Developing a Brighter Future

A case study on renewable energy use in Ladakh

Report from a Minor Field Study, March–April 2009

Sebastian Andersson
Erik Gustavsson

Bachelor thesis (15 credits)
HEKK01 Spring 2010
Human Ecology Division
Lund University

Supervisor:
Thomas Malm
Human Ecology Division
Lund University

Abstract

This paper deals with the energy development in the Himalayan region of Ladakh, looking into how different initiatives of renewable energy use affect perceived and material living standards. The study is based on a minor field study carried out in Ladakh in the spring of 2009, and will be presented as a case study.

Today, most parts of Ladakh already rely to some extent on renewable energy sources as a complement to fossil fuels for their energy supply. The area now stands at the threshold to an energy-intensive age. In a time when energy usage is increasing, new ways to meet popular demand are needed.

The paper analyzes the different types of technologies utilized in the increasing renewable energy production, dividing them into different subgroups depending on their relationship with global material flows. It also studies possibilities for energy development in remote rural areas where grid electricity is not a feasible option.

The paper also offers a critical discussion of conventional and sustainable development, where it argues that one possible way of achieving strong sustainability is through what is here called independent technology, that is, technology that can be constructed locally without relying on global flows of resources.

Keywords: Ladakh, renewable energy, global material flows, strong sustainability

Contents

1. Introduction

> Today we understand that the future of humanity very much depends on our planet, and that the future of the planet very much depends on humanity. But this has not always been clear to us. Until now, you see, Mother Earth has somehow tolerated sloppy house habits but now human use, population, and technology have reached that certain stage where Mother Earth no longer accepts our presence with silence. In many ways she is now telling us, "My children are behaving badly". She is warning us that there are limits to our actions.
>
> - H.H. the XIV Dalai Lama

High up in the mountains of northern India, located between the Great Himalaya and Karakoram mountain ranges, is the region of Ladakh. Though once an independent kingdom, it has been a part of India since the 1830s. The area is noted for the beauty of its scenery, with great mountain peaks always within sight along the horizon.

We found the above words by the Dalai Lama inscribed on a brass plaque, resting on a shelf in the dining room of our guesthouse. For the first weeks of our stay we had our lunch and dinner in this room, overlooking the Dalai Lama's summer palace through the glass sheets that made up the southern wall to provide light and heating. It was in this atmosphere that we would sum up the material collected during the day, with a portrait of His Holiness looking down at us from the opposite wall, and it came to serve us as a home away from home.

We arrived in Ladakh in the early spring, when all the mountains were still snow-clad and the few poplars and willows scattered across the otherwise barren landscape were still the same shade of steely gray as the surrounding stony desert.

When we got out of the Kushok Bakula Rinpoche Airport outside the city of Leh the sun was shining so brightly that we had to shield our eyes, despite the fact that we had got used to the sun and heat of Delhi and Rajasthan. Still weary after almost a week on the road south of the Himalayas, we were quite overwhelmed by the beauty of this high altitude desert.

At this point we were not sure where to go, as we had not been able to get in touch with our contacts in Ladakh for some weeks. This later turned out to be because an antenna mast had collapsed during the winter and spare parts could not be brought in until the Zoji La, the mountain pass connecting Ladakh to Kashmir, would open again in May.

This illustrates, in a rather tangible manner, how cut off Ladakh is from the surrounding areas. Because of this, it has proved difficult to develop the area in a conventional manner. With the exception of liquid petroleum gas, almost no fossil fuels are extracted within its borders. All the diesel and kerosene used for heating and lighting purposes has to be brought in from the outside. Fossil fuels therefore constitute a rather unreliable mean of providing energy.

As material living standards and the need for reliable energy is increasing the oil dependency is becoming a major obstacle for the development of the area. Thus, the need for a source of energy that does not rely on outside materials for it's sustenance has become clear. This has encouraged many different projects for renewable energy all around Ladakh through the efforts of a number of NGOs as well as by the Indian government.

As of now, most parts of Ladakh are supplied with electricity through various means of renewable energy sources as a complement to fossil energy. By being unable to completely rely on the path already trodden by western societies and to some extent turn to more sustainable alternatives one could argue that the Ladakhi society might be so far behind the western world that they are, in fact, ahead of us.

The first chapters of this thesis deals with the methodological approach to the field and our field work, and collected material.

After this, Chapter 4 further introduces the field of study, the Himalayan region of Ladakh. It gives a short background of the history and geography of Ladakh and its people. We also discuss the situation in present day Ladakh from a social and ecological perspective.

Chapter 5 provides a discussion on the concepts of conventional and sustainable development and the discourse which surrounds them. We focus especially on the relation between these discourses and the role of different technologies in energy production.

In Chapter 6 we describe the present situation with regards to energy and electricity in rural areas of Ladakh, and introduce the Ladakh Ecological Development Group, a local NGO working with these matters.

The discussion on different renewable energy technologies and their relation to global material flows is the main framework for Chapter 7. We identify two separate realms of technology within the renewable energy spectrum: dependent and independent technologies. We describe and analyze the different technologies we encountered in the field using this division as a starting point.

Chapter 8 is a reflection on the material living standards in Ladakh, with specific focus on the potential of renewable energy as seen at the SECMOL campus, as observed by people from other parts of the world

Chapter 9 deals briefly with the technical aspect of energy development and the possible extent to which renewable energy projects could be implemented in Ladakh.

2. Aim and research topics

The main purpose of this study is to analyze different initiatives of utilizing renewable energy sources that can improve the perceived and material living standards in Ladakh in a context of strong sustainability.

We would like to discuss the differences between various technologies and their relationship to resource flows, world trade, and humans. For this analysis we utilize Hornborg's view of machines and modern technology as vehicles for obscuring the patterns of global terms of trade on which they ultimately depend (Hornborg, 2009:242)[1].

We have chosen to focus on the aspect of energy development as we perceive that it reflects the transition to a energy intensive modern lifestyle that relies on global flows of resources.

We want to highlight the kind of local technologies that could be made easily available and affordable to everyone, as conventional development seldom or late reaches the remote and/or poor parts of the world system and has many problems of its own.

When describing this subject, it is impossible to avoid putting some effort into explaining some of the more technical aspects of energy development in the Leh region. These are however not to be regarded as more than a means of providing a wider perspective of the main subject. We would also like to emphasize the importance of understanding the ideologies and ideas at play in relation to development and environment.

1 See also Hornborg (2001)

3. Fieldwork and methodology

3.1 Initial plans and experiences in the field

Upon arriving in Ladakh our ambition was to work mainly with the Tibetan Children's Village (TCV) in Choglamsar, whom we already had been in contact with concerning our study. Though the time we spent with the TCV was very rewarding, we felt the need for information from more sources.

Luckily, the TCV came to function as a gateway for our contact with other NGOs, as well as providing us with a guide to show us places of interest around the Leh district.

We spent the first weeks staying at a guesthouse just outside Choglamsar. During this time we made short excursions to the city of Leh as well as the surrounding countryside, and made short visits to the greenhouse project in Stakna, the office of the LEDeG (Ladakh Ecological Development Group) and SECMOL (Students' Educational and Cultural Movement of Ladakh). SECMOL maintains an alternative campus outside the village of Phey, about 18 kilometers from Leh. The latter proved particularly interesting as the campus had a lot of interesting energy projects, and we ended up spending almost half of our stay there. Even if SECMOL cannot be claimed to be representative of Ladakh as a whole, it still provides interesting insights into what *could* be achieved by use of local means and materials.

One of the benefits of staying at SECMOL was that we had the chance to socialize with Ladakhi students as well as visitors and volunteers from across the world and learn of their views and experiences. Being able to get the point of view on this way of life from people used to western living standards added a new and interesting perspective to our study that we had not expected to find.

3.2 Interview strategies and observation

Our main approach was participatory observation, meaning that a lot of our field material was collected by observing our surroundings during our daily activities – our morning walk from our guest house in Zampa to the bus stop in Choglamsar and our small day trips to nearby villages, but also from the weeks we spent on living at SECMOL's Phey campus. The opportunity to spend time with Ladakhi students from many different parts of Ladakh was very informative and gave us insight into places we would not have been able to go to.

We had some problems as we do not speak either Ladakhi or Tibetan and in some places the people only spoke very little or no English. The only way to handle this problem short of a good interpreter was to rephrase each question, sometimes numerous times. As a consequence of this, some of the depth of the questions was sacrificed, but in return we would get an answer that was hopefully not based on misunderstandings.

For almost a week we had a local guide that functioned as a translator and showed us some of the places of relevance such as SECMOL and a greenhouse project in Stakna. This was much needed as some of the places would have been hard to find. Getting any information from people would also have been harder without someone to help us come in contact with people. At most of the other places such as TCV, SECMOL, LEDeG and so on the informants had almost fluent or at least very good English.

A lot of information was gained through spending time at SECMOL campus in Phey, as we lived there for some time and got to meet the students and staff on a daily basis. A lot of understanding came from just ordinary conversation or from making small-talk during work hours (cutting dead trees, building greenhouses or similar) while some of the information was gained through semi structured interviews with students, staff and volunteers.

During a typical day in the field we either be at SECMOL campus or on an excursion to some place of interest in or outside Leh. We usually spent some time talking to both Ladakhis and other travelers and observing everyday activities wherever we were. We always carried with us a notepad each, a camera, and a tape recorder if any interesting opportunity should turn up. At the end of the day, just before going to bed, we would sum up the experiences of the day and discuss different topics that had come up. For the most part, we transcribed our field notes and talked about the next step in our research.

3.3 Selection of informants and places

As mentioned we only had very little planned for our stay in Ladakh at first, as we were quite uncertain of what to expect. Thus we had made the assumption that we would discover the best opportunities after arriving in the field. We wanted to be flexible and able to grasp opportunities, a mix of systematic planning and more intuitive ideas) seemed to be the optimal way to go (cf Kaijser & Öhlander, 1999:27. This proved right and several of the locations and people we met were far from our original plan, vague as it may have been.

As Ladakh is an area close to the borders of both Pakistan and Tibet there is a lot of military activity in the area. Because of this, there are restrictions for where one could go without a special permit. Though our original plan was to stay in the Leh area, we were aware that if we would have been able to go to the Changthang area (an area of the Tibetan plateau that extends into Ladakh) it would have been a good contrast. To go to a restricted area one needed a permit that was only issued to a larger group. Because of this, we decided not to spend time trying to find other people who would go with us and work towards achieving a better understanding of a smaller area, rather than less understanding of a bigger one.

With the time frame set we wanted to have about 10-15 semi structured interviews with persons from different organizations/places, and in both formal and informal contexts, as it was our intent to gather a material that was big enough to work with, but not to big to analyze (cf Kaijser & Öhlander, 1999:21).

We ended up with 14 interviews of different length and a lot of field notes from everyday conversations that were not recorded or done as a formal interview. The recorded interviews were done with officials and staff from three different NGOs, and with a number of students, visitors and volunteers at especially SECMOL.

However, the majority of our gathered material consists of field notes. On many occasions, we would find ourselves involved in rewarding conversations that had started out as small talk; interrupting these conversations to take out the recorder would not only feel slightly awkward for both parties, but would also disturb the flow of the conversation, risking the loss of valuable information. Instead, we relied on our trusty notepads and often cross-checked the information with each other later.

We have decided to keep all our informants anonymous. This is due to the fact that we moved within a small community where most people would have been quite easily identifiable. We learned that the energy/NGO issue was the subject of some political disagreement and as we are uncertain of whether or not this could become a problem, we want to keep the impact of our research to a minimum.

3.4 Reflecting on our role as researchers

Many of our informants were people who were used to dealing with travelers from across the world, whether through business contacts or tourism. As we kept the habit of always initiating conversations with our informants by introducing ourselves and our area of interest, we were at many occasions greeted by an arsenal of discursive keywords: terms regarding sustainability, eco-friendliness, the wastefulness of Western lifestyle, the reliance on fossil fuels, alternative energy sources, etc. These are words that were perceived as connected to our research and role as human ecologists. This became a dilemma in one way, as it would color the data collected. As noted by other researchers in the field the relation between what people say and what people do is an interesting matter, which is why observation is as important as interviews to our study (Hylland Eriksen, 2005:75).

One of the things that were problematic to our role as researchers was the hierarchy and the view of Westerners was the fact that we were regarded as “Sirs”. Almost no matter the context, people would treat us rather formally. Our appearance had an impact on how we were perceived and treated and how people would talk to us. This was inevitable, of course. At some places calling us “sir” was the formal way to talk to us, at other places in non-formal contexts we insisted on not being called “sir” but to no avail.

This, of course, depended on the time spent in that particular place and with other factors. And when looking back on it we both agree that we were probably more bothered by being called “sir” in in-formal contexts than the persons calling us “sir”. But it felt like when we were not called “sir” we had more of a conversation based on a personal relation rather than a professional relation. One possibility is that the word “sir” has a different cultural meaning to people, and is perhaps in fact not as formal as we perceived it to be.

During our work with TCV and SECMOL we were, however, not addressed as 'sir'. The setting in these places felt more neutral. This may not have constituted a difference in their perception of us, but it did affect our own perception of the situation. We felt that we were able to act less formal and to engage in conversations more freely, which in turn enabled us to discover things beyond the information yielded by our pre-phrased questions.

The gender perspective is also important to reflect upon. Being two western white males, we found it to be especially difficult to engage in conversation with Ladakhi women, many of who were somewhat reluctant to speak much with us. Even though we found some who were willing to, the majority of our informants were still male.

Another problem would be that when talking to persons of lower rank at NGOs, it would be hard to get information about negative aspects such as bad living standard or failed projects. But by asking different persons as well as trying to get our own perspective on the matter we tried to get a more holistic view. This was different depending on places, some were very open about the results of their projects.

4. Ladakh - Little Tibet in India

4.1 Geography

The area called Ladakh – the name is probably derived from *la-dags*, Tibetan for "land of mountain passes" according to Norberg-Hodge[2] (2009:10) – is a part of the Indian state of Jammu and Kashmir (see maps in fig. 1), and is located between the Karakoram mountain range in the north, and the Great Himalayan range in the south. The area spans a total of 95,876 square km and since 1979 it is divided into Leh and Kargil districts (Chatterji, 1987).

Ladakh is the largest area of Jammu and Kashmir, and covers more than half of the state's area. The population does not differ much between the two districts that comprise the area, although the Leh district is by far the largest in terms of area (Pareek et al., 2007:xxi).

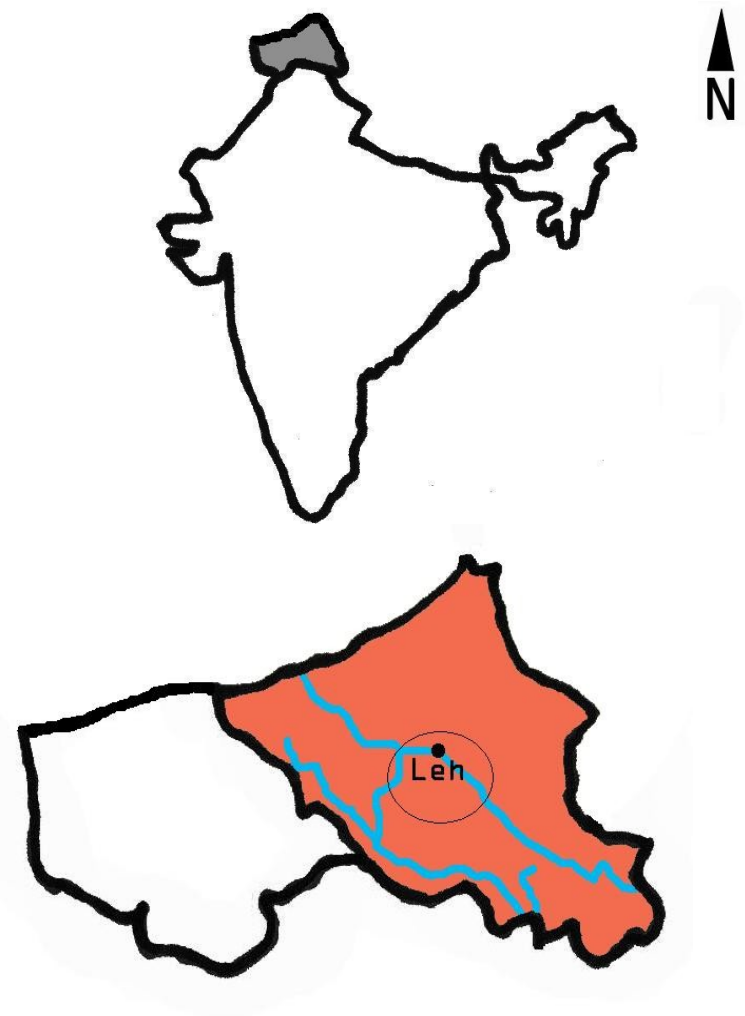

Fig 1. Top: Showing the location of Jammu & Kashmir in India. Bottom: Jammu & Kashmir, with Ladakh highlighted in red. The circle shows the area where this study was carried out. Map by the authors.

2 While Helena Norberg-Hodge could be criticized with regards to objectivity, her long experience of Ladakh makes her work indispensable when dealing with aspects that cannot be assessed first hand. We have therefore decided to largely limit our use of her work to aspects of quantitative and "hard-fact" character rather than qualitative and analytic aspects.

Ladakh is one of the least accessible parts of the Himalayas, with about 74 percent of the area located above 4,500 m. For example, the village of Rumbak where some of our research was conducted is located at 4900 meters (see fig.2). Natural resources such as forests and minerals are scarce, and due to the high altitude the climate is cold and arid. (Chatterji, 1987). The landscape consists mostly of desert, and during the winters temperatures can be as low as minus 40 °C (Pareek et al., 2007: xxi).

Fig 2: Mountains surrounding Rumbak (photo by Sebastian Andersson).

4.2 Short history of Ladakh

Ladakh was an independent Buddhist kingdom from about 950 AD until it was invaded by Hindu Dogras in 1834 and was put under the rule of the Maharaja of Jammu and Kashmir. In effect this made Ladakh part of British India.

In 1947 Jammu and Kashmir became a state in the newly independent Dominion of India. The area that was formerly the kingdom of Ladakh is now divided between India, Pakistan and the Aksai Chin district of the People's Republic of China (Pareek et al., 2007:xxii).

Ladakh has since become one of India's most important strategic zones owing to the tension and occasional armed conflicts during the last decades between the Indian republic and the neighboring states of Pakistan and China (Norberg-Hodge, 2009:10-11).

Even today the military importance of Ladakh is very evident, and the military presence is heavy. There are several army camps surrounding the city of Leh, and the majority of vehicles on the roads of Ladakh are painted in the characteristic military green color.

4.3 Demography

The language, art, architecture, medicine and music of Ladakh is so similar to that of neighboring Tibet that Ladakh is sometimes referred to as "Little Tibet". For a long time, interchange with Tibet played a major role in everyday life (Norberg-Hodge, 2009:10). This was something that we were reminded of during our stay, as many of the exiled Tibetans we met told us that the culture was "exactly the same".

About half the population of Ladakh are Tibetan Buddhists, whereas the rest of Jammu and Kashmir is mostly Islamic. About 45% of the inhabitants of Ladakh are Shia Muslims, and roughly one per cent of the population consists of Christians, Hindus and Sikh (Pareek et al., 2007:xxii).

The importance of religion was apparent, as every village we visited – no matter how small – had some place of worship. The Buddhist monasteries, or *gompas*, are so numerous that for the most part you can stand by one of them and see the next. It should be added that for the most part gompas are built atop high hills. Many of the people in and outside of Leh carried some sort of religious symbol, mostly praying beads or praying wheels, some of which were large and lavishly decorated. In the Leh bazaar district there are two mosques, as well as many stupas (some of which are integrated into the streets and buildings).

The Leh district, which is the focus of this study, had a population of 117,232 persons as of 2001. The main city of Leh had 28,639 inhabitants at that time, and the remaining two thirds of the population live in rural areas (Census of India 2001).

Traditionally, people have been living in small village units that have been more or less self-sufficient. There was balance between the inflow and output of energy, and material output was distributed within the community in such a way that there was little difference in living standards (Chatterji, 1987).

Most Ladakhis sustain themselves as self-supporting farmers living in small villages, the size of which is determined by the access to water. Very few crops are suited for the harsh climate, and the growing season spans only about four months. The base for the traditional Ladakhi diet is roasted barley flour, and about two thirds of farmlands is used to grow barley. The remainder is used for fast-growing wheat, and most farmers also have small fields of vegetables (Norberg-Hodge, 2009:11).

4.4 Ladakh today

Ladakh was until recently a pretty isolated area but with increased access to the region it soon became a part of the world system more directly. In the traditional society of Ladakh there was little need for money but when becoming a part of the market economy this lead to shifts from dependence on family, land and village-relations to money, employment and cities. With need for money to buy food

instead of cultivating the land themselves the situation made them even more dependent on the world system.

When the crisis in Jammu and Kashmir brought tourist activity in the Kashmir valley to a halt, Ladakh, being largely unaffected by the political disturbances, became the new focus of trekking and other tourist activities. From this point tourism became a main source of income (Pareek et al., 2007:xxii).

When we spoke to one off our informants he described the changes that had occurred in Leh with the phrase "Leh has become Disney world" and continued to describe that all shops in the city all carry the same commodities of low quality. Leh had become another tourism center and it hardly represented Ladakh and its culture anymore. We were advised that if we were interested in experiencing the *real* Ladakh, we should go by bus instead of taking a taxi and go to the countryside instead of focusing on the city of Leh.

The growing population of Leh and the fact that the only airport in Ladakh is situated in Leh, has lead to a increased demand for electricity and modern commodities. The increase of tourism has also contributed to this effect. The influence of Western popular culture was apparent in Leh and its surroundings. For example, one evening we found ourselves involved in a discussion about the Evil Dead movies with one of our informants.

The city of Leh today is an interesting blend of traditional ways of life mixed up with modern phenomena. As you walk down the streets of the main bazaar you need to keep out of the way of new cars as you push your way past vegetable merchants in traditional robes sitting along the sidewalks with their trolleys as seen in fig.3.

Fig. 3: Leh, main bazaar (photo by Erik Gustavsson).

This is not unique for Leh, however. More than a few of the small traditional farmhouses that are scattered across the countryside have a new car parked in the yard, and many of them have satellite dishes on the roof. It is worth noting that there is a big difference between villages located along the main roads and the more remote areas.

4.5 Environmental threats

According to an informant at LEDeG, the Himalayan regions like Ladakh are the first to be affected by climate change:

> Ladakh and the Himalayan region people are the first victims of this climate change. The glaciers will melt, and the glaciers are an immense source of water. So: one [*he raised one finger*] you will not have fresh water to drink, [*raising a second finger*] fresh water to irrigate. Then people will suffer.

As he pointed our to us, the people of Himalayas rely heavily on water from the glaciers for drinking and irrigation. If climate change causes the glaciers to melt, there will be a serious shortage of fresh water – something that is already a problem to begin with. Some artificial glaciers - essentially frozen dams - have been created, though no work of this kind is being conducted by the LEDeG, which was portrayed as the main actor on the scene when it comes to environmental issues.

A Tibetan exile who had been living in the region for more than 30 years told us that the winters used to be much colder and harsher, and noted that nowadays it was almost summer by the time of the year that we had arrived in Ladakh, which was early March. He further enhanced this argument by pointing at his feet. He was only wearing plastic flip-flop sandals.

This man went on to tell us that over the past 20 years he had seen a gradual shift in the weather. According to him, it had been getting cloudier, and the clouds were lower now than before. He said that you should be able to see the Stok valley, on the other side of the Indus river, from Choglamsar. He pointed out the window in the direction of Stok, but the village was almost completely obscured by thick mist.

We also learned that the heavier rainfalls cause the traditional buildings to leak, and sometimes even collapse. The traditional Ladakh house is built from locally produced mud bricks, with roofing made from the branches of willow trees that are then covered with mud and sand. Because of this, some newer houses are constructed from concrete, and have sheet iron for roofing. In some cases the old roofs have simply been replaced with sheet iron after being damaged by the rains. Since neither sheet iron nor concrete is produced within Ladakh, this has further reinforced the regions dependence on imports.

Another problem, which is very visible due to its material character, is littering. There is no efficient institutional system for garbage handling, and non-

degradable materials can be found laying about in the surroundings of urban areas (see fig. 4)

Fig. 4: Plastic bottles in a creek outside Choglamsar (photo by Sebastian Andersson).

5. The concept of development

5.1 Conventional development

As we will discuss the development in Ladakh we want to consider the meaning of the concepts of conventional – or *unidimensional* development, as it was articulated by Trainer (2000) – versus the popular term *sustainable development*. As Ladakh is developing more and more we want to highlight the problems with conventional development. We also want to discuss the term *sustainable development* as this term has become increasingly vague and has become a big part of development discourse in recent years.

We will try to describe a few of the different definitions of the term *development* that are of particular interest to this study, starting with a critique of the conventional model of development that generalizes that increasing GNP equals increasing life standards and is therefore to be considered development (Daly, 1996:28). GNP has even been described as "the god to which we pray"(Schor, 1998:21) which hints at the dominant nature of this concept. The critique of development is mostly based on Trainer's (2000) evaluation of the unidimensional conception, as well as the work of Hornborg (2001, 2009) and Norgaard (1994):

> A fundamental problem is the inclination in both core and periphery to define 'progress' in terms of economic growth and technological advances (Norgaard, 1994, cited in Hornborg, 2009:245).

Conventional development has a characteristic pattern of relying on capital intensive technology and fossil fuels, which leads to a increasing centralization and a greater dependence on the market economy (Dawa Norboo, 1997:iii). There is critique of the conventional idea of development, as it in many cases equals development to monetary wealth, i.e. the quest for GNP growth (Trainer, 2000:98).

The conventional development, or unidimensional development, is based on the idea that development is progress and improving human welfare through availability and acquiring of goods and services, where there is a single path where countries can go from an underdeveloped state to developed one (Trainer, 2000:98, 100).

To reach this "developed" state one needs to produce more goods, which increases wealth and benefits. Increased production requires investment and investment in turn requires capital. The best way to accumulate capital is to export to rich countries (Trainer, 2000:97-98).

The more production there is, the more capital accumulation there will be, and the more states will be able to spend on education, health, welfare, public facilities, and the environment (Trainer, 2000:98), an assumption which is also reflected in the environmental Kuznets curve.

According to Hornborg (2001:33), this is rather the result of ecologic load displacement, where affluent nations become tempted to see their "...green forests and fertile fields as evidence that worries about global ecology are unfounded".

We need to instead consider a systemic perspective of the world, "...in which one country's environmental problems may be the flip side of another country's growth." (Hornborg, 2001:33).

However, development does not happen instantly, but is a very slow process. Development problems creates a need for capital as well, but as capital can not be accumulated quickly these problems can not be solved quickly (Trainer, 2000:98). However, the further development goes, the more wealth will be accumulated and in time it is assumed to "trickle down to enrich all" (Trainer, 2000:98).

> …it is nonsense to assume that these developments must wait until there has been a large increase in capital formation, infrastructure, exports and the GNP[…] Most of them do not need many more resources to do this than they already have. What they do need is a clear alternative development vision and the will to organize so as to draw out and co-ordinate the resources they do have, above all the energy and knowledge of local people (Trainer 2000:105-106).

5.2 The WCED and sustainable development

There has been rising concern about the consequences of human activities on earth. With topics concerning different issues like: deforestation, the environmental destruction of the oceans, ozone holes, global warming etc. Many of these problems have been traced to be consequences of the modern western lifestyle and industrial capitalism.

Lately the concerns have been that the western lifestyle would probably destroy the opportunities for later generations to enjoy the same living standard, especially if there would be equality in living standard i.e. that all humans would live according to standards. To ensure a safer future for coming generations a new kind of development was needed, one that would not only stop humanity from destroying the very system it depends on, but also securing a future for its offspring for many generations to come.

In 1987 the World Commission on Environment and Development (WCED) published the report *Our Common Future*. This document introduced the term *sustainable development* and tried to make it clear that we only have this one planet and that nations need to change their ways where "...each community, each country, strives for survival and prosperity with little regard for its impact on others" (WCED, 1987). This called for changes with the goal of improving the situation for people socially as well as halting the destruction of the environment.

The term "sustainable development" tries to describe a state of perpetual harmony between ecological systems and human systems.
This was defined by the WCED as follows:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987:43).

Even if the definition of sustainable development in O*ur Common Future* sounds very promising, the major problem with the term is that the definition is very

vague. This was probably a good political strategy at the time, as a consensus on a vague concept was better than disagreement over a sharper one (Daly, 1996:2). However the possibility for interpretations made some to identify more with the 'sustainable' part and hear a call for ecological and social transformation, others identified more with the 'development' part and interpret it to mean more sensitive growth, a reformed version of *status quo* (Wackernagel & Rees, 1996:33).

With different actors the definitions became different, this as actors have roots in different ideologies as well as different agendas. Some might use the term for their own economic interests, e.g. by promoting products by branding them as being *eco-friendly* or *climate neutral*. With the term meaning something positive "no one can publicly advocate unsustainable progress and maintain credibility" (Norgaard, 1994:11) Daly states that "[a]cceptance of a largely undefined term sets the stage for a situation where whoever can pin his or her definition to the term will automatically win a large political battle for influence over our future" (Daly, 1996:2). This is further enforced by Norgaard: "With the term meaning something different to everyone, the quest for sustainable development is off to a cacophonous start" (Norgaard, 1994:11)

One of the problems with defining the term is to see the difference between true development and mere growth, to not see sustainable development as a second version of today's economic system but rather as a new concept that involves social justice and ecological equity. *Growth* means getting bigger, increasing in size while *development* means getting better (Daly, 1996:1).

In this context sustainable development would be a "…progressive social betterment without growing beyond ecological carrying capacity (Wackernagel & Rees, 1996:33) instead of the common idea that if we just get enough economic growth we will be able to tackle these problems, as is described by means of environmental Kuznets curves.

> What we have long perceived as "development" is basically a manifestation of capital accumulation, and capital accumulation has always been an uneven and inequitable process, generating an increasing polarization between "developed" centers and "underdeveloped" peripheries. Against this background, the faith of the Brundtland report in global economic growth as a road to equity and sustainability is not very persuasive (Hornborg, 2001:55-56).

5.3 Strong vs. Weak sustainable development.

This concept assumes that there are two types of sustainable development. One definition is described as weak and the other one as strong. It is generalized that one is favored by economists (weak) and one by ecologists (strong) (Hermele, 2002:100-101).

The weak concept has its roots in neo-classical economic theory and assumes that manufactured capital (e.g., income) and natural capital are close substitutes (Rennings & Wiggering, 1996:25). This is based on the assumption that complex environmental systems can be valued in monetary terms and thereby

interchangeable with manufactured capital of the same value and that environmental damage can be valued in monetary units (Rennings & Wiggering, 1996:25). As an example, according to this concept countries that depend on large scale imports such as Japan or the Netherlands would be sustainable.

> It fails to recognize that so much of the so-called rich countries` money savings comes from the depletion of other countries` natural capital and exploitation of global common-pool assets (Wackernagel & Rees 1996:37).

Strong sustainable development is based on the assumption that environmental damage can't be valued in money, as ecologic systems are complex systems and one small change could affect other parts of the system in ways that we are as yet unaware of. We depend on both local ecosystems and ones far away. To estimate a loss in one ecosystem accurately is very difficult, as the loss in one system will cause changes in others.

> Often damage cost cannot be calculated because individual preferences are unknown and information about benefit losses connected with environmental degradation do not exist (Rennings &Wiggering 1996:27).

5.4 Renewable and locally adapted energy

What will be needed to achieve sustainable development is, as noted, a sustainable energy source, to move away from the use of finite energy sources such as fossil fuels that one day will depleted or become to expensive to use (Katti & Khedkar, 2005).

Western society is very energy demanding, and one of the biggest challenges it faces today is to find energy sources which are both renewable and non-polluting and which are able to supply it with enough energy. This will require both technological innovations and changes in lifestyle if the goal is to be able to pursue a *real* sustainable development.

Western society will need to change its energy use as well as the energy sources it depends on. However, countries/regions that still are developing might be able to take a different route and make use of renewable energy sources already from the beginning.

The concept of renewable energy covers many different technologies. The ones of relevance will be explained in more detail later. Renewable energy sources are generally cleaner and have less environmental impact (Katti & Khedkar, 2005) than conventional energy sources such as fossil fuels.

In order for renewable energy sources to be more sustainable, one also needs to take local factors into consideration. A technology that works well in one type of environment might be directly unsuitable in another and vice versa. If energy sources are locally adapted we will also face less dependence on the same raw materials globally. By using local materials the costs as well as transports are decreased.

Most part of the renewable investments is made within the country, commonly in the same state or town as the energy users instead of depending on costly imports (Katti & Khedkar, 2005). The outcome of this is that energy cost stays in the country "…to create jobs and fuel local economies instead of overseas" (Katti & Khedkar, 2005).

Renewable energy also has another dimension, as many sources of energy in rural and poor regions of the world are a serious source of indoor pollution that cause environmental and health problems and contributes to deforestation (Katti & Khedkar, 2005).

Concerning the development issue in Ladakh, the area is quite diverse as some areas are already fairly developed, whilst there are remote villages that do not have roads or electricity. At the moment the development in some areas is very progressive whilst in others it is headed in another direction. As development continues, there are many different actors on the stage and the future is anything but clear.

6. The energy situation in Ladakh

6.1 The case of Rumbak

Known as 'the snow leopard capital of the world', Rumbak is a small mountain village located to the south-west of Leh, in the Hemis National Park. Although construction of a road connecting the village to the city of Leh has commenced, the only way to reach the village is still by foot. Part of a popular trekking route, the walk to Rumbak from the nearest village takes about four or five hours for an inexperienced trekker such as myself.

The village of Rumbak is a small settlement of eight households, and like most villages in Ladakh it is largely self-sufficient. When something from the outside is needed, one of the villagers will take the long walk to reach the main road to get into Leh.

The village itself matches the image of the typical Himalayan settlement, with traditional houses constructed from mud bricks and with willow branch roofs (see fig. 5)

Fig. 5: The village of Rumbak (photo by Sebastian Andersson).

Most of the households in Rumbak provide lodging for trekkers, thus earning a little extra income. Among the first things I noticed stepping into the large kitchen of the homestay was a solar powered lamp hanging in the middle of the room. LEDeG has installed approximately two thousand home lighting systems in different villages in Ladakh. As electricity is solely used for the purpose of lighting in most parts of Ladakh, the amount of energy from a single small solar panel is enough to supply the electricity needed for one household.

The village also has one single diesel powered generator as a backup for cloudy days.

Most cooking is done on a stove fueled with dried cow dung and twigs, despite the fact that most households have LPG-stoves as well.

There are many villages in Ladakh that are smaller than Rumbak. For example, the village of Jingchan that I passed on the way to Rumbak consists of only three households. This fact, along with the fact that most villages in Ladakh are situated at high altitudes and are scattered across a large area makes the installation of power lines impossible. The heavy snowfall during the winter months would also cause considerable problems should such installations be made (Pareek et al., 2007:2).

6.2 Village electrification in rural areas

India as a whole is experiencing a rising demand for electricity in rural areas. In 2003, there were a total of about 96,000 villages without electricity, 20,000 of which were located in difficult to reach areas, where conventional grid electricity is not a viable option. In addition to these, there are several thousand small hamlets located in difficult areas that need to be electrified. The Indian Ministry of Non-Conventional Energy Sources (MNES) has taken up a program to electrify these villages and hamlets through means of renewable energy sources (Sastry, 2003:2125).

Characteristic of these villages is that they are located at least 3-30 kilometers away from the present electrical grid, and most of them have fewer than 500 inhabitants. The levels of income, literacy and technical skills are low, and power demand in these villages is predicted to be low in the near future (Sastry, 2003:2126).

The program of village electrification was taken up in 2001-2002, with the concept of either generating power locally and administer it within a village, or installing individual home systems (Sastry, 2003:2125).

During the two year period from when the program started until May 2003, a total of 915 villages had been electrified through renewable means, out of the 20,000 mentioned above. Work on another 1114 villages had commenced, and another thousand were proposed to commence in 2004 (Sastry, 2003:2127).

One of the main concerns of the MNES is ensuring long term sustainability of the various projects. The general practice includes the users paying an initial amount for connection, and a monthly fee to cover maintenance costs.

The MNES has spent quite a lot of resources on developing renewable energy sources in the Ladakh region. In 2001, a special project was started in cooperation with the local government to enable a higher degree of electrification (Sastry, 2003:2128).

Today, electricity in rural parts of Ladakh is almost exclusively used for lighting purposes, as told to us by LEDeG, among others. Besides lighting, electricity is sometimes used for small electrical equipment, like radios.

As long as this is the case, small scale solar energy systems will be sufficient to provide homes with electricity. However, if the need for energy increases these small systems will not be enough. This could be the case if homes are heated by means that require electricity, or if demand for more advanced electrical equipment should rise, as it has done in more urban areas of India.

It has been recognized that energy demands will increase in the future as people will require more hours of energy availability or newer amenities. If energy generates extra income, this too will contribute to the rise in demand (Sastry, 2003:2127).

6.3 LEDeG – the NGO perspective

The Ladakh Ecological Development Group (LEDeG) is a Non Governmental Organization founded in 1983 with the goal of promoting ecological and sustainable development in Ladakh while building on traditional culture.

The organization was awarded the Right Livelihood Award, known as the Alternative Nobel Prize, for it's work in 1986 (Pareek et al., 2007:xx). LEDeG has been working with renewable energy sources since the organization was established, and has installed a large amount of projects all over Ladakh. Aside from the work with sustainable energy LEDeG have also begun planning a small sanitation program in the city of Leh.

LEDeG consists of four sections. These are the Information, Education, and Cultural Preservation section, the Agriculture section, the Appropriate Technology section, and the Handicrafts section.

The first, the Information, Education and Cultural Preservation section, focuses on showing the limitations and faults of the conventional western development model and making the public aware of the worldwide strive for preservation of biological and cultural diversity.

The Agriculture section works with raising the status of the traditional farmers and finding organic ways of developing traditional farming techniques.

The Appropriate Technology section is focused on developing and installing new means of energy production that utilize renewable energy sources and are adapted to the specific conditions of the environment in Ladakh. This includes passive solar heating, solar water heating and micro-hydro electricity.

Finally, the Handicrafts section is providing courses in a wide variety of handicrafts to villagers, the point of which is to support village economy and prevent urbanization. The items produced by the villagers are sold in Leh by two shops under the management of LEDeG (Dawa Norboo, 1997:iii-iv).

Since the establishment of the group, LEDeG has been working with decentralized energy production as opposed to the capital intensive, increasingly centralized approach to energy production.

The energy production advocated by the LEDeG is focusing on renewable resources like solar power which is abundant and also the possibilities for water power in the proximity of streams. A lot of installations utilizing such resources can be found throughout Ladakh, including Trombe walls, solar water heaters, solar parabolic reflector cookers, micro-hydro electric units and solar photovoltaic (solar lighting) units (Pareek et al., 2007:xxv-xxvi).

Before making any installations of power units in villages especially micro hydro, the LEDeG make careful assessments on whether or not this type of power supply is suited to the specific conditions of the site (Pareek et al., 2007:72-73). When installations are made in a village some of the villagers are trained by LEDeG in handling the particular technology that has been installed. Basically, the villagers themselves own the installation, and after the one-year maintenance training program they assume complete responsibility for it. Should problems arise that the villagers are incapable of handling they will turn to LEDeG for help. LEDeG also do follow-up visits about once or twice a year.

According to one of our informants at LEDeG, one of the main concerns of the organization when starting projects in rural areas is that the technology should be user friendly while fulfilling the needs of the people. The aim is to minimize the requirement of technical qualifications to run and maintain the installations.

This ambition, which characterizes the efforts made by both LEDeG and SECMOL is reflected by what one of our American informants said about the subject: "...you don't need to call plumbers, stuff like that […] because you know they can do it, or they don't have it."

7. Renewable energy projects

7.1 Differences in technology: Dependent versus independent

When discussing energy in Ladakh one needs to look at what the needs are there. In the urban areas the energy from either conventional sources, i.e. grid power from diesel generator etc. or alternative sources such as solar panels etc. The need for energy in the urban area of Leh is rising as there are more and more applications available, some of these would be TV-sets and stereos. However, in many of the rural areas there is little or no power beyond that of supporting a light bulb.

Electricity is one of the important factors when it comes to improving material living standards in many of the remote villages in Ladakh (Norboo 1997:1). To cover the basic needs of light and heat there are some technologies that are suitable in a context of strong sustainability. The problem here is to find energy sources that can be sponsored by other actors as the inhabitants of many rural settlements do not have much income and therefore cannot afford these improvements by themselves.

During our stay in Ladakh we came in contact with energy sources and technologies that have potential to improve material living standards without jeopardizing the environment. Most of these are based on cheap, local materials. They are simple yet efficient and work perfectly with little or almost no impact on the environment. We discovered a surprisingly large quantity of projects working with this type of technologies.

We have decided to classify the different technologies into two different categories: *dependent* and *independent* technologies. All the technologies that are divided into these categories are renewable energy sources. There are of course many technologies that that depend on finite energy sources such as fossil fuels. These will not be described as either dependent or independent, but instead as non-renewable energy sources, for example diesel generators.

The *dependent technologies* would best be described as requiring installation, maintenance and repairs by trained personnel. In making this distinction between *dependent* and *independent* technologies we draw upon Hornborg's (2001) discussion on *technomass,* machines, and dependence on global resource flows. Technomass is defined as a mechanical counterpart of biomass, one that ultimately relies on limited resources and leaves us with the entropy it causes, in the form of various kinds of pollution (Hornborg, 2001:17).

> For biomass, growth is a morally neutral reward, granted by nature itself, whereas for technomass it is a reward resulting from human ideologies and generating unequal, global relations of exchange (Hornborg, 2001:17).

This would be how we define *dependent technologies*, as technologies which for their initial construction and/or continuing operation rely on global flows of resources – which occur on a basis of unequal exchange. Basically it is technology that would become useless without the access to global resources. To use an example from Hornborg (2009): "...when there is no longer any diesel in the

tractor, it is just an assemblage of scrap metal. Again, what ultimately keep the machines running are global terms of trade" (Hornborg, 2009:242).

These technologies are often imported from the outside and some have problems functioning properly in the harsh climate of Ladakh. They also sometimes require expensive extra parts to be imported if something breaks. In remote areas, this can also be very complicated and time consuming, especially in the winter. These technologies are more expensive than the independent technologies, but in return offer more services, like converting solar energy to electricity.

Independent technologies, on the other hand, are defined by their ability to be constructed from local materials using only basic technical knowledge. Further, these technologies are not relying on specific components or blueprints as they can be built from a wide range of materials, and all parts could be easily replaced by something else of roughly the same function.

Independent technologies include passive room heating and the passive solar water heating. These technologies are constructed from local and/or cheap materials and are easy to use and repair. They have little or no environmental impact.

However, these technologies do not offer an equally stable output of energy as they rely directly on solar energy. For example, passive room heating will not warm a room if there is no sunshine, compared to a solar panel, which of course also depends on sunshine, but has a battery that allows it to store the energy.

By making this distinction, we aim to emphasize the importance of revealing the fetishism of dependent technologies, what Hornborg (2001) calls *machine fetishism*:

> The fetish character of the machine resides in its ability to present itself to our consciousness as a local achievement rather than a product of the confluence of global flows (Hornborg, 2001:147).

One of the challenges with development of living standard in an energy context is that some of the population consists of nomads. They require a different approach, as conventional development seldom targets this lifestyle. For nomads the use of a solar lantern or solar cooker could be of great use without depending on expensive fossil fuels or compromising their way of life.

7.2 Solar electricity

The greatest source of renewable energy is the sun. The earth is powered by a solar flux of about 175,000 terawatts per second, with the commercial energy flow being about 10 terawatts. This shows that we have enough of energy input on earth from the sun if we only knew how to harness it (Wackernagel & Rees, 1996:71).

As solar power can be used for both electricity, heating of water and for passive room heating, it sounds like the ideal solution to the energy demand.

The question of energy and energy use is only partly a technical question, as it also has important social and cultural implications. In Ladakh energy demand is rising - in India as a whole for about 9% per year (Sastry, 2003:2125). Ladakh needs to find local energy sources if the cost of the energy is to be affordable and available to all, which should be the ideal scenario.

The demand for electricity will continue to rise as there is a strong trend of urbanization. Leh, for example, has more than tripled its population in the last two decades (Goodall, 2004:221). There have also been changes in lifestyle, shifting towards a more energy consuming lifestyle.

Ladakh's environment is well fitted for the use of solar power and this development has already started. While Ladakh is developing fast – in economical terms – not everyone in the region have yet experienced the trickle-down effect of economical development. The challenge will be to develop these poorer areas in a different way than the conventional as to avoid facing the same problems as Western society has done.

Solar energy can be used all over the world, but it is certainly more effective in areas with more days of sun share than others. Solar power is not an even energy flow as it will be interrupted by clouds as well as night time, so to get more energy from solar the ideal place is somewhere where the sun shines for many hours a day as well as having backup energy sources to prevent shortages. Solar lighting could also be used as a safeguard for the unreliable grid electricity, however if used the other way around using diesel generators as backup it could generate more money for the users as they would use less diesel. Of course, it would also be better from an environmental perspective.

One of the places that use solar power a lot is the SECMOL's alternative campus in Phey. They have 14 solar panels that supply the campus with enough electricity to have five computers, a TV and on sunny days even allowing the use of carpentry and soldering tools, as well as additional laptops and other minor electronic devices. The battery system for the solar panels can stay charged for about three days of cloudy weather (Web 1) and if the power fails, they have a backup diesel-generator.

The solar panels also power the much needed water pumps for irrigation of fields and trees at the Phey campus (Web 1). As little grows in Ladakh without irrigation the energy for pumps is important, and this energy demand should be included when talking about the energy needs of the Ladakhi.

Solar panels are widely used in Ladakh in many different places, for example in schools, homes, shops, temples (gompas), military bases and many more.
Just walking around in the markets of Leh one could find solar panels in front of shops, and when traveling the countryside one can see solar panels atop houses and other buildings quite often. They are definitely not a rare sight around Ladakh.

At most of the places we visited, families had solar lighting as well as grid electricity to safeguard them from the power failures and ensuring them light during the evenings.

As solar panels are dependent technologies, the most usual problem is the lack of trained personnel to maintain the panels/batteries. At many places the solar panels generate much electricity, but there is a lack of battery capacity or too old batteries to store the energy and the full potential of the panels are lost. Both the batteries and the solar panels themselves are dependent on a global flow of resources to maintain an optimal energy generation and storage capacity.
The construction of solar panels and batteries cannot be done in any village by someone without the proper training, but are advanced processes that depend on industrial machinery, technical qualifications and industrially processed chemical components.

Solar panels are one of the more expensive power sources but the availability coincides with peak usage (Katti & Khedkar, 2005). Grid energy, on the other hand, is one of the cheapest electricity supplies since the energy companies only charge a monthly fee for the number of light bulbs and appliances that the user claim to own. This is far from sustainable, as there no incentive for energy conservation (Dawa Norboo, 1997:17). This was confirmed by one of our informants, who also told us that different campaigns have aimed to reduce non-reported energy usage, non of which have been especially successful.

As the use of grid energy is not controlled overuse can cause power failures. During our stay for three and a half weeks at a guest house we experienced several power failures on the grid energy. These were mostly short ones but longer failures did happen and some days there were several power failures within just a few hours. However, these power failures could indeed stem from other sources than overuse.

The Tibetan Children's Village started using solar electricity in the early eighties, making them one among the first to do so in Ladakh. The first projects consisted mainly of solar lighting and were built with one small solar panel and battery per building. This type of lighting system is installed in all the buildings of the village. This has been saving them energy and money as well as providing a more stable energy source than the rather unstable national power grid. TCV invested in solar lighting to provide the children with light for home studies in the evening as well as light during classes.

Recently a new solar power system was installed. This system, consisting of solar panels and a central battery unit, provides several buildings with electricity and lighting. This is a step towards self-reliance for the TCV Choglamsar. As of today, the TCV have three branch schools near the Tibetan border that are sustained completely by means of solar energy.

As we spent our time at SECMOL during March to April the weather was rather cloudy and according to some informants these would be the cloudiest months of the year. As it was very cloudy some days the generator had to be used but the people at the campus said it was a lot more stable before our arrival. Even if the generator had to be used a couple of time the energy flow was more even than the

grid energy and it was available the entire day and night. According to the staff at SECMOL the solar plant had been working more efficiently earlier, but both the batteries and some of the solar panels were getting worn out.

7.3 Passive heating systems

In Ladakh we met some people who told us that they lived in houses that could get as as cold as -25°C indoors during winter and depended on a single stove that used cow dung and fire wood as the only heat source. The cold climate makes indoor heating essential and the conventional methods are dung, wood (which are very labor intensive to acquire) or fossil fuels like kerosene and oil (Web 2).

Solar power is not only used as a source for electricity but can also be used for passive room heating, something that we have seen done with good results. Trombe walls combined with insulation can reduce the reliance on heating sources by two-thirds. This reduces labor time and the use of fossil fuels, which also reduces indoor air pollution and health hazards connected to it (Web 2). One of the biggest advantages over other technologies is that is both very simple and cheap and can be done with mostly locally produced materials.

The concept is to use the heat from the sun and amplify it with the use of simple glass windows combined with a black painted wall made of bricks (preferable mud bricks because of their ability to keep the heat for a longer period of time behind the windows leaving a small space between the windows and the wall.

The so called Trombe wall should be placed facing south to allow maximum intake of sun. The sun beams will hit the window, be amplified and then hit the black painted wall, this will generate heat. The brick wall has a two holes, one at the top allowing warm air to flow into the room behind the wall, and one a the bottom allowing cold air from the room to flow in front of the brick wall to be heated (see fig. 6).

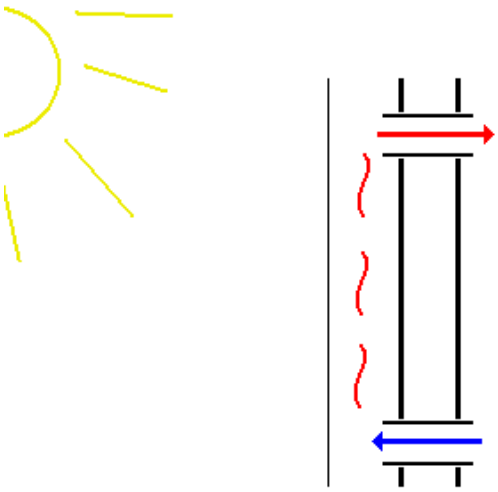

Fig. 6: Trombe wall (figure by Erik Gustavsson).

Another design that can easily be used to help keeping the heat inside the house is to have high thermal mass in walls and floors. This is used at the SECMOL campus where the buildings were constructed three feet below the ground level on the north side. This makes the temperature more even as it benefits from the stability of the earth's temperature, which is cool in the summer and relatively warm in the winter. The three feet of earth that was removed was later used as walls for the building (Web 1).

The key to retaining the heat is the use of insulation. At SECMOLs campus in Phey they did not use modern and imported materials but rather wood waste that was generated during the building process and later served to insulate the ceiling, preventing heat loss through the roof (Web 1).

This is not only easy to do but also very cheap, and could improve the living standard for some households. Following is a calculation of the insulation abilities in different materials:

> If comparing 'thermal conductivity' (insulation property) of common Ladakhi building materials, you find that mud is the best:
> 1 ft mud wall = 2 ft concrete = 4 ft stone = 1.5 inch of saw dust. = 1 inch of Thermocol, rockwool etc (Web 1).

The floors were insulated by layers of rocks in different sizes to create insulating air-pockets, on top of the rocks a layer of gravel and cement has been added to act as a heat bank. In some places of the campus, such as the main hall slate is used for the top layer. This does not only reduce the use of cement but also becomes a heat bank as they are thermally cut off from the cold ground (Web 1). The slate comes from local mountains where it was waste from road construction sites.

The walls are insulated by a jacket wall outside the main wall; this was constructed with a six inch gap between the walls and is filled with saw dust, wood shavings and some paper or plastic garbage like bottles and bags from the city. Cow dung mixed with earth and clay have been used as a thermally effective insulating plaster (Web 1).

The main building at the SECMOL Phey campus uses different passive room heating techniques as well as good insulation and the thermal mass from the earth. With this design the minimum observed temperature indoors during winter is +8°C when the outside temperature falls to about -25°C (Web 1).

What is exceptional is that they use no external heating and this shows the potential for alternative house designs that takes thermal mass, passive solar heating, different materials and insulation into consideration instead of following other building styles that are not as well adapted or requires a lot more energy input to produce the same good results.

Rammed earth is an old building technique that has been used when constructing many of the old buildings in Ladakh such as the old monasteries (gompas) as well as the main building at SECMOL's Phey campus. The technique is basically compressing damp earth into a wood frame. It's very much like when making

bricks but instead of making many small pieces one makes a whole solid wall. Rammed earth has many advantages over other types of building techniques, for example it can be constructed from local materials in Ladakh. The material is very cheap and reduces need for wood, which is a scarce resource that often is imported or requires lots of irrigation to grow.

Another benefit of rammed earth is its good thermal mass i.e. it absorbs heat during the day and releases it during the evening. As Ladakh has many days of sun share, rammed earth buildings can be very effective, especially when combined with insulation and Trombe walls.

Helena Norberg-Hodge describes how the Ladakhis patch and mend their worn-out robes until they fall apart and then use them to prevent leakage in the irrigation channels or as insulation. This illustrates a principle that is very natural to the Ladakhis – nothing is discarded, even after it can no longer be used in the way it was perhaps originally manufactured for (Norberg-Hodge, 2009:25). For example, during our visit to Ladakh we saw old tin cans used to protect young trees from the goats and donkeys that would otherwise have eaten the bark off of them, and pieces of old clothing or newspapers used for insulation.

It is all about re-use rather than re-cycling. This way of thinking also permeates the construction techniques used at SECMOL; pieces of old clothing are used as insulation, and the toilet paper is straps of old newspapers. We also observed this at the recycling station at SECMOL, which was not a recycling station in the sense we are used to, but more of a gathering station for materials that could be used for something else.

The design of the house, location, facing, thermal mass and many other factors is important to get the most out of solar heating. To have south facing windows is important as the sun stays in the southern sky in winter (Web 1).

Ordinary windows provide some heat during the day, and they also supply the house with light, reducing the usage of electricity. The windows should be constructed with a small “roof” above them. This roof will give shade to the window during the hot summer and allows full intake of the lower winter sun when heating is more needed.

We spent three and a half weeks at SECMOL’s Phey campus, and during this time we reached some understanding about how it is to live there. As we were not there during the cold part of the year we did not experience the cold outside temperatures. However, the indoor temperature was always pleasant even if it was a bit chilly outside. Even during the colder nights we had a comfortable temperature in our room, but in some of the bigger rooms it was a bit colder according to some of the American students who stayed there. The Ladakhis, however, did not seem to mind the cold. When asked about this they told us that they found the lodging at SECMOL to be quite comfortable when compared to what they were used to back home. We also noted that there seemed to be a difference in the tolerance of cold water between the Ladakhis and ourselves. Some of our Ladakhi friends even seemed to prefer to take a shower in the

afternoon when chances for warm water were significantly lower, rather than to wait in line for the warm water showers at lunch-time.

We did also spend some time in the staff living quarters which at that time were inside a seasonal greenhouse. The plastic sheets of the greenhouse were removed as the days grew warmer. The same kind of construction was applied to other parts of the campus.

The staff quarters were very comfortable heat-wise, maybe even a bit too warm during the sunnier days and mornings. This changed as the plastic was removed. According to the people at SECMOL, these greenhouses were the most successful heating technique they had implemented.

7.4 Solar water heating

Another of the heating systems is the water heating. This can be constructed in a very simple way using cheap materials or in more technology-based and therefore more expensive way. Both can be seen in numerous locations around Ladakh and both have their advantages and disadvantages.

The simpler and cheaper way is the one that is used at the SECMOL Phey campus (see fig. 7). Their design is a 100 liter water heater using basic material that is easily available and costs about 3, 500rs (about 77 USD) (Web 1). It is constructed from aluminum sheets painted black or black plastic, greenhouse plastic, a frame made of mud bricks and wood, and a common toilet-tank valve if desired.

Fig. 7: Water heater at SECMOL Campus (photo by Sebastian Andersson).

It is a shallow tray that is painted black in the bottom and can hold two inches of water. The black paint or plastic will absorb the sun's rays and convert it to heat, warming the water inside. The tray's walls are built with mud bricks, the sheets sides are tilted to form the tray and the top is covered with the greenhouse plastic. The toilet tank valve is used on the inlet pipe to prevent overflow by automatically letting cold water in when warm water is drawn out, and cutting the supply when the water level has reached the desired height. The water heaters at SECMOLs Phey campus produces 100 liters of 45°C water by noon if it has been filled with water in the morning (Web 1).

One of the advantages of this technology is that is has no pipes inside that can freeze, which allows it to be used all through winter without draining. If the water in the tray freezes during the night nothing breaks and it simply melts again in the morning and starts warming up (Web 1).

The other solar water heating method consists of dependent technology and is a lot more expensive. These heaters require personnel trained to maintain them and most types require insulation not to freeze, which will otherwise cause the pipes to break. Both these problems were confirmed with the water heaters at TCV Choglamsar, which were currently out of order. As these types of water heaters consist of more advanced parts, they are also much more expensive to repair.

There are lots of different types of dependent technology-based water heaters, some of which can handle the climate of Ladakh better. With heaters of proper design and with proper insulation the result can be quite successful, such as a number of heaters we observed at the Mahabodhi meditation center and school outside Leh.

The advantages of this kind of heater is that if they are well insulated they can store hot water for up to three sunless days and we were also told that they work all year around, even down to temperatures of -28 ° C, provided that there is sunshine.

7.5 Greenhouses

Since Ladakh has a very arid climate the possibilities of growing groceries are small. With a growing population the demand for food is increasing and it is very important to provide locally produced foodstuffs inside Ladakh. This is due to the fact that import will be very expensive during the winter as air traffic is the only possible means for transport. However, because of the high sun share there is good potential for greenhouses in Ladakh. If they are designed properly they can produce groceries even during the cold winters.

Greenhouses are seen at many places all over the Leh region, but there are lots of different designs. Some uses the thermal mass from the earth by making a hole in the ground and then covering it with greenhouse plastic. We did not observe too many places that had this type of greenhouse. However the technique of placing the greenhouse a few feet under ground-level to get the insulation from the earth was observed at many places.

The more usual kind is built from mud bricks with a small roof and the southern sloping wall made from greenhouse plastic. This type of greenhouse is the most common in the Leh district and is used for mostly for small scale production, i.e. household needs, but it was observed at other places as well, such as Mahabodhi meditation center (see fig. 8). The materials are cheap and can achieve great results as Ladakh have many days of sun share.

Fig. 8: Greenhouse at the Mahabodhi meditation center (photo by Sebastian Andersson).

During the summer of 2008 the nine greenhouses (a mix of the two types of greenhouses mentioned earlier) at Mahabodhi produced about 250kg of tomatoes, according to one of the monks at the center.

Another positive effect of the use of greenhouses is the effect that the water used for irrigation is not as easily lost as when irrigating outside a greenhouse. The water vaporizes but most of it stays inside the greenhouse. This makes the greenhouses a bit better on conserving water as well.

Greenhouses can produce tomatoes and other vegetables during summer. During the winters more durable vegetables are favored. This includes different kinds of spinach, which is grown all year round and is used much in the Ladakhi cuisine. Greenhouses also prolong the growing season for different types of cabbage and potatoes which reduces imports of vegetables.

One of the more creative ways is to incorporate the greenhouse with a house. This was seen at some places, one of them the SECMOL Phey campus. At one place the greenhouse was built adjacent to the house with the greenhouse plastic functioning as both a greenhouse and a second wall for the house, providing it with a bit of extra heat and insulation. The effect was further enhanced by covering the plastic with thick blankets during night-time and cloudy days, this working as insulation for both the house and the greenhouse. During the summer when the climate is quite hot the plastic can be removed and the greenhouse becomes a vegetable garden. This depends on what kinds of vegetables are grown.

The prospect for greenhouses is good in Ladakh and this will probably play an important role as the area develops further and its population grows. With rising

needs for food, scarce resources and expensive imports during winter the incorporation of greenhouses adjacent to living quarters could be very successful. This can improve the economy of households and make them less dependent on imports. Water scarcity, however, is a limiting factor as to how effective these greenhouses can be.

7.6 Solar cookers

Another way to use the sun directly through independent technology is through amplifying the heat of the sun rays. There are many different kinds, from small portable ones to big parabolic dish mirrors. The smaller ones can be seen at various spots around Ladakh. Though some of them are built from imported materials, this is not necessarily the case – an efficient solar cooker could easily be built using only a small box, black paint, a sheet of glass, and some kind of reflector (e.g., polished metal, a mirror, tin foil).

At SECMOL's Phey campus they used two big parabolic reflectors covered with mirrors (see fig. 9) that focuses the sun to another smaller reflector that is placed under the pots in the kitchen (see fig. 10). This design is simple yet very efficient and produces about as much energy as a large gas burner (Web 1).

Fig. 9: The solar cooker at SECMOL (photo by Sebastian Andersson).

A disadvantage of the cookers is that they are a vulnerable to momentary shifts in the weather. If it is cloudy the cooker will not work. For this reason it might be best used as a primary heat source to cook with if there are other means of energy sources available as back up.

For example, the solar cookers at SECMOL is used less than fifty percent of the time, and the TCV completely refrain from using them, due to the need to have food for the school children prepared on time.

Fig. 10: The solar cooker from inside the kitchen (photo by Sebastian Andersson).

Solar cookers might be a good solution for rural households as it reduces the need for firewood and dung (which is scarce and labor intensive) and thereby also the amount of fumes inside the houses.

7.7 Hydro electricity

One of the sources of energy that is being most utilized in Ladakh is hydro power. Significant problems with freezing in winter have had the consequence that most utility scale power systems are hybrid systems, rather than relying only on hydro power. The city of Leh and it's surroundings, for example, uses a hybrid power system combining diesel power from the generator station in Choglamsar with power from the hydro electric power plant on the Indus river in Stakna (Dawa Norboo, 1997:16).

Apart from the few utility scale hydro power plants there are a number of small village scale systems install in various villages all over Ladakh. Some are installed by LEDeG, and some by Indian government agencies. Some of these are fed by springs and thus do not have freezing problems, but most micro hydro systems run at a lower production rate part of the year due to freezing (Dawa Norboo, 1997:29).

According to a study conducted by LEDeG solar power is the best choice for area with limited water supply. However, in some areas solar electricity has become a competitor rather than a compliment to hydro power. This is due to the fact that the villagers perceived their energy needs to be fulfilled by the two CFLs that a standard solar home lighting system can support. In some places this has led to a neglect and closure of micro hydro plants (Pareek et al., 2007:100).

Some hydroelectric systems have also been closed because of conflicts over water rights with farmers, which is a problem especially during the irrigation season. Another matter we came across that affects the use of water sources is that water, being a scarce resource, is also the subject of lore. One of our informants told us of a spring that "...it´s inhabited by a spring spirit, and if you dig underneath the villagers say that the spirits could perhaps pack up their spring and leave."

This is also a reason why many villagers prefer photovoltaic (solar) energy over hydro power. The solar installations also require less maintenance. Both types of systems are installed at full subsidiary, so the higher cost of installation for solar power does not cause any problems to the villagers (Dawa Norboo, 1997:31).

The cost of installation varies between the different types of systems, with the village scale hydro units installed by LEDeG being the least expensive (Pareek et al., 2007:71). Larger scale hydro power plants are much more expensive per kWhr, but are in return more reliable (Dawa Norboo, 1997:16).

8. Reflections on living standards in Ladakh - an outside perspective

Though material living standards in Ladakh are significantly lower than in the western world we found that adjusting to this new level of comfort to be surprisingly easy.

We had chosen the months of March and April to conduct our study, and during this time the supply of different types of food was scarce. As one of our informants put it: "April is the worst month. The weather is bad and there is nothing to eat but dhal."[3] During the winter months (mostly October through April) the pass of Zoji La is closed, and the only way to reach Ladakh from the outside is by air. We experienced the opening of the Zoji La through the sudden appearance of a variety of vegetables in the cooking.

At the time of our arrival there was no running water at our guesthouse since the pipes had been disconnected to prevent them from breaking during the winter, so whenever we wanted to take a shower we had to ask for a bucket of hot water. Also, there was no heating in our quarters, so we had to rely on a mobile gas heater to keep warm in the evenings.

Despite this, we never really experienced any discomfort, and after a few days we had almost stopped thinking about it completely.

During our stay at the SECMOL campus in Phey we had the opportunity to discuss the differences in material and social living standards between Ladakh and the west with a number of volunteers and students from the USA and Europe.

The subjects being discussed included how they perceived their living standards and quality of life were being affected by the lack of a lot of modern amenities and other western standards, and whether they would consider living with standards comparable to those at the SECMOL campus on a long term basis.

None considered their quality of life being negatively affected, besides maybe missing access to hot showers at any hour of the day or some types of food. Some actually even expressed that they experienced their living standards were affected positively, pointing out among other things that the lack of technical gadgets would bring some sort of relief.

It is worth pointing out that these statements only relate to the way of life and living standards at the SECMOL campus, and that the rest of Ladakh would likely be different. This is something that our informants were very aware of, and most of them pointed out this difference.

3 *Dhal* is common Indian dish prepared from dried beans and/or lentils. Without changing the seasoning, it can become a bit monotonous in the long run.

9. Prospects for a brighter future

In 1995 the LEDeG initiated their Renewable Energy Project with the objective of evaluating the renewable energy potential of Ladakh. The data was collected in 1996 and includes information on solar, wind and hydro resources and the local climate (Dawa Norboo, 1997:iv).

This data suggests that there is a large potential for solar and hydro energy, but that the conditions for wind power are quite unstable. The strongest winds occur during the summer, although the spring and fall are not far behind. The winter months have much less wind and the ratio between winter and summer is fifteen to one (compared to e.g. hydroelectric power plants for which the ratio varies between four to one and two to one). This makes wind power unsuitable for year round power supply. The wind cycle, however, correlates with the agricultural season. This means that wind power is possibly a suitable way of providing power for irrigation pumps near rivers (Dawa Norboo, 1997:12). The study takes note of the fact that wind potential is very site specific, so additional data collection is required for each proposed installation (Dawa Norboo, 1997:3).

The solar data points to the fact that Ladakh has a great potential for solar energy, even during winters when the days get shorter. This does not mean that solar energy does not have limitations. As many of the villages of Ladakh are situated high up in the mountains the effect of mountain shading must be taken into consideration in planning the installation of solar energy systems. Some villages receive only half as much sunlight as the city of Leh because of the mountain shading (Dawa Norboo, 1997:24). In these cases other technologies may be more appropriate.

Flow measurements conducted at the larger streams of Ladakh suggest a large potential for hydro power, especially in the streams at Dah, Hanu, Wanla and Domkhar. Theoretically, these four streams have sufficient potential to meet the electricity needs for the entire Ladakh district (Dawa Norboo, 1997:13). There are however some obstacles for this. The two major difficulties are the cost of building such power plants, and the second is the difficulty and cost of distributing this electricity to the scattered villages of Ladakh.

There is also a great potential for various smaller streams to provide power for smaller areas. One of the main problems with hydro power installations is the risk of freezing during the winters. The systems that do not freeze also have a generally lower output in the winter due to water shortage, since most streams are fed by snow melt (Dawa Norboo, 1997:29, 32).

The LEDeG Renewable energy project has begun to examine possible ways of solving the problem with freezing during the winters, and in the future this problem might be reduced to a minimum (Dawa Norboo, 1997:29-30)

Most of these prospects rely on imported technology and raw materials, and thereby also on global resource flows. While they are a significantly better option from an environmental perspective than relying on fossil fuels, this means that they come with problems of their own.

10. Concluding discussion

Today, initiatives connected to both ideologies of development, i.e. conventional and strong sustainable, are represented in Ladakh. Although the area still mainly powered by non-renewable energy sources, solar and other types of renewable energy are used to quite a large extent. But distinctions can not be made so easily, focusing only on the dichotomy between non-renewable and renewable energy. We argue that another dichotomy, between dependent and independent technologies, is equally important in reaching an understanding of how local communities can fill their needs without compromising others. In a larger context it also illustrates the significance of global resource flows and unequal exchange in energy development.

While in some other contexts it might be desirable to avoid creating dichotomies and rather strive to bridge those that already exist, we would argue that in this case these dichotomies serve the purpose of disarming the illusion of weak sustainability and the assumption that technology gets more efficient the more advanced it is. It is also important to reveal and break down the fetishism of dependent technologies.

Of course, a shift to renewable energy sources is not the only thing that is needed to achieve a development headed towards strong sustainability, but considering the energy trends of today it is definitely a crucial step. It cannot be stressed enough that local consumption should be met with local production if we are to stray from the current logic of exchange in the world-system. Also, it is worth noting that a shift from non-renewable to renewable energy production, and eventually to independent technology, will also require shifts in consumption patterns.

In addition, because of the scarce natural resources and the difficulties surrounding import, especially to the more inaccessible parts of Ladakh such as Rumbak, conventional ways of development do not pay off in well Ladakh. This has pushed towards finding alternative solutions which are cheaper and not dependent – to the same extent – on imported technology or fuel.

Some of the innovations that have been inadvertently encouraged by conventional development in this fashion are showing that technology does not have to be advanced, expensive or imported in order to improve the material living standards of people living in even the most remote rural areas.

In switching from finite to renewable energy sources, replacing large scale conventional power plants with an equally large scale renewable energy source could prove to be a trap. An example of this would be the hydro power plant at Stakna, which experiences significantly more maintenance problems and power failures than most of the small scale hydro plants.

Since electricity in Ladakh is mainly used for lighting purposes and some basic electrical equipment the small scale energy sources used around the area provides enough power. However, should the material living standards of Ladakh approach those of the western world today these small scale solutions will not be enough. This is by no means a way of saying that Ladakh should not develop, but rather a

critique of the way of life that Western societies have come to take for granted, as well as of conventional development.

Without being overly optimistic, our own and others' reflections on the living standards of the SECMOL campus (see chapter 8) hints at the possibility that such a shift of consumption patterns as suggested above is not inconceivable. As we have learned from our time in Ladakh, even those who are used to all the luxuries of the west can appreciate the standards achievable by use of the energy and heating techniques mentioned.

11. Acknowledgments

First and foremost we would like to thank the Human Ecology Division of Lund University for the help with our project and for granting us the Minor Field Study scholarship and the Swedish International Development Cooperation Agency (SIDA) for the scholarship that enabled this project and experience.

We would also like to thank our supervisor at the Human Ecology Division, Dr. Thomas Malm.

We would like to direct a special thanks to Mr. Tenzin Rabten for his personal commitment to help us, and also the Tibetan Children's Village for all the help, for taking care of us, for a warm welcome and for their continuous support during our stay.

Mr. Jan Schlenk for the help with planning and contact arrangements.

All people at the Phothang Gyaphelling guesthouse for their hospitality and kindness, for their concern about our well-being and for the interesting conversations that taught us a lot about the Tibetan situation as well as life in Tibet and Ladakh.

The staff and students at SECMOL for their hospitality and for everything that we learned from each and everyone, for excepting us as a part of the community and for broadening our understanding of Ladakhi culture and customs.

The students and teachers of the Vermont Intercultural Semesters (VIS) who provided our study with a perspective that had not otherwise been possible.

The Ladakh Ecological Development Group (LEDeG) for providing us with valuable insights into development issues of Ladakh and the organization's work..

To everyone we met, to all the friends we made, for your hospitality, kindness and interest in us and our project. For all the fun times, for all the conversations, the late night card games, momo nights and everything else – there is simply to much to mention.

And finally to all friends, family and loved ones in Sweden for continuous moral support and help with the project.

Thukje-che / Jullay !

12. Acronyms

GNP – Gross National Product

LEDeG – Ladakh Ecological Development Group

LPG – Liquid Petroleum Gas

MNES – Indian Ministry of Non-Conventional Energy Sources

NGO – Non-Governmental Organization

TCV – Tibetan Children's Villages

SECMOL – Students' Educational and Cultural Movement of Ladakh

WCED – World Commission on Environment and Development

13. References

Chatterji, Sandhya, 1987. Development Prospects in Ladakh. *Mountain Research and Development.* 7(3):217-218

Daly Herman E. 1996. *Beyond Growth: The Economics of Sustainable Development.* Boston: Beacon Press.

Dawa Norboo (Project Coordinator), 1997. *Renewable Energy Resource Data Collection in Ladakh, India: A Summary of Data Collected and Other Work Completed in 1996*. Leh: Ladakh Ecological Development Group.

Hermele, Kenneth. 2002. *Vad Kostar Framtiden? Globaliseringen, Miljön och Sverige*. Stockholm: Ordfront Förlag.

Hornborg, Alf, 2001. *The Power of the Machine: Global Inequalities of Economy, Technology and the Environment*. Walnut Creek: AltaMira Press.

Hornborg, Alf, 2009. Zero-Sum World: Challenges in Conceptualizing Enviromental Load Displacement and Ecologically Unequal Exchange in the World-System. *International Journal of Comparative Sociology* 50(3-4):237-262

Hylland Eriksen, Thomas, 2005. *Vad är Socialantropologi?* Stockholm: Bokförlaget Natur och Kultur.

Kaijser, Lars & Öhlander, Magnus, red. 1999. *Etnologiskt fältarbete*. Lund: Studentlitteratur

Katti, Pradeep K & Dr. Khedkar, Mohan K. 2005. Towards Sustainable Energy Systems: Integrating Renewable Energy Sources Is The Key For Rural Area Power Supply. *2005 International Power Engineering Conference*, pp. 1-104

Norberg-Hodge, Helena, 1991. *Ancient Futures: Lessons from Ladakh for Globalizing World*. San Fransisco: Sierra Club Books.

Norgaard, Richard B. 1994 *Development Betrayed: The End of Progress and a Coevolutionary Revision of the Future.* London: Routledge.

Pareek, Lalit; Kelawala, Meherzad; Kapoor, Rohit and Tsephel, Stanzin, 2007. *A study on Micro Hydro Units in Ladakh: To Analyse Their Feasibility Using Quantitative & Qualitative Tools, Institutional Arrangements, and Costing Methods*. Dehra Dun: Bishen Singh Mahendra Pal Singh.

Rennings Klaus & Wiggering Hubert, 1997. Steps Towards Indicators of Sustainable Development: Linking Economic and Ecological Concepts. *Ecological Economics.* 20(1):25-36

Sastry E.V.R. 2003. Village Electrification Programme in India. *Proceedings of 3rd World Conference on Photovoltaic Energy Conversion.* Vol 3, pp. 2125-2128.

Schor, Juliet B. 1998. *The Overspent American: Why We Want What We Don't Need*. New York: HarperPerennial.

Trainer, Ted, 2000. What Does Development Mean? A Rejection of the Unidimensional Conception. *The International Journal of Sociology and Social Policy* 20(5/6):95-113

Wackernagel, Mathis & Rees, William, 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth.* Gabriola Island: New Society Publishers.

World Commission of Environment and Development [WCED]. 1987. *Our Common Future*. Oxford: Oxford University Press.

Internet sources

Web 1:
Student's Educational and Cultural Movement of Ladakh
http://www.secmol.org/solarenergy/
2009-07-21

Web 2:
Update Report by LEDeG. 2008.
http://www.rightlivelihood.org/fileadmin/Files/PDF/Literature_Recipients/Ladakh/LEDeG_update_2008.pdf
2009-07-21