Sustainable development of disaster-affected rural landscape of Kedar valley (Uttarakhand) through simple technological interventions

Unprecedented rains (400 mm) for more than four days during mid-June 2013 resulted in flash floods followed by landslides at many places, killing more than 6000 pilgrims and tourists and damaging property in different parts of Uttarakhand. Overflowing rivers destroyed many lodges/hotels, human settlements and thousands of hectares of agricultural and forest land. This natural disaster also has claimed the lives of many locals living in the area (950). The research team from GBPIHED, Garhwal Unit (GU) estimates that approximately 10–15 years will be required to revive the tourism-based economy and infrastructure of the Kedar valley. Post-disaster, local inhabitants in the Kedar valley are facing challenges due to food insecurity, poverty and insecurity regarding the future as the economy of the region was tourism dependent. Such a situation is of serious concern to the government and its several departments and poses several challenges for designing appropriate strategies/action plans and their implementation.

For people of the Kedarnath valley, pilgrimage tourism has been the major source of employment and livelihood, while agriculture, animal husbandry and minor forest product collection are subsidiary occupations. Before the disaster, diverse employment options were available to the rural people such as running hotels, lodges, restaurants, tea stalls, shops and to serve as porters, horse owners and operators, travel guides, etc. But after the floods, almost all the income-generating activities and livelihood options have totally collapsed in the valley. In view of this, there is an urgent need to empower and develop the capacity and skills of these people in harnessing the potential of bio-resources available in the region, as well as application of simple, cost-effective technological interventions for diversification of land-based and other livelihood options in order to develop the disaster-affected areas.

Lessons from the past experiences and hill/mountain specificities, such as diversity in livelihood strategies, economic marginalization, isolation, difficult topography, cultural diversity and ecological fragility were taken into account in identifying potential resources and options for livelihood improvement and income generation through appropriate and simple technological interventions. A detailed study by GBPIHED, GU on the bio-resources potential, and cost–benefit analysis of various production systems and articulated needs of the disaster-affected areas has led to the recommendation of priority interventions and simple, cost-effective technology package for sustainable development and natural resource management (Table 1). The low-cost technological interventions aim to improve agricultural productivity through protected cultivation, improved composting, soil/water management practices, bio-prospecting/value addition to forest/farm products, restoration of degraded and flooded landscape using sloping watershed environmental engineering technology (SWEET) and improved product storage devices. An example of the success of such a multidisciplinary and participatory action research approach is the 2007-based GBPIHED-GU-Rural Technology Centre which is a knowledge resource based model for livelihood enhancement in Kedar valley. Under this rural technology model, village communities, individual household, NGOs, etc. were given on-site training, knowledge and technical input to initiate activities for economic development and

Table 1. Suitable options for sustainable development of disaster-affected villages/areas through simple technological interventions

1. Demonstration and promotion of low-cost protected cultivation (i.e. polyhouse, polytunnel, nethouse, polypit) for seasonal and off-seasonal vegetable (cabbage, cauliflower, cucumber, brinjal, green peeper, bottle gourd, etc.), and flower cultivation (gladiolus and lilium).
2. Integration of medicinal and aromatic plant cultivation (*Picrorahiza kurrooa*, *Sassurea costus*, *Inula racemosa*, *Valerina wallichii*) with horticultural trees (apple, apricot, pears) between 2000 and 2800 m asl.
3. Demonstration and promotion of fodder resources like *Pennisetum purpureum*, *Desmodium*, *Pongolla*, *lollium*, etc. in degraded land/waste land.
4. Rehabilitation/restoration of degraded/damaged rural landscape/township and its surrounding areas through SWEET, while using fast-growing and climate-resilent multipurpose tree species such as *Alnus nepalensis*, *Dalbergia sisso*, *Albizia lebbeck*, *Ficus auriculata*, *Celtis australis*, *Grewia oppositifolia*, *Morus serrata*, etc.
5. Low-cost water harvesting tank technology using plastic sheet to collect rainwater by diverting surface run-off from upstream as well as rainwater and spring sanctuary development in water-deficit areas.
6. Demonstration and promotion of organic farming through bio- and vermicomposting by digging appropriate pits or manure heaps covered by polythene sheet in high-altitude villages to speed-up the decomposition process.
7. Bioprospecting and value-addition of wild resources (i.e. *Rhododendron arboretum*, *Ficus auriculata*, *Diplazium esculentum*, *Hippophae salicifolia*, *Viburnum mullaha*) and medicinal and aromatic plants (*Peonia emodi*, *Allium humile*, *Angelica gluaca*, *Carum carvi*, *Cinnammomum tamalas*, etc.).
8. Promotion of local, high-altitude bamboo locally called ringal (*Thamnocalamus falconeri* and *T. spathiflorus*)-based small cottage industries for the preparation of basket/mat/carpet, etc.
9. Promotion of community-based eco-tourism/nature tourism, homestay accommodation and eco-tourism products development along with protected area management since the upper Kedar valley falls under the Kedarnath Wildlife Sanctuary.

natural resource management. Over the last seven years a large number of local people, especially farmers have been empowered and exposed to various options of livelihood improvement and income generation through this centre. However, many of the farmers did not replicate or adopt these technologies on their farms due to lack of time from their involvement in tourism and the financial gain through it.

Lack of livelihood options for the landless and those with small land holdings compel them to extract and exploit natural resources found in and around the area. Therefore, there is an urgent need for linking developmental organizations with village institutions like the village panchayat for rebuilding infrastructure and to provide opportunities in the disaster-affected regions of the state. Capacity building through on-site training programmes, live demonstrations and interactions between stakeholders and scientists should be facilitated. Government aid alone will not help in this case. Stakeholder and private sector participation is vital in such cases.

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Notes on conservation of 'RET' plants in India

Conservation of rare, endangered and threatened (RET) plant species is an important issue. Hundreds of RET plants in India have already been recorded and their conservation suggested[1]. The *Red Data Book*[2] has enlisted 622 vascular plant species (VPS) of Indian flora till 1990; this red figure rose to 1255 VPS[3] till 2003, and it is on the increase day by day[4]. In India, the RET species constitute 7.7% of known VPS[3]. Globally, 13.8% of VPS are RET[3]. According to the International Union for Conservation of Nature and Natural Resources, the current species extinction rate is between 1000 and 10,000 times higher than it would naturally be[5]. Once a species becomes extinct, the particular genetic resource is lost forever.

The floristic diversity and conservation strategies in India have been assessed earlier[6–8]. Several *in situ* and *ex situ* conservation measures have been taken through biosphere reserves, national parks, world heritage sites, botanical gardens, greenhouses, etc.[8]. In spite of all those efforts, plant species are disappearing due to various causes[2] and the red list becoming longer; only a handful of species are rediscovered after a long time – almost a century or even centuries[9,10]. An updated list of species rediscovered so far from India is necessary to better conservation of biodiversity – both *in situ* and *ex situ*.

Mere enlisting of RET species, as often done, has no meaning unless the dwindling populations are properly conserved and replenished in nature. Through various tissue culture and micropropagation techniques plants can be regenerated, thereby *in vitro* to *in vivo* propagation of the vanishing plants may be considered. Also, a database regarding species which are recovering from RET to normal status, if any, is essential to update the floristic status of the country. Hopefully, some leading Central and State agencies/institutes would come forward with such efforts in near future.

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