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Renewable Energy as a Means to Community Development: A Case Study of Solar Power With Avani in Kumaon, Uttarakhand

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RENEWABLE ENERGY AS A MEANS TO COMMUNITY DEVELOPMENT: A CASE STUDY OF SOLAR POWER WITH AVANI IN KUMAON, UTTARAKHAND

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1. Introduction

Energy poverty: Reality in rural India

For the woman who must spend four hours walking to the forest, cutting wood, carrying it back on her head and lighting a fire in her home, energy poverty is a harsh reality of everyday life. As of 2000, more than 500 million Indians did not have access to electricity, which accounts for 35% of the world's population living without this facility[i]. Energy poverty is defined as the inability to afford access to a sustainable energy supply[ii]. The concept of energy poverty as a focus of sustainable development is given more importance by the correlation between electricity consumption and GDP and HDI[iii]. Rural energy policies and programs have focused on improving electrification rates and substituting traditional biomass with renewable energy[iv]. Connecting these remote villages to adequate and sustainable infrastructure is a huge logistical challenge for rural development. Decentralized production of energy based on locally available resources has gained steam as a sustainable way to electrify remote villages that are off the grid.

Government renewable energy plans: An emphasis on solar power

In a statement on June 30, 2008, India's Prime Minister, Dr. Manmohan Singh, launched the National Action Plan on Climate Change by stressing the evolution from economic dependence on fossil fuels to the development of renewable energy, in which "the sun occupies the center stage"[v]. He avows that India must "develop solar energy as a source of abundant energy to power our economy and transform the lives of our people"[vi]. India's National Electricity Policy aims to achieve universal electricity access by 2010 and meet full demands by 2012. The ambitious National Solar Mission aims to produce 20 GW of power by 2020 and cut greenhouse gas emissions by 42 million tons per year.

Soon solar-powered equipment will be mandatory in hospitals, hotels, and government buildings. For rural development, micro-finance loans will be provided for solar-powered lighting in three million households[vii]. I asked Siddarth Pathak, a Greenpeace India Climate and Energy Campaigner, if he thought the NSM was more about sustaining economic growth, or if it was a sincere commitment to generating sustainable livelihoods. He admitted that while the economy does tend to supersede the desire for sustainable livelihoods, the plan does have "something for the poor"[viii]. The focus on rural electrification will boost micro-grids and cut down on kerosene subsidies. At the core of India's renewable energy plans is an emphasis on the decentralized production of *saur urza*, or solar power.

However, NGOs are also working to ensure that renewable energy is a sustainable foundation of community development. For this paper, I have examined the ability of decentralized solar power to organize communities and expand social opportunities in the Kumaon Region of eastern Uttarakhand. I spent three weeks researching with AVANI, an organization that trains youth to install solar panels and organizes Village Solar Energy Committees (VSECs) to maintain this system.

Uttarakhand: Remote mountainous villages

The former region of Uttaranchal used to be a part of Uttar Pradesh, but in 2000 it became its own state and in 2007 changed its name to Uttarakhand. Since then, more companies and factories have been setting up business in the state, but it still largely remains undeveloped. In the Pithoragarh District, where AVANI is located, no town has a population greater than 5,000 people, and 79.5 percent live in villages, where the average population is 500[ix]. Villages and hamlets are tucked away inside nooks and

crannies of the mountains of the Himalayan range. Dirt paths, stone steps, and goat trails wind through the hills for several kilometers before reaching some villages from the road. These villages are so remote that basic services such as health and education are of varying quality and usually are located quite far away. Most towns in the eastern Kumaon Region do not have adequate health facilities, and many people have died on the long journey to a hospital in cities like Nainatal or Haldwani. Building infrastructure and extending services to these remote areas presents a significant challenge to rural development.

Livelihood opportunities in rural villages are limited and physical labor is a daily demand. Some families have retired Service members, but the primary sources of livelihood are "*kheti ka kam*" (agricultural work) and "*ghar ka kam*" (house work). Keeping cows and goats is a mainstay of village life. Many families qualify for BPL (Below Poverty Line) cards, which allow them to purchase rations at a lower than market price. Due to the lack of job opportunities in these villages, it has become a custom for young men to search for work in the cities and they are rarely able to return home. Countless terraces that maximize cultivation space sculpt the hills like a layered cake. While walking on paths I often saw women carrying huge bundles of firewood on their heads, making their way back home to cook or provide light. The women of the hills are known for being strong and working hard. The state of Uttarakhand is famous for its abundant natural beauty and purity, and AVANI's main campus at Tripuradevi is nestled onto a hillside opposite the snow-capped peaks of the Himalayas.

AVANI: Providing solar and livelihood opportunities

AVANI's solar program began in 1997 as the Kumaon Chapter of the Social Work Research Centre or Barefoot College, which is based in Tilonia, Rajasthan. Following the Barefoot Model, village youth are trained to build, install, maintain and repair Solar Home Lighting Systems (SHLS) and solar lanterns. The solar systems were initially subsidized by the European Union (EU) and the Uttarakhand Renewable Energy Development Agency (UREDA). Since 1997 AVANI has worked to provide solar installations for 1767 families in more than 245 villages and hamlets[x]. In 2010 AVANI aims to be certified as a manufacturing unit of solar equipment, which will "help AVANI access a larger market for its solar products"[xi]. Solar water heaters are in use at AVANI's campus in Tripuradevi, but as they require several large solar panels and are quite expensive, additional villages have yet to benefit from them. AVANI is looking to install solar water heaters for hospitals, hotels, and guesthouses in the area. A network of Village Solar Energy Committees ensures decentralized maintenance and ownership.

Village Solar Energy Committees (VSECs) or solar "*samitis*" were designed to make village ownership of solar power financially self-reliant. AVANI initially approached the villages through the *Gram Pradhan*, the head of the village *Panchayat*, and tapped into the leadership structure of elders and educated villagers to assess and respond to village interest in the program[xii]. AVANI provided guidelines for the roles of VSECs, namely that of collecting user fees, paying the salary of the solar technicians, and discussing energy issues. The VSECs also provide credit to poor families who cannot afford this renewable technology. There are currently 23 VSECs operating independently. At the Solar Workshop in Tripuradevi, nine solar technicians are

currently employed, four of which are women. This past year they made 57 field visits to different villages[xiii]. The solar technicians and the VSECs maintain this decentralized network of solar power.

As AVANI's leadership recognized that many people were unable to afford solar power because of a lack of income, they began training women to spin and weave using local resources for natural dyes and weaving materials. The project grew into a decentralized system with 6 field centers serving 43 villages in the Kumaon region. These centers send unfinished products to AVANI's main campus at Tripuradevi for finishing and marketing of these traditional crafts. AVANI has won numerous awards and has now registered as the Kumaon Earthcraft Self Reliant Cooperative. This organization has generated an association of livelihood opportunities in addition to a self-reliant solar technology system.

Objectives

Assessment of:

- Training model, local management capacity, and personal empowerment of solar technicians
- Social development impacts of solar power: Health, education, community, environment, communication
- Economic development impacts of solar power: Income-generating activities
- Expansion of livelihood opportunities facilitated by AVANI
- Extent of rural-urban migration in the Kumaon Region: Forces, attitudes, village impacts
- Ability of VSECs to organize villages, ensure local management, and expand energy access through micro-credit loans
- Potential for VSECs to become active bodies for community-based natural resource management and environmental development issues
- Environmental education disseminated by AVANI
- Communication between VSECs and *Panchayats*
- Awareness about government schemes and subsidies
- Gaps in government service and India's National Solar Mission

Field Study Methods

"Living with"

For three weeks I had the privilege of living, eating, playing and working with the AVANI community at the Tripuradevi campus. This enabled me to experience their daily routines and be present in their lives, instead of just extracting information from them. I lived in the girls' dormitory with the weavers, solar technicians, and other interns. Most nights they would sit and knit garments, chat, and sing Kumaoni and Hindi songs. We shared stories, food, pictures, frustrations and hopes. I cherished the opportunity to connect with Indian youth my age, and that alone has made this experience

unforgettable. Sometimes I would help the cooks make chapatti, and I will never forget huddling in the "mess" on wooden picnic tables, scooping up hot vegetables and rice and talking about how cold it was. These accommodations allowed me to experience their stories as a friend instead of strictly a researcher.

Participant observation

I spent time with the solar technicians in their workshop, observing their complicated technical work. They were always welcoming and eager to explain what they were doing. I also went on field visits to the villages of Golti, Sukna, Bhayun, Mana, Dewi, Matkoli and Digoli, where I spent my final week at the Digoli Field Center. We would rumble along in an old truck and then hike for several kilometers to reach these villages. I witnessed battery repair work, solar lantern sales, and how the technicians interact with the community. I met with VSECs, members and leaders to discuss their meetings.

Informal interviews

As my research methodology allowed me many freedoms of friendship, all of my interviews with the solar technicians and AVANI staff were informal. Sometimes we would sit in the sunlight outside the solar workshop. Once I interviewed someone while we both sat under the covers and she knitted a muffler. A lot of my impressions have been formed while the tape recorder has been off and my notebook has not been handy. Interviews with villagers, *Panchayat* members, and VSEC members were also informal and sometimes impromptu. Everyone was welcoming, open to talking, and interested as to why I would be so far from home. I have accepted countless numbers of *chai* with *misri*, the sugar cubes that are given with the hot tea. I have gnawed on sugar cane,

peeled oranges, enjoyed *kheer* with *ghee*, and eaten meals with the people I have interviewed. Being a part of their lives has helped me see the human reality that statistics and trends can only begin to relate.

Brief statement of findings

- Employment as a solar technician builds confidence and self-respect through learning new skills, earning money, and gaining exposure to different people. The program design effectively ensures technical management at the local level and provides the youth a livelihood option in the Kumaon Region. Although technicians expressed hope for their children, many have limited hopes for their own future livelihood, educational, or vocational opportunities. Improvements could include more holistic training sessions that do not merely focus on technical skills. Night classes at AVANI headquarters could expand social opportunities.
- Rural-urban migration is increasingly a defining aspect of village life, as young men are compelled to search for jobs in cities to generate sufficient cash for their families. Income-generating job opportunities in Kumaoni villages are minimal, and livelihoods are primarily restricted to agricultural and house work. Men who return from the cities also are highly respected by villagers.
- The socio-economic development benefits of solar power are multifold: Educational opportunities are expanded, health risks are minimized by lessening indoor pollution, social quality of life is enhanced by reliable light, communication freedoms such television are made available, and pressures on forests for firewood are reduced. Yet domestic lighting alone does not change the village economy by expanding income-generating activities; skills and training must be provided for productive uses.
- AVANI's decentralized field centers offer significant livelihood opportunities to women as weavers and spinners, and generating this income makes renewable energy more affordable. The provision of solar-powered spinning wheels must include adequate and persistent training, along with a progress check-up system, to ensure user knowledge, equipment care and program success.
- Village Solar Energy Committees (VSECs) effectively fulfill the objective of ensuring technical and financial management and maintenance of solar systems at the local level. While VSECs have the capacity to provide micro-credit loans to expand access to energy, these funds are rarely utilized or publicized. If AVANI

increased its consultancy with these *samitis*, these funds could also be used for the purchase of other renewable technologies or for income-generating activities. Although VSECs generally do not deal directly with other development issues, they have engendered other groups such as women's committees that do fill this role.

- VSECs provide a community organizational structure for handling environmental development issues, but this updated mission must be clearly articulated to empower these bodies instead of limiting them to solar energy. A revised mandate could create Village Energy and Environment Committees (VEECs) that have an enormous potential to be catalysts for community-based natural resource management, and committees are eager for training and knowledge supplied by AVANI. Biogas is a stimulating issue that could be taken up by the VEECs and disseminated in villages.
- Initial communication between VSECs and *Panchayats* is not sufficient if these bodies want to expand their roles to deal with further environmental issues. Currently awareness and expectations about government schemes are minimal, and multiple sectors would benefit from increased dialogue. Additional NGOs and the Forest Department programs could tap into VEECs to bolster participation and cooperation in environmental projects, and to introduce environmental education to villages.
- Government provision of electricity is unreliable and costly, as the absence of maintenance systems weakens equipment dependability and incorrect service charges are not easily negotiated. India's ambitious National Solar Mission aims to expand access to renewable energy, but due to the lack of a capacity to sustain these installations, the program's effectiveness might not be fully realized.

2. Solar technicians

Training: Building capacities

The program is modeled to train village youth with little or no formal education to become skilled solar technicians. Currently there are nine solar technicians living and working at AVANI's main campus in Tripuradevi. The youth all come from different villages and their ages range between 20 and 30. They are trained for 3-6 months in installation, maintenance and repair of solar panels and lanterns. Some of the boys also learn welding and calendaring skills. I asked the solar technicians if training included leadership-building elements, but the training seems to focus only on the technical aspects of solar power. Jagdish did say that there are workshops given about the objectives of solar power[xiv]. The equipment comes from Delhi and is assembled at the workshop in Tripuradevi. The cost of one Solar Home Lighting System is Rs. 15,000, but subsidies make them affordable to villages. A mini solar lantern is Rs. 2,200 and it has more than six hours of battery life. The large solar lantern is Rs. 4,400 and has about four hours of battery life. I observed the solar technicians assembling LEDs, testing batteries, filing pieces, and connecting wires. Amusingly, for the first couple of days, they would carefully explain each part of the technical equipment to me, as if I were a specialist in solar power. I quickly explained to them that I was impressed with their knowledge, which far outstripped my own, but I was more interested more in the social development aspects of their work. AVANI's training program builds up a sustainable network of local expertise and management.

Sustainability and local management

AVANI's decentralized system of renewable energy that is maintained locally strengthens the reliability of solar power equipment. Households contribute a monthly service fee of Rs. 30 towards the salary of solar technicians. According to AVANI's Annual Report for 2006-2007, collecting fees from users in villages generates almost 90% of the salary of solar technicians[xv]. Through the necessity of traveling back to their villages for maintenance and repairs, the program is designed to encourage youth to stay in the area and not migrate to the cities for work. Although every village with solar power does not have a solar technician, technicians also provide services for non-project villages. Some of the technicians did express their desire to stay in the hills, because of the clean water, air, and trees. However, some do not want their kids to live here because of the lack of job and quality educational opportunities. The solar technician's salary stands at Rs. 2,250 a month, which is indeed income, but the amount alone is not more substantial than many jobs youth could find in the cities. However, the fact that the program is efficiently maintained, financed in a sustainable manner, and the youth can stay near their homes is impressive.

Rural-urban migration: Custom, compulsion and respect

Due to a lack of jobs in these remote mountain areas, it has become the custom for young men head to the cities in search of employment. The women carry the burden of agricultural duties in addition to housework. The men generally stay in the cities for about one year, working usually in the service sector as a driver or for a private company. They send money back home, and may return for a month or so before heading back to keep working. Darpan Singh, who was home in the village of Digoli for a few days

before returning to his bakery job in Delhi, explained that his livelihood could only be in the city; he is obligated to go there to earn something[xvi]. I was able to attend the wedding of a young girl in Digoli, and her brother explained his compulsion to work in the city. He said that it is impossible for young men to stay in the village because where will the cash come from to clothe and feed their families and provide a good education for their kids? Furthermore, people in the village highly respect young men who go to cities for work. They respect him even more than the young man who stays at home, works hard in the fields, and is good to his family in the village[xvii]. While the young men do send money home and return, some elders do have a pessimistic view on their contribution. Referring to how rainwater falls in the hills and immediately rushes out of them, Jagdish concluded, "The water of the hills and the youth of the hills won't help the hills"[xviii]. Solar home lighting systems have not generated substantial job opportunities in villages outside of solar technicians and AVANI staff, but hopefully domestic lighting will make home more of an attractive place to come back to.

Empowerment: Expanded social freedoms but with limits

All of the technicians affirmed their happiness with this job opportunity, but it seems to be just a job to them, not one in which the salary is particularly good or in which their ambition to pursue other work is encouraged or strengthened. When asked how their families and villages felt about their work, all of the solar technicians said they were happy. At the Tripuradevi campus, the technicians enjoy living and working as a community, and have more exposure to different kinds of people. For the female technicians, if they were not working at AVANI they would be working at home or in the fields. Dhana Mahara's father left her family and her mother became very ill when

Dhana was in the 8th standard. She left school to care for her mother and take care of work at home. When her mother got better, they attended a VSEC meeting and her mother stood up and expressed her hope that her daughter could work at AVANI. She said, "I'm sick, she is not in school, what will she do at home? Let her work at AVANI,"[xix] Radha Karki's parents feel good about her work, and their respect and pride are enough for her, even though some people do not think girls should do this type of work[xx]. Raju, a staff member at AVANI, explained that at first some people in the villages think that the youth cannot learn about the complexities of *bijali*, or electricity, because they do not have the education for it[xxi]. Radha explained that although her parents initially told her she could not go to AVANI, she insisted, exclaiming, "Yes, I can do it." Now her parents are happy that she is working and proud of what she can do[xxii]. This job opportunity expands social freedoms, but technicians' prospects for the future were not so upbeat.

When asked about what their hopes for future employment were, female technicians responded by saying they did not know, but they would probably get married and work at home or in the fields. Male technicians did not seem especially optimistic about their job options close to home[xxiii]. Perhaps if training included other capacity-building elements instead of focusing exclusively on solar technology, these youth would be able to climb an employment ladder with more versatile skills and knowledge. All of the technicians expressed interest in night classes, especially in English, which could be coordinated at Tripuradevi. The benefits of employment as a solar technician include a decent salary, fulfilling work, strengthened self-respect, exposure to diversity, living with a community, and working close to home.

Building for the next generation

When I asked what the female Technicians wanted for their children in the future, they all expressed their desire for them to enjoy a good education and obtain quality jobs. Although many of the women come from villages and families that believe girls should stay at home or in the village, these women want their children to be allowed to seek work wherever they want. When I asked Anita Bista, a solar technician whose village is a 10 km walk from the road, if she would let her daughters leave her village, she responded, "*Larkiyo ko dur dur kam karne ke lie bhej sakti hai*," (I am able to send [my] girls far, far away for work)[xxiv]. I asked why far away, and she replied, "*Kyoki mere bacche sab kuch pata ho sake…ham piche ke piche hi rahe*" (because my children should be able to know everything…we remain only behind)[xxv]. Anita dreams for her children to have the freedom to explore whatever they want. Meena Arya divulged that once she is married, her in-laws will not allow her to work at AVANI or elsewhere, but when asked if she would let her children work, she responded, "Why not? I will let them"[xxvi]. The women want their children to enjoy educational and vocational opportunities that they themselves could not enjoy.

3. Village social development impacts

Education: Improved opportunities

A reliable light source creates domestic atmospheres that facilitate learning. Mehar Singh, of Sukna, said he "needed" solar power so that at night his children could write and read[xxvii]. Their education was of utmost importance to him. Most of the people I interviewed affirmed that children do study at night now. One evening I had dinner at the home of a solar technician, Mumta. While she worked in the kitchen I lifted up her delighted children and swung them around. Later her eight year-old daughter Dikshya pulled out her schoolbooks and worked on her homework by the solar LED light. Before that moment, I had taken the benefit of children studying at night for granted, but when I saw her carefully outlining the days of the week in her notebook, I realized how difficult it would have been to study by the light of a small bottle of kerosene. Divan Singh, an elderly man who held his granddaughter while we talked, told me that while solar power has so many benefits, it is really the next generation that will truly reap them. He has passed more than half of his life without electricity, and he was not able to get a proper education. He hopes that the future will be brighter for his young family[xxviii]. Educational opportunities are enhanced by the reliability and accessibility of solar light.

Health: Minimized risks

Burning *chilka*, or pinewood, is the traditional source of light in remote villages, yet the health effects of indoor smoke pollution are alleviated with clean energy. Mehar Singh, of Sukna, recounted how smoke affected his children's eyes, nose and mouth[xxix]. Some people also light dry sticks as a torch for checking on the animals at night. The flammable hay can easily catch on fire, and solar lanterns have helped mitigate this issue.

The burden of cutting and carrying firewood from the forest falls primarily on women, who daily must spend three to four hours of hard labor to complete this task. Solar power has lessened this burden of time and energy, although women still use firewood for cooking.

Social relations/community: Enhanced social life

Reliable solar energy has improved village quality of social life. Those of us who expect electricity to work and illuminate social spaces may not fully realize the power of light. I asked villagers what they do at night with the solar power, and generally the first thing they mentioned was "*khana banane ke lie*" (for making food). Others said that their homes are more welcoming places to receive guests, and that community celebrations like weddings or holidays are more easily facilitated and enhanced. I attended the wedding of Hema Devi, a weaver at the Digoli Field Center, and all of the festivities were lit with solar lights. Improved safety at night is also an impact cited by a World Bank report on rural electrification that AVANI's solar lanterns uphold[xxx]. Being able to interact openly with one's community is a social freedom enhanced by solar power.

Environment: Mitigated deforestation, kerosene consumption and emissions

Solar energy use in remote areas has the potential to ease pressures on forests, lessen consumption of kerosene, and make indoor cooking less of a health hazard. Radha Karki, a solar technician, explained that if people do not have solar power or electricity, they make their own lamps. Glass bottles are filled with kerosene, and then a wick is inserted in the top. Otherwise people cut dry, dead trees for cooking food, lighting and heating their homes. While there is a law against cutting living trees, many people do this if the wood is closer. The urban impact of cutting down on greenhouse gas emissions is

understandably much higher than that of rural areas, as urban consumption of energy far outstrips rural. In the Kumaon region solar home lighting systems primarily help alleviate demands on forests.

Communication: Televisions and mobile phones

The batteries for solar panels can be hooked up to power small televisions or charge mobile phones, which increase communication with the outside world. Pradeep, a volunteer at AVANI who traveled to a distant village to witness new solar panel installation, pointed out that most of the villagers immediately wanted to know if they could hook up a TV or charge their mobile phones[xxxi]. The battery for the solar panel can generate enough electricity for a small black-and-white set. Jagdish, the Solar Program Director at Tripuradevi, acknowledged that people were excited about the opportunity to watch TV and a lot of people would probably not be using the light for studying[xxxii]. A World Bank study cites that women in electrified households are 3-4 times more likely to read[xxxiii]. However, illiteracy, a lack of reading material, and a higher motivation to watch TV all raise doubt about this claim's veracity in the Kumaon Region. When I asked if anyone watched the news, most villagers responded that they are far more interested in serials, films, or spiritual music. Also, on several hikes to villages, I witnessed young boys or sometimes women perched upon high rocks in an attempt to catch a network signal. Indeed, one woman sat chatting on her mobile while an elderly woman next to her shepherded goats away from the baby goats she was feeding. TV and mobile phones are social opportunities made available by access to energy, but the concern is that these outlets are further fueling migration to the cities.

4. Village economic development impacts

Income-generating activities: Guidance needed

Without guidance from AVANI or other NGOs about income-generating possibilities, solar home lighting systems have not generated substantial job opportunities. Livelihood opportunities and access to energy are mutually reinforcing, and AVANI's model of training and employing women as weavers has generated much-needed extra income. When villagers are provided with materials such as for spinning or for weaving mats, they can indeed benefit from access to solar power at night. They can perform these activities in addition to their household and field responsibilities. Jagdish said that in the new installation village, another NGO is providing villagers with Tibetan wool for spinning, so their income will double to about Rs. 80 per kg[xxxiv]. But the argument that solar lights alone can spur cottage industries in the home is unrealistic, as the light is principally used for domestic purposes. Developing economically and environmentally sustainable livelihoods is a distant goal of renewable energy, and solar home lighting systems are in important step to this realization.

Villagers need guidance and support in order to develop the potential to use solar power productively. The Social Research Work Centre's stated objective is "to achieve the sustainable development of the local communities by means of setting up of reliable decentralized network that provides the necessary institutional, technical and financial support for the dissemination of solar energy. In addition it seeks to improve the standard of living of the local population by making available additional sources of income derived from the exploitation of RES [Renewable Energies]"[xxxv]. AVANI's solar program has successfully established a sustainable management system that still runs

without funding. However, the latter part of the statement still needs further development. Without knowledge, training or skills, new jobs are not easily created simply by the availability of light in the home. In his article about decentralized power, Dinesh Sharma agrees, "Provision of electricity alone is not enough and additional measures such as marketing linkages, skill upgradation and micro-finance are necessary to enhance incomes of people"[xxxvi]. Productive uses of solar powered technologies such as irrigation pumps are potentially useful, but the possible inequalities of access must be considered in the planning process. AVANI's program has focused on domestic lighting, but hopefully future plans about productive uses of energy could be discussed.

Charkhas: Solar-powered spinning wheels and program flaws

AVANI has tried to target the poorest villagers, who do not have access to light other than firewood, by providing *charkhas*, or solar-powered spinning wheels, to generate income, yet insufficient training and equipment upkeep has resulted in dysfunctional production. Six spinning wheels were given to villagers in Digoli so that they could earn extra wages through this supplemental job that would produce more thread than the *takali*, or hand spinner. The wheels are powered by solar panels, which were paid for in installments of Rs. 100-200. However, I interviewed three spinners and the current system has several obstacles.

Three cases: Insufficient training, maintenance and response mechanism

Anita Devi is a woman who lives alone in the village of Matkoli after she left her abusive husband. She had no electricity at her house until she paid for a solar panel in installments of Rs. 100, and she was also given a *charkha* to generate income. However, two years later her machine is in disrepair and she admits that spinning by hand is still

much easier for her. Yet she is only earning Rs. 20 a month. Although she was briefly trained at the beginning, she does not have full knowledge about the machine[xxxvii]. Sometimes messages do not reach her about meetings at the Digoli Field Center. If spinning wheels are introduced to homes in a decentralized effort, there must be a progress tracking mechanism.

Tulsi Devi also thought she could earn more money with the spinning machine, but the hand spinner is still much easier for her. Her machine is out of order, as her kids bothered it, but no one has fixed it yet. She is very unhappy with the machine and is interested in giving or selling it back to AVANI[xxxviii]. She also admits that sometimes she is too busy at home to go to training sessions and does not have full knowledge about the machine. Again, there is no maintenance system in place to respond to her situation.

Hema Devi also knows that she could potentially make more thread with the machine, but it is not working and she cannot fix it. She is making about Rs. 200 a month by hand spinning, and she had hoped that with the *charkha* she could reach about Rs. 600 a month. According to Hema Devi, a trainer came at the beginning for four or five days to cover all six machines. He reached her right at the very end, at a time when she was unable to adequately meet with him[xxxix]. Persistence in ensuring follow-up training seems to be missing in this program design. Before any more spinning wheels are distributed, AVANI must ensure that there is a proper maintenance, progress tracking system, and repair response mechanism in order for the program to succeed.

Reaching the poorest families with renewable technologies

The families most in need could benefit from such a strengthened program, as they are the ones who struggle with no cash flow. One family in Digoli without access to

electricity has five adults, all of whom do hard labor in the fields but hold no income-generating jobs. We talked about bringing in a silk spinning machine for their home, so that after AVANI supplied the materials, they could generate income to supplement their field labor[xl]. During four months of training they could earn Rs. 500-600 per month, and then they would earn income at a piece rate. Some spinners can receive around Rs. 2,500 a month. They expressed interest but would need financial assistance to purchase the solar panels. The VSECs have the financial capacity to provide loans to those currently without electricity and unable to afford it, but the process of connecting resources to meet a need must be strengthened. Identifying these families through outreach visits could build relationships and awareness about available funds in order to employ more people.

5. Village Solar Energy Committees

Financial and technical management at the local level

There are currently 23 Village Solar Energy Committees (VSECs) active in the Kumaon Region that comprise a network of financial and technical management. Membership is made up of all the users of solar power in one village. The primary purpose is to collect fees from users, discuss problems such as a dysfunctional solar unit, and pay the salary of the solar technicians. Some also have a financial capacity for micro-credit, in that they provide loans to poor families who could not otherwise afford solar power. Govind Singh, the treasurer of the VSEC in Golti Village, said that the committees were made so that people would be aware of government schemes, or *yojna*, and so the government would not take their money[xli]. Everyone pays Rs. 3,000 at the beginning for their batteries, and then when the battery dies after seven to eight years, this money is used to replace it. Solar users with AVANI must pay Rs. 30 a month, which pays for the salary of the solar technician. Hereafter they are no longer billed by the government if they do not use electricity.

This stakeholder system empowers local ownership of solar power. The Electricity Policy of 2005 says, "…the success of distributed generation depends largely on willingness and participation of the local community"[xlii]. In a phone interview with Siddarth Pathak, a Greenpeace Climate and Energy Organizer, Pathak expressed his enthusiasm for this step, which is "making power a rural development issue"[xliii]. He explained that every *Panchayat* has an energy committee, but it is "completely dysfunctional"[xliv]. The VSECs have successfully established and led a sustainable networks of solar users.

Government provision of electricity

Service failures: An example from Sukna Village

In the village of Sukna, about a three-kilometer hike down from the road, there is no VSEC, resulting in dysfunctional solar equipment. On this field visit, I clambered down the steep, rocky path, struggling to follow Sita, a weaver who was guiding me to the Sukna Field Center. About 40 families in Sukna have solar home lighting systems that were provided under the government's Rural Electrification Scheme. The government scheme provides a BPL (Below Poverty Line) Meter for free to those who hold BPL cards, but the customer will still pay about Rs. 200-300 for loading and transportation[xlv]. The cost of electricity is Rs. 1-1.5 per unit. People who do not hold BPL cards would pay Rs. 1500-2000 for an APL (Above Poverty Line) Meter, and Rs. 2 per unit. However, after installation, the government does not provide maintenance or repairing service. Consequently, only about four or five families have solar power sets that actually still work. The others might work for half an hour or an hour before faltering. Jagdish Singh, an AVANI staff member at the Sukna Field Center, mentioned that these villagers also do not take good care of the equipment. AVANI could contact these villages with government-provided solar systems to see if they are interested in joining the sustainable maintenance system of AVANI.

Lack of local voice: An example from Digoli Village

A VSEC can respond to problems with equipment and fees in way that the government cannot, as Anan Singh, the only storeowner in the village of Digoli, will tell you. He has had government electricity for the past 10 years, but the service has been unreliable and very costly. Mr. Singh is considered APL (Above Poverty Line), so he

should be paying Rs. 2 per unit of electricity, as compared to Rs. 1 for BPL families. He uses about one unit of electricity per day, so in one month the total bill should come to Rs. 60. No one comes from the government to perform a meter reading, yet they continue to send him monthly bills of Rs. 400[xlvi]. He pulled out the rumpled bills and smacked them as his voice rose with anger. "*Ham log ungdhere me hai, ham ungdhere me hi rahna hai*!" (We people are in the darkness, we must live only in the darkness!)[xlvii]. More than the literal translation, his answer refers to the sentiment that the government has forgotten about the people in remote villages and left them to fend for themselves. They are so far from the road and the grid that they do not matter. Not only is Mr. Singh being charged more than six times higher than the true cost, but the electricity is irregular. It will stay for ten minutes and then go for ten minutes. He is interested in having AVANI install solar panels because clearly his current situation is not acceptable. VSECs are able to respond to local maintenance problems and hear village voices in a way that the government is unable to do.

6. VSEC credit and development capacity

Micro-credit loans: Expanding energy access

One of the VSECs' roles is to expand access to energy by providing loans to families who cannot afford solar panels or other renewable technologies. A World Bank Report published by the Energy Sector Management Assistance Programme (ESMAP) states the three main obstacles to rural acceptance of renewable technologies such as solar power are a lack of awareness about the technology, the high system cost, and the lack of credit availability[xlviii]. While VSECs do have funds available for renewable technologies, it seems as though the vibrancy of this system varies from village to village. The VSECs I interviewed said they were all interested and willing to provide loans for solar panels, but they acknowledged that they had not provided very many[xlix]. Sometimes villagers just did not seek out these funds, perhaps due to a lack of knowledge about their availability. Increased awareness about this program could further expand access to solar power and other technologies. The VSECs could make a point of actively seeking out these people without electricity and offering financial assistance. In addition, AVANI could increase its consultancy with VSECs to use these funds for other income-generating activities or community development projects.

VSECs' capacity for development: Limited activities

While AVANI literature has mentioned that these committees are slowly building up the capacity to address other areas of development, the committees' current role is primarily financial and technical. I repeatedly asked whether the committees work with any other development issues besides solar power, and the answer from the technicians was always no. The VSEC in the village of Bhayun, however, has proved to be an exception.

The committee meets around the temple, under the trees, to eat together and discuss issues in addition to solar power. Ganga Devi, a member of the committee, explained that the meetings are "open forums" for discussing any issue ranging from rainwater tanks to work in fields[l]. The president of this VSEC was a woman, although I was unable to interview her. The group decided together to take out a loan for a tractor. I am excited by the decision to address community issues and work together to take action, but Rajnish Jain, AVANI's director, expressed his hope that the group will choose more a more environmentally friendly option in the future. The VSECs are important bodies to build a capacity for community development, but currently the role appears to focus on sustaining technical and financial matters.

Empowering other community groups: *Mahila samitis*

Although VSECs' development activities outside of solar power are limited, some VSECs have also engendered women's self-help groups and given them more of a developmental role. In a meeting with the VSEC in the village of Mana, committee members confirmed that at times they do hold meetings in conjunction with the *mahila samiti,* or women's committee. The women's groups also have funds available that villagers actively use much more so than the funds of the VSECs. Perhaps the *mahila samitis* could spread awareness about the availability of VSEC funds and their designated purposes, namely that of expanding access to renewable energy. The VSECs conveyed their desire to provide money to anyone, even those outside the village, who wanted to purchase solar power[li]. This desire could be channeled to spread additional renewable energy technologies. If the VSECs were challenged by the mission of handling other environmental development issues, these funds might be more widely used.

7. The vision: Village Energy and Environment Committees

Potential revision of VSEC Mission

The existing Village Solar Energy Committees (VSECs) provide a structure for community organization around environmental development issues, but they lack the training, knowledge and an updated mission. These bodies have performed their primary function of establishing financial and technical management of solar power at the local level, but the potential is there for these groups to expand their scope of activities to include environmental issues on a scale larger than just promoting renewable technologies. Community-based natural resource management (CBNRM) has gained momentum as a viable way to organize the community, expand control of and access to natural resources, and encourage capacity-building. If VSECs expanded their mandate to become Village Energy and Environment Committees (VEECs), CBNRM would have a stronger base from which to grow. Rajnish Jain, the Director of AVANI, said that this was "the dream," namely that these committees could evolve to handle other environmental issues[lii]. However, if the committee meetings are merely viewed by other villagers as discussions about batteries and solar user fees, there is a possibility that their role could become obsolete or their legitimacy could be weakened by inactivity. As most villagers acknowledged that the demand for firewood far outstrips the supply, VEECs could mobilize this sentiment and work with Forest Department programs like Jalayagnam to promote joint forestry management[liii]. The community organization is there, and with guidance from AVANI, these bodies could become powerful catalysts for energy and environmental development decisions.

Requirements: Training and environmental education

This updated mandate for VEECs must be accompanied by adequate training and environmental education. Mr. Gokalanand Josi, the president of the Dewi VSEC, said that in committee meetings they mainly only discuss solar power because they do not have the knowledge or specialty to discuss other issues[liv]. He wants technicians or someone to come from outside to provide knowledge and train the leaders of the village. Villagers such as Harish Singh of Digoli have expressed a desire to read, but reading material is quite spare in these remote villages[lv]. AVANI could fill this gap and spread environmental awareness in one move to make environmental literature available in villages. Some VSEC members expressed their inability to articulate environmental issues or why solar power is eco-friendly. Sanju Bora, the Treasurer of the Digoli Solar Samiti said AVANI should arrange more training for the VSECs[lvi]. AVANI should bolster its formal environmental education program to guide and provide information to these activated VEECs.

Example of a potential issue: Biogas

If AVANI provided accurate environmental and technical information about an issue like biogas to VEECs, these bodies could mobilize village enthusiasm about biogas and provide credit to facilitate its extension. The benefits of biogas plants for generating cooking fuel are enormous, yet villagers have been reluctant to accept this technology. Villagers must daily spend between three and four hours collecting firewood from the forest. This hard labor usually falls upon the shoulders of women. Rapid deforestation is accelerating, and often people will cut green trees, even though it is against the law, because they will not have to walk as far. The smoke produced by burning *chilka* inside

homes also damages respiratory health. India's 2001 Census indicates that more than 139 million households still rely on traditional fuels for cooking[lvii]. Kerosene is not a viable financial or logistical option for remote villages, as transportation to and from roads is costly. For a biogas plant, between 10-25 kg of cow dung and water mixture is needed, which takes about 20 minutes to prepare. The waste that comes out of the output pipe can be used as compost for the fields. However, village enthusiasm for building biogas plants has been minimal. Most people have explained that 25 kg is a lot of cow dung, and they cannot count on their animals to produce this amount daily. Others point out that burning wood inside heats their houses. Some say they do not have adequate space around their homes for the plant. Still others have said that the taste of chapatti cooked over the fire is far superior to that of chapatti cooked on a gas stove. VEECs could serve as the conduits for information about the advantages of biogas from AVANI, as well as agents for facilitating their extension.

Harnessing local resources: One man's story

Bachi Singh is the only man in Digoli who owns a biogas plant, and VEECs could his use voice to increase village interest in biogas. He is glad that he is saving money that would have been spent on kerosene. Bringing the kerosene tank to the road, filling it, and transporting it back costs about Rs. 600. He claims that one buffalo can produce enough cow dung in 24 hours. When the large chamber was first constructed, Mr. Singh went to the whole village asking for *gobar*, or cow dung, to fill it. His satisfaction with biogas benefits should be harnessed and publicized by AVANI or VEECs. Mr. Singh's ability to articulate the escalating problem of deforestation also illustrates how VEECs can utilize local human resources to spread awareness, as Mr. Singh's voice is respected and trusted.

He himself has told a lot of villagers about the benefits of biogas, but says that while they are interested, they are waiting for a government subsidy[lviii]. Currently the price is between Rs. 12,000-13,000, but a government subsidy lowers the price to Rs. 4,500. However, if villagers knew more about the time and labor they would save by installing a biogas plant, perhaps more would be built. The VEECs could provide accurate knowledge about maintenance, as many villagers had incorrect information about the process. The VEECs could also provide credit for biogas plants, as most people would be more interested if biogas were more affordable. VEECs could develop the capacity to transfer information from AVANI to their villages, provide credit for system purchases, and serve as a conduit between villages and AVANI.

8. VSECs and local governance

Panchayats: Limited interaction but encouraging potential

Currently VSECs and *Panchayats* rarely communicate, but villagers would benefit from increased awareness about government schemes and subsidies. When I asked what the government does in their villages, both Radha and Meena immediately exclaimed, "*Kuch nahi*!" (Nothing!)[lix].They dismissed the notion that governments might be helping out their villages. Villagers mostly responded by saying the *Panchayat* was working to build a "*rasta mazbut*," or strong road, for their village. Most of these villages or hamlets are quite difficult to access, and climbing through the hills on the steep slopes is the only way to reach them. I interviewed Jagat Singh, a *Panchayat* board member from Sukna, and he asserted that the main problem in his village that the *Panchayat* was working on was building a good road[lx]. On the way to Sukna I did witness several men working with cement and stones to improve the path. Apparently some of the VSECs did meet with the *Panchayat* when the whole village was first discussing adopting solar power. But after this, the two groups have not worked in conjunction with one another, resulting in little awareness about government schemes and subsidies, as well as an unfulfilled potential to coordinate efforts.

Awareness about government schemes: Disillusionment

Most people expressed interest in purchasing solar lighting systems or other renewable technology if there were a subsidy scheme that enabled them to buy at a lower cost. When I asked the Mana VSEC about how they hear about government schemes, they explained that they hear news broadcasts on the radio, but no one benefits in the villages because they are so far from the road that the money is either consumed through

government corruption or others are getting the subsidy first[lxi]. The president of the VSEC in the neighboring village of Dewi confirmed this sentiment. He said that he listens to these broadcasts but does not care because it may be written on paper but there is no result[lxii]. If *Panchayats* and VSECs worked together on communicating information about environmental subsidies, the efforts of both bodies could be coordinated together to benefit their villages.

Prospective linkages between sectors: Environmental coordination

VEECs are reserves for community organization around environmental issues, which other programs could tap into and harness. I had the opportunity to interview Araghu Nandan Pant, a member of the Forest Department, who happened to be walking through Sukna. He is working with Jalayagnam, a Forest Department program, to distribute rainwater harvesting tanks, build check dams for soil erosion, and foster reforestation efforts. He noted that in Sukna, where there is no VSEC, the "community of villagers is not a reality"[lxiii]. The villagers are unaware of government schemes and community participation is low. I asked how an environmental committee could improve the situation, and he agreed that the people "need direction through conference with each other"[lxiv]. For the environmental projects he is involved with, he meets directly with the villagers to gather their support. But he acknowledged, "The villagers are not interested in learning knowledge from us"[lxv]. He cited illiteracy as an obstacle to participation. As a result of this field visit, I have concluded that a VSEC or some sort of environmental body is absolutely necessary in order for environmental projects to succeed. Solar equipment could be maintained and repaired by a solar technician. A sense of

community could be bolstered. Finally, environmental efforts such as those initiated by NGOs or the Forest Department could succeed with the support of the community.

9. Conclusions

- Employment as a solar technician builds confidence and self-respect through learning new skills, earning money, and gaining exposure to different people. The program design effectively ensures technical management at the local level and provides the youth a livelihood option in the Kumaon Region. Although technicians expressed hope for their children, many have limited hopes for their own future livelihood, educational, or vocational opportunities. Improvements could include more holistic training sessions that do not merely focus on technical skills. Night classes at AVANI headquarters could expand social opportunities.
- Rural-urban migration is increasingly a defining aspect of village life, as young men are compelled to search for jobs in cities to generate sufficient cash for their families. Income-generating job opportunities in Kumaoni villages are minimal, and livelihoods are primarily restricted to agricultural and house work. Men who return from the cities also are highly respected by villagers.
- The socio-economic development benefits of solar power are multifold: Educational opportunities are expanded, health risks are minimized by lessening indoor pollution, social quality of life is enhanced by reliable light, communication freedoms such television are made available, and pressures on forests for firewood are reduced. Yet domestic lighting alone does not change the village economy by expanding income-generating activities; skills and training must be provided for productive uses.
- AVANI's decentralized field centers offer significant livelihood opportunities to women as weavers and spinners, and generating this income makes renewable energy more affordable. The provision of solar-powered spinning wheels must include adequate and persistent training, along with a progress check-up system, to ensure user knowledge, equipment care and program success.
- Village Solar Energy Committees (VSECs) effectively fulfill the objective of ensuring technical and financial management and maintenance of solar systems at the local level. While VSECs have the capacity to provide micro-credit loans to

expand access to energy, these funds are rarely utilized or publicized. If AVANI increased its consultancy with these *samitis*, these funds could also be used for the purchase of other renewable technologies or for income-generating activities. Although VSECs generally do not deal directly with other development issues, they have engendered other groups such as women's committees that do fill this role.

- VSECs provide a community organizational structure for handling environmental development issues, but this updated mission must be clearly articulated to empower these bodies instead of limiting them to solar energy. A revised mandate could create Village Energy and Environment Committees (VEECs) that have an enormous potential to be catalysts for community-based natural resource management, and committees are eager for training and knowledge supplied by AVANI. Biogas is a stimulating issue that could be taken up by the VEECs and disseminated in villages.
- Initial communication between VSECs and *Panchayats* is not sufficient if these bodies want to expand their roles to deal with further environmental issues. Currently awareness and expectations about government schemes are minimal, and multiple sectors would benefit from increased dialogue. Additional NGOs and the Forest Department programs could tap into VEECs to bolster participation and cooperation in environmental projects, and to introduce environmental education to villages.
- Government provision of electricity is unreliable and costly, as the absence of maintenance systems weakens equipment dependability and incorrect service charges are not easily negotiated. India's ambitious National Solar Mission aims to expand access to renewable energy, but due to the lack of a capacity to sustain these installations, the program's effectiveness might not be fully realized.

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12. Recommendations for further study

Through my research and experiences living in the Kumaon region, there are several issues that could be areas of future study:

- AVANI's updated mandate for VEECs, as well as the formulation and dissemination of environmental information through these bodies
- VEECs' mobilization of village interest in biogas
- Uttarakhand's potential for utilizing locally available resources with micro-hydro power
- Domestic violence in rural Uttarakhand
- Alcoholism and its socio-economic impacts on village life

For students interested in researching with AVANI, I suggest taking the train from Delhi to Kathgodam Station, where you can have a taxi meet you from AVANI. The main campus at Tripuradevi is about six hours from Kathgodam.

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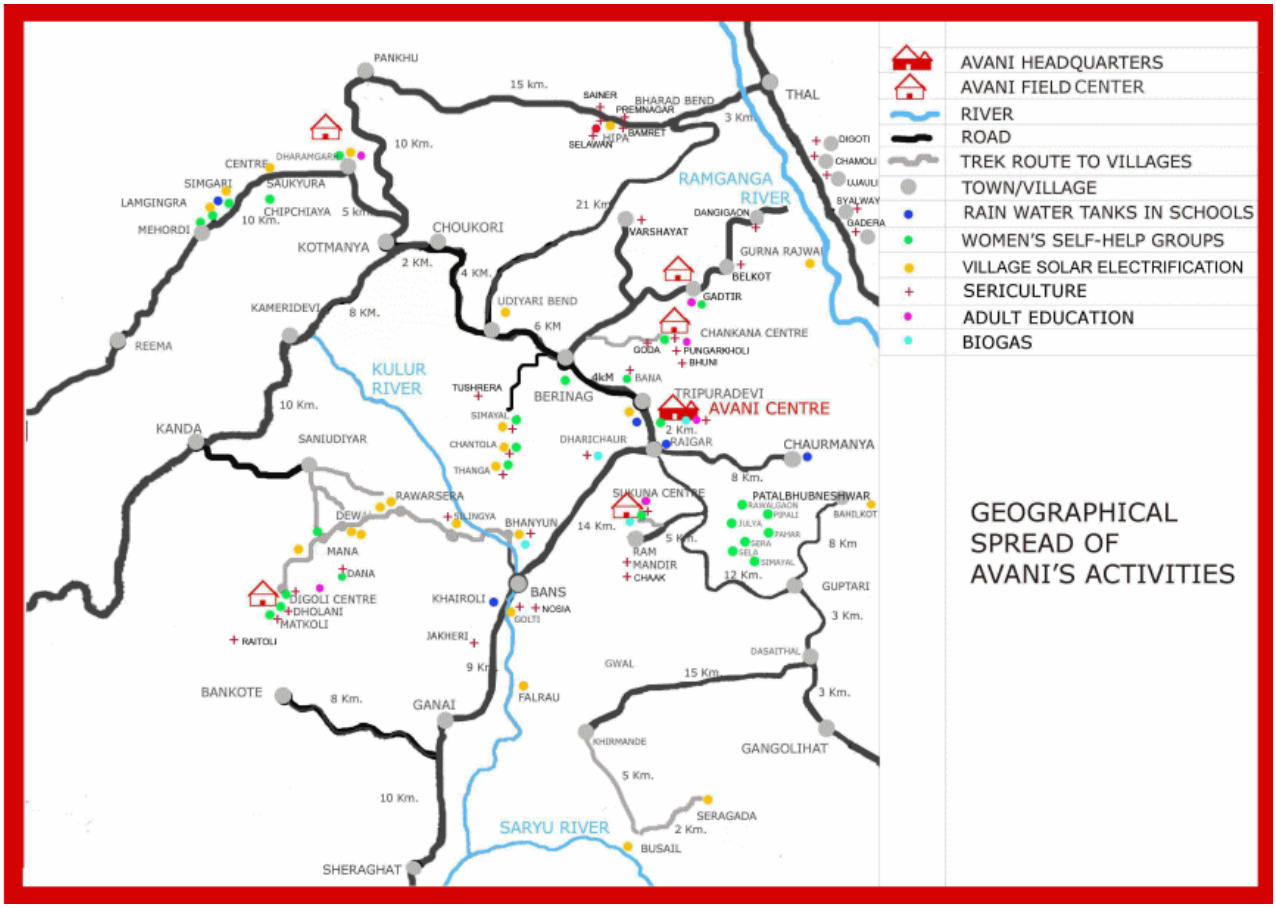
(meeting with villagers in Digoli)

14. Appendices



15. Glossary

Hindi	English
-*Bijali*	-Electricity
-*Charkha*	-Spinning wheel
-*Chilka*	-Pinewood used for lighting fires
-*Gobar*	-Cow dung used for biogas plants
-*Gram Pradhan*	-Leader of *Panchayat* at village level
-*Mahila samiti*	-Women's committee
-*Saur urza*	-Solar power
-*Solar samiti*	-Solar committee, i.e. VSEC
-*Takali*	-Hand spinner
-*Yojna*	-Planning/scheme

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