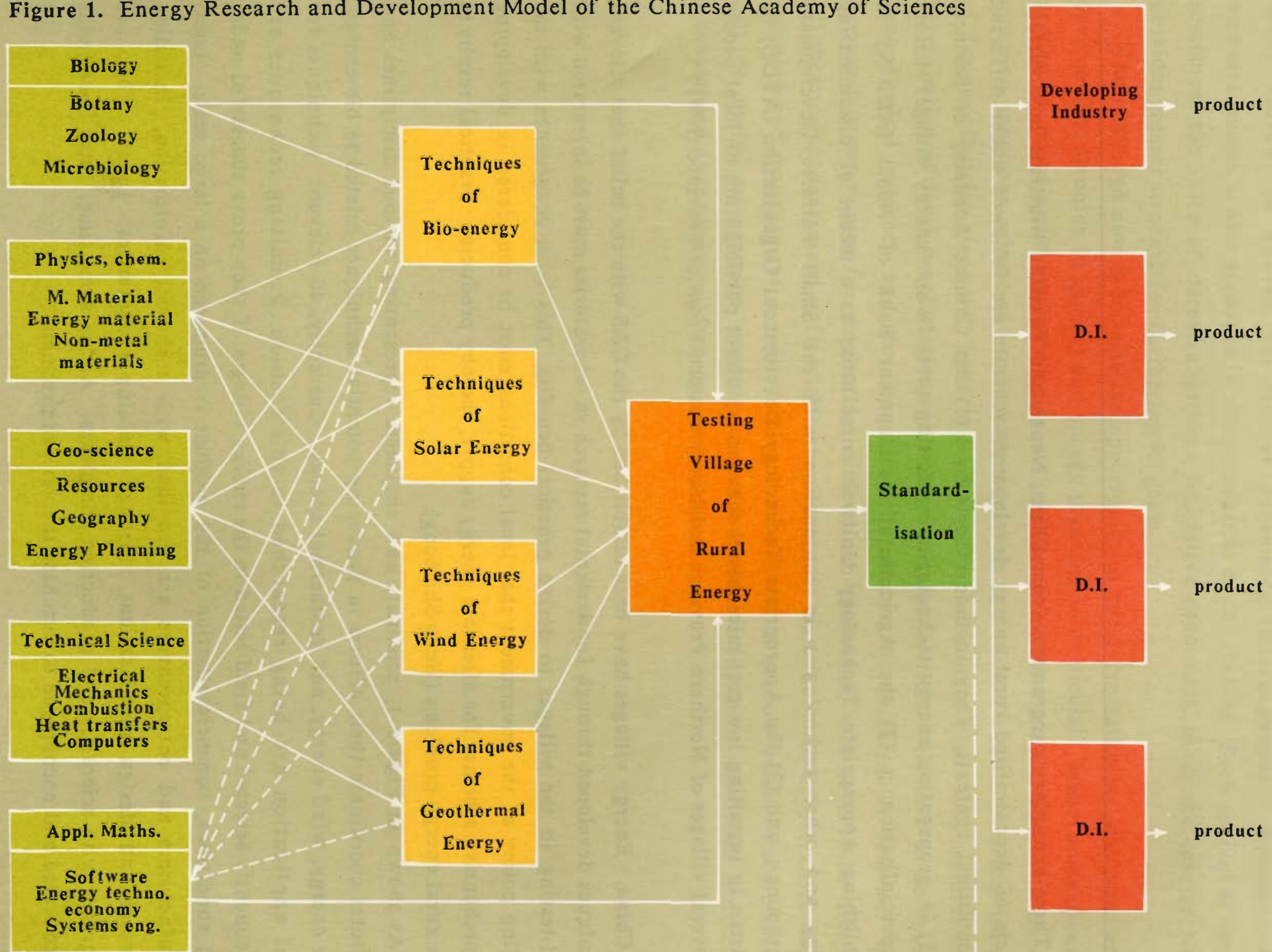
Examples of Decentralised Efforts from Selected Countries

Three exemplary programmes from China, Nepal, and Pakistan illustrate how various models of decentralised rural energy development schemes are followed under differing sociopolitical contexts. They include efforts by : (1) the Chinese Academy of Sciences (CAS) in propagating energy technologies by testing them in six "energy villages" before commercialisation ; (2) the Agricultural Development Bank of Nepal (ADB/N) in establishing Appropriate Technology Units in rural areas as a means of disseminating energy and other technologies in conjunction with the Small Farmers Development Programme ; and (3) the Appropriate Technology Development Organization (ATDO) of Pakistan in installing low-cost microhydel schemes by direct participation of local people in several villages of Northern Province and North Western Frontier Province (NWFP).

China. Energy villages have been established by the CAS with the belief that relevant techniques developed through fundamental research in laboratories must be integrated with field-testing in the villages to derive practical benefits. This is in congruence with the guiding policy of the government that local conditions must be considered in developing comprehensive schemes for alternate energy supply, thereby producing practical results to solve rural energy problems (Wang Shizhong).

As shown in Figure 1, scientists and engineers representing various disciplines and institutes coordinate their efforts in producing potential techniques related to bio-energy, solar energy, wind energy, and geothermal energy. Currently, 40 relevant techniques for rural application are being researched in this fashion. Promising techniques are subsequently selected and field tested in the energy villages. If they prove successful under field conditions, commercialisation of the product is promoted on a large scale. Local manufacturers and entrepreneurs are provided with technical information, including drawings and design specifications, through training programmes. Local efforts are integrated with scientific and production complexes. At the same time, rural households are educated and encouraged to purchase the various products.

Figure 1. Energy Research and Development Model of the Chinese Academy of Sciences



Source : Wang Shizhong

The six energy villages of different provinces of the country, include: Xin Fu, Shunde County, Guangdong Province; Nie Jia Zhuang, Luan Cheng County, Hebei Province; Shuang Quan Chun, Hai Lun County, Heilongjiang Province; Shuang Liu, Chengdu, Sichuan Province; Yi Li, Xinjiang Province; and Gu Zhen County, Anhui Province.

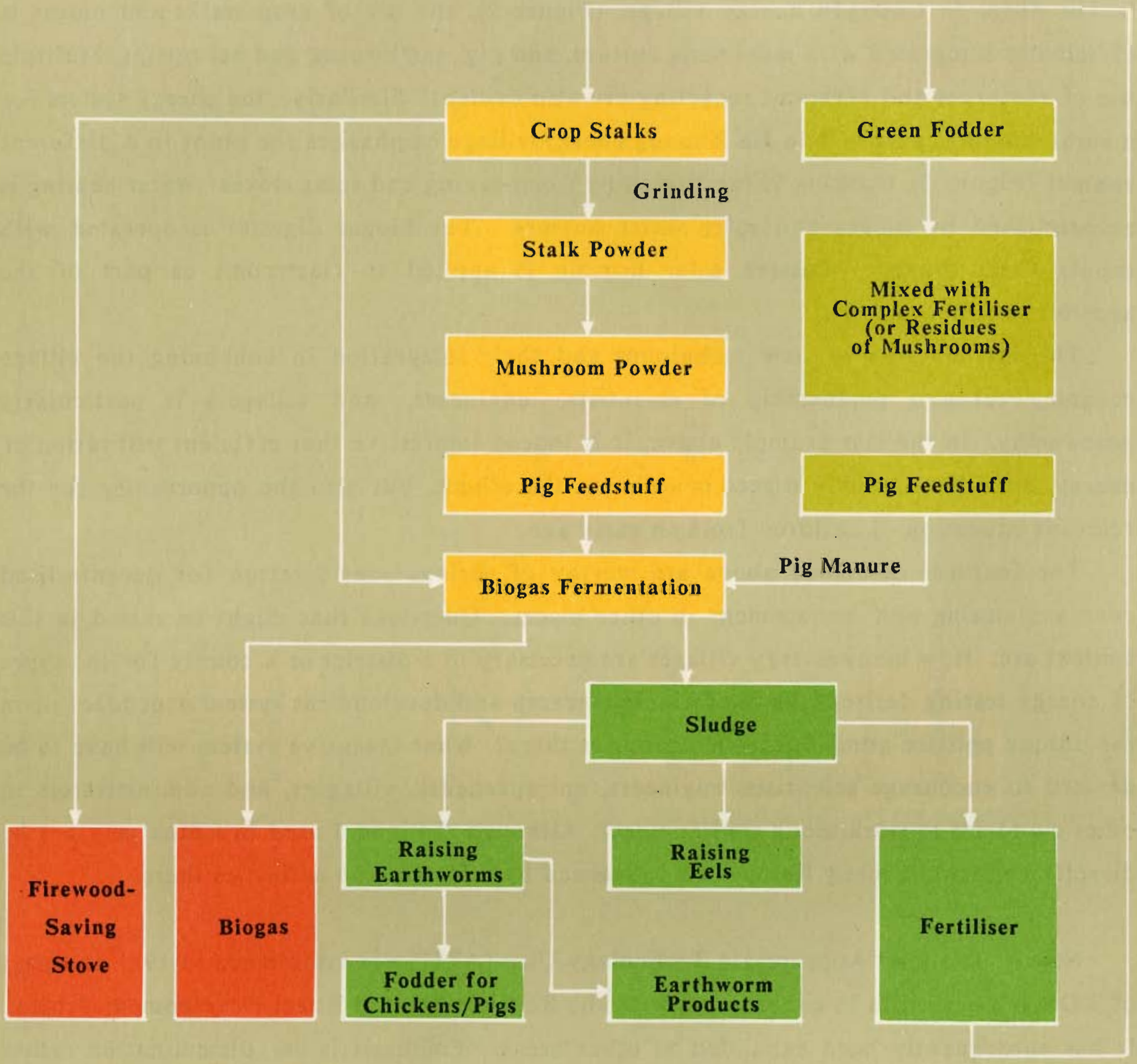
Comprehensive use of energy resources is the fundamental concept pursued in all the villages. Emphasis on specific combinations vary from one area to another: forest, wood gas, and biogas in Shuang Quan Chun; coal and wood gas in Yi Li; biogas and solar energy in Gu Zhen. In Chengdu energy village, (Figure 2), the use of crop stalks and biogas is efficiently integrated with mushroom culture, and pig, earthworm, and eel raising. Multiple use of resources and efficient recycling are also evident. Similarly, the energy system for a rural school as part of Nie Jia Zhuang energy village emphasises the point in a different context (Figure 3). Cooking is facilitated by wood-saving and solar stoves. Water heating is accomplished by biogas and solar water heaters. The biogas digester is operated with inputs from toilets. Passive solar heating is applied to classrooms as part of the architectural design.

The introduction of new techniques and their integration in enhancing the village economy through partnership of scientists, engineers, and villagers is particularly noteworthy. In the last example above, it is indeed impressive that efficient utilisation of energy provides not only direct benefits to the school, but also the opportunity for the relevant education of children from an early age.

The features described above are worthy of serious consideration for decentralised energy planning and management in other places. Questions that might be raised in this context are: How many energy villages are necessary in a district or a county for the types of energy testing desired? Is the Chinese research and development system dependent upon the unique politico-administrative structures there? What incentive system will have to be devised to encourage scientists, engineers, entrepreneurs, villagers, and administrators in other countries to work along similar lines? Although the model used in China may not be directly applicable, many lessons can be learned by reflecting on activities there.

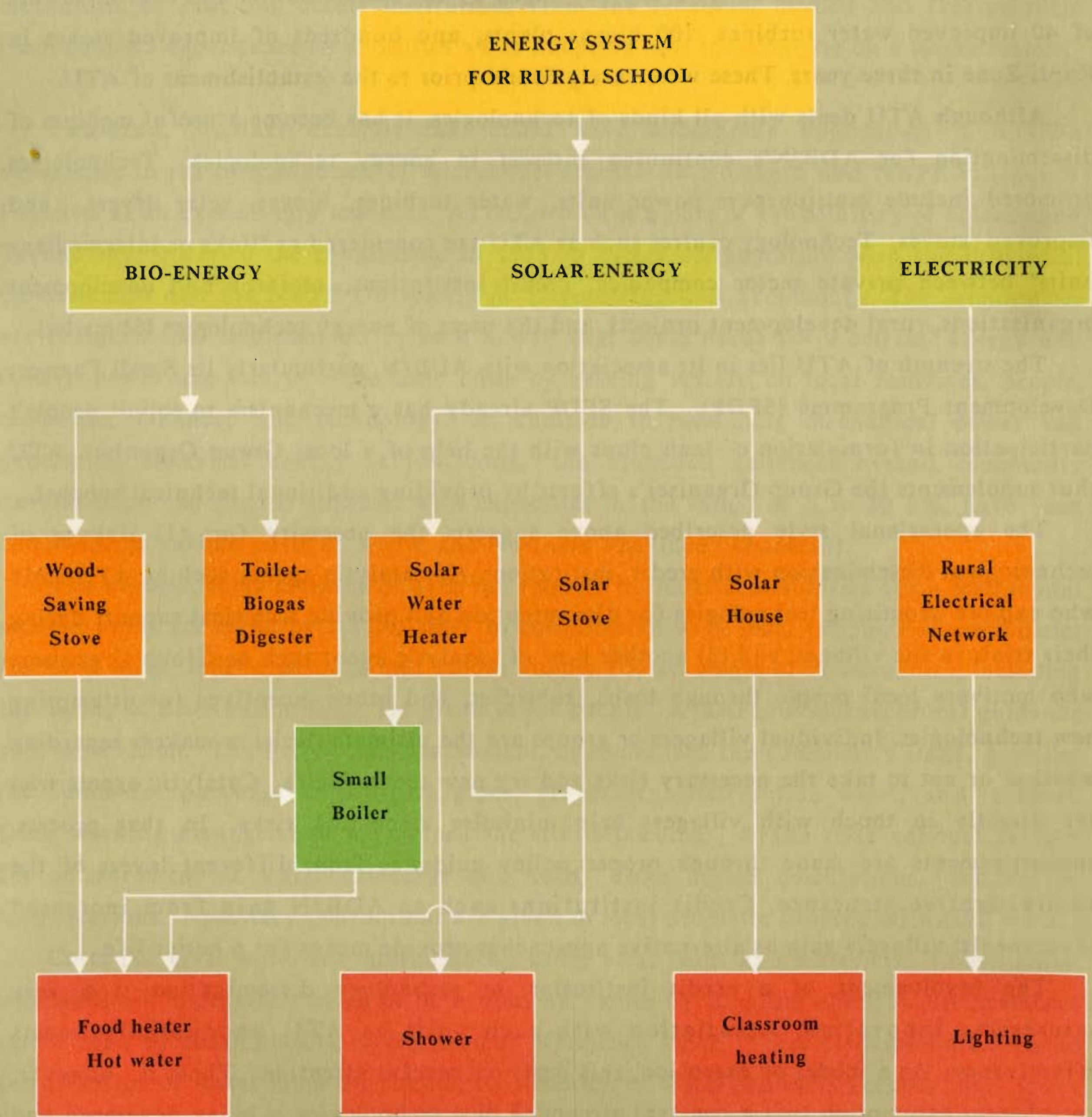
Nepal. The first Appropriate Technology Unit (ATU) was established in 1981 as a part of ADB/N's activities in conjunction with the Rapti Integrated Rural Development Project. It has subsequently been expanded to other areas. Emphasis is on dissemination rather than development of appropriate technologies (ADB/N 1985). New products and/or designs are sought and field-tested in the service area. Samples are given to farmers for trial under local conditions. The results are then closely monitored to determine their usefulness, reliability, economic viability, and most importantly, acceptance by the farmer. During the test period, ATU pays for part or all of the costs in order to get a new product into the

Figure 2. Energy and Ecological Cycle in Chengdu Energy Village



Source : Wang Shizhong

Figure 3. Energy System in a Rural School of Nie Jia Zhuang Energy Village



Source : Wang Shizhong

field quickly and to cover the farmer's expenses, in case of failures. After it is proven, ATU arranges to supply and distribute the product with little or no financial subsidy.

Where relatively large investments (by the farmer's standards) are required, ADB/N arranges loans for acquisition of the product. As interest and demand grow, ATU assists in training local businesses and craftsmen to manufacture the devices. This generates new sources of income and a reliable supply of desired appropriate technologies for purchase by local farmers. The success of ATU can be judged by the dissemination and continuous use of 40 improved water turbines, 100 biogas plants, and hundreds of improved stoves in Rapti Zone in three years. These were rarely found prior to the establishment of ATU.

Although ATU deals with all kinds of technologies, it has become a useful medium of dissemination for ADB/N's continuing interest in energy technologies. Technologies promoted include multipurpose power units, water turbines, biogas, solar dryers, and improved stoves. Technology centres such as ATU are considered as "links or intermediary units" between private sector companies, credit institutions, research and development organisations, rural development projects, and the users of energy technologies (Shrestha).

The strength of ATU lies in its association with ADB/N, particularly its Small Farmers Development Programme (SFDP). The SFDP already has a mechanism to solicit people's participation in formulation of loan plans with the help of a local Group Organiser. ATU thus supplements the Group Organiser's efforts by providing additional technical support.

The operational style described above suggests the necessity for: (1) linkage of technological dissemination with credit institutions; (2) catalytic agents such as ATU staff who explore promising technologies for dissemination and provide technical support during their trials in the villages; and (3) another type of catalytic agent such as Group Organisers who motivate local people through loans, subsidies, and other incentives for attempting new technologies. Individual villagers or groups are the ultimate decision makers regarding whether or not to take the necessary risks and try new technologies. Catalytic agents who are directly in touch with villagers help minimise associated risks. In that process, encouragements are made through proper policy guidance from different layers of the administrative structure. Credit institutions such as ADB/N gain from increased investments; villagers gain as alternative approaches provide means for a better life.

The involvement of a credit institution in technology dissemination is a very interesting innovation. Association with such units as ATU undoubtedly boosts effectiveness. As a model of extension, this deserves careful attention. There is, however, an inherent assumption that a constant stream of new technologies is being developed and that these are ready to be disseminated with slight modifications. How the feedback from field experiences is introduced for further improvements or new developments is not clear. It is a drawback that there is an absence of association with an integrated research and development system as in the case of the Chinese Academy of Sciences, where field experiences, fundamental research, and private efforts are closely interlinked.

Two other questions are also pertinent. One is related to the relevance of the present scheme to the needs of the very poor. What is the assurance that these needs are reflected in the choice of technologies for dissemination? The second question concerns the role of subsidy. If subsidies are used as incentives in testing new technologies, what is the mechanism of relieving credit institutions from the financial burden and freeing them from people's dependence on subsidies while adopting new technologies on a larger scale?

Pakistan. Another example that could have widespread application is ATDO's experience in the dissemination of microhydel schemes in Northern and NWFP villages of Pakistan at an exceedingly low cost. ATDO, which is a part of the Ministry of Science and Technology, initiated the programme in 1975 in direct collaboration with the Provincial Governments and the NWFP University of Engineering and Technology. The programmes are designed and implemented in such a way that basic needs for electrical energy and motive power are met at reasonable costs by relying mainly on local resources, people, materials, finance, and technology. In addition to producing mechanical power and generating electrical energy at low costs, the approach enhances overall community development. So far, 57 schemes with capacities in the range of 5 to 30 kW, have been completed in various parts of NWFP and Northern Province (Abdullah).

The process starts essentially with the request by local communities for a microhydel scheme. Plans are made by ATDO staff in consultation with local people. Responsibilities for civil work, local materials, and labour supply for all stages of construction, including the laying of distribution lines, are given to the people. ATDO provides technical guidance and supervision. The Provincial Government, or sometimes the community itself, provides the funds for purchase of penstock pipes, generators, distribution wires, and turbines. Once working arrangements are agreed the site is selected. ATDO staff conduct surveys for measurement of water discharge and head, make design calculations, and define specifications. Necessary instructions are given to local people to proceed with civil work.

Costs for civil work are minimised by using local skills and materials. Construction standards are maintained in terms of utilitarian values by studying specific circumstances rather than by consideration of engineering efficiency alone. These principles are adopted for diversion of water from the stream; construction of water channels, forebay, and power house; selection of penstock pipes and generators; design and fabrication of turbines; and installation of distribution lines. On this basis, total cost in 1984 for installation of a 20 kW scheme was about PRs 65,000 (US$1 = PRs 15.00). The distribution lines cost an additional PRs 60,000. The unit cost per kW of power generated (excluding the transmission) is thus

PRs 3,250. When transmission costs are included, the unit cost per kW delivered is PRs 6,250. This figure is very low compared to the usual cost range of US$1000 to 3000 per kW (1980) for microhydel schemes.

Operation and maintenance are usually organised by a villager associated with all stages of the work. On-the-job training is provided by ATDO staff. For the maintenance of the power channel, a village group is sometimes called upon. Community residents decide who is entitled to receive electricity. Tariff rates are determined by the community and are charged on the basis of the type of bulb used, rather than by using the meter.

Motive power of the turbine shaft is used in some instances to operate small machines during the daytime (e.g. grain grinders, rice hullers, cotton ginners, electric saws, lathes, and grinders). The generator, in this case, is started only during the night.

Many innovations are evident here. One that is particularly noteworthy is the collaboration among ATDO, Provincial Government, NWFP University of Engineering and Technology, and local community members towards a common cause. Such collaboration yielded significantly low-cost designs and comprehensive work plans that meet the requirements of the village communities in question. To be sure, the quality of the schemes is not comparable to scaled-down versions of large hydel schemes. But, does the sacrifice in quality matter as long as the beneficiaries have a scheme that provides desired services at an affordable cost? This illustrates a new approach to technological design and implementation at the village level, through interactions and shared responsibilities among technologists, administrators, and beneficiaries.

Several questions come to mind. What are the limitations of the system described above? Can the same approach be applied if the capacity is greater than 30 kW? What are the possible technological, organisational, and coordination constraints if the scale is increased? The rate at which installation in the area has taken place is 57 schemes in about ten years (i.e. an average of five to six schemes per year). Can this rate be increased? Are the constraints related to demand from the people, manpower, and technological limitations for extension, or funding problems? There are also questions concerning operation and maintenance. Are all 57 schemes working satisfactorily? What happens when parts are broken or need repair? Is there a regular servicing facility? Another important dimension may also be brought in here. Can microhydel development be integrated with other energy schemes so as to align them with a comprehensive energy plan?

The examples from China, Nepal, and Pakistan cited above are mainly technology - focused. Can the lessons learned extended to the district level for energy planning? What should be the focus in district energy planning and how can it be effectively implemented? These queries constitute the subject for discussion in the next section.