CHAPTER 2

RENAISSANCE OF WATERMILLS FOR SUSTAINABLE DEVELOPMENT IN RURAL UTTARAKHAND

Chapter Overview

- *To assess power scenario of the country.*
- *To understand the power scenario of the state of Uttarakhand and its future plans.*
- *To identify the village electrification status in Uttarakhand and understand the related issues and challenges.*
- *To understand the importance of renaissance of watermills in the state of Uttarakhand for sustainable development.*

Lack of energy is one of the many factors limiting peoples living in remote, inaccessible areas in achieving a dignified life with adequate food, income and employment options. Marginalized and poor, both economically and socially, they continue to suffer from food insecurity and incomes that are inadequate in meeting their basic needs. Access to reliable energy sources is critical for the substantive improvements in their quality of life. Electricity is unarguably the most effective energy source with electricity driven systems being the most user friendly for household use and in production processes. And hence, there is direct link between electrification and rural development.

Given that large parts of rural areas will continue to be unserviced by conventional power, micro - energy solutions based on local resources become significant. They have the potential to effect concrete and sustainable improvements in villages/ community livelihoods and food security – identifiable

by a "better quality of life" and "increased dignity" within a broader scope of environmental improvement and the flow on effects this brings.

Access to energy/ electricity offers the potential to develop a wholly integrated approach to village/community development, bringing in issues of environment and resource management, safe water supply, new and greater opportunities for generating

Additional income and improving food security as well as promoting healthier living environment is the key achievement through the implementation of such energy peripherals as watermills.

As human development index is directly proportional to energy development index which is also evident from the fact that all the millennium development goals also, set by UN, for the developing countries require the use of energy.

2.1 MILLENNIUM DEVELOPMENT GOALS

All the millennium development goals also, set by UN, for the developing countries require the use of energy.

- Eradicate extreme Poverty and Hunger.
- Achieve universal primary education.
- Promote gender equality and empower women.
- Reduce child mortality.
- Improve maternal health.
- Combat HIV/ AIDS, malaria and other diseases.
- Ensure environmental sustainability.
- Develop a global partnership for development.

India is one of the world's emerging economic giants and centre of energy use. India faces formidable challenges in meeting its energy needs and in providing adequate energy of desired quality in various forms in a sustainable manner and at competitive prices.

2.2 CHALLENGES BEFORE THE COUNTRY

India needs to sustain an 8% to 10% economic growth rate, over next 25 years. If is to eradicate poverty and meet its human development goals. All millennium development goals are also linked with energy; therefore rising share of energy has to be met by inputs as demand is outstripping indigenous supply. By 2031-32 power generation capacity must increase to nearly 800000 MW from the current capacity of around 150000 MW [2].

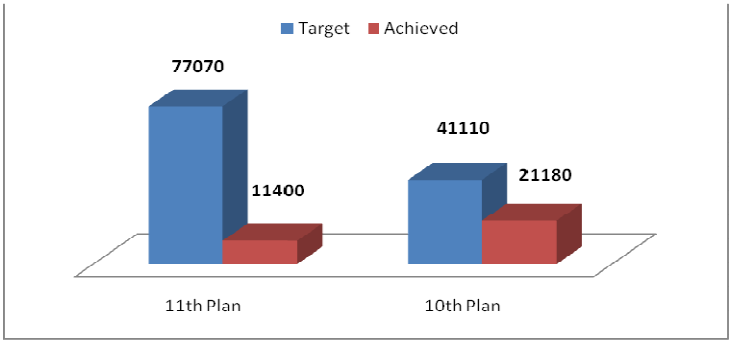
Similarly, as 65% of India's generation is depend on thermal power generation; energy mix for fossil fuel will need to expand to over 2 billion tonnes per annum. Increasing fossil fuel consumption has serious implications for the environment, in terms of rising concern of green house gases. The nature and dimension of this challenge becomes clear when we look at the energy scene in the country.

2.3 THE ENERGY SCENE

Per capita consumption of energy in India is one of the lowest in the world. India consumed 520 kgoe (kg of oil equivalent in 2003) per person of primary energy. [3]

Even though 85% of villages are considered to be electrified, those who have access to electricity suffer from the interrupted and poor quality of the supply.

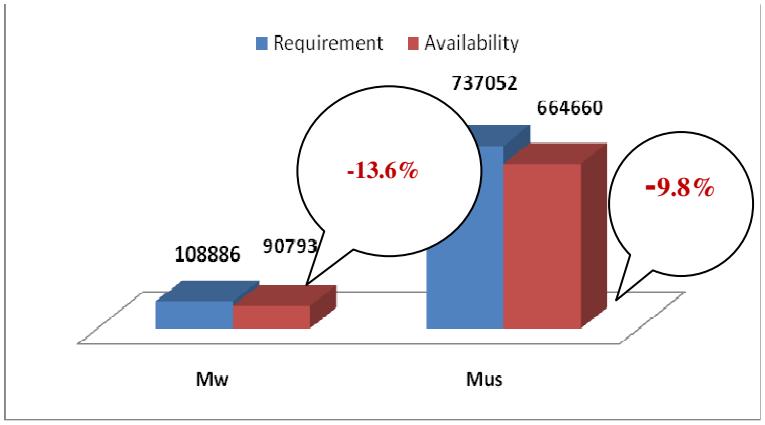
The Ministry of Power had set an ambitious target of capacity addition in the 10th Plan, but actual capacity added was only 21180MW. During 11th Plan actual capacity added till date was only 11,400 MW i.e. remaining 83% is under construction [4].



(Capacity Addition Target V/s Achieved in MW [5])

2.4 DEMAND AND SUPPLY GAP

Actual Power Supply Position in the Country is as shown below, hence there is need to develop broad vision for the energy services of all sectors. The demand / supply gap of power sectors has been widening over the years and the unmet demand is expected to widen the gap substantially over the next few years. This would not only impede development but also fail to provide the required thrust in the private sector participation in the power sector and kick-start the economy.



(Demand and Supply gap (MW) [6]

2.5 ENERGY SCENARIO IN UTTARAKHAND

Uttarakhand is a Green state of India covering almost 65% of land under forest area. This state carries nine million population in an about 16,000 villages. Only 25 % of the population is residing in the urban areas. Rivers of Uttarakhand offers a vast hydro power potential. Also, the tremendous Hydro potential of 20,000 MW can be harnessed; presently this state is fulfilling its energy requirement of 3500 MUs from Hydro entirely. Uttarakhand renowned as Energy surplus state aims to develop 10,000 MW by 2018. However in recent years due to rapid industrialization and corresponding growth it also facing energy challenges. [7]

Table 2.1: State Power supply positions.

Particulars	**Position**
Average Daily Peak Load	1200 MW
Off peak load Demand	1000 MW
Net Generation from State	600 MW
Daily average Energy Demand	24.8 MU
Energy Availability	22.3 MU
Energy deficit	2.5 MU

(Monthly MIS Report Nov 2009 [8])

2.6 ROADMAP TO STRENGTHEN THE POWER SECTOR

Power and energy are essential for economic and social development in Uttarakhand. The government of Uttarakhand (GOU) has a long-term roadmap to strengthen the power sector.

Besides capital investments to increase power generation and improve Transmission and distribution, the roadmap also includes institutional change and capacity building for policy reform and improved financial management.

Private sector participation in all parts of the power sector is an objective, as well as tariff regime improvements and the establishment of sound regulatory, legal, and governance frameworks. The roadmap is centered on clean energy development and energy efficiency, which are fast becoming priority themes in India, with particular relevance to states with the resources and physical conditions to broaden the generation base.

A key feature of the roadmap is that it blends, phases, and sequences a diverse range of investment and non investment interventions over time. The overall objective is to raise output and efficiency while ensuring fully inclusive power services for all types of consumers: residential, industrial, commercial, and public administrations.

The capital investment program (the program) itself will require about $12 billion over 2006–2018. This includes new assets and the rehabilitation of existing assets in generation, transmission, and distribution. Given the relatively large size of the program, and in view of the state's limited financial resources and institutional capabilities, the investments will be phased and distributed among public and private sponsors. Planned capital investments from 2006–2012 are estimated at about $5 billion. The financing plan involves central and state government authorities (through budget allocations), local banks, private sponsors, national

utility companies, capital market operators, and international financial institutions. International loan syndications and bond issues are possible, the latter of which may be enhanced through guarantee products available from multilateral financing institutions and the international insurance market. These enhancements can increase maturities and bring down the total cost of funds to the issuer [9].

The roadmap and the program (investment and non investment) are fully consistent with the government of India (GOI) "Power for All by 2012" policy objectives.

2.6.1 Generation

At year-end 2006 -07, Uttarakhand had generating capacity of 2819 megawatts (MW), entirely from hydropower plants. Total theoretical potential is estimated at 20,000 MW. Capacity expansions planned through to 2018 total about 10,000 MW. There are 14 projects under construction, totaling 5,525 MW in new capacity by 2010. An additional 4,791 MW are in the development stage, with commissioning due soon after 2010, and an additional 9,090 MW is planned beyond that. Approximately $4 billion in new investment is required for new generating capacity to be commissioned by 2012, most of which will be provided by central public sector utilities (CSPUs), Uttarakhand Jal Vidyut Nigam, Limited (UJVNL), the state generating utility, and private sector developers.

The generation expansion program is dominated by clean energy development in the form of low-carbon generation operations, and energy efficiency improvements in the form of renovation and system loss reduction. While most of the new hydropower capacity during the first phase will come from large (more than 100 MW) and medium (25–100 MW) plants, the program includes small run of river hydropower plants (3–25 MW). Numerous candidate sites have been identified, with a cumulative capacity of around 1,000 MW, about 10% of which

is now operating. Independent power producers are expected to develop about half of the small hydropower plants (SHPPs). SHPPs provide power directly to local grids (at 33 kilovolts [kV]), and therefore are integral to meeting rural electrification objectives. SHPPs can be constructed much faster than medium- and larger-sized ones, are environmentally friendly, and are expected to generate tradable carbon credits, with substantial financial upside to the project sponsors. GOU is also working to develop carbon credit opportunities [10].

2.6.2 Transmission

The state-level transmission network needs to be expanded quickly to accommodate a four fold increase in generation and energy transfers by 2012. Transmission expansion is integrated with generation expansion activities, and calls for 785 kilometers (km) of 400 kV lines, 180 km of 220 kV lines, 665 km of 132 kV lines, 8 substations, and auxiliary equipment. Power Transmission Corporation of Uttarakhand, Limited (PTCUL) is the lead project sponsor, and will require around $550 million to support these investments [11].

2.6.3 Distribution

The sector roadmap targets 100% village electrification by 2008 and 100% household electrification by 2012, which requires extending the 33 kV and 11 kV distribution networks. The state distribution company, Uttarakhand Power Corporation Limited (UPCL), is implementing a comprehensive system overhaul including energy audits, physical upgrades, expansion of service areas, and improvements in metering, billing, and collection. UPCL's business plan calls for about $370 million in new investment through 2012, which is being met through central Government incentive programs, state budget transfers, and revenue collection from ongoing operations. The company is moving toward fully

commercial operations, and further restructuring covering operational, financial and management matters is being considered by GOU, the Uttarakhand Energy Department (UED), and UPCL management. External financing may be required after the expiration of funds available under the Accelerated Power Development and Reform Program [12].

2.6.4 Policy framework and Capacity

Uttarakhand's power sector was unbundled beginning in 2001, and operations have been rapidly evolving from a system run by regulated monopolies to one incorporating several private groups and more competitive market conditions. A number of reforms have been implemented, and others will be phased in between now and 2012. The Uttarakhand Electricity Regulatory Commission (UERC) actively monitors and promotes reforms to sustain commercial operations.

Generation is the most open of the three sub sectors, with central public sector utilities and private companies developing several major projects. The transmission sector has some current limitations to private sector involvement, but the policy framework caters for public and/or private initiatives, including joint ventures and wholly owned private sector operations, some of which may come on stream in the short to medium term. As noted above, the distribution sub sector is undergoing a system-wide overhaul. Further restructuring will be implemented subject to careful planning and extensive stakeholder consultations. In the meantime, some design, construction, and maintenance operations will be outsourced to the private sector.

Capacity to implement the sector roadmap remains a constraint. At the central government level the capacity to formulate and execute policy reforms is sound, and to a large extent already tested, since this is done mainly by the Ministry of Power and the Central Electricity Authority. At the state level, GOU, UED,

UERC, and the utilities have strong planning capability. Financial management and fiduciary oversight systems are in place, but can benefit from additional assistance and training. Policy formulation, project definition, project management, and project monitoring will be strengthened over the near term, and ADB intervention includes support for capacity building in these areas. The utilities have the capacity to plan and issue tenders for civil works contracts, the purchase of plant and equipment, and the issuance of concessions, joint ventures, and management contracts [13].

2.7 POWER SECTOR ANALYSIS

2.7.1 Northern region supply and demand scenario

The persistent power shortage in the northern region can theoretically be made up with imports from the eastern and northeastern regions. However, several constraints and issues impede such imports, namely:

- The eastern region surplus depends on coal-fired generation, which is not favored by current national policy;
- The projected northeastern region surplus depends on large hydropower plants (HPPs) that have yet to be constructed;
- Interstate transmission capacity must be expanded to eliminate bottlenecks at the “chicken’s neck” in West Bengal; and
- Overall transmission capacity must be constructed to wheel the expected surpluses between regions.

Given these constraints, the projected northern region deficit can readily be met by expanding Uttarakhand’s hydropower capacity.

Table 2.2: Power Generation Scenario [14]

Region	**Installed Capacity (MW)**	**Peak Demand (MW)**	**Peak Availability (MW)**	**Surplus/ (Deficit) (MW)**
Northern	44,300	41,200	33,200	(8,000)
Western	44,500	41,000	33,000	(8,000)
Southern	37,000	35,000	31,000	(4,000)
Eastern	27,000	13,500	24,000	10,500
Northeastern	6,300	1,500	4,500	3,000
Total	**158,100**	**132,200**	**124,700**	**(7,500)**

[14]

2.7.2 Performance of the power sector in Uttarakhand

The Uttarakhand power sector has shown strengths in terms of reducing cross-subsidies across customer categories, implementing merit order dispatch principles, rationalizing tariff slabs, and completing interface metering, weaknesses have overshadowed strengths especially in terms of

- High aggregate technical and commercial losses (44% in 2003-04)
- No significant capacity additions to date.

The government of Uttarakhand is obligated to formulate a financial restructuring plan for securing financial restructuring support that is based on meeting loss reduction targets across the state.

Uttaranchal's separation from Uttar Pradesh provided some immediate benefits to the state, for example, segregating the state's grid operations translated into lower overall demand on the Uttarakhand grid, and thus annual aggregate power availability effectively increased (though seasonal shortages still occur).

A key positive operational parameter has been the recent performance of Uttarakhand Jal Vidyut Nigam, Limited's HPPs, with a high availability factor and the ability to keep auxiliary consumption within normative levels. The financial risk of the utilities was rated low: Uttarakhand Power Corporation, Limited (UPCL) has been regular in its debt servicing to lenders and earned cash profits in fiscal year (FY) 2001 and FY2002. For FY2003, the coverage of cash costs was high at 85%. However, collection efficiency is an area with scope for improvement [15].

a. Generation potential and expansion plans

Uttarakhand is currently a net importer of electric power, but generates a seasonal surplus and plans to become a net exporter of power by 2010 by expanding its hydropower and high voltage transmission capacity. Total capacity expansion of 10,000 megawatts (MW) is planned through 2018. Currently 14 projects totaling 5,525 MW are under construction3 and expected to be commissioned by 2010. An additional 4,791 MW are under development, with expected commissioning dates after 2010, and another 9,090 MW are planned [16].

b. Transmission system expansion

The transmission system within Uttarakhand is the responsibility of the Power Transmission Corporation of Uttarakhand, Limited (PTCUL), which provides open access to its facilities on terms that are subject to tariff orders issued by the Uttarakhand Electricity Regulatory Commission. PTCUL was formed by separating UPCL's transmission assets and undertakings and commenced operations on 1 June 2004. The major challenges facing PTCUL are building and operating a network to cope with a fourfold increase in energy transfers within its first 10 years of operation and building the human resource capacity to sustain corporate operations [17].

The integrated transmission system for Uttarakhand is intended to provide for the evacuation of new HPP capacity in the state's four major river basins. The load flow studies used to develop PTCUL's transmission system have estimated requirements needed to meet peak conditions in the northern region and therefore allow for the evacuation of electric power from the planned new generation capacities [18].

c. Distribution operations

UPCL is the sole distribution licensee in Uttarakhand. A key challenge is the high level of aggregate technical and commercial losses, which increased during the first 3 years of its operations. However, the trend has been reversing in FY2005. Commercial losses increased from Rs 981.1 million in FY2002 to Rs 2,049.5 million in FY2003 with transmission and distribution losses estimated at 35%. Nevertheless, UPCL's overall financial position during the 3-year period ending FY2004 has been reasonably robust because of its high financial margins: UPCL has been able to generate and/or purchase power an average rate of about Re1 per kilowatt-hour while charging consumers at an average rate of Rs2.50 per kilowatt-hour. At the same time, since the creation of the state and the establishment of state-level grid operations, overall end-user tariffs have decreased, load shedding has decreased, and consumer satisfaction has improved. Pursuant to tariff orders issued by the Uttarakhand Electricity Regulatory Commission, UPCL has initiated systematic efforts to reduce losses, addressing both technical and non technical losses [19].

Table 2.3: Uttarakhand Tariffs by Consumer Category (Rs/kilowatt-hour) [20]

Category	**Before the Creation of State ERC (FY 2002)**	**After the Creation of the State ERC (FY2005)**
Domestic	2.05	1.93
Non domestic (commercial)	4.96	3.21
Private Tube Wells	0.80	1.52
Industry	4.44	3.03

2.8 SMALL HYDRO POTENTIAL/PROJECTS

In addition to the large & medium identified hydro potential of about 20,000 MW. Uttarakhand State is also having about 1500 MW potential in the segment of Small Hydro projects up to 25 MW capacities, ranging even up to 1 MW also [21].

The status of SHPs developed so far is being given here below:-

Table 2.4: Status of SHPs [22]

Developers	**No. of Projects**	**Total Capacity (in MW)**
State undertaking (UJVNL)	31	54.405
State Agency (UREDA)	32	2.8875 (For Village Electrification)
Private	02	6.60

While most of the SHP projects developed so far under state undertaking UJVNL and all under private sector are being fed to grid, the projects under UREDA (Uttarakhand Renewable Energy Development Agency) are mostly stand alone projects with electrification of remotest villages as its primary goal. Such stand alone projects are being managed by the local community for day to day operation and maintenance through a registered society with elected representatives among the consumers. Such stand alone projects were planned and constructed by the State's agency with 100 percent funding through Govt. grant.

The table shows the status of SHP projects allotted to/under construction by various developers is being given below:-

Table 2.5: Status of SHPs [23]

Developer	**Allotment Procedure**	**Nos**	**Capacity (MW)**
Central Sector	-	Nil	Nil
State Undertaking (UJVNL)	Allotment Order	16	82.30
State's Agency (UREDA)	Allotment Order	18	1.82
Private Sector	Earlier MOU route &	32	218.55
	Transparent bidding process.	8	100.10

2.8.1 Allotment procedure

The allotment of hydro project sites, whether large, medium or small to private parties was being done earlier during the time of erstwhile Uttar Pradesh through MOU route only. In case of SHPs such sites were even identified through self identification by the parties themselves. This process had its own merits and demerits. In such a case deciding for optimum size and site of projects and optimum utilization of streams may have raised some criticism. Now Uttarakhand Govt. has decided and put in place a mechanism and policy of transparent bidding process for allotment of identified projects to private sector. As DPRs are not ready and cost surprises even after having a good DPR may be there, hence tariff based bidding process has not so far been adopted by Govt. of Uttarakhand.

2.8.2 Evacuation of power

Evacuation of power from large, medium and small hydro power projects is also a major issue especially with regard to forest, environmental, rehabilitation and availability of space point of views as these constraints have to be dealt with effectively along with minimizing the cost. Govt. of Uttarakhand has prepared such integrated evacuation project to evacuate power from all new hydro power projects. A project of $300 million has been sanctioned by Asian Development Bank for which final agreements have to be signed after approval from Govt. of India [24].

2.8.3 General experience

The pace of developing the allocated hydro power projects whether large, medium or small has not been encouraging so far.

- Various reasons may be quoted for delay in developing the projects ranging from preparing the DPR and getting clearance to actual implementation.
- In the Govt. Sector the paucity of funds and less attention to hydro power projects led to delays of some of the projects while Tehri Hydro Power Project faced a lot of issues ranging from lack of funds to R&R issues and R&R policy and even to religious/social and environmental issues. Now Tehri Stage-I (1000 MW) project is under commissioning stage.
- In case of private sector as well as central sector projects there were delays due to various reasons.
- In case of SHPs under state's undertaking as well as private sector the situation is the same and one can observe delays due to various reasons.

At the time of erstwhile state of Uttar Pradesh as many as 22 SHPs under less than 5 MW category (up to 3 MW) and 12 SHPs between 5-25 MW have been allocated to private developers or parties through MOU route by allocating them a particular river or stream and asking them to identify up to 3 projects and prepare DPRs and then construct those projects. These allotments were made prior to 1997 and Agreement (MOU) for implementation with a time bound time schedule of commissioning were signed but only 2 projects under up to 3 MW category have so far completed while for others the new state of Uttarakhand has further given extended time schedule by signing a new Implementation Agreement [25].

2.8.4 Rural Electrification

In case of micro hydel schemes, especially for electrification of remote villages, stand alone projects have been allocated to UREDA (Uttarakhand Renewable Energy Development Agency). Earlier during the time of erstwhile state of Uttar Pradesh NEDA (Non-Conventional Energy Development Agency) have been given this mandate of implementing such stand alone schemes. Before the creation of the new state such schemes were constructed by NEDA and then by UREDA through funds from State & Central Govt. as grants and then handed over to the local community through their society to manage them for operation and maintenance. The tariff, operating hours, collection, operation and maintenance is being taken care by that society itself. After creation of the new State UREDA has made model byelaws and made these societies to register themselves under Societies Registration Act, thereby making them legal entities.

UREDA played a role by helping these societies and the office bearers through their capacity building. Now a new role has been assigned to such societies. New schemes under this category are now being planned and executed by taking active participation of the community by involving these registered societies through 10% funding from the community and implement the schemes through such

societies. Some of such schemes which are already under operation has been synchronized with the grid to enhance the PLF of such plants by feeding the electricity generated into the grid (even at 11 KV) when local demand is not there. Even import-export meters have been put for facilitating import and export of electricity. Such a mechanism is also envisaged under the Electricity Act, 2003 where in rural areas generation and distribution through such one or other way is allowed. The local communities has now learned and started to install electronic meters to each connection, using CFL to benefit more and more consumers out of limited capacity of the plant and charging per unit rate of electricity rather than per bulb rate or so.

The need now is to utilize such stand alone schemes for development of local area/villages and linking such scheme to other economic activities of that area thereby raising the livelihood and standard of life of the rural people.

Table 2.6: Status of Village Electrification [26]

Name of District	**No of villages Electrified by UPCL**	**No of villages Electrified by UREDA**	**% of Electrification**
Dehradun	727	4	99.05
Uttakashi	631	33	97.36
Pauri	2996	137	99.43
Tehri	1689	45	96.28
Chamoli	1086	66	98.80
Rudraprayag	637	21	100.00
Haridwar	492	4	97.25
Garhwal Zone	8258	310	98.41
Kumaon Zone	6524	339	97.28
Uttarakhand	14782	649	97.91

Table 2.7: Status as per Rajiv Gandhi Gramin Vikas Yojna [27]

Year	Target	Progress
2007-2008	350	346
2008-2009	257	195
2009-2010	70	7

2.8.5 Challenges

The Operation of Small Hydro Power Projects poses unique challenges:

- The power stations are located in remote hilly areas where even road linkages are not available.
- The small hydro power stations are prone to natural calamities such as flash floods due to cloud bursting, land sliding, avalanche's causing heavy damages & long shut downs. Road blockages & severe climatic conditions causing difficulty in construction, operation & maintenance.
- Small Hydro Power Stations arc normally connected through service lines or weak grid connections, therefore incidence of disruptions are mainly, causing low generation.
- The specific cost (Cost/kW) of a small hydro projects generally tends to be higher because of the intrinsic reasons associated with them comparatively small power output. The specialized nature of the generating plant and equipment especially in case of very small heads, leads to comparatively higher cost of generation.
- Due to their locations in far off & inaccessible locations of the state, it is difficult to provide necessary technical skill & spares in case of breakdown, necessitating long shut down requiring heavy expenditure & loss of revenue.

- The load factor of SHP's tend to lower and there is considerable variability in quantum of generation across different SHP's in different years. An important reason for their variations in output is the lack of critical size in case of SHP & also varying hydrological and climatic conditions for year to year.

- The plants have to be shut down for app. 30- days during monsoons due to high silt contents & debris in the flowing water which cannot be handled by D-silting tanks. This happens normally every year.

- Some of the commissioned plants have highly sophisticated machines and without the availability of skilled labour in remote areas, there is lot of difficulty in operating & maintaining them. As a result the machines are degenerating and their efficiencies are declining.

- Many a times the telephone lines remain interrupted that create lack of communication, especially during monsoon.

- Long transmission lines are prone to frequent damages.

2.9 NEW INITIATIVE: WATERMILLS/GHARAT

A watermill is a machine constructed by connecting a waterwheel to a millstone. At present there are about 15,448 traditional water mills (functional as well as non-functional) in the state of Uttarakhand. Upgradation of these watermills would directly affect around 30000 people considering the employment opportunity of two persons per watermill. Each watermill having an average 1.5 kW of capacity working on an average 8 hours a day shall generate about 4320 kWh / year and will compensate an equivalent of 6 tones of CO2 which will get about Rs 3000 per year additional income under CDM process at present rate.

Up-gradation and production of new modern technologies specially designed for the grass root conditions of the area can be taken up in a big way so that the productivity of this important section of population gets increased and they get higher returns with lesser efforts. Upgradation of such traditional watermills can be great source of employment generation.

The up-graded watermills of this hilly region can be essential and important source of energy in remote areas. These watermills can not only provide electricity to small areas but are also used for grinding grains. Up-graded watermill can produce power up to 5 kW which is sufficient for electrification of 20-25 families within the diameter of 500 meters.

Summary

- *It is noted that there is acute shortage of power in the country and currently it is approx. 13.2%.*
- *Uttarakhand which used to be a energy surplus state, facing power shortage to the tune of 10%.*
- *It has a rich hydrology offering vast potential for hydropower development in all major, mini and micro segments.*
- *Village electrification is a big challenge considering remote hilly terrain of the state.*
- *Watermill is an age old mechanism to develop mechanical power which can be improved and play a significant role in sustainable development of the state.*