tested the Anahat solar cooker over a flame with community member Maria Ajayi. McLean did not know how to use the cooker in the sun. Her hope was that someone would test it in the sun after she left, but this did not happen. FF had heard of solar cookers, but had not seen or tried them. Therefore, both organizations needed training on the building and use of solar stoves. We chose to build stoves rather than buy them, because built stoves are less expensive. We hope that some of the trainees will develop viable businesses selling solar stoves.

We intend to publish the results of this project online, as well as to collaborate online. Therefore a website training component was required for the project. In 2004 I trained some people at OCDN to use Yahoo! Groups and weblogs, which are free, easy-to-develop websites offered by various providers such as www.blogger.com. I conducted similar training at FF as part of this project this year.

After teaching about video production, solar cooking, and website development, the project's goal was to create training videos in local languages to fulfill two purposes. The first was to evaluate whether these videos were sufficient training materials to "train the trainers" who did not have access to the resource people or funding that would enable them to learn how to solar cook in person. The second was to use these videos for solar cooking promotion and training in OCDN and FF's communities. The second half of this one-year project focuses on promoting solar cooking in the communities of the two telecentres, and will be completed in December 2005. I will not be in Nigeria during this time, but will provide support through the use of ICTs. David Mutua at FF, and Pastor David at OCDN, will be the project leaders of this phase.

7.1 Project Implementation

As described above, this project required three training programs on video production, solar cooking, and online networking and publication. I conducted most of this training as a volunteer. Fantsuam Foundation invited Pastor Shadrach Caleb from Jos, Plateau State, Nigeria, to teach people from FF and OCDN how to build and use solar stoves. He only used the parabolic stove for cooking, and the box cooker for keeping the cooked food warm. I could not attend this training as planned, because my visa was not granted in time. When I arrived later, I tested the box cooker as a solar cooker in its own right, and in many ways, preferred it to the parabolic cooker.

The community development objective was to introduce solar cooking into the local communities of the two Nigerian NGO partners – a large undertaking. FF and OCDN hoped to develop community committees to acquire, promote, train, and support the use of solar stoves in regions that had never heard of them before. As part of the solar cooking

project, OCDN and FF committed to conducting awareness and training programs to support the adoption of solar cooking in their communities. Details about the training programs, video creation, video evaluation, and outreach and promotion plans are provided below.

7.1.1 Solar Cooker Construction

In February 2005, Pastor Caleb taught people how to make box and parabolic solar cookers at FF.[17] Two people representing OCDN were present: Pastor David Adesokan, the volunteer telecentre manager, and Maria Ajayi, an Ago-Are community member who had tested solar cooking over a flame with Pam McLean in 2004. David Mutua, the FF project leader, some other FF staff, and Kafanchan community members also participated. In terms of the DOI model, these people would be considered "innovators." They built one cardboard/wood/iron parabolic cooker, and one insulated cardboard box cooker with a glass lid. These cookers belong to FF, and our project used them for training and creating the videos. It was hoped that some of those trained to build solar cookers would develop small businesses to sell solar stoves, to reduce the costs of the cookers, and to create local economic opportunities. Many of the people who attended the construction workshop in February 2005 said that the potential to sell solar cookers motivated their attendance at the workshop.

When I came in April, I brought a prefabricated CooKit panel cooker from SCI that we duplicated, which was also used for videos and training. In a later workshop, Pastor Caleb helped us build a wooden box cooker with a glass lid, with a double wall of cardboard lined with tinfoil as insulation. The main purpose of his second visit was to teach us how to more easily construct parabolic stoves, since the first stove took three days to build. A lack of money to buy materials and to hire Pastor Caleb for enough time to build a cooker, meant that he just told us about his improved process for building parabolic dishes from concrete or plaster or clay, rather than cardboard and wood. As of August 2005, FF

[17] For pictures of the stoves built and used in this project, please see section *4.4 Types of Solar Cookers.*

has not tried this method of construction, nor have they built a second parabolic stove using the original construction method. In May we had a meeting with some of the original trainees to arrange the building of a second parabolic cooker, but lack of money was a large factor in hindering this plan.

In June, David Mutua conducted a construction workshop at OCDN in Ago-Are on how to make a wooden box cooker with two layers of foil-covered cardboard on the walls, and a black cardboard bottom. He also led construction of a CooKit panel cooker. These remain the property of OCDN for testing and training.

On my last day at FF in late June, I started making a Minimum Box cardboard cooker with two volunteers, who completed it after I left. This stove is simpler to make than the other cardboard box cooker, and it used scrap plastic for the lid instead of glass to reduce costs. SCI shares that clear plastic lids are 10% less efficient than glass lids. Whether the cost or efficiency is more important needs more research. Its extra reflector on the top may make it hotter than the other box cooker, but it has not been tested yet because it is the rainy season in Nigeria. The Minimum Box Cooker and the CooKit are particularly easy to make. They are affordable to the lower economic class, who suffer most from the rising costs of kerosene, and who rely most on diminishing fuel wood reserves, and therefore suffer the health hazards of wood smoke to the eyes and lungs. The average monthly fuel costs from those who completed our questionnaires ranged from 656 to 1400 Naira ($6.56 to $14 CAD), depending on the fuel used and its collection method (e.g., bought or gathered). A panel solar cooker can be made for approximately 400 Naira ($4 CAD). If we assume that solar cooking can reduce fuel needs by 30%, this cooker will pay for itself within one to two months.

7.1.2 Technical Preparations

Upon my arrival at FF, the first week was spent in technical preparations for the video work. While OCDN relies solely on PCs, and FF uses PCs almost exclusively, several experienced video editors advised us to use Macintosh computers, which are more

stable for video editing than Windows. Their PCs were inadequate for video editing anyway, so we took the advice to buy Macintosh computers. However, we also tried to upgrade and test a PC for editing, and spent the whole week unsuccessfully trying to get the PC to upload videos from the cameras via the USB port. We finally learned that the video output only worked through firewire, not USB. That meant we needed to procure a firewire card. This involved two trips to a city 90 minutes away on public transport, which took several days to arrange. During the same period, we went through three different hardware configurations on the PC, since messages were confused and needs misunderstood. At one point the 2 gigabyte (GB) hard drive was upgraded to an 8 GB hard drive, but I needed an 80 GB hard drive, which was available at FF and that I thought I had clearly requested. From our preparatory emails, I had expected a dual hard drive server with adequate RAM to be available for the project, but this machine was dedicated to other purposes. It took weeks to upgrade a refurbished Pentium to a machine that was capable of video editing, and in the end, the system was still not ready when I left three months later. If FF did not have a computer maintenance training program, it is likely that the expense of hiring someone for the upgrade, and the cost of the parts, would have been prohibitive for them. The computer was slowly upgraded by adding memory, adding an 80 GB hard drive, adding a firewire card, and installing two video editing programs on it. This took weeks. At one point we were able to test Visual Studio 7 on it, which often crashed. I increased the PC's virtual memory to see if this would resolve the problem, but the results are unknown, because shortly thereafter it needed another Windows installation. Windows needed to be installed twice, and one of the Pinnacle Studio 9 CDs was unreadable by the time they were ready to reinstall it again three months after beginning this process. We therefore never used the PC for videos. It appears that the advice I received not to use PCs for video editing was well founded, even though most of the system problems appeared to be independent of the video programs. These technical issues drove home a critical point: if these problems had occurred at OCDN, the lack of technical expertise, parts and money would have made fixing the PC impossible. They might also have been

even more time consuming, because the computer would have had to be brought to Ibadan, and picked up at a later time (Ibadan is a three hour drive away, and the nearest city where computer repairs and parts are available). If communications were required during the repair, these could only be made by email, since Ago-Are has very unreliable telephone service, and none of the OCDN staff currently use cell phones. If the repair shop doesn't use email for customer support (which is almost 100% likely), several trips to Ibadan might have been involved before the PC was ready, to resolve setbacks and questions. It is easy to see how these types of problems affect project timelines and successes.

It was easier to set up the Macintosh computer. The 120 GB external hard drive I sent from Canada needed to be configured, and we had to test the cycle of video upload, editing, and outputting one. (It is very unlikely that Macintosh parts could be sourced in Nigeria; they would need to be shipped from Europe.) It was frustrating that downloading to the Sony Digital 8 camera did not work. After 5 days of frustration, and emails to videographers in Canada, I found the documentation that said this feature was disabled on this camera. Similar frustrations occurred trying to troubleshoot the problems burning CDs and DVDs. It turned out that the Mac did not have an internal burner, so we needed to quickly buy an external burner, since outputting to one camera was not working. Luckily John Dada from FF was able to purchase this outside of Nigeria, since he was travelling at the time. But unfortunately, since we were unaware of the constraint, he bought a DVD burner that did not support iDVD. This meant I had to find and download alternative software, Toast Lite, again using contacts in Canada to help me source it online. If we had attempted to setup a Macintosh computer at OCDN, we would have had even more significant difficulties and delays, because the Internet connection is so slow, unreliable, and the power so intermittent as to make a large download (even 500 kilobytes) virtually impossible to complete. During my three weeks at OCDN, I never succeeded in downloading a 2 MB solar cooking file that would have been helpful, and it took me repeated efforts over days to download necessary software upgrades for the PC just for

administration and communication (e.g., drivers and patches). We would have had to ask FF to download the files and mail them to OCDN on a CD. All of these time delays, technical problems and infrastructure issues affected the project.

7.1.3 Video Training

The second week at FF, I conducted video editing training for twelve students, all of whom had attended a two-day course on how to use a camera two months earlier. They had not used a camera since then, and none of them owned one. By the time I conducted the advanced course, they had forgotten the basics about how to operate the camera. They also were unaware of advanced camera techniques like backlighting and night shots. Therefore, we reviewed the basics, plus the new material, including storyboarding, shooting and computer editing. Computer editing was the priority, and all students but one had prior computer experience. It was a struggle to give twelve students enough computer time to edit their three-minute video assignments on one computer in a three-day course. All of them had the chance to begin the work and to try each task, but only four students earned their certificates by producing a three-minute video that demonstrated all of the basic editing features they learned with titles, transitions, and sound. Some of the videos were excellent for a first project, but most needed more work. The intensity of the three-day course, and a lack of time and familiarity with cameras and computers contributed to this. The students were invited to work on their own to finish their assignments after the end of the course, but most did not arrange to do so. However, everyone gained new skills, knowledge and experience in video production through the course.

FF did not consult with me before registering so many students for the class. They often have eighteen students in their other training courses, but these are offered in labs where almost every student has a computer and can work at the same time as the instructor. Because we had one computer, I had to demonstrate lessons to the whole class, and then let them practice in small groups. We projected the computer image onto the wall so everybody could see it, but hands-on training is critical to learn computer skills.

I also requested assistants to help me coach the students, but those who planned to help were most often unavailable because of FF work commitments. I used these lessons to change the course that was run at OCDN into more of a “train the trainer” model. We limited the class to four students, and specifically invited Kola, who had extensive VHS video experience. Although he had never used a computer before, we thought he could learn computer editing quickly because he knew the concepts from analogue editing, and this was true. We also shot a simple video about how to use the editing software as a training resource.

After the students completed their video course at FF, John Dada asked them to create videos about community issues such as sewage and drainage, and gravesites. One of the videos was completed while I was there; some others were in progress. The videos have not yet been used for community viewings with the goal of facilitating community projects, but the potential and intention to do so exists. Now, the skills and equipment to produce these videos are available. Some trainees who did not formally complete the video editing course participated in these community video projects, which are great opportunities to help them improve their skills, while at the same time contributing to their communities. Unless they buy their own cameras (a prohibitive expensive for almost all of them), this is the only opportunity they have to make videos. They need someone to nurture their work, and to initiate and facilitate the community participation required to use these videos in PAR projects.

It was very interesting to see the videos that students developed on their own. They produced some wonderful shorts in very limited timeframes. I would love to see what they come up with given a blank tape and agenda. I think some very telling community and individual portraits would develop. Their presence in the community and FF campus spurred the interest of other people to request video training. FF is considering offering another course for them. The students’ experience with ICTs has opened their eyes to new possibilities. It will be interesting to see how the NGO continues to encourage this skill

development and its use for community betterment, and how these skills and the information it brings forward are disseminated in the future.

7.1.4 Creating the Solar Cooking Video

I requested the help of four students to create the solar cooking video as their video project after the course. Two of them, Gloria Ayuba and Ezekiel Kyari, were able to dedicate themselves to this task, and became key members of the solar cooking project. Having keen volunteers was crucial, since FF staff did not have enough time to participate in this work. One FF staff person who was expected to participate in the project did not have enough time to attend the video course, solar cooking meetings, or participate in the project at all. Another staff person was uninterested in it, and asked to be excused. The project leader managed nineteen projects, and had no time to devote to day-to-day activities. Neither did other staff have the time to practice solar cooking during work hours. While solar cooking is a wonderful skill that the Microfinance Project Officers could pass on to their three thousand clients, arrangements for this have not yet been made. The Project Officers themselves have not even received solar cooking training yet. I relied on Gloria and Ezekiel as informal assistants until they became formal FF volunteers. They are responsible for signing out cameras and booking the Macintosh computer for editing work for FF-commissioned videos, although it appears that they are the only two people presently using this equipment. They also do not have fulltime access to the Macintosh computer, as it is also used for administrative purposes. A better use of the Macintosh computer would be to acquire another PC for administration, to free up the Macintosh computer for the video work that requires it.

Gloria, Ezekiel and I learned how to solar cook together through practice. At the same time, we videotaped our work. I explained what we were doing in English, and then Gloria or Ezekiel explained it in Hausa. In this manner, we created lots of video footage in English and Hausa. We had six weeks at Fantsuam Foundation after the video training course was completed during which we could make and test the video before I went to

OCDN in southern Nigeria to support the solar cooking project there. This modeled the use of video as a relevant educational tool to the community, one that recent trainees could already use themselves. This should reinforce the diffusion of the innovation of video at FF and in BayanLoco, as DOI and social learning theory predict (Rogers 2003:242).

Because I do not speak Hausa, I had to rely on Gloria and Ezekiel to edit the Hausa videos. This slowed progress considerably. Especially during the time that their volunteer positions were informal, they sometimes did not come in due to other commitments. When the rains began, it was particularly hard for them to come in because they were needed on the farms.

Also, the external Lacie hard drive was too slow for our low-end Macintosh computer to write to while editing. We therefore had to edit on the internal hard drive, and use the Lacie for a backup drive. The internal hard drive could store only 30 minutes of video (one minute takes approximately 1 GB). To swap 30 minutes of video to and from the Lacie is time consuming. Also, the Lacie does not have a battery, so it could not be used after work hours unless there was electricity (which was about half of the time). Therefore, I made a strategic decision to stop developing an English video concurrently with a Hausa video, and we focused all our time on the Hausa video. I had to rely on Ezekiel and Gloria for this.

This reliance on Gloria and Ezekiel helped them to take ownership of the project. They knew that they were critical contributors, and were dedicated to the project, sometimes staying very late to meet deadlines. Initially I wanted to leave the video almost fully under their discretion, because I wanted to be a resource person, not the director. After my three week whirlwind video-training-solar-training-video-production experience at OCDN, I realized that a lot of guidance was helpful for trainees during their first video production. Especially since I would be available as a mentor for only a short while, it was beneficial to actively share ideas and direction with them. I showed them how to overlay relevant photos and footage during interviews, rather than leaving the visuals as a long

shot of the speaker. I helped them critique their storyboards to make their actions more dynamic. The first version of the video looked like a cooking show with lots of testimonials about how good the food tasted. After testing it in a workshop, we changed it to an instructional video about how to aim the stoves, since this was the weakest training area. I made detailed suggestions about additional changes to clarify these instructions, and asked them to shoot and test them on their own while I was with OCDN. They did not work on the video while I was gone, and I am not fully cognizant of why. I know that Ezekiel was away part of the time, and the Macintosh computer was unavailable part of the time, and imagine that they did not feel empowered enough as volunteers yet to request the materials and use the solar cookers on their own. I reminded them about these edits and tests when I returned from OCDN, and hope that David Mutua can help them implement them, since I have returned to Canada.

Short timelines were an impediment at FF, but the time pressures were even greater at OCDN, where I spent only three weeks. I focused on video training and the production of a solar cooking video in the Yoruba language, while David Mutua conducted solar cooking training. Since Ago-Are is in a Yoruba speaking area, we could not use our Hausa video there. We tried to add Yoruba voiceovers to it, but the timing differences between the Yoruba and the Hausa made this so difficult that extensive editing would have been needed to make the visuals match the Yoruba. Therefore we decided that creating a new, Yoruba video would be a better use of time, and produce better results. Due to cloudy weather, David only conducted cooking trials on two days. This did not provide the staff and volunteers with enough experience in solar cooking, nor did we get enough footage to make a Yoruba solar cooking video.

Because no one gained enough solar cooking experience to explain it well on their own, we shot a video in which the speaker translated my English scripts into Yoruba on the fly, section by section. When someone retranslated it to English for me, the number of errors and omissions made it clear this method was not working. It was very helpful to have a second person retranslate the Yoruba translations for me, so that I could recognize the

mistakes that would not be obvious to someone who did not have enough solar cooking experience. So I asked some participants to translate the English into written Yoruba scripts. This proved very difficult, and when my time there was almost over, we realized that we needed the help of a Yoruba expert. We were lucky to get this help from Chief Michael Adepoju Adekanmbi. Unfortunately, inadequate time remained to shoot the video during this visit, but the video trainees are ready to edit this video on their own, once their camera and editing equipment arrive (and the sun comes out). We simultaneously edited a second Yoruba video about constructing a box solar cooker, which we finished on my last day there. Testing the videos created at OCDN was not intended to be part of this research project, nor was there an opportunity to do so.

I then returned to BayanLoco where I spent two more weeks at Fantsuam Foundation. During this busy time we conducted a final video evaluation, made a new style of box cooker and burned DVDs. I also conducted a training course on how to make weblogs with www.blogger.com, how to manage online communities using Yahoo! Groups, and how to edit websites using MS FrontPage. Now that I am in Toronto, our Yahoo! Group has become our online collaboration tool for discussing solar cooking, in addition to email. A stranger in India found our online group and joined it, and we will invite other solar cookers in Nigeria to join us online at http://groups.yahoo.com/group/solarcookingnigeria/.

The training participants and I discussed whether an online group or a weblog was more appropriate for an online solar cooking group. The participants preferred the design of the weblog, but the functionality of the Yahoo! Group, so we chose Yahoo! Groups as the better tool to use for our purposes. (Yahoo! is the most popular email provider in Nigeria, so it saves a registration step to use their online group rather than an alternative, such as MSN Groups). The Yahoo! Group is very easy to participate in. After signing up for the group, messages come to your inbox; you do not have to visit a website to get them. To send a message to everyone one must simply write an email. On the other hand, the primary means of access to a weblog is by visiting it online. You can arrange to get emails whenever a weblog is updated, but this requires registering for a Blogger account and

changing some administrative options. To read a weblog but not post to it (or to only leave comments on others' postings), one does not need to register for the blog. The most common way to contribute to a blog is to do so online, and this requires registration. You can update a blog by sending an email to a specific address, but this takes more administration to set up, and would require more user training. Also, it is easier to share files using Yahoo! Groups than Blogger, and introductory messages, with optional file attachments, can be set up for automatic delivery to new members when they sign up for the group.

7.1.5 Solar Cooking Workshops and Video Trials

When we had a video that was good enough to show to an audience, we conducted our first public solar cooking workshop at FF. I wanted to show the video as soon as possible, to gauge its effectiveness and to have time to make changes, if required.

The workshops were free. As was usual for other workshops and meetings, the attendees arrived late. One came several hours late. One attendee was working at FF, and came in and out. Three trainees were there for the whole workshop, and I focused my attention on them. They were father Victor, son Ibrahim, and daughter-in-law Hawa. They reiterated their intention to solar cook often throughout my time in BayanLoco, and I believe they will be one of the first families to adopt solar cooking. After watching the video, we cooked jollof rice in the parabolic stove, yams in the panel cooker, and potato porridge in the cardboard box cooker.

It took until almost noon to get the food into the sun. The trainees began solar cooking and adjusting the stoves themselves with encouragement. The day was hot, and the trainees sought shelter from the sun. It is helpful to put the food preparation table in a shady spot, so that it is more comfortable to work at, to provide drinking water, and to have some seats in the shade.

The yams were cooked first, in two hours. Everyone was very surprised at how hot the stoves got, and that food actually cooked in them. I was busy videotaping, showing the

video to a latecomer, getting cloths and cooking utensils, and interviewing the trainees. My assistant Gloria was late, and due to these distractions, the parabolic cooker was not adjusted frequently or carefully enough to keep it at its maximum heat, slowing down the cooking. The attendees all took their leave around 2 PM, saying that they'd seen enough of solar cooking to believe it was a wonderful technology that they intended to use themselves. I wonder if we would have had sales or orders if there had been a procedure in place to acquire a stove?

It took until 4 PM to finish cooking the jollof rice and potato porridge. Gloria and I took the food to the participants to taste, and they all enjoyed eating the solar cooked food. Victor provided a very interesting comment. When I asked whether he was ready to get his own solar stove, he said that he would like to try cooking once or twice more before he would be ready for his own stove. It would be very helpful to have a means of accommodating this – perhaps by inviting trainees to bring their food to the training site so that someone can supervise and help them with their own cooking attempts, or by organizing a "cooking club," or renting or loaning out stoves. This can help people experiment and choose between various stoves. One advantage of a "cooking club" would be the social aspect and support, and the role modeling that could be provided, especially if it there were a few spots for drop-in attendees.

Other workshops progressed similarly. They all started late since usually only one person (or no one) was present on time. We had to send someone to fetch people who promised to come, or find new participants at the last minute. The second and third workshops showed almost the same version of a Hausa video, which was a more appropriate language for the area and target audience than English. We had changed the video content to highlight how to focus the three types of solar cookers to the sun: the CooKit panel cooker, a box cooker, and a parabolic cooker. In the last version, we added an introduction for artistic purposes, and a conclusion to reinforce the key lessons. I have ideas for future changes that we did not have time to implement while I was there, which are documented in the *8.2 Future Improvements to the Video* section, below.

7.1.6 Comparisons Between the Stoves

In one workshop I discovered a “natural” solar cooker and trainer, Paulina Sheyin. I invited her to join the informal Kafanchan Solar Cooking Group that FF has been trying to create to help with this project, and she has become one of the most committed members (although the output of this group is quite low). Paulina took a leadership role in the solar cooking, which I invited the participants to organize themselves, choosing which foods to cook. They decided to cook fish soup in both the parabolic and box cookers to do a “taste test,” and cook rice in the box cooker, which can hold many pots. The parabolic cooker got hot enough to boil oil to fry onions with. This was a great surprise to the women. The total cooking time on the parabolic stove was several hours, indicating that the stove did not remain as hot as a fire. This means that the women found it hard to keep it focused, through lack of practice, or lack of attention. As usual, my multiple roles directing videographers and with logistics made it difficult to closely monitor the cooking. In the box cooker, we let the onions cook alone for a while, but they did not approach frying temperature. Then we added the tomatoes and fish, and left it until 5 PM, hoping it would thicken. In a closed pot in a closed box, evaporation is negligible.

The women all preferred the taste of the soup cooked in the parabolic cooker; the soup cooked in the box did not taste the same due to the different cooking procedure, particularly the inability to fry onions and evaporate water. This led most of the women to say that they preferred the parabolic stove. A lively discussion ensued, after which all of the women changed their minds to prefer the box cooker, because of the work involved in focusing the parabolic stove. The fact that you can cook many foods at once in the box stove, versus one pot on the parabolic stove, was another contributing factor. I suggested that women use their wood fires or kerosene stoves to fry the onions for a soup before putting it in the box cooker, to see if this would make it taste right.

My personal preference is the insulated cardboard box stove with a black iron plate in the bottom. The plate gets so hot I was surprised that we could not fry on it. The walls allow it to maintain heat and cook under cloudy conditions, and it needs very little attention.

The only helpful adjustment is to point the smallest side towards the sun to minimize the shadow of the wall inside the box, and perhaps to tilt the stove up towards the sun to prevent shadows in the early morning and late afternoon. However, left alone on a sunny day, it will cook well, and tracking the sun appears to be less important in it than in the panel cooker (although I did not test this theory practically). There is a definite heat loss using a black cardboard bottom instead of an iron one. I am interested to know how adding a reflector panel to shine into the box would affect its performance. If it sped up the cooking it would be beneficial, and if it cast too many shadows in changing sun angles to leaving the stove carefree, the panel could be removed for unattended cooking.

7.2 Reflections on ICT4D Theory in Practice

One ICT4D framework that attracts me is that of the Information and Communication for Development in Support of Rural Livelihoods program announced by FAO, the World Bank, and DFID in 2004 (FAO/WB/DFID 2004), which is described in section *6.3 My Personal Perspectives on ICT4D,* above. Six of their seven recommendations were directly addressed by the solar cooking project (see items 1 to 6 in the following table). In addition, the project addressed other issues in ICT4D practice (see items 7 to 9 in the following table):

1. Ensure equitable access.	a) The medium of a video instead of text addresses literacy issues. It is also a locally familiar medium. b) The project methodology assumes a two-step process of disseminating knowledge. The video is intended to "train the trainers," as well as to train community members. The trainers can choose to use the most appropriate methods of disseminating solar cooking information for their communities, including in-person training, demonstrations, and showing the video. c) The program is designed for women, who are sometimes excluded from development projects in general, and ICT-related projects in particular. d) It provides micro-credit loans to help economically disadvantaged people to purchase stoves. e) Diffusion of innovations strategies from Rogers and Röling et al, were shared with the project leaders, with recommendations to target the more disadvantaged community members in an explicit attempt to reduce the gap between the higher and lower income families (or at least not widen it).
2. Promote local content.	The key outcome of the project is locally created videos teaching solar cooking.
3. Strengthen existing policies and systems.	Fantsuam Foundation already serves approximately three thousand women in existing micro-credit programs. We will use these groups to share information about solar cooking. Also, the project partners, FF, OCDN, and International Institute of Tropical Agriculture (IITA) currently work together on other projects. IITA has strong networks from its agricultural extension work, and if the pilot programs at OCDN and FF are successful, IITA could expand the project reach through those networks.

4. Build capacity.	This project developed the capacity of two NGOs to begin creating their own audiovisual materials – something that neither organization had the knowledge to do before. They also received training in solar cooking and website development. Even more exciting is the fact that these NGOs are ICT training centres, so that they can continue training others after this project ends. Many students at FF have requested video training. FF is considering running future video courses, and intends to offer a website development course.
5. Use realistic technologies.	Video is a very important communication tool in Africa, where a long history of oral cultures, and a significant amount of illiteracy make printed materials less accessible. Modern video cameras are also easy to learn how to use. Videos are very popular, and the small towns of Ago-Are and BayanLoco have enough customers to keep video rental stores in business. The solar cooking videos will be shown by OCDN in their Community Television Viewing Centre, and by FF at workshops in their classrooms. Portable DVD players and a video projector were bought for this project to bring the videos to the community.
6. Build knowledge partnerships.	The development of this project has already resulted in strong new knowledge partnerships among myself, FF, OCDN, Solar Cookers International, and a growing network of solar cookers in Nigeria, whom we have met in person or indirectly. Ongoing communication will be facilitated through a new online solar cooking group.
7. Lack of relevant content.	While this issue is similar to “promote local content” and “ensure equitable access,” it encompasses additional items including the importance of the content to the audience and language. Solar cooking was an identified community need by OCDN and FF staff. Although their community members’ lack of exposure to solar cooking prevented them for identifying it as a solution, they did identify the expense of cooking fuels, the scarcity of firewood, and eye irritation from smoke as problems.
8. Indigenous knowledge is not highly valued.	This project combines the foreign knowledge of solar cooking, with local adaptations developed by people in Nigeria. The parabolic stove we used was designed in Nigeria. We also experimented with local cuisine, e.g., comparing the taste of stew cooked in the box and parabolic cookers. Additional tests are required, e.g., to see whether frying the onions and tomatoes first, and then finishing the stew in the box or panel cooker, will taste better than just using these cookers alone to make stew.

9. There is greater empowerment in producing knowledge than just using it, and this power has largely resided with professional development organizations.	Volunteers sharing their experience made the video, not professional actors or development agents. It used simple editing techniques, not professional post-production editing, to demonstrate the local capacity to produce effective videos. Fantsuam Foundation has already begun developing its own videos about other issues. At the time of writing, OCDN did not yet have the equipment in house to do so.

Table 3: Key Principles for ICD Addressed in Project

The NGOs in this project also face significant issues. The fact that OCDN does not yet have the camcorder and Macintosh computer that were bought for them under this project, means that they cannot currently practice and use the video skills they learned. FF has yet to deliver this equipment to them. This means there will be a greater time lag than desired between the training and their continued practice. When FF does deliver this equipment to them, a means of addressing this problem would be to have someone give them a "refresher course."

It was also clear that ongoing mentorship and support is very helpful. OCDN does not have this support now, and FF has limited support, particularly through David Mutua. For example, while David and I were in BayanLoco, John Dada asked Gloria and Ezekiel to make a promotional video about FF within two weeks, via email. When we returned two days before the deadline, they had not started the project. Potential reasons for this were Ezekiel's absence for part of that time; the unavailability of the Macintosh computer; Gloria's infrequent access to email, since she does not have a desk, computer, or email access apart from using the Internet Café (although she is given a number of free Internet hours as a volunteer). She learned how to use email just before I went to Ago-Are, and is not yet very practiced in it, and therefore does not rely on email as a communication tool, which would encourage her to read them more often. Upon our return, Ezekiel prepared a storyboard. I helped with the planning and arranging access to the Macintosh computer, and coached their initial shooting. Then I left Gloria to take over (it was my last week there, and I had too many other responsibilities to provide more assistance). The videotape was of poor quality due to sound and content issues. Someone needs to help interviewees to

practice giving good interviews, and Gloria needs the confidence to request a reshoot when required because of fumbled words, external noise, etc. Even experienced public speakers need to plan their thoughts, and sometimes reshoot interviews. Video is a medium that offers the opportunity to do so, and this should be taken advantage of.

I was burning DVDs the day before I left, but since then no one has been able to do so. I showed people this several times while I was there, and tried to help them troubleshoot online, but they cannot resolve the problem. If the equipment is faulty, financial constraints will either delay or preclude getting a replacement drive.

At a higher level, there is a need to combine the skills of community development, with technical skills. The people who learn to make videos, for example, are not necessarily those who can initiate, or coordinate, community development activities, such as public workshops. From my limited observations at FF, John Dada was the person most concerned with community development, as shown by his request that the video trainees conduct research and make videos about community issues such as drainage, sanitation, and burials. John Dada was away travelling for most of the time I was at FF, so he could not fulfill this role then. John is also very busy when he is present, and therefore cannot provide a lot of hands-on guidance to these projects. While I was there, I noticed that he shared his ideas briefly in person or via email, and relied on others to implement them. But the others are not necessarily empowered to do so, and not enough community participation has been developed to combine the principles of participatory development, with the ICT skills that can help implement them. Perhaps John, and others at FF, could support community leaders who have more time to become involved in these types of activities.

Both FF and OCDN have the desire to help improve their communities, and are taking practical steps to do so (e.g., the micro-finance program at FF, the Farmers Help Desk project at OCDN, and the solar cooking project at both). However, they could achieve higher impacts, and attract more help from the broader community in these projects, if they

were supported to evolve into the Community Communication Centre (CCC) model Shirley White recommends (see section *6.2.2 Audiovisual ICTs for Development,* above). This would broaden community participation, help bring together technical and non-technical aspects of projects, increase the community ownership of the projects and of the telecentres who exist to serve them. I believe that investing resources into furthering this community development vision and capacity would have a greater impact, in the long run, than investing in a higher speed Internet connection, more computers, or another isolated project at both of these organizations. Indeed, ICTs are tools to help meet goals, and in the current model, the telecentres are more focused on the tools than on their impact. Expertise and training in technical tools is their current mandate, and a necessary foundation for an evolution to a focus on development goals.

Financial pressures are a large impediment to developing this CCC model. In our solar cooking project, I was limited by funding to a three-month visit, rather than the six-month visit that was originally planned for the project. Staff people at FF and OCDN are already working near (or over) capacity on existing projects. The volunteers, Gloria and Ezekiel, were able to invest their time because they are recent graduates who live with their parents. However, they have responsibilities at home, Gloria is beginning a tailoring business, and they need to become financially self-sufficient soon. To rely on volunteers who have extra time does not necessarily allow for the required community members to participate in projects for their best success, or for continuity and long-term project stability.

In summary, it is easy to use a computer to improve what you already do (for example, manage micro-finance records). There is a clear return on the investment of time, money, and resources. The task is defined, the training needs are simple, and the benefits obvious. On the other hand, it is often difficult to use computers, and other technologies such as camcorders, to do something new. The return on investment is unclear. The task is undefined. It may be complex and ongoing, and change over time. The training needs are diverse and hard to identify, because the outputs and the possibilities are unknown. It requires new conceptions, imagining new possibilities, and it takes a lot of time. The fact

that digital ICTs will help one do these tasks better, or perhaps even make them possible at all, does not make the work simple; it just makes it more simple than it otherwise would have been. These are the kind of results that ICT4D and participatory development projects are trying to achieve, and in many cases, we are still trying to implement the basics of infrastructure, equipment, skills, and funding. This means that to some extent, achieving our visions, and dreaming more dreams, will have to wait for these practicalities to be sorted out first. But as my friend Jocelyn says, “It’s not impossible. It’s just difficult.”

7.3 Reflections on PAR Theory In Practice

Since PAR emphasizes group wisdom, and a role for leaders as facilitators who help uncover it, rather than provide all of the answers, the internal balance that I found myself seeking in this project was one between being a “learner with,” and a “participant with,” versus a “teacher of.” On one hand, I was there to train community members in solar cooking, video and website development skills. On the other hand, I was there to learn what people’s needs were, to verify that solar cooking met a true need, and to transfer enough skills to local people that they could use them independently, in whatever way they saw fit. My desire to share my skills and insights from others’ experiences elsewhere, but not to direct their application in this project, influenced my actions. I was aware that my role as a trainer and an outside facilitator conferred aspects of respect and power on me, and I wanted to empower others while fulfilling the valid responsibilities of my role. One of the ways I sought to achieve this balance was to teach technical editing skills and theory, while leaving the content and form up to the students and NGO partners. I sought to teach the techniques of solar cooking, while inviting discussion and decisions about which type of solar cooker best met the lifestyle needs of participants. However, since lifestyle changes would help people reap more benefits from solar cooking, I wanted to offer suggestions about how people could take best advantage of it (e.g., starting the evening meal in the morning to accommodate slower cooking). I think that making suggestions is fine, when they are offered in an open-ended manner. However, my awareness of being an outsider

made me hesitate to make suggestions, because I felt a lack of authority to do so, and my different background might make some of them inappropriate. My biggest concern was to avoid the big mistake of doing development "to," rather than "with," a community. But PAR does not proscribe input from the facilitator; it only proscribes valuing this input as inherently more valuable than the input of others, the attitude of authoritarianism, and the imposition of one's will. Throughout the trip I gained more comfort that my input was valid to share in what to me were "grey" areas, e.g., video content versus skills. It has become my conviction that one must not confuse fully sharing one's skills, ideas and knowledge with an abuse of power. In effective PAR, the group will evaluate everyone's input on its own merit, so there should be no hesitation on the part of the facilitator to share his or her input, when it is held lightly in outstretched hands as an offering, not given as a directive.

With respect to owning and creating knowledge, I particularly like this quotation from Fals-Borda (1992:18):

> Therefore what is at issue for Participatory Action-Research now and in the future is to increase the input to and control over the process of production of knowledge, its storage and its use of enlightened common people – the subordinate classes, the poor, the peripheral, the voiceless, the untrained, the exploited grassroots in general.

Video is a medium through which input and control over the production of knowledge can be owned by almost anyone, because it is easy to use and does not require literacy. The solar cooking video in this project embodied this. Local actors demonstrated solar cooking and construction in local settings, based on local experience and adaptation of solar cooking to local needs and foods. The production process was under indigenous control, as are the use of the videos. Their primary purpose is for local

knowledge sharing, and we hope to share them more widely wherever the knowledge will be useful.

FF has had a lot of difficulty initiating a community group to help introduce solar cooking to Kafanchan from start to finish: from stove building to marketing, to promotion, training and support. They relied on those who attended Pastor Caleb's construction workshop in February to form this group. I feel that this does not provide an inadequate basis for a participatory community development group because it does not represent the whole community. Since the course cost 2,000 Naira ($20 CAD), it excluded those who could not afford it. It also excluded those who could not take a week off from work or personal commitments, and included only those who were attracted to building solar cookers. This group should provide a good source of people who want to develop businesses selling solar cookers. However, it is not representative and it should be broadened to reflect the wider community for the purpose of introducing solar cooking to the community. To date, there have been several group meetings, one of which was well attended (eight out of ten came). Other meetings that occurred during my visit had only two to four attendees, who decided that they could not make decisions without the larger group. There were successful smaller meetings for finishing the box cooker and testing alternative stove materials. David Mutua's proposition to this group was that they form a cooperative, pay fees, and use them to fund their initial work. I see problems in this, due to unclear and varying levels of commitment and input. Since the intention is to pay people for their work, a clearer arrangement is needed on how to reward extremely diverse contributions of time and skills, and how to share decision making among group members who have varying levels of input. What I hope will work well is that the group members invest in their own panel cookers, test them, and confirm that they are satisfied with solar cooking. At the same time they should define a price at which they would sell solar cookers. Then FF can arrange training sessions, take orders and forward them to the sellers, and perhaps charge a commission on cooker sales to pay for trainers, food, or research, development, and outreach.

In Ago-Are, we more carefully requested community involvement by meeting the Community Chairman, and members of the elected local Community Council. We made open invitations to the solar cooking workshop, and asked the Chairman to appoint people, and perhaps to sponsor them if necessary. OCDN tried to charge 2,000 Naira ($20 CAD), but at that price no one responded. They changed the fee to 1,000 Naira ($10 CAD), and then waived it, as response was very low. The project bought the materials for OCDN's solar cookers: a panel cooker and a wooden box cooker with a glass lid. Short timelines (our time there was only three weeks and the workshop had to be arranged as soon as possible), plus communication difficulties with the lack of phones, meant that few people came. Approximately ten people started the course, and this diminished rapidly over the first three days. David Mutua was discouraged due to cloudy weather, and only tried to cook on two days. Getting the food into the sun late, and taking it out of the sun earlier than was necessary, meant that he finished the cooking on an electric stove both days. Therefore there were very few opportunities for the trainees to practice or observe solar cooking. I was disappointed that David did not put water and a wapi (a pasteurization tester) out on the other days, although during our evening meetings Pastor David, David Mutua and I agreed to do so. Instead the stoves remained indoors – a very poor use of the training period, even if the sun was insufficient for cooking. When I was testing homemade wapis, I found that water heated quickly (but that day I had to bring the stoves in early due to rain). However, I was extremely busy with the video training, and trying to edit a Yoruba video in our short timeframes, and could not take on the added responsibility of cooking demonstrations. I also wanted the local project members to take on this responsibility themselves. It was disappointing that they did not. While the weather was partially cloudy, it rarely rained, and I worry that the lack of solar cooking modeling during the solar cooking training period diminished the group's confidence in it. Now, it is the rainy season, so there has been no solar cooking progress since David and I left OCDN. However, Pastor David has assured me via email that he will renew use of the cookers in the dry season, and that he will encourage and enable Maria to use the cookers. Once again, the time delay

between initial observations and experimentation with solar cooking and its usage will be greater than desired, and offer additional challenges.

7.4 Reflections on Diffusion of Innovations Theory In Practice

As disappointing as it was to return home without having seen any solar cookers brought into homes, Nigerian community developers told me to be patient; progress was indeed occurring. Diffusion of innovations research states that it takes a long time for a new idea to become adopted – years, in fact. Adding the impact of the rainy season on this project, it is not appropriate to be discouraged yet; it is time to actively promote solar cooking, using the lessons from DOI research. Solar Cooker International's experience has been that it takes five years of active promotion (SCI) to reach 15% of homes with solar cookers (Dennery 2005), which is the penetration rate after which DOI predicts that an idea can reach the "take-off point," using Rogers' terminology – the point at which adoption of an innovation becomes self-sustaining (Rogers 2003:274).

SCI recommends that trainers practice solar cooking themselves for several months to gain experience to help others. Even Gloria, Ezekiel and I did not get this much intense solar cooking practice while I was there. In Kafanchan, I have particularly encouraged Paulina, Hawa and her family, Gloria, and a few other participants to practice solar cooking. In Ago-Are, I have encouraged Maria to become the solar cooking expert and future trainer. Pastor David does not cook enough to expect him to become an effective role model of solar cooking, and a woman can fill this role better, as it is primarily women who cook in Nigeria. Once these people have experience solar cooking, they can become effective change agents, and model solar cooking to neighbours – an important step in diffusion. A limitation of the project so far has been that the organizations have owned the stoves, and organizations do not cook, nor are they models or change agents; people are. In future projects that seek to diffuse an innovation into homes, rather than organizations, I would emphasize the training of individuals, rather than institutional capacity building. For future solar cooking projects, I would encourage that solar cookers

be supplied to a certain number of families, and that they were provided the opportunity to experiment with various cooker designs by having multiple cookers, or by trading them. This would help us to compare, adapt, and recommend the most appropriate cookers. It would also develop solar cooker role models, a very important component of project success and diffusion.

With respect to the characteristics that impact an innovation's attractiveness according to DOI theory, solar cooking fares well. Trainees who completed the questionnaire noted its advantages for saving money, work, and health problems. While it is a foreign practice, it does not contravene beliefs, and is similar to solar food drying, a very common food preservation method in Africa. It can be easily tested, and the NGO project partners should offer more means to help people do so before buying their own cookers. Solar cooking is highly observable and simple. There are numerous solar cooker designs that emphasize different factors, such as cost or speed of cooking, and therefore is highly adaptable. It impacts a daily activity, so has the potential to become well practiced, and is highly relevant.

I played the role of the "change agent," in Rogers' terminology. I had several disadvantages in this role because I was different in many respects from the community I was serving (in country of origin, colour, education, accent or language, and life experience). Gloria and Ezekiel became what Rogers' calls "communications aides" to help bridge the gaps between community members and myself. The more similar a communications aide is to his or her audience, the higher his or her effectiveness will be. Via the video, communications aides can accompany change agents anywhere, "virtually," overcoming financial or logistical travel constraints. Video provides the opportunity to include multiple aides, in either one video, or via different videos for different audiences. Nigeria, for example, has three main language and people groups, who at the minimum should be represented as communications aides to reach the whole country. We started to address this by creating one Hausa and one Yoruba video. Within a language, other demographic characteristics, including gender, economic class, and education, can be

considered to find appropriate communications aides. Local change agents, people who have the respect of their own communities, can also be videotaped, thereby reaching wider audiences.

One critique of DOI is that it sometimes increases economic disparities within a community. The fact that the most educated and well off tend to be early adopters is one factor for this, and so is inaccessibility of the innovation to lower economic classes. To decrease the socioeconomic gaps within target communities via solar cooking adoption (or at least not widen them), FF and OCDN's solar cooking workshops and support should remain free to help solar cooking become accessible to the whole community. At the least, they should be geared to ability to pay, to balance the funding requirements for the promoters with the financial resources of the community members. To increase the diffusion among lower socio-economic classes, perhaps some members of this class would agree to be solar cooking role models and information contacts, trading a commitment of time for this work for a low or no cost solar stove. The plan to offer micro-finance loans to help people buy cookers at FF is another way of supporting lower income families. OCDN does not have a micro-finance program, but alternative savings schemes are being tried in their community. If they find a successful model, perhaps they can apply one to solar cooking. Another way to reduce economic gaps is to choose opinion leaders and communications aides from lower socioeconomic classes (Rogers 2003:464-467).

With respect to the communication processes impacting DOI, video has a direct impact upon many of them. It can be used via mass media to introduce the concept to large numbers of people, particularly in the initial diffusion steps of informing people about the innovation, and persuading them to try it. It enables various communication aides and opinion leaders to speak about and model solar cooking on video, who would be unable to reach wide audiences in person. Even more significantly, in my opinion, is the way that video can mitigate one of the biggest shortcomings of the diffusion of innovations by word of mouth: the huge degradation in the amount and accuracy of knowledge that is passed from the first generation of learners to the second generation. If sometimes only 14% of the

original message is transferred from one learner to his or her colleague, and 25% of it is distorted (Röling et al 1976:162), clearly an alternative means of sharing information is required.

Video provides a possible solution. Videos can be duplicated inexpensively, and can reach many times the people that a trainer or extension agent can in person to convey 100% of the message to each new generation of learners. This mitigates a serious shortfall of the diffusion model. If 14% of the original message is passed on to the second generation, at the same ratio, less than 2% reaches the third generation, and virtually none reaches the fourth generation. Learning 14% of an innovation is not enough to adopt it successfully. No wonder many innovations that rely on word of mouth diffusion are unsuccessful. This can potentially discredit the information source, the innovation, and cause serious harm to the adopters who miss 86% of the message, especially parts that deal with health risks, and key success factors without which their new investment will fail (wasting time, money, or risking health, crops, or food security, depending on what the innovation is). Video provides the opportunity to bring 100% of the training to wider audiences. And since audiovisual training has 50% retention rates, as opposed to 20% for hearing alone (Pike 1989:61), it more than doubles the learning for most people. Practice is the best trainer; when the video is combined with a practical workshop, retention rates should increase to 90% (Pike 1989:61).

Diffusion strategies that I recommend for future phases of this project include supporting ten families in each area to adopt solar cooking, who can help adapt the technology to local needs, model it to neighbours, and become future trainers and change agents. It would be valuable to introduce companion technologies at the same time, such as retained heat cooking (or “hay box” cooking) for times when solar cooking is not possible due to weather. This phase in particular could address the criticism from DOI research that there is a lack of attention to reinvention and a top-down bias (Rogers:183). This can be addressed by analysing women’s needs, their daily routines, working with them to see what cooker and what lifestyle patterns are most helpful.

A national outreach program would evolve naturally if solar cooking was included in home economics and food science courses at colleges of education, where public school teachers are trained. The teachers would then teach solar cooking through public schools. There are also opportunities to teach solar cooking through religious organizations (particularly Muslim and Christian women's groups). The ECWA Seminary at Kagoro, near Kafanchan, trains pastor's wives. These women would be able to pass the knowledge on to women in their churches or "cooking clubs," if they were trained to solar cook. I had the opportunity during this trip to share these ideas with a missionary teacher at the seminary, a home economics teacher at a college of education, and a program designer within the federal Ministry of Women Affairs, all of who supported this idea. I sent a proposal for implementing these ideas to the Ministry of Women Affairs. They are uniquely able to support and diffuse this technology throughout Nigeria, and welcome the input of partners to help them meet their mandates.

To address the tendency for a pro-innovation bias to exist, we should research the impact on solar cooking adopters, as Rogers advises (Rogers 2003:106-107). This research should include impacts not only on the cook, but on the whole family, including economic impact, enjoyment of food, food availability (e.g., it may now be ready for kids after school rather than later in the evening), plus the impact on the cook's routine and use of time.

Additional recommendations for future field research based on diffusion of innovations theories are provided in section *9.5 Recommendations for Future Research,* below.

8 The Research Findings

The original intention of this project was to test the videos as a "train the trainer" tool for change agents who had not participated in the solar cooking project. Because of delays in getting a visa, my time in the field was reduced from six to three months, yet the scope of the project remained unchanged. The resultant time pressures meant that there was less time to develop the video and to find this specialized audience to evaluate it. Instead, we revised the project and tested the video as a training tool for community members, who were not the originally intended research audience, although they are the end users and intended solar cooking project beneficiaries.

Three training workshops were conducted at FF, using the locally made videos. In the first one, we showed an English video that featured explanations about solar cooking, its benefits, health risk (of blindness from the sun's reflections), and how to use it. Four people attended the full workshop, another person left while the food was cooking, and two people saw most of the video and presentation, but little of the cooking, including Mary, a home economics teacher at the local College of Education. Two people completed post-training surveys after this workshop. Mary did not complete a questionnaire and so is not represented in the formal research results presented in this paper, but informally she provides a positive example of the video's effectiveness as a "train the trainer" resource. Because Mary arrived late, she watched the video on her own, as someone might do who ordered a training CD or watched it on the Internet. From her questions and comments, it was clear that Mary understood the principles behind solar cooking, and had the potential and interest to experiment with solar cooking. Her job provides her with a unique position to teach solar cooking to future home economics teachers, who then could then teach it in public schools.

After watching the video, but before beginning the cooking practice, the two trainees who completed surveys both said that they felt confident that they could solar cook on their own now, and that they intended to use a solar cooker themselves. One of them wrote that the parabolic stove must be refocused periodically. During the practice, however, it was discovered that none

of the trainees could demonstrate how to focus the parabolic stove without assistance. Therefore, we adjusted the video and added a section that clearly outlined the steps to focus three types of stoves: the panel CooKit, box cooker, and parabolic solar cooker. The language of the video was changed to Hausa, the predominant language near BayanLoco.

The new version of the video was tested in another training workshop that six women attended. We showed the video, conducted the post-training survey, asked the women to individually show us how to focus the stoves, and then solar cooked a meal with them. This workshop was interesting in several respects. A natural leader emerged, a nurse who had experience in public health work. Her name is Paulina, and she has become a supportive community member who is very interested is promoting solar cooking in Kafanchan. She helped lead the next training workshop, and I hope that she will become a future trainer.

Of the five women who had heard of solar cooking before, three knew “nothing” about it, two knew “a little.” Two of them worked at FF, and had seen me solar cooking there before attending the workshop. In the pre-training survey, three of them noted saving money as a motivation for solar cooking. Two mentioned saving time, three wanted to save the work of collecting firewood, one knew it provided health benefits of not having to inhale smoke. Five said that they wanted to try it (one did not answer). Four predicted that they would prefer the fast cooker (parabolic stove); two predicted they would prefer a more carefree slow cooker. It is interesting to note that after cooking fish soup in both the parabolic and box cookers, and preferring the taste of the soup cooked on the parabolic stove, the women unanimously agreed, after much discussion, that they preferred the box cooker because it can be left alone for long periods of time, and therefore is more convenient than the parabolic stove, which must be adjusted every ten or fifteen minutes to keep it hot.

In the final training workshop, we showed the same video with the addition of an introduction, and closing remarks that summarized the key points about solar cooking.

Because most trainees had trouble aiming the stoves towards the sun, particularly the parabolic stove, it would have been useful to test other versions of the video to see if this aspect

could have been improved. Also, most of the participants forgot to protect their eyes from the glare of the sun to prevent blindness, particularly with parabolic stoves. We added a reminder about this in the ending of the third version of the video, but it still was not enough to make the viewers take precautions when they demonstrated how to use the stoves. Ideas about potential improvements to the video are shared in section *8.2 Future Improvements to the Video,* below.

Copies of the pre-training and post-training surveys are provided in Appendices A and B, below, and the results of the survey are provided in Appendices C and D.

8.1 Data Analysis and Reflections on Results

I believe that we can draw some conclusions from this research. One is that video is an important and effective means of transmitting information and influencing ideas. After watching the video, but before trying solar cooking or even getting a close look at the stoves, 89% of respondents said that they intended to try solar cooking, and one said that she was "likely" to try it. The reasons given were that it is easy to use (mentioned by 4 people), it is inexpensive (3), it eliminates smoke (2) and heat (1), it is neat (1), it was taught to them (2), it reduces illness (1), and it reduces stress (1). Therefore, the video was effective at explaining solar cooking, and persuading people that it was worthwhile to try.

MOTIVATIONS TO TRY SOLAR COOKING AFTER WATCHING THE VIDEO	
Inexpensive	4
Easy to use	3
Eliminates smoke	2
Eliminates heat	1
Reduces stress	1

Information that people said that they would tell friends who wanted to learn about solar cooking included the facts that you need black pots (4), that it is easy (3), particularly when compared to wood (1). They said that one must adjust the stoves towards the sun (4). While the survey directed respondents to demonstrate how to use the box cooker,

rather than explain it, some interviewees still wrote down responses that included putting the pot in a bag (2), covering the stove (2), and using a black pot (2). Similarly, the respondents were asked to demonstrate, rather than explain, the method of using the parabolic cooker, but some written answers were provided, including adjusting it every fifteen minutes (2) or periodically (1). One respondent correctly described that the shadows of the stand should fall on its base, and that the dish should be adjusted to eliminate the shadow of the nail in its centre.

INFORMATION RETAINED BY PARTICIPANTS THAT THEY FELT IMPORTANT TO SHARE TO OTHER POTENTIAL SOLAR COOKERS	
Black pots are needed	4
It is easy	3
It is easy, especially compared to wood	1
The stoves must be adjusted towards the sun	4

ADDITIONAL INFORMATION ON THE BOX COOKER (PROVIDED BY SOME PARTICIPANTS, BUT NOT REQUESTED / REQUIRED)	
Put the pot in a bag	2
Cover the stove	2
Use a black pot	2

ADDITIONAL INFORMATION ON THE PARABOLIC COOKER (PROVIDED BY SOME PARTICIPANTS, BUT NOT REQUESTED / REQUIRED)	
Adjusting it every fifteen minutes	2
Adjusting it periodically	1
Shadows of the stand should fall on its base	1
Dish should be adjusted to eliminate the shadow of the nail in its centre.	1

The video explained that solar cookers can pasteurize water, and that a water purification indicator, called a “wapi,” demonstrated that the water was pasteurized when the wax inside it melted. When asked to describe the steps to pasteurizing water,

respondents said by using the wapi (7). Three said that the wax inside the wapi must melt; two said the water must be "well cooked." One woman said that she did not understand the video; she was not a fluent Hausa speaker, so language was likely an issue. Since most respondents understood that they needed to put the wapi in the water, I believe that through experience they could easily tell when the wapi's wax was melted or not, and successfully pasteurize water.

PARTICIPANTS' DESCRIPTION OF STEPS TO PASTEURIZE WATER	
By using the wapi	7
The wax inside the wapi must melt	3
The water must be "well cooked"	2

The video also effectively communicated ideas for recipes. Everyone at the first workshop was disappointed that we did not have plantains to cook, since the video they watched included testimonies of people saying that solar cooked plantain tasted great. Participants who watched the other videos did not mention plantains, since it was not included in the Hausa video they watched. Cooking fish soup was demonstrated, and that is what the second group of participants cooked. I believe that short recipe videos would be valuable resources to help women adopt solar cooking more successfully. This could be combined with information on nutrition to create an added learning benefit.

Most trainees could not aim the stoves properly based on the video alone. In our first attempt to explain this better, we enumerated the steps for aiming each stove, and demonstrated how to do it properly. 78% of trainees said that they felt ready to solar cook by themselves based on the video, one "thought so," and one "thought not," but in fact none of them could properly aim the parabolic stove without assistance. Perhaps an improved video will have better success. Clearly, testing whether your video is effective is very important. Ideas for changes to the video that may make it a better training tool are provided below.

8.2 Future Improvements to the Video

The hardest part of solar cooking for the project participants was focusing the stoves to catch the sun's rays most effectively. The method of doing so depends on the solar stove being used. Adding the following video content should encourage viewers to think through the instructions, which should lead to better recall and practice:

1. Include examples in which the stoves are set up incorrectly, and explain why.
2. Show a stove's position, and ask viewers to decide whether it is correct or not. Then tell them the answer.
3. Show a person solar cooking, and ask the viewers if they have done everything correctly. After a pause, identify any mistakes, for example, forgetting to use safety precautions against blindness. The final examples should be correct.

8.3 Other Training Mediums

8.3.1 Diagrams

Training improvements can also occur apart from the video. For each type of solar cooker I would like to develop a diagram that reminds people how to protect their eyes to prevent blindness, and how to focus the stove properly. One should be printed and affixed to each stove, or drawn on it. Instructions in the major local languages should also be affixed to each stove. These are examples of graphical and textual training supplements. The diagrams should be field tested to confirm that they convey the intended message to the widest populations, including people from diverse language groups, tribes, educational levels, occupations, gender and age. These visual and textual lessons should help people remember and share more than the 14% of information suggested by Röling et al (1976:162), when they tell others how to solar cook.

Another helpful printed resource is a visual chart of the best cooking times, the best cooking pots (e.g., black ones with thin walls), cooking times for various foods,

cooking methods for various foods (e.g., how much water to add, and how small to cut pieces). SCI has already developed such charts.[18]

8.3.2 Songs

I am interested in the use of songs, especially action songs that can remind people how to use the stoves. They can also share health tips (e.g., why drinking water should be pasteurized, how to pasteurize water in a solar cooker, and how to keep it pure upon removal from the solar cooker). Even recipes could be sung. An action song could become an attention-grabbing attraction when solar cookers are demonstrated at markets and public venues. Action songs are audiovisual mediums. We should remember that the digital format isn't the only format that audiovisuals come in (and they would also make great video content!). Songs are good audio communication tools that could be used for radio promotions, and mnemonic devices (Ong 1982:33).

8.3.3 Dramas

Drama is a live audiovisual expression that has been successfully used for training in Africa. Ochuko Ojido, from the Nigerian NGO, Community Life Project, told me that they use drama to communicate health messages (Ojido 2005). His NGO has begun to videotape the dramas to show them at other times and places, because videos are more cost effective than live dramas. Ojido reiterated the statement that Africans are visual, and that sights are remembered more than the spoken word. The combination of sights with sounds in a drama should make their impact even higher.

8.3.4 Websites and Online Groups

A solar cooking website will be developed as part of this project. Websites offer interactive audiovisual effects. Its interactive properties can be advantageous as a training medium by asking people to decide whether a stove is correctly positioned or not in a picture, and then confirming or correcting their choice. We could ask them to identify

[18] See http://www.solarcooking.org/images/cooking-times.gif; other resources are available in their books, which can be ordered at http://www.solarcookers.org/

positive and negative actions in photos, or answer multiple-choice questions, and provide immediate feedback.

The solar cooking project team, whose members are located in two Nigerian communities, and myself in Canada, will primarily communicate through a new online group, which will allow people to share their experiences, questions and answers, and encourage each other. It will also link to solar cooking documents and other websites. We will invite other global solar cookers to join us online, particularly those in Nigeria.

9 Recommendations

My experience of implementing this solar cooking and video training project taught me some valuable lessons that I offer as suggestions for future projects. These have been organized into topics, and documented below.

9.1 Recommendations to Improve the Video

These methods of training people how to focus the stoves using video (or in person) should be tried and tested. This content may encourage viewers to think through the instructions, which should lead to better recall and practice:

1. Include examples in which the stoves are set up incorrectly, and explain why.
2. Show a stove's position, and ask viewers to decide whether it is correct or not. Then tell them the answer.
3. Show a person solar cooking, and ask the viewers if they have done everything correctly. After a pause, identify any mistakes, for example, forgetting to use safety precautions against blindness. The final examples should be correct.

9.2 Capacity Building Recommendations

9.2.1 Opportunity to Practice

Whether with a video camera, computer editing system, or a solar stove, people need the opportunity to practice new skills, especially before deciding whether they intend to invest in a new technology that might require the financial commitment of a loan. This could also help people decide which solar stove they like best before committing to one. One of the solar stove trainees, Victor, said that he would like to solar cook three times before deciding whether he wanted to adopt the technology.

Fantsuam Foundation offered its video students the chance to sign out cameras for use in its own projects. They will not lend or rent out cameras for other purposes due to

the risk that the cameras will become damaged, but they will offer loans to people who want to buy their own cameras, particularly to start their own video businesses. They do not have any similar arrangements for people to try solar cookers, but I believe it would help with the promotion of solar stoves. OCDN does not have a lending program for any equipment, and in fact was still waiting to receive their camera and Macintosh computer from Fantsuam Foundation at the time of writing.

9.2.2 Ongoing Support

While I was in Nigeria, I spent hours outside of formal training programs to individually coach, encourage and correct my students. This was very important to nurturing them to be able to make their own videos, from storyboards to final edits. They completed the construction of new solar stoves after I left, and are capable of testing the stoves, and training others to use them. Katrina Chan, a CUSO cooperant who had worked at Fantsuam Foundation for one year at the time, remarked that it was wonderful to observe students making videos and solar cooking after the training programs. In her experience, she and others who have attended other training programs in Nigeria rarely implement the skills they are taught. She believes that the ongoing support that I offered by practicing the skills at Fantsuam Foundation, and enlisting the students' ongoing help, made the difference. According to social learning theory, modeling the use of video as an educational tool for solar cooking was another important factor (Rogers 2003:242). Therefore, this project facilitated the diffusion of video as a relevant technology, as well as solar cooking.

Support is easiest to offer in person, but it can also be provided remotely. The intention with this solar cooking project was to develop videos that would be used as distance learning materials by other organizations and individuals. No one will be available to provide in-person support to the distance learners, and therefore online support will be a critical component in helping them become proficient solar cookers. This is possible through email, online chat (whether voice or text), online groups, and telephone.

For example, I troubleshot problems burning DVDs with FF in August from Toronto using an online text chat. I frequently exchange emails with project members at FF and OCDN. We use an online Yahoo! Group to collaborate on solar cooking with a broader audience, including someone in India. FF has the bandwidth and headset required to conduct online voice chats. David Mutua frequently uses Skype, a free software tool, for voice chats. I have found that Skype works poorly on slow connections, and sometimes use MSN Messenger's audio chat capabilities, which are better on slow connections, but not completely reliable. Telephone support is also possible for those who have access to them. There are good long distance cards that make phone calls to developing countries inexpensive. All of these technologies can allow someone to provide remote support to people around the world. And once that person gains the skills you are helping to impart through online support, they can share them in person with their peers.

Katrina Chan (2005) shared some of her reflections about this project:

> I'm a Canadian CUSO cooperant on a two-year placement with our partner NGO, Fantsuam Foundation, located in rural Nigeria… FF offers volunteer and internship opportunities to students enrolled in our computer programs to enable them to gain hands on experience. To that end we have invited several visitors from all over Nigeria, Africa, and other parts of the world to share information and expertise. Most come for short visits of a few weeks and are therefore limited in the kind of training they can offer and the monitoring of its success. Carole's stay of a few months allowed her to integrate and establish a rapport with a number of the members who took part in her solar cooking, video skills, and web design workshops. Knowledge, attitude, and practice is always difficult to influence, but Carole was able to create a comfortable learning environment by exhibiting patience, providing clear and appropriate instructions backed up by expertise, demonstrating the value of the

skills being imparted and her obvious passion for the subject, and being available for consultations and technical support when needed during and after the sessions. Her workshops had a good balance of theory and practice, which may explain the ongoing involvement of some of the participants with the project and other FF programs after her departure.

9.2.3 Financial/Material Support

At the project halfway point, all of the available project funds had been spent (in fact, overspent), and approximately 20% of the funding will be received after the project completion. Cash flow problems make it difficult for the participating organizations to continue investing financially in the project, so the volunteer trainers and potential sellers of solar cooker are expected to buy their own materials to make their own cookers. However, the concept of solar cooking is still new and unproven enough to make people hesitate to invest in this technology. Everybody says that it is a great idea, but when asked to make their own stoves, people are not responding.

There are some ways to address this. One is to seek more funding. Another is to use the solar cookers that are already built more effectively. I have suggested that OCDN loan the stoves to their community trainer, Maria, until she can prove the technology enough to justify buying her own cooker. At that time she will have the experience to train others effectively, and assure them that investing in solar cooking is worthwhile. OCDN could rent at a nominal fee, or offer for free, the chance to test the stoves by community members. This should generate firm orders that a builder can fulfill without financial risk. A similar arrangement could also be applied at FF.

Another opportunity is to look for sources of free, or inexpensive used materials for the solar cookers. A doctor in Kafanchan supplied free cartons to the project because he knew where to source them. We requested used newspapers from someone else, and a man on the Kafanchan Solar Cooking Group said that he could find more. We secured

donated used printing press plates for trial in solar stoves, but found that tinfoil was a better reflective material. Local shopkeepers have offered to save clear plastic bags for us. When a viable market has been developed for solar stoves, everyone providing these inputs can be offered financial remuneration for their inputs. At that time, perhaps commissions from solar cooker sales can be donated to a fund for promotion, training, and support, that will result in future sales for the builders.

9.3 Solar Cooking Promotion Recommendations

9.3.1 Opportunity to Procure Equipment

One hundred percent of the solar cooking trainees wanted to try solar cooking themselves after attending a workshop. However, we did not have stoves for sale, nor a means of fulfilling orders. This is because the project intended to attract local entrepreneurs to build and sell solar stoves. This has not yet been put in place.

Before any large-scale promotion of new devices is done, a supply of them must be available. It would have been helpful to have had a temporary source of cookers during our pilot project, and one should be arranged for the promotions due to begin after the rainy season, if local builders will not be ready to supply cookers by then. Research from *Deutsche Gesellschaft für Technische Zusammenarbeit* (GTZ) in Southern Africa urges organizations to introduce solar stoves at a price that allows a for-profit organization to take over the manufacture and distribution of solar stoves at the same price, to ensure project sustainability (GTZ and DME 2004:6). Therefore an appropriate price to cover local production should be applied while selling imported, or donated, cookers. It may also be possible for the NGOs to sell supplies for people to build their own solar cookers, perhaps through an occasional or as-needed solar cooker building workshop. Donating supplies to the early adopters might be a good investment to long-term sustainability.

During the pilot project, entrepreneurs should be supported to research the market, in order to take over supplying the product if the demand for it is proven. If FF hires local

people to build the stoves, and acts as a middleman to bring customer orders to these suppliers, I believe they can develop a supply chain more easily. This is because it would reduce the risk of loss for the builders.

9.3.2 Financial Support to Procure Equipment

Although eventually the stoves will save more money than they cost, getting together a few dollars for a CooKit, or sparing the hours to make it, are beyond some subsistence farmers and traders. For example, I invited a workshop participant named Rhoda to help construct a CooKit that would be donated to her, but she could not spare the hours away from work to make it (at least at that point in time). Her daily income buys daily bread for herself and four children. Therefore we made a stove for Rhoda.

Mrs. Kazanka, the General Secretary of Fantsuam Foundation, believes that more people will want to buy a stove than make one. This is because to buy a stove is quick and easy, and the skills to make one for personal use will not be required frequently. If one prefers a parabolic cooker, or a wood and glass box cooker, one may not have the building expertise required to make it. What would help people like Rhoda to buy stoves are micro-finance loans. FF runs a large micro-finance program, and intends to provide loans for the purchase of solar cookers. OCDN does not have a micro-finance program in place, and does not presently have the capacity to start one. Some people in their community have joined savings clubs, one of which was unsuccessful, and one of which is still in progress. If they manage to find a working model, perhaps OCDN can help organize solar cooking savings clubs to help people afford solar cookers. The support of a solar cooking club might help the members share experiences and questions, solve problems, share recipes, and encourage the lifestyle changes required for successful solar cooking (e.g., setting it up to start cooking in the morning; pasteurizing water).

9.3.3 Solar Cooking Workshop Logistics

One thing I have learned is that solar cooking is slow. People feel hot, hungry and thirsty well before the food is ready, but there are ways to make the workshops more

comfortable. First, put the food preparation table in the shade, and provide a shady spot for people to rest while they are waiting for the solar cooking to finish. Secondly, provide drinking water. Thirdly, cook something very easy to serve as snacks, and as quick demonstration foods. Plantains are excellent choices, and a favourite solar cooked food. Placed in the cooker in their skin alone, they cook in one hour and taste delicious. “Hard boiled” eggs take one hour, and these provide another excellent snack (they do not need to be put in water). Another advantage is that people who leave the workshops early will taste a completed recipe.

9.3.4 Solar Cooking Test for Nigerian Soup

How can the integrity of a traditional recipe be maintained with the new cooking method? For example, can a good tasting soup, which is a staple of Nigerian cooking, be solar cooked by first using a wood fire or kerosene stove to fry the onions and tomatoes, and then finishing the soup in a box or panel solar cooker? This should be tested, as soups are important staples of Nigerian diets.

9.4 Practitioner Preparation

9.4.1 Practice Participatory Action Research Tools

Proficiency using participatory action research tools helps the facilitator to focus on the process and discussion, not the methodology, when in the field. This is particularly important when factors such as cultural or language differences also require his or her attention. The vast difference between reading about and practicing the tools leads me to suggest that new PAR researchers practice them in low-key interpersonal situations with friends, in supportive places such as small work or volunteer teams, or with academic colleagues for fun or to meet real goals, before going to the field. While you are there, the freedom to experiment with new methodologies and tools on the spot is important. Remember that PAR defines you as a learner/participant as well, and give yourself the grace that you give others to experiment and make mistakes.

9.5 Recommendations for Future Research

9.5.1 How to Evaluate Participants' Learning

Testing whether your video is effective is very important to fine-tuning it, but this cannot be adequately accomplished through questionnaires or interviews, as participants may miscalculate their level of learning. This testing is best done through hands-on demonstrations. In this project more people said they were ready to solar cook on the questionnaires, than could properly apply the techniques in person.

9.5.2 Videos as a "Train the Trainer" Resource

It was my original intention to test the solar cooking videos as training materials for community development workers, rather than for the general public. Due to project constraints, this was not possible. It would be interesting to compare the impact of a video for the training of trainers, versus the training of end users. Differences in these two audiences might include their access to additional support, motivation, education, and exposure to new ideas or technologies. Another difference would be where they fit into the diffusion of innovation model as an early adopter or a later adopter.

9.5.3 Amateur versus Professional Video

A question worth exploring is whether a professional-looking, edited video has more impact than a simple video that uses in-camera edits, or no edits. If the content is effectively communicated in a simple video, then today's easy to use cameras can be used by almost anyone for educational purposes. The video content will need excellent planning and storyboarding, however, because editing it later is not possible in this case. Ochuko Ojidoh from the Community Life Project in Nigeria says that they use rough videos effectively in their work. For example, they might videotape a meeting and playback the video immediately to remind people of the discussion, make the issues clearer, and help them see gaps in the discussion or plans (Ojidoh 2005).

9.5.4 Baseline Surveys for Diffusion of Innovations Research

When solar cooking is introduced into communities that have not been well exposed to the concept, an opportunity exists to conduct longitudinal studies on the impact of audiovisual training materials and diffusion of innovations practices in them. A baseline survey would be required throughout the community before starting the interventions, or at least via surveys at community demonstrations, and at the beginning of training or awareness programs. This will allow experimental DOI research to be designed, and avoid some of the pitfalls of the pro-innovation bias that occurs when DOI research is conducted after an innovation has already been introduced into a community (Rogers 2003:112). If a face-to-face or online group is created, the issues they discuss can be documented for later analysis.

9.5.5 Longitudinal Studies for Diffusion of Innovations Research

Collecting data through a long-term study will avoid the recall problem faced in historical studies, leading to more accurate data (Rogers 2003:113, 126). For example, data can be collected when solar cookers are bought, when people attend solar cooking construction workshops, and then more widely to uncover information about rejection, discontinuance, re-invention, and the impact of the adoption of solar cooking (Rogers 2003:114-115).

9.5.6 Consequences of Solar Cooking Adoption

Rogers' (2003:450) discussion on desirable and undesirable consequences, direct and indirect consequences, and anticipated and unanticipated consequences of various innovations has influenced me to reflect on the consequences of solar cooking adoption. One means of anticipating undesirable effects is to research other solar cooking projects, such as the Programme for Biomass Energy Conservation (ProBEC) in Southern Africa.[19] Another is to brainstorm with community members about the potential consequences of introducing solar cooking. The stakeholders should design a monitoring and evaluation

[19] See http://www.probec.org

method of tracking these consequences, and plan risk-mitigating strategies of the possible negative effects. One method for brainstorming is through meetings with a wide range of stakeholder representatives to discuss the various cooking methods, their inputs, outputs, costs and benefits. A foreseen consequence of solar cooking is the need for a backup cooking method for cloudy days. A mitigating strategy is to have alternative fuels available. The discussion might include how accessible these fuels are during cooking hours, whether they should be kept in personal supply, and how quickly unused kerosene evaporates.

If the unforeseen negative effects outweighed the benefits, the solar cooking outreach program will need to be changed to address them, or even be discontinued. However, the long history of successful solar cooking in other regions suggests that this scenario is unlikely.

9.5.7 Research on Rates of Knowledge Retention and Sharing (a)

Röling et al (1976:162) found that in one case, only 14% of the necessary information about something was passed on to others, and in another case, 25% of the information passed on was faulty. One of reasons for this may be that we remember only 20% of what we hear, 30% of what we see, versus 50% of what we see and hear, 70% of what we say, and 90% of what we say and do (Pike 1989:61). Videos can be used to help people see and hear one hundred percent of the message from the original change agent. How many people can be directly reached via a change agent, versus the number who can be directly reached by a video outreach program organized by an organization? How many more people can be reached by offering free, on-demand access to the video at a telecentre? And what impact does seeing the video have on the rates of information recalled by viewers, and shared from one person to another? If the same information is shared each time, what differences in learning and adoption rates would occur between people who:

a) Attend solar cooking training in person, where solar cooking is demonstrated but not practiced, but do not see the video;

b) Attend the type of solar cooking training described in (a) above, plus see the video; or

c) Only see the video?

Note: This research design excludes the practice of solar cooking in order to isolate and compare the impact of video training versus in-person training. This limits to the test to the communication channel, and excludes differences due to learning styles. However, when one is not conducting an experiment, solar cooking practice should be included as an important part of training, because research shows that practice is a very effective teaching method (Pike 1989:61).

9.5.8 Research on Rates of Knowledge Retention and Sharing (b)

In section *8.3 Other Training Mediums,* above, I discussed putting graphical and textual instructions on solar cookers, and teaching songs about solar cooking. After validating that they convey the intended messages, these ideas should be field tested to confirm whether they help people to remember more information when they solar cook, enabling more successful adoption, and whether they help people to share more information, more accurately, when they tell others how to solar cook.

9.5.9 Educational Material Comparisons

The impetus from this study arose when I wondered whether a video would be a more successful training medium than the printed materials published by SCI about solar cooking. It would be interesting to evaluate this hypothesis, either using the solar cooking materials, or other important development messages, such as HIV/AIDS prevention. The research criteria could include the language of the material, its results, how many people implemented its messages and to what extent, how much of the information was

remembered, the satisfaction or frustration levels with the training materials, and how many people were impacted by the materials over a period of time.

9.5.10 Impact of Videos on Rates of Adoption or Rejection of an Innovation

SCI says that to successfully introduce solar cooking to a new region takes approximately five years to achieve (SCI). However, SCI has not used videos as training tools in their projects as of yet. Will the use of videos speed up the decision-making step in the diffusion of innovations process (Rogers 2003:20)? Will it reduce the amount of time required to achieve the “take-off point” of sustainable diffusion?

10 Conclusion

Africa's under-development, large distances, and lack of alternative communication and information sources, make the use of digital ICTs such as CD-ROMs, video, and the Internet especially important and valuable for training, information sharing and communicating. These ICTs can be used creatively in ways unique to the South. One of them is providing shared access to them in public facilities, whereas individual or family ownership is prevalent in the North. Another is combining technologies, such as using the Internet for research, while disseminating the research results through community radio, loudspeakers, or bulletin boards. Another method of improving information flows is to link them to traditional knowledge networks, such as chiefs and elders, or the town crier.

While the applicability of digital ICTs to development is often strongly supported and predicted, previous projects have had mixed results. Experience has shown that simply providing technology is not enough – it must be made locally appropriate, driven by a community's true needs versus directed by an external agency, and be integrated into existing social and knowledge-sharing processes.

The focus on the use of modern ICTs for development has progressed from providing the necessary infrastructure, to customizing applications for them, to creating local content and community services with them. Continued efforts are required at all of these levels, since much still remains to be done to provide access to these ICTs throughout Africa, and to support their productive use.

As technology becomes more powerful, easier to use, and less expensive, and as successful projects demonstrate their applicability in the South, one can expect that their use and value to development will continue to increase and expand in creative ways.

From personal experience at two rural telecentres in rural Nigeria, I have observed that email and online chatting are very popular, and important, uses of technology. When telephone access is unavailable, unreliable, or unaffordable, email provides an excellent means of

communication. It can help people keep in touch with family and friends in other African cities and villages, as well as overseas. Since children often move away from home for education, and family members disperse to find work opportunities, communication is a very important service; one that someone from the North can hardly imagine living without. During only one month in 2004, in a village with no telephone or Internet service, no television and very poor radio reception, I felt extremely isolated from family, friends, and world news. When I returned to this village in 2005, which now had Internet services, I sincerely appreciated the opportunity to communicate with people, read news, and conduct online research.

Development practitioners expect computers, CD-ROMs, and Internet access to be of value to communities for learning about issues of importance to them, but even information that communities request do not get used (Thione 2003:66). One of the research communities in Nigeria had informational materials about things like malaria prevention, ergonomic well designs, and solar cooking, particularly since their interest in that technology had been piqued by the donation of a solar cooker. Solar cooking met expressed needs such as reducing the expense of fossil fuels, and the hardship of collecting and using firewood. To my surprise, simple instructions on the building and use of a simple solar cooker, which I tested myself and forwarded to them to try, were not implemented. However, their motivation to try solar cooking was great enough for them to develop a joint project for me to return to show them in person.

The lack of implementation of printed instructions was intriguing. While in general, text is a limited means of communication in rural Africa due to language and literacy levels, in this case the recipients included an NGO director with a PhD, a pastor, and an ICT trainer. This led me to research whether a video about solar cooking would be a more appropriate “train the trainer” tool for people in rural areas, who have no access to such information in person, nor the funds to easily pursue it in person. The result was the solar cooking project that this paper documents. The project developed new capacities in two Nigerian telecentres to create their own videos, and to build and use solar cookers. Together we developed a solar cooking video in the African language, Hausa, and tested its effectiveness. We faced significant, but not unlikely, constraints in this development project. One was time: due to visa delays and limited funding, my time on the

ground was reduced from six months to three. Also, the participants that I most closely worked with were volunteers, as the telecentre staff I expected to work with had too many competing responsibilities to dedicate adequate time to learn solar cooking, video production, and to produce a video within our time frames. For practical reasons, we also tested the video primarily with audiences of end users, rather than trainers: audiences who have different characteristics that may affect their learning, and modeling, of solar cooking.

The research showed that the video was effective in communicating knowledge about solar cooking (step one of Rogers' diffusion of innovations model), and persuading people it was worthwhile to try (step two of the model; Rogers 2003:20). However, when workshop participants watched the video, and then went to the stove to implement the steps, they could not successfully adjust the most complicated solar stove. Improving the content of the video, and modifying the video's use in the workshop to a more interactive method (e.g., watching step one on video, then doing step one hands-on), are examples of ways that the video might become more effective.

Solar Cookers International's experience, and research on the diffusion of innovations, both confirm that it takes years to successfully introduce innovations into new communities. Key factors that impact its success include the adaptability of the technology to local needs, its trialability, observability, and the manner in which it is communicated. In these respects, there is no reason for discouragement that solar cooking was not more enthusiastically adopted in these communities yet, after only three months of work with FF, and three weeks of work with OCDN. Rather, DOI research provides helpful lessons to encourage the ongoing, flexible, adaptation of solar cooking until it becomes either rejected as inappropriate, or adopted to the point of sustainable dissemination.

One of the ways in which a video may mitigate a key shortfall of the diffusion of innovations model is to make original training information accessible to a much wider population than could be achieved through an extension agent, printed materials, or mass media. As little as 14% of information about innovations reaches the second generation of learners via word of mouth, and up to 25% of it may be erroneous (Röling et al 1976:162). This is insufficient to

successfully adopt the innovation, and may be an important cause of the failure of many innovations, at great expense to those who tried to adopt them – and those who supported these projects. If a video can help bring 100% of the information directly to more people, this should be a big step forward. In addition, if we only remember 20% of what we hear (Pike 1989:61), only 2.8% of the mere 14% of second-hand information may be remembered by the second generation of learners. To increase this is clearly an important priority, without which innovations will not be adopted, or worse, will be poorly adopted to the detriment of the users. In the case of solar cooking, poor instructions about eye protection could even result in blindness. On the other hand, 50% of information that we both see and hear is recalled. Compared to a trainer who shares information only verbally, adding a video to the training could increase its effectiveness from 20% to 50%. If practice is added, the recall level rises to 90% (Pike 1989:61).

I applaud the work of organizations such as Communicating for Change in Nigeria, who not only produce audiovisual training materials, but train people to effectively use them, and develop teaching resources to help the trainers to do so. All producers of "train the trainer" materials, and all diffusion of innovation projects, should help their trainers to learn how to train. Also, whether the training material is for end users or trainers, two-way support, which can be provided via digital ICTs, is important. It is insufficient to simply provide content, without helping people to interact about it, ask questions, troubleshoot problems in applying its content, or learn how to share it effectively with others.

FAO, DFID, and the World Bank (2004) have recently developed valuable principles for the application of ICTs to rural livelihoods, which should inform future projects. In addition, Shirley White (2003b:392-397) has developed a model to evolve telecentres into Community Communication Centres. These would facilitate the participation of all community members into visioning, defining, and implementing their own development goals, for which ICTs may or may not contribute as effective tools. To make the most progress towards community development, for example, to meet the Millennium Development Goals, we must empower Southern ICT users to apply ICTs creatively to their own needs, in their own way. Importing the patterns of ICT use in the North to the South is not currently feasible, neither is it necessarily appropriate or applicable.

Instead, Africans need to create their own new path. Digital ICTs have a unique capability to help people within communities, and around the world, to see, hear, and share ideas about how to blaze this path, what successes are occurring elsewhere, what pitfalls to avoid, and dreams of what is possible. I remain committed to listening to others' gifts of their ideas about this new way, and to offering my own gift of ideas, loosely held in open hands.

Appendix A: Solar Cooking Questionnaire – Pre-Training

This questionnaire should be administered to participants in the training program, before the program starts. It can be conducted in advance so as not to interfere with the training schedule. It can also be used as widely as desired for a baseline community survey about solar cooking knowledge.

Reminder: Please first ask respondents to fill out the Consent Form. Even though we ask for their name below, we will keep it private if they requested us to on the Consent Form.

About Yourself

First, please tell us a little bit about yourself.

Name: _____

[Gender: _____ - interviewer can fill this in without asking]

Occupation: _____

Age (years): _____< 15 _____16 – 20 _____21-25 _____26-36 _____36-45 _____>45

Husband's Income per month: _____
Wife's Income per month: _____
Children's Income per month: _____

Who lives in your household (e.g., grandparents, parents, # children)? _____

_____

Who does the cooking? If more than one person, please estimate the percentage.

_____

Please tell us about your typical daily cooking habits.

Time of day:					
Time spent cooking:					
Typical food and drinks cooked at this time:					

Do you eat uncooked meals at other times during the day? Do you and your family eat out regularly (e.g., buy lunch at work)?

_____

Please tell us about your current cooking methods.

	Wood	Gas	Kerosene	Charcoal	Animal Waste (Dung)
Cost per month:					
Who gets it?					
Where do you get it?					
How often do you get it?					
How long does it take to collect it each time?					
What do you like about it (the benefits of it)?					
Are there any problems with it? If yes, what?					
What do you think could resolve these problems?					

About Solar Cooking

1. Have you ever heard of solar cooking?

_____*Yes* _____*No*

Those Who Have Heard About Solar Cooking

2. If you have heard of solar cooking:
   a) How much do you know about it?
   _____*0 = nothing* _____*2 = a little*
   _____*3 = some* _____*4 = a lot*

   b) What have you heard about it?

c) When did you first hear about the idea of solar cooking?

d) Who informed you about it?

e) Do you know anyone who's tried solar cooking? _____*Yes* _____*No*

If yes to e: How successful was it?
_____*0 = do not know* _____*1 = not at all successful*
_____*2 = not very successful* _____*3 = successful*
_____*4 = very successful*

How often do they solar cook?
_____*0 = do not know* _____*1 = rarely (< 1/month)*
_____*2 = occasionally (<4/month)* _____*3 = often (>1 / week)*

Can we contact them and talk to them?

3. Have you tried solar cooking? _____*Yes* _____*No*

4. If you have tried solar cooking:
   a) Why?

   b) What kind of solar cooker was it (person can describe or draw it)?
   _____Panel _____Box _____Parabolic

   c) Where did you get it?
   _____Made it _____Bought it

   d) Please describe in detail where you got the instructions, or from whom you bought it?

   e) Did you consider it a success? Why / why not?

   f) What was your evaluation of solar cooking?

   g) What benefits did it have?

h) What problems did it have?

i) How often do you solar cook?

j) Has this changed over time? Please explain why.

5. If you have heard of solar cooking but have not tried it:
   a) Why haven't you tried solar cooking?

   b) What is preventing or discouraging you from trying solar cooking?

   c) What information would you like to know before you try solar cooking?

   d) What benefits does it appear to have?

   e) What problems does it appear to have?

   f) What would encourage you to try solar cooking?

Those Who Have NOT Heard About Solar Cooking

Solar cooking is cooking with the sun's heat only; you do not need a fire and you don't need any other fuel. You put your food in a black pot that is good at capturing the sun's heat. You put the put under glass or a plastic bag so that the heat cannot escape. And you put the pot over a silver box or bowl that shines the sun's rays onto the black pot.

6.

a) What do you think about solar cooking?

b) Would you try it yourself?

_____*0 = No* _____*1 = Unlikely* _____*2 = Likely* _____*3 = Yes*

c) Why do you say that?

d) What would encourage you to try it?

e) What would discourage you from trying it?

f) Some solar cookers cook slowly; you put your food in them and come back in a few hours, and it is cooked. Other types cook quickly; you have to keep turning them to the sun, and stirring the food so it won't burn. Which type seems better to you?

_____*Slow cooker* _____*Fast cooker*

Appendix B: Solar Cooking Questionnaire – Post-Training

This questionnaire should be administered to participants in the training program, right after the program ends. Please see the guidelines above about privacy and who should administer it.

1. Do you feel ready to build a solar cooker by yourself?
   _____*0 = No* _____*1 = I don't think so* _____*2 = I think so* _____*3 = Yes*

2. Do you feel ready to do solar cooking by yourself?
   _____*0 = No* _____*1 = I don't think so* _____*2 = I think so* _____*3 = Yes*

3. Do you intend to use a solar cooker?
   _____*0 = No* _____*1 = Unlikely* _____*2 = Likely* _____*3 = Yes*

4. Why?

5. When do you plan to try it?

6. Is there anything that worries you about solar cooking? _____*Yes* _____*No*

   a) If yes, what?

   b) How can your worries be resolved?

7. Imagine your friend learned that you attended solar cooking training and asked you what solar cooking is. What will you tell her?

8. Imagine your friend wants you to teach her how to solar cook. How will you respond?

9. Can you please show me how you cook food in a box cooker? *(Note, please have the solar cooker and materials present.)*

10. Can you please show me how you cook food in a parabolic cooker? *(Note, please have the solar cooker and materials present.)*

11. What are the steps to purifying water with a solar cooker, from beginning to end? *(Note, these can be drawn or spoken.)*

12. How do you know the water is purified?

13. Were the diagrams we developed helpful? Can you please draw and explain them for me?

14. Were the songs we developed helpful? Can you please sing them for me?

Appendix C: Questionnaire Results – Pre-Training

Ten people completed the pre-training questionnaire. Here are the results.

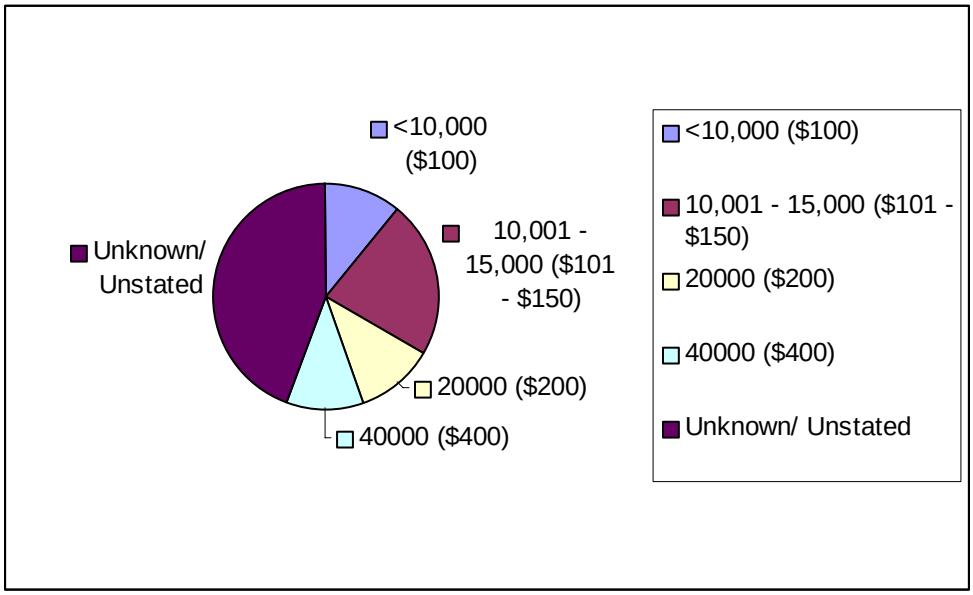
Demographics / General (n=10):

Gender: All were female

Age: 6 were 26 – 35 years old; 3 were 36 – 45 years old; one was > 45 years old

Occupation: 4 housewives; two nurses; one petty trader; one cleaner; one unknown (no answer was provided)

Monthly Household Income (in Naira and CAD; 100 Naira = $1 CAD):



Cooked Meals per Day:

	Morning (6:30 – 8 AM)	Midday (10 AM – 1 PM)	Evening (3 – 6 PM)
Number who Cook	9	9	10
Minutes Spent Cooking	Range = 15 – 120 Average = 40 Median = 30	Range = 30 – 120 Average = 72 Median = 60	Range = 30 – 120 Average = 88 Median = 120

Foods Cooked *Note: Some respondents listed more than one main food per meal, probably meaning "I cook one or the other"*	Porridge or pap = 5 Tea = 3 Yams = 2 Rice = 2 Leftovers = 1 Tuwo (corn paste) = 1 Potatoes = 1 Moin Moin (bean cake) = 1 Soup or beans = 1	Rice = 7 Yams = 4 Beans = 4 Porridge = 1 Leftovers = 1 Tuwo = 1 Ginger drink = 1 Eba or amala (cassava paste) = 1	Tuwo and sauce = 8 Rice = 2 Eba and soup = 1 Yams = 1 Beans = 1 Pap (porridge) = 1 Moin Moin (bean cake) = 1

Uncooked Meals per Day:

Number who Eat Uncooked Meals	9
Foods Eaten	Fruit = 6 Gari (cassava drink) = 4 Peanuts = 2 Avocado = 1 Sugarcane = 1

Please tell us about your current cooking methods.

	Wood	**Kerosene**
Number who use it:	7	5
Cost per month:	Average = 1,386 Median = 600	Average = 656 Median = 600
Total Cost for those who use both (n=2)	Costs = 1200, 1600 Average = 1,400	
Who gets it?	Wife/self = 5 Unknown = 2	Wife/self = 3 Husband = 1 Unknown = 1
Where do you get it?	Vendors = 4 Forest = 4 *(one respondent uses both sources)*	Vendors = 5

	Wood	Kerosene
How often do you get it?	Daily = 3 Monthly = 1 Every 6 months = 1 As required = 1 Unknown = 1	Every 10 days = 1 Twice Monthly = 2 Monthly = 2
How long does it take to collect it each time?	*From the forest:* 7.5 hours = 1 10 hours = 1 1 day = 1 A whole day or week = 1 A week for 1 pickup = 1 *From vendors:* Quick, 30 minutes	10 minutes = 1 30 minutes = 1 Unknown = 3
What do you like about it (the benefits of it)?	Cooks fast = 4 Cooks properly = 1 Adequate supply = 1 Sell it for profit = 2	Easy to get = 1 Cooks fast = 1 Faster than wood = 1 Pots stay clean = 2 Easy, no stress = 1 You stay clean, no smoke, no need to check flame = 1
Are there any problems with it? If yes, what?	Fire accidents = 2 Smoke hurts eyes = 5 Smoke hurts chest = 1 Getting the wood = 2 Chopping the wood = 2 No problems = 1	Fire accidents = 1 Poor kerosene can explode = 1 Dangerous for kids = 1 Dirty wicks cause smoke, wicks must be complete, stove must be clean = 1 Expensive = 3 No problems = 1
What do you think could resolve these problems?	Take care of the wood after use. Ensure the fire keeps burning = 1 Get a paid job = 2 Can prevent accidents, but not smoke in the eyes = 1 Using solar stoves = 1	Take care of stove and check before use = 1 No resolution = 1 If the Nigerian economy improves = 1 If government can reduce price and stabilize it = 1

About Solar Cooking

Have you ever heard of solar cooking? Yes = 5, No = 5

Some solar cookers cook slowly; you put your food in them and come back in a few hours, and it is cooked. Other types cook quickly; you have to keep turning them to the sun, and stirring the food so it won't burn. Which type seems better to you?

Fast cooker = 5*

Slow cooker = 3

No answer = 2

**Note: After the workshop, one respondent changed her answer to "slow cooker." And, after one of the workshops, five women discussed the pros and cons of the parabolic and box cookers, both of which they had tested, and they agreed, after discussion, that the box cooker was better.*

Those Who Have Heard of Solar Cooking Before (n=5):

How much do you know about solar cooking: Nothing = 3, A little = 2

What have you heard about it?

Nothing = 1

That it cooks with the sun = 3

Saw someone on this project cook with it = 1

"You can use local materials to build one and cook with it. It takes time for the cooking, you need patience. Need sunlight, can start at 9 AM." = 1

When did you first hear about the idea of solar cooking?

February 2005 = 1

March 2005 = 2

April 2005 = 1

May 2005 = 1

Who informed you about it? Someone involved with this solar cooking project = 5 (100%)

Do you know anyone who's tried solar cooking? Yes = 3 (60%), No = 2 (40%)

How successful was it? Very successful = 1; Not at all successful = 1; No answer = 2

How often do they solar cook? Occasionally = 2; No answer / don't know = 3

Have you tried solar cooking? No = 5 (100%)

Those Who Have Heard of Solar Cooking But Never Tried It (n=5):

Why haven't you tried solar cooking?

"I have no idea" = 1

"No time to attend the solar stove workshop" = 1

"I don't have a solar stove" = 1

"I don't know how to do it" = 1

No answer = 1

What is preventing or discouraging you from trying solar cooking?

"Nothing" = 1

"No idea" = 1

"I don't know much about it" = 1

"Because I don't have one" = 1

No answer = 1

What information would you like to know before you try solar cooking?

"How to use it" = 3

"How it is constructed" = 1

"Everything about it" = 1

No answer = 1

Some respondents offered multiple answers.

What benefits does it appear to have?

Save money = 3

"It helps in reducing the burden of collecting wood from the forest. It is cost effective. It reduces sickness tendencies." = 1

"A lot, especially saving money. Not wasting time at market." = 1

Can cook with it = 1

What problems does it appear to have?

Lack of sunshine = 3

"If I don't have the materials to build the stove. African cooking has many steps; you must do one at a time, not put everything in the pot at once. It's time consuming." = 1

What would encourage you to try solar cooking?

"Reducing problems with fuel wood" = 2

"It is a clean way to cook" = 1

Training = 1

Those Who Have NOT Heard About Solar Cooking (n=5)

What do you think about solar cooking?

"Fine, good" *[this probably means easy to use and fast, based on the answers to other questions]* = 1

Would you try it yourself?

Yes = 2

No answer = 3

Why do you say that?

"I want to know how it works; practice makes perfect." = 1

No answer = 4

What would encourage you to try it?

"Knowing the benefits and problems, being taught how to" = 1

"I like the technology" = 1

What would discourage you from trying it?

"Nothing" = 1

No answer = 4

Appendix D: Questionnaire Results – Post-Training

Two people completed the post-training questionnaire after having watched a video on how to solar cook in English. This video provided general information about solar cooking; its benefits with respect to saving money, reducing deforestation, and reducing the hazards of cooking smoke. It demonstrated solar cooking in the box cooker, and provided testimonials of people tasting food cooked in the solar cooker.

Seven people completed the post-training questionnaire after having watched a video on how to solar cook in Hausa, the prevalent language in the north. This video provided general information about solar cooking: its benefits with respect to saving money, reducing deforestation, and reducing the hazards of cooking smoke. It demonstrated the use of a "water purification indicator" produced by Solar Cookers International called a "WAPI." It demonstrated solar cooking in the box cooker, and provided detailed instructions about how to aim three stoves towards the sun: the CooKit panel solar cooker, a box solar cooker, and a parabolic solar cooker. After watching this video, respondents were asked to demonstrate using the stoves in person, rather than verbally describing how to use the stoves in the survey.

The results are presented separated based on the video that the respondents watched before responding to the questionnaire, which are distinguished as the "English" or "Hausa" videos.

Demographics / General (n=9):

	English Video	Hausa Video
Gender:	Female = 1, male = 1	Female = 7
Age:	26 – 35 = 1 > 45 = 1	26 – 35 = 2 36 – 45 = 2 Unknown = 3

Do you feel ready to build a solar cooker by yourself?

Yes = 1	Yes = 2

Note: I advised interviewers to skip this question since the respondents had not received training on how to build stoves, but provided the three answers that they provided anyway.

Do you feel ready to do solar cooking by yourself?

Yes = 2	Yes = 4 I think so = 1 I don't think so = 1

English Video Hausa Video

Do you intend to use a solar cooker?

Yes = 2 Yes = 6, Likely = 1

Why?

Easy to use = 1
I was taught to use it = 1

Easy to use = 2
Reduces sickness = 1
Reduces stress = 1
Inexpensive = 3
I was taught to use it = 1
"Very comfortable - no smoke, can relax while cooking, leave food to cook" = 1
"Because I like to use it, no smoke, not too much heat, it's neat" = 1

When do you plan to try it?

Anytime = 1
When I am ready = 1

Anytime = 3
When there is sunshine/ dry season = 3
In 1 week = 1
As soon as possible = 1

Is there anything that worries you about solar cooking?

Yes, lack of sunshine = 2

Yes, lack of sunshine = 3
Yes, adjusting the parabolic stove = 1

How can your worries be resolved?

By informing my teachers = 1

By informing my teachers = 1
More training = 1

Imagine your friend learned that you attended solar cooking training and asked you what solar cooking is. What will you tell her?

English Video:

"I will show the person how to use the sun to cook" = 1
"I will invite her to come and learn it because it is very easy and good cooking" = 1

Hausa Video:

"Solar cooking is the use of a constructed solar stove for cooking using the sun as the source of energy. The black is needed for the cooking on the solar stove." = 1

"It is a stove that uses sun to cook" = 1

"I will tell them that I was training how to use the solar cooker in cooking" = 1

"I will invite her to come and learn because is very easy and good cooking" = 1

"It is easy versus wood, etc. Comfortable, less expensive. Neat - not dirty like firewood." = 1

"I will tell her that it is good and very interesting but I do not have the stove by myself, is less expensive" = 1

"Solar cooking is the use of sun's heat to cook using solar cookers" = 1

Imagine your friend wants you to teach her how to solar cook. How will you respond?

English Video:

By demonstrating how to use it = 2
"…and by telling her how to use it" = 1

Hausa Video:

"I show her how to do the cooking by preparing my food as usual before placing it on the stove and explain to her on how to adjust the stove." = 1

"It is kept and adjusted towards the sun. Black pots are needed for use." = 1

"I will respond to her or them about how to use the solar cooker. When sun rise you will take the solar to the place I want it be and set." = 1

"By demonstrating it to her, and tell her how to use it" = 1

"You need a black pot to absorb heat. Make sure there is sun. Check direction of the sun always." = 1

"If I have the stove, I will teach her how to use it. Only that we must use black pot, not white one." = 1

"The solar stove is kept in the sun and to face the direction of the sun. Then the pot is now put on the stove to cook." = 1

Can you please show me how you cook food in a box cooker? *(Note, please have the solar cooker and materials present.)*

Note, I asked people to demonstrate this in person, rather than describe it. However, some interviewees also recorded these verbal responses:

Hausa Video:

"After preparing the food, I will open the solar box and put my pot inside and then cover it and allow it to cook. But first of all I will set the box towards the sun." = 1

"You get a black pot, put whatever you want to cook in it, put it in a polythene bag and put it on the stove." = 1

"I use black pot in my cooking in box cooker and before I put it in the cooker box I will prepare the necessary thing I want to cook and after that I will put my white bag and put it in the box." = 1

"I will put the solar box in the sun, open it, put my pot inside it and cover it and all it to cook." = 1

During the demonstrations, everyone succeeded in putting the black pot inside a closed box solar cooker, which would have worked. About half of the trainees also could aim the stoves to reduce the shadows, making the stove more efficient. None of them remembered to protect their eyes. Only the Hausa video included instructions about aiming the stove to reduce shadows.

Can you please show me how you cook food in a parabolic cooker? *(Note, please have the solar cooker and materials present.)*

Note, I asked people to demonstrate this in person, rather than describe it. However, some interviewees recorded these verbal responses:

English Video:

"You will put it in the sun and adjust it from time to time." = 1

Hausa Video:

"After grinding my tomatoes I will put it on the parabolic stove to cook. I will come after every fifteen minutes to adjust it." = 1

"The stove should be adjusted towards the sun before the pot is put on it. The food should be checked in 15 minute intervals." = 1

"Using the parabolic cooker I will use my black pot and prepare all the necessary thing and I will take the parabolic to where I will set it and I will put my pot" = 1

"The stove is to face the direction of the sun. The shadows of the stand should be directly on the base of the stand. The dish should be adjusted to remove any shadow of the nail at the middle. Then the pot is put on the stove to cook." = 1

Only the Hausa video included instructions about aiming the stove to reduce shadows, so seven trainees conducted the practical test. During the demonstrations, everyone succeeded in putting the black put on the parabolic solar cooker. Two trainees understood how to aim the stoves, but no one could do it 100% correctly. Some only remembered to check the base, not the nail. None of them remembered to protect their eyes.

What are the steps to purifying water with a solar cooker, from beginning to end? *(Note, these can be drawn or spoken.)* How do you know the water is purified?

English Video:

"By using wapi; when it is well cooked" = 1

Hausa Video:

"After washing the pot I will pour some water inside then put the wapi inside and then put the pot on the solar stove. The wapi will indicate to me if the water is safe to drink when its candle inside melts." = 1, *and 2 similar responses except that washing the pot is not mentioned*

"By using wapi; when it is well cooking" = 1

"By using wapi; the water will look clean" = 1

"WAPI - put it in the water, let it heat, then water will be ready *[she said she did not understand how to tell, and she was a poor Hausa speaker; myself and another woman tried to tell her about the video as we watched it]*" = 1

"I did not understand; unclear" = 1

Based on these comments, I estimate the understanding as:

Complete = 3
Possibly = 3
Confused = 2

In practice, this will become clear when they see the melted wax in the wapi.

Were the diagrams we developed helpful? Can you please draw and explain them for me?

N/A; we did not create diagrams.

Were the songs we developed helpful? Can you please sing them for me?

N/A; we did not create songs.

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