

restoration and gave an example of Jebel Hafet. Mufid Samarai (SRA) spoke about utilizing indigenous seeds and plants as engineering materials. Studies carried out by SRA on sustainable indigenous seeds, and reeds used for low-cost housing and for the enhancement of engineering materials were also discussed. M. Ifikhar Hussain (International Centre for Biosaline Agriculture (ICBA), Dubai) talked about the local buffelgrass as an alternative to exotic Rhodes grass. Tamer Khafaga (Dubai Desert Conservation Reserve, UAE) spoke about vegetation diversity, effect of grazing on regeneration pattern in the Dubai Desert Conservation Reserve, and highlighted the need for effective biodiversity conservation and management strategies in the arid region. Jacqueline St Quinton (Birkbeck College, London University, UK) presented interesting research on invasive species, and highlighted the ecological, economic and social/aesthetic impacts of invasive plants in sensitive ecosystems. In the poster session, N. K. Rao and Mohamed Shahid (ICBA) briefed the participants about desert gourd as a potential bio-

energy feedstock crop for marginal environments and new records for the flora of the UAE. During discussions, the participants emphasized the need to define rare species of the region that require collaborative efforts for their conservation. In order to recognize the commonality of the floras and their conservation, it was recommended that a regional database be created that comprises all of the plant taxa of the region. The role of seed and DNA banks, and their importance was discussed. The need for a common GeneBank for the Arabian Peninsula was also highlighted and discussed.

Ahmad Hegazy (Cairo University, Egypt) introduced the concept of networking institutions as a supporting tool in the understanding and conservation of biodiversity in the UAE and the Arabian Peninsula. The possibility of creating a website that would help in obtaining information on scientific research, establishing research links and proposing collaborative projects for the knowledge, documentation and preservation of biodiversity was also discussed. All participants agreed on the importance of establishing a research network that-

would connect all concerned parties and researchers in the Arabian Peninsula. Participants also exchanged experiences and examples as to how these issues could be undertaken by early career researchers at universities and research institutes in the UAE and the Arabian Peninsula.

ACKNOWLEDGEMENTS. We thank Renata Cordeiro, Hemat Kandil, Mona Abdelrahman, Mohamed Hasan and Muhammad Fiaz for their outstanding contribution in organizing this workshop. Financial support from the British Council is gratefully acknowledged.

Sanjay Gairola*, **Hatem A. Shabana** and **Tamer Mahmoud**, Sharjah Seed Bank and Herbarium, Sharjah Research Academy, Sharjah, UAE; **Shahina A. Ghazanfar**, Royal Botanic Gardens Kew, Richmond, Surrey, London TW9 3AB, UK; **Ali El-Keblawy**, Department of Applied Biology, Faculty of Science, University of Sharjah, Sharjah, UAE.
*e-mail: sgairola@sra.ae

MEETING REPORT

Strategic environmental assessment of hydropower projects*

The Indian Himalayan Region (IHR), spreading from Arunachal Pradesh in the east to Jammu and Kashmir in the west and covering 530,795 km² of geographical area, holds a special place in the mountain ecosystems of the world. The IHR is also known as the third water tower of the earth and supplies water to a larger part of the Indian subcontinent. Due to the rich water potential of the IHR and the ever-increasing energy demands of the country, the Government of India recognized that hydropower potential needs to be harnessed to the maxi-

imum for economic development. The IHR accounts for approximately 18% of India's total geographical area and contrarily owns more than 75% (117,139 MW) of the total exploitable potential. In a landmark move towards implementation of hydropower projects, the Prime Minister of India launched a 50,000 MW hydroelectric initiative programme, formulated by the Central Electricity Authority (CEA) for the preparation of Preliminary Feasibility Reports of 162 new hydroelectric schemes (47,930 MW). Surprisingly, 133 of these schemes are in IHR. In order to tap the available hydropower potential, various rivers and streams have been dammed to harness hydroelectricity. For example, River Satluj in Himachal Pradesh (HP) is one of the largest river systems with a total demarcated catchment area of 21,457 km² spreading over the districts of Lahaul & Spiti, Kinnaur, Shimla, Kullu, Mandi, Bilaspur, Solan, Hamirpur and Una. Cur-

rently, there are more than 38 hydroelectric projects of different categories which are either proposed, or under construction or commissioned in the basin. HP is extremely rich in hydel resources and the state has about 25% of the national potential. Satluj, Yamuna, Beas, Ravi and Chenab are the main five rivers in HP. It has been estimated that about 27,436 MW of hydel power can be generated in the state in these basins. The basin-wise potential is 13,332 MW in the Satluj, 5,995 MW in the Beas, 4,032 MW in the Chenab, 3,237 MW in the Ravi and 840 MW in the Yamuna.

Strategic Environmental Assessment (SEA) is defined as a systematic process for evaluating the environmental consequences of proposed policy, programme or plan. At present, SEA is neither legally followed in India nor has the government framed any guidelines for it. Today, the natural resources are becoming scarce. Thus, there is a need for evolving SEA to

*A report on a Training Workshop on 'Strategic Environmental Assessment (SEA) of Hydropower Projects: An Important tool for Sustainable Development in the Satluj basin'. The workshop was organized by the G.B. Pant National Institute of Himalayan Environment and Sustainable Development, Himachal Regional Centre, Mohal-Kullu held on 23 December 2016 at Deputy Commissioner Office, Reckong Peo, Himachal Pradesh.

formulate an effective approach to address the risks of unplanned development by involving different scientific institutions, local governments, environmentalists, non-governmental organizations (NGOs) and local stakeholders. In this context, a training workshop was held on 23 December 2016 in which 70 stakeholders, including Government officers, project developers, affected people due to construction of hydropower projects, local people, environmental experts, consultants, media, NGOs, research scholars and scientists participated. They discussed the environmental problems arising due to the present hydropower development and sustainable management focusing mainly on the Satluj basin.

J. C. Kuniyal (GBPNIHESD, Himachal Regional Centre, Mohal-Kullu) extended a warm welcome to the dignitaries and the participants. Then he discussed the training module regarding SEA of hydropower projects, overall status, upslope and downslope impacts, overlapping between the large (>25 MW), medium (5–25 MW) and small (<5 MW) projects, and a strategic plan for the future development of hydropower projects in the IHR. Land-use and land-cover change (1989–2014) within a demarcated buffer zone (7514 km²) of the Satluj basin, was found to increase in terms of barren land (8.10%), built-up area (0.08%), water bodies (0.16%) and erosion (0.02%). On the other hand, forest (2.68%), agricultural (1.68%) and grazing (0.24%) land during the period showed a decrease.

These projects are being introduced in a series without the assessment of either the carrying capacity of the basin or determining the aerial inter-distance between projects. As a result, overlapping between the projects is a common phenomenon indicating adverse impacts in the region. Large projects (>25 MW) considering 7 km aerial distance between projects, have an overlapped area of 721 km² (11.19%). Medium projects (5–25 MW) considering 5 km aerial distance between projects have overlapped an area of 133 km² (2.06%). Only 20 out of 38 projects (small and large) could fulfil the criteria of the present recommended aerial inter-distance. Finally Kuniyal, based on his research findings, suggested a strategy that there should be a fixed aerial equidistance between the two hydropower projects, i.e. 7 km for large (>25 MW) and 5 km for medium (>5 MW) and <25 MW) and 3 km for small

(<5 MW) to make the projects economically beneficial and environmentally sound in the mountains.

Renu Lata (GBPNIHESD) spoke about hydropower development, existing policy in India and its comparison with other Hindu Kush Himalayan countries. She stated that due to construction activities like blasting and tunnelling, there is an imbalance in groundwater regime. Drying-up of springs in the upper reaches and regeneration of new springs in the lower reaches together have affected land-use pattern and the overall ecological system. She mentioned that hydropower should transform from engineering to ecological, and from technical engineering to social engineering in order to strengthen economy, and increase the livelihood options of local communities and their surrounding environment. Thus, there is a need to fill up the gaps and amend the existing hydropower policies in the IHR and the Hindu Kush region.

Avninder Kumar (Sub-Divisional Magistrate, Kalpa) spoke in detail on Local Area Development Authority (LADA), Local Area Development Fund (LADF) policy and its guidelines to the stakeholders. He mentioned that the LADA policy is the backbone of resettlement and rehabilitation plan. He further stated that according to LADA policy, 70% of LADF will be spent on the project-affected areas and the remaining 30% on project-affected zone. Priority is given to drinking water, village paths, irrigation, sanitation, solid waste management, Mahila Mandal Bhawan, Panchayat Bhawan, cremation ground, etc. followed by repairing and maintenance of existing structures as well as soil conservation, kucha road construction, etc.

R. S. Negi (IAS, Retd) suggested that areas above 2500 m in the Satluj basin should be declared as 'Eco-Sensitive Zone' under the Environment Protection Act, 1986 and construction of hydroelectric projects beyond this needs to be banned completely. One of the main reasons for a conflict between hydropower projects and surrounding local communities is a lack of access of the affected villagers to royalties being earned by the project developers. The river morphology is destroyed by construction activities of hydropower projects. He suggested the use of hi-tech tunnel-boring machines rather than blasting with age-old techniques.

Naresh Kumar Lath (IAS, Deputy Commissioner, Kinnaur) in his conclud-

ing remarks said that sustainable development of hydroelectric projects is the need of the hour to sustain biodiversity and other environmental problems. He said that all the issues at various levels need to be considered in a proper scientific manner and existing policies need to be implemented for the development of hydroelectric projects.

During the interactive session, stakeholders suggested that the IHR is fragile and sensitive. Blasting causes several environmental and social impacts such as drying up of springs, increasing frequency of landslides and formation of cracks in houses, etc. They mentioned that Environmental Impact Assessment (EIA) of hydropower projects is practised in isolation. No efforts have been made to assess carrying capacity, or regarding cumulative impact assessment to determine the number of projects in a basin. Projects that started functioning have already blocked the river flow; absence of fish above Rampur up to Karcham-Tapri is the best example. Dumping of excavation material next to or directly into the Satluj has led to sediment loads. This not only deteriorates water quality, but also causes siltation in downstream dams. The hydropower agencies operating in the area are not serious about degradation of the environment. They submit EIA reports for obtaining clearances for the projects. After allotment of projects, the agencies rarely work in accordance with the EIA reports and environmental management plans. Suggestions by stakeholders at the time of public hearings are not followed during execution. All the stakeholders including natives agreed to work together. However, issues pertaining to protection of the environment and sustainable development need to be resolved in a cohesive manner.

Jagdish Chandra Kuniyal*, Renu Lata, Amit Kumar, Bhim Chand, Nidhi Kanwar and Sheetal Chaudhary, G.B. Pant National Institute of Himalayan Environment and Sustainable Development, Himachal Regional Centre, Mohal-Kullu 175 126, India; **Kireet Kumar**, G.B. Pant National Institute of Himalayan Environment and Sustainable Development, Kosi-Katarmal, Almora 263 643, India; **Pitamber Prasad Dhyani**, Shri Guru Ram Rai University, Dehradun 248 001, India.
*e-mail: jckuniyal@gmail.com
