During the **Third Session** in the afternoon, Country Statements were presented by the principal participants from China, India, Pakistan, and Nepal. There was no participant from Bhutan. The highlights of these statements are presented here while summarised versions are given in Annex 1.

China - Recent Development

Dr.Tong Jiandong presented the **China** Report concerning the status, government strategies and support, and the impending problems. He stated that the figures presented in the China Report, submitted to ICIMOD, had been updated and new figures included installations during 1993. At present, there were about 48,300 installations in the MMHP-SHP range (up to 25 MW capacity) in China having a total installed capacity of about 15,000 MW; whereas installations in the MMHP range (up to 500 kW) were about 45,600, with a total installed capacity of about 6,000 MW. Giving a brief history of MMHP-SHP development in China, Dr. Tong noted that China had started MMHP development in the fifties and progress over the years was remarkable. Almost all the equipment for MMHP-SHP plants was being manufactured locally. There were about 100 equipment manufacturers, having a cumulative production capacity of about 1,200 MW/year. Most of the MMHP capacity was connected to the local grids. The overall development of MMHP for rural electrification was also progressing at a very fast rate of about 1,000 MW/year. Over the years, the technology had improved considerably, and many small, low quality plants had been replaced by more reliable and larger plants. About 73 per cent of the electricity in rural areas was being consumed by industry and only 13 per cent for lighting purposes. The main features of MMHP development in China were decentralised development and operation; extensive planning policy and material support from various government levels (e.g., Central, Provincial, County); emphasis on 'self-construction, self-management, and self-consumption'; and diversification of end-uses. Dr. Tong thus concluded that MMHP had become an important energy resource for rural areas and a precious contributor to the booming rural economy.

India - Current Initiatives

Mr. Arun Kumar then presented the Country Report for **India**. He stated that the Indian Government had embarked upon promotion of MMHP-SHP (up to 3 MW) capacity on a preferential basis, so that about a 600 MW installed capacity could be added in the 1992-97 period, both in the public as well as in the private sector. MMHP-SHP was being promoted to provide electricity to the people of remote hilly regions, to help protect the environment, and to encourage private sector participation in this important endeavour for national development. He further eleborated that the private sector was being encouraged through many incentives such as subsidies (up to 50% of cost), soft loans (at 12.5% rate), arrangements for buying back power, and encouragement to take over and manage existing MMHP plants in the remote areas. In addition, concessions in custom duties and tax holidays were also being provided. In some areas, portable MHP sets were being provided to communities free of cost for installation and use of electricity. Mr. Arun Kumar further noted that some problems had been encountered with MMHP installations, such as, silting, damage to civil works, non-availability of adequate workshops for repairs, inadequate institutional

support, and lack of people's participation. He also mentioned some constraints, especially regarding detailed investigations and preparation of Detailed Project Reports (DPRs), land acquisition, government clearances, coordination between the various government agencies giving clearance and poor infrastructural facilities for the north-eastern mountain regions. The State Electricity Boards (SEBs) were also according low priority to MMHP projects.

Mr. Arun Kumar also made some suggestions regarding specific issues raised in the Synthesis Report, e.g., MMHP should be given preferential support, especially in the poorer, remote areas and for isolated plants; networking of repair workshops; encouragement for establishing small-scale industries, and water pumping for irrigation or domestic use. Mr. Arun Kumar also gave the details of some MMHP plants that had been handed over to local communities in the Uttar Pradesh hills for operation, distribution, and revenue collection. Similar efforts were underway in other States also.

Pakistan - Highlights

Dr. M. Abdullah presented the Country Statement for **Pakistan**. He noted that the recoverable hydropower potential in Pakistan was about 21,000 MW out of which 3,330 MW had been exploited mainly in the medium and large range. The Government of Pakistan accorded high priority to the development of indigenous energy resources, especially for rural electrification. The Pakistan Council of Appropriate Technology (PCAT) and the Aga Khan Rural Support Programme (AKRSP) were assisting in the installation of private MMHP in the northern mountain areas of Pakistan. So far, about 190 plants had been established, by these two organisations, with an installed capacity of about 2.6 MW and providing electricity to more than 11,000 households. PCAT provided cost subsidies of from 40-50 per cent whereas subsidies from AKRSP varied from 20 to 80 per cent. No loans or other incentives were available in Pakistan. The recipient communities provided the remaining cost in cash or kind. After installation, the communities owned the plants and were responsible for operation, maintenance, repair, distribution, and revenue collection.

Dr. Abdullah went on to state that electricity had considerably improved the life of the people in the remote mountain villages and also provided some relief from drudgery and unemployment through agro-processing units, which had been established in about 20 per cent of cases. The MHP plants, mostly in the five to 30 kW range, were indigenously designed and manufactured, costing around US$ 250 to 600 per kW (installed). They did not have any automatic control systems, and regulation was carried out manually. At present, there was no formal training available for the installers, manufacturers, or operators. Villagers usually had some experience in building and maintaining irrigation channels. However, the capability to repair electro-mechanical equipment was weak. Some training was provided to the operators during installation, but that was also inadequate. The need for training various groups could not be over-emphasised.

Dr. Abdullah further noted that the prospects for MMHP development in the Northern Areas of Pakistan were considerable and could meet the energy needs of these areas, especially for the establishment of local industries. People recognised the benefits of MMHP and the demand was quite high.

Dr. Abdullah also identified a number of problems associated with private MMHP in Pakistan, i.e., lack of proper systems to deal with conflicts in the villages, lack of adequate

funds, and lack of technical and transportation facilities in the remote areas. He, therefore, made the following recommendations to accelerate the MMHP programmes. Decentralised/private MMHP should be recognised as a viable option for remote rural areas; PCAT and AKRSP should further strengthen their technical/professional capabilities, local industries should be encouraged to diversify the end-uses, an adequate training system should be devised for concerned groups, and electrification through grid extension and through MMHP plants should be properly coordinated.

Nepal - Programme Status

Dr. K.B. Rokaya presented the country statement for **Nepal**. He remarked that per capita energy usage in Nepal was very low and was characterised by a heavy dependence on traditional biomass fuels which had many ill effects. Therefore, it was necessary to develop indigenous and viable sources such as MMHP, which had been around for centuries, and considerable expertise had been accumulated within the country in developing and installing modern MMHP plants. Dr. Rokaya added that, until the present, about 37 plants had been installed in the government sector in the MMHP range (up to a 1,000 kW capacity), and about 900 more were installed in the private sector in the MHP range (up to a 100 kW capacity). These plants were mainly for agro-processing, but about 100 or so also generated electricity. The privately installed plants were contributing significantly to meeting the energy needs in many remote areas. His Majesty's Government of Nepal (HMG/N), had also contributed significantly towards the development of private MMHP through delicensing plants of up to 100 kW and by providing subsidies for the equipment. Installation rates had declined during the past five years.

Dr. Rokaya further noted that capital costs, as well as repair costs, for MHP were site-specific and varied considerably. During recent years, the cost per kW was between NRs 77,000 to 100,000 (US$ 1,530-2,000). Over all, MHP plants for agro-processing were reported to be viable both financially and technically. Some factors affecting the profitability of the plants could be improved through appropriate efforts; e.g., consistent and transparent government policies, effective management and monitoring of loans and subsidies, R & D, promotional activities, adequate training facilities, and establishment of an independent institute to promote MMHP.

On the technical side, Dr. Rokaya remarked that lack of standardisation and quality control, plus improper installation practices had caused frequent breakdowns and the repairs were not easy to carry out. Therefore, the owners faced considerable hardships in getting repairs done which were difficult, time consuming, and expensive. He stated that political commitment, institutional arrangements, financial support, coordination, training, and improvement of technology would be helpful in enhanced dissemination of MMHP technology.

Discussions

After the presentation, discussions followed. A question was asked from the floor concerning how MMHP-electricity was able to replace biomass to that extent in China. Dr. Tong pointed out that proliferation of rural industries was remarkable, therefore use of electricity had risen considerably to cater for this need. Also, cooking was carried out on electricity in many areas for a good part of the year. There was some discussion on why cost/kW of generation varied

so much across the countries. It was clarified that cost figures in some cases represented just the plant cost; whereas, in other cases, costs such as civil, electro-mechanical, and distribution lines were also included. The cost per kW was also dependent upon plant size and it was pointed out that in China the cost was inversely related to the size. Therefore, at present, manufacturers were reluctant to manufacture turbines with less than a 50 kW capacity.

Plant/load factor was another intensely-discussed issue. Low plant factors in general were observed across the countries in the HKH region, but it was pointed out that this factor alone should not be used in deciding the viability of MMHP. It was again pointed out that, in China, many isolated and old micro-stations were decomissioned each year due to low load factors. The floor also discussed the grid connected MMHPs and the system of power sale and buy-back arrangements prevalent in China. It was pointed out that transactions between local grids took place in the form of barter. With regard to the subsidy issue, it was observed that cost/kW was quite low in Pakistan and a still sizeable subsidy programme was in place. It was clarified that, even though both PCAT and AKRSP had decreased the subsidy in the recent past, there was still a need to support MMHP development by subsidies from the Government. Only in the long run could it be completely withdrawn. The local user organisations, it was pointed out, were using their savings to meet their share of obligations in availing of MMHP plants.

In the Indian case, it was pointed out that MMHP in the stand-alone mode were not considered to be viable. They were also not very reliable because of frequent breakdowns caused by mechanical failures or damage to civil structures. In remote areas these units primarily provided electricity for lighting. Other household needs were being met by fuelwood. In the case of Pakistan also, electric lighting was the first priority followed by other secondary uses. Therefore, investment in MMHP should also be seen as an investment in improvement of the quality of life. There were some questions from the floor regarding the modalities of implementation by AKRSP in Pakistan. It was pointed out that basically two stages could be visualised. Firstly, local people had to be organised into groups (village organisations) and, secondly, they had to arrange for operation and maintenance expenses. Only then was the plant to be provided.

The floor discussion also touched upon the objectives of MMHP development which were seen to be more than economic objectives alone. Similarly, discussion took place on the need to expand end-uses. With regard to the question of subsidies for increasing end-uses, it was found that only in Nepal was there such a provision in the Annapurna Conservation Area Project (ACAP). The other countries had no policies in this respect.

After concluding the discussions, the Chairman of the Session, Dr. Mahesh Banskota, made his observations and suggested that MMHP should not be seen in isolation but in the totality of its forward linkages. He cited the Chinese experience in this respect. The Chairman underscored the need for political commitment for the development of MMHP. Only then, he observed, would proper policy support, legal backing, skill development programmes, fund allocations, etc, become meaningful. The Chairman also underlined the importance of the participative process for MMHP development. This process could be extended to each phase of MMHP development, e.g., construction, operation, and maintenance. The Chairman concluded by observing that it was essential to speak the same language while promoting MMHP, otherwise, he cautioned, there were dangers of misunderstanding the basic objectives of promotional efforts.

Synthesis of Country Experiences

During **Session Four** on the second day, Dr. Junejo presented the Synthesis Report on the Status, Policies, Problems, and Prospects of MMHP. The Synthesis Report was the base document for the Consultative Meeting and had been sent to participants in advance. A summarised version of the Report is given in Annex 2. Highlights of the Report are briefly given below.

There were considerable advantages of MMHP in remote mountain areas compared to other systems, such as diesel plants and grid electricity, and a sizeable potential also existed in the mountain areas of all the countries in the HKH Region.

Only China had exploited the MMHP-SHP resource to a significant extent. The level of exploitation in most other countries was around one to two per cent of the viable potential. Dr. Junejo then gave some installation figures for Bhutan, China, India, Nepal, and Pakistan. He stated that there were 19 MMHP plants (up to 1,000 kW) installed in Bhutan with a total capacity of 3.40 MW, and 145 plants were working in India with a total installed capacity of about 106 MW; in both cases in the public sector. In Nepal, there were 36 existing MMHP plants in the Public Sector with a total capacity of about nine MW. In addition, there were about 900 private MHP plants (up to a 100 kW capacity), mostly used for agro-processing, with a total installed capacity of about 11 MW. However, about 200 plants had the facility to generate electricity, either in addition to agro-processing or as stand-alone. In Pakistan there were about 65 MMHP plants in the public sector, with an installed capacity of about 17 MW and 186 plants in the private sector with a total capacity of 2.6 MW. In China, the maximum number of MMHP plants had been installed, and currently there were about 49,000 MMHP plants (up to 500 kW in capacity) with a total installed capacity of about 4,800 MW. These plants were installed and were being managed by local administrations at the village, county, or township level. Except for Bhutan, where the manufacture of MMHP equipment was not being undertaken, all the other countries had a sizeable capacity to manufacture most components. The costs of such equipment was lower than those for imported equipment by a factor ranging from two to five.

Dr. Junejo further explained that many Governments of the Region, including China, Nepal, and India had made special provisions for MMHP through legislation, policy declarations, and provision of incentives. HMG/Nepal had allowed the delicensing of plants of up to 1,000 kW in capacity, announced special incentives for private sector participation, and provided loans and subsidies for such installations. Grants and loans were also being provided by the Governments of China and India, while the Government of Pakistan provided some subsidies for private MHP installations. Many of the private plants in Nepal and Pakistan were owned and managed by local people from consumer communities, while implementing agencies, such as the Pakistan Council of Appropriate Technology (PCAT) or the Agricultural Development Bank of Nepal (ADB/N) (in collaboration with the manufactures/installers), surveyed the sites, designed the plants, and had them manufactured, installed, and commissioned. After commissioning, the plants were handed over to the users/owners for operation, maintenance, and utilisation. In China also, plants were managed and utilised in a decentralised manner at the village or county level.

Dr. Junejo noted that funding for private/decentralised plants came from various sources such as bank loans, subsidies, and owners' contributions. The level of external funding

varied considerably. In Pakistan, for example, villagers were contributing about 60 per cent of the costs of plants at present, whereas in most other cases the contribution by villagers was around 10 to 20 per cent, mostly in kind. In Nepal, applicants for plants obtained bank loans at interest rates which were only slightly lower than the commercial lending rates. The Government of India was also providing loans to the extent of 75 per cent of plant costs at 12.5 per cent interest rates. However, in India, entrepreneurs had to obtain clearances from three government departments and were expected to pay about 10 per cent in royalty to the Government for use of water.

Dr. Junejo went on to explain that only in a very few cases were the plant factors reasonable, i.e., 40 per cent or above; otherwise factors varied between 10-30 per cent. The plant factors were even lower for electrification schemes than for agro-processing units, and incomes from the plants were barely enough to cover operation and maintenance costs. This was, in fact, one of the serious problems of private MMHP plants. Another serious problem concerned the inadequate capabilities of the managers and operators of the plants who usually had had no schooling and were insufficiently trained to manage and run the plants properly. Carrying out of repairs was also quite difficult and expensive in remote and inaccessible areas.

In terms of the impacts and benefits of MMHP, China had achieved the maximum benefits and even now they were talking of increasing the pace rather than slowing down. They were improving the technology, enhancing plant factors, and diversifying end uses. Technology and its advantages, as well as its limitations, were also well known in Nepal and Pakistan. However, the associated problems had also become serious, especially in Nepal. Training was one aspect which could alleviate many of the problems, and this was necessary for various groups including decision makers, village elders and influentials, surveyors and assessors of sites, various technical personnel, plant managers, operators, and repairers.

During the discussions that followed the presentation of the Synthesis Report, the meeting was informed that the rates of interest for MMHP/SHP installations in India had gone down to 12.5 per cent recently and that subsidies were available only up to three megawatts. In the case of Nepal, it was stated that surveys for potential assessment of the installations were usually not adequate and many MMHP plants were not running well. One of the main installers, the Development and consulting Services (DCS) was only undertaking technical feasibility, and commercial feasibility was almost non-existent. In many cases, the consumers were not paying the bills because electricity supply was unreliable and poor. Steps to improve the MMHP plants and electrical supply were discussed in detail, and it was pointed out that these steps would escalate the costs. There were inevitably many responses to this aspect. General consensus was that it was necessary to improve plant reliability and performance. This approach might even be more cost effective in the long-term since other end-uses could only come about when the supply was good (quality-wise) and reliable. Another issue raised was that, in many areas of the HKH Region, especially Nepal, the people were so poor that electricity was a luxury for them and they found it quite difficult to pay cash for it. This point was conceded and it was suggested that the only worthwhile suggestion could be that this point be given due consideration at the time of feasibility. The possibility of establishing an independent institution was also discussed in detail. General consensus, especially from the Nepali participants, was that such an Institution was necessary. However, if it was in the private sector (totally independent) then it may not have adequate authority to implement the rules or guidelines. On the other hand, if it was in the government sector, it may not be efficient enough. This situation needed more thinking and debate.

The viability of MMHP was discussed next. It was reported that agro-processing units were generally doing well economically but that electricity generation through MMHP had serious problems. What could be done to improve the viability of electricity plants? The response was that electrical light was the best lighting system; therefore, it should not be compared with kerosene lamps. Additionally, the amount of money being spent on electricity was comparably even lower than the cost of kerosene. Therefore, this must be considered as an additional benefit. It was also stated that MMHP and electricity generated by it could be an effective tool to promote rural development. However, other inputs had also to be provided to make it work. Various training aspects were than discussed and most participants were of the opinion that adequate training to various groups, including engineers (electrical, mechanical, civil), managers, operators, wiring technicians, and installers would improve the situation and make the electricity supply more reliable. The proposed training of decision-makers was also discussed and suggestions were made to make it effective. It was suggested that an attempt should be made to convince the decision-makers about the usefulness and advantages of MMHP, highlighting the success stories, comparing it with other energy options, focussing on its suitability for specific remote areas, and outlining the constraints. It was also suggested that, instead of calling it a training course, the programme should be called a Seminar. It was also suggested that, ICIMOD should play a major role in developing and organising training programmes for other groups.

The Chairman of the Session, Mr. Ueli Meier, then thanked the speaker and the participants and stated that viability and reliability had become the important issues concerning MMHP.