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*Despite abundant wild edible plant resources with immense potential for economic development, Uttaranchal, a newly created hill state situated in the Central Indian Himalaya, remains underdeveloped, owing primarily to inaccessibility and poor infrastructure. Development initiatives show little concern for mountain perspectives. Yet the region is rich in resources and underutilized plant species with potential food value, about which there is little knowledge. For the present study, 13 potentially exploitable wild fruit species and 1 semidomesticated species with good potential for exploitation were selected; 6—*Aegle marmelos *(bael or Bengal quince),* Berberis asiatica *(barberry),* Hippophae rhamnoides *(sea buckthorn),* Myrica nagi *(box myrtle),* Rubus ellipticus *(yellow Himalayan raspberry), and* Prunus armeniaca *(apricot)—were examined closely in terms of economic potential. A variety of value-added edible products such as jam, jelly, juice, and squash were made to generate income from these wild fruits, particularly for poor rural people. This was demonstrated locally to encourage people to engage in small-scale village-level cottage industries.*

Potential bioresources

Underexploited and underutilized natural resources with potential economic significance are crucial in maintaining subsistence lifestyles in traditional mountain societies. However, present development policy ignores scientific management and sustainable harvesting of this vital resource base. Neglect and disappearance of natural resources, along with a large-scale shift to technologies and increasing dependence on external resources, are reaching crisis proportions in Uttaranchal, with disastrous consequences for biological diversity and development of sustainable systems. Steady erosion of valuable genetic resources must be met by steps to conserve them for the future. In addition, conventional multipurpose crops are unsuitable for remote mountain areas, owing to several constraints. Hence the need for alternative plant species and appropriate technologies to improve economic conditions.

Bioprospecting in Uttaranchal

The wild fruits of many plant species have served as dietary staples and medicine for thousands of years, particularly in the tribal and rural areas of the Himalaya (Figure 1A-B). Although they are not consumed in large quantities, their role in local communities cannot be ignored. In the Central Himalaya today, berries as well as small and large fruits of wild origin are often eaten raw or occasionally mixed with salt and mustard oil for better taste, although consumption is largely limited to edible forms in rural areas. In recent times, though, a few species (eg *Myrica nagi*) have been marketed, while juice and squash are prepared from the flowers of *Rhododendron arboreum* by the natives of Uttaranchal. Bioprospecting of this enormous potential biological wealth requires reliable information on status and distribution patterns, as well as knowledge of anthropogenic disturbance, if any.

Fruit/flower collection period and production

Prior to practical applications, it is vital to have precise information about the flowering, fruiting, and harvesting of wild fruits. To avoid waste, calendars have been developed for clear information about fruit ripening and the appropriate time for harvesting a given species. Given the phenology of these species, it is conceivable that year-round resources could be made available for village-level cottage industries. This would not only provide jobs for local people but also improve the local economy.

Nutritional attributes

Wild fruits are richer in nutritional composition than cultivated fruits. Among wild and semiwild fruits, *Hippophae rhamnoides* has the highest protein content, followed by *Myrica nagi*, whereas cultivated species such as *Citrus sinensis* and *Citrus aurantium* are very low in protein. From available literature and information gathered from other reliable sources (village heads and other persons with sound knowledge of ethnobotany), it is clear that

FIGURE 1A-B Wild fruit with economic potential: A) *Rubus ellipticus,* B) *Myrica esculenta*. (Photos by R.K. Maikhuri)

wild fruits and their edible products have high energy content and enormous medicinal potential.

Economic potential

The total monetary benefit derived was markedly higher on a daily basis than the inputs required for all wild fruits studied, with maximum net return obtained for *Hippophae rhamnoides*. Hence considerable income can be earned with little effort. However, before beginning the work of fruit collection, there should be awareness of and allowance for the fact that the wild fruits of any plant species do not last longer than 20–25 days. Therefore, juice extraction from the plants should be planned for the time when the fruits are fully ripened.

Squash made from all these wild fruits (Table 1) is of potential economic value, with a maximum daily net return for *Hippophae rhamnoides* and a minimum net return for *Myrica nagi*. The high net return in the case of the former is due to the huge quantity of fruit produced by a small number of branches. Collection therefore takes the least time for a large quantity of fruit (12–15 kg/person/day). The juice of *Hippophae rhamnoides* is very sour, so one bottle can easily be diluted into four bottles of squash, which is not the case with other fruits.

A cost–benefit analysis of jam prepared from the wild fruit of *Rubus ellipticus* shows that the net daily return obtained is greater than the net return from *Berberis asiatica* juice. A cost–benefit analysis for jam and sauce prepared from ripe apricots (*Prunus armeniaca*) is shown in Table 2. It was estimated that at the initial stage of fruiting, approximately 30–40 kg of fruit

TABLE 1 Cost–benefit analysis (Rs/day) for squash prepared from pure juice extracted from some important wild fruits in Garhwal Himalaya.

Production	Monetary equivalent (Rs)							
	Myrica		*Berberis*		*Aegle*		*Hippophae*	
	1994-95	2000-01	1994-95	2000-01	1994-95	2000-01	1994-95	2000-01
Input	147	300	186	325	254	450	540	1380
Output	225	780	300	850	450	1100	1000	2400
Net return	78	480	114	525	196	650	460	1020

TABLE 2 Cost–benefit analysis (Rs) for juice and sauce prepared from a 15 to 20-year-old apricot tree (*Prunus armeniaca*), a semidomesticated plant of the higher Garhwal Himalaya (1600–2400 m).

Production	Jam		Sauce	
	1994-95	2000-01	1994-95	2000-01
Input	1453	2100	1096	1780
Output	8326	12,500	5620	8900
Net return	6872	10,400	4524	7120

are obtained from each plant every year for 3–4 years. At present, the fruit goes to waste during the peak ripening period, owing to low levels of consumption by local people, lack of proper storage space, and lack of a market. However, the majority of the local people in *P. armeniaca* growing areas extract edible oil from the plant's seed kernel. Net return from all wild edibles (juice, squash, sauce, and jam) increased greatly within a short period of 5–6 years due to increasing demand in the local market, particularly during summer season when pilgrimage and tourism are at their peak.

Employment and marketing opportunities

Unemployment in Uttaranchal is currently an acute problem. There are not enough public sector jobs for all educated young people. The region has a total population of 6 million, many of whom are presently unemployed or severely underemployed. Thousands of new jobs must be created. The threat of unemployment could certainly be reduced if educated as well as uneducated and unemployed youths in this region engaged themselves fully in the preparation of quality food and other products from wild edible fruits (following the successful example of the G.B. Pant Institute of Himalayan Environment and Development). It is clear that items prepared from the variety of fruits have promising economic potential. Total output and net return are very high for the food items described, because all these plants grow abundantly in the wild and no further inputs are required, except collecting the fruit.

The Central Himalaya, particularly Uttaranchal, is an important religious and tourist center, visited by millions of pilgrims and tourists every year. If the quality

FIGURE 2 Juice prepared from wild *Hippophae rhamnoides* berries. (Photo by R.K. Maikhuri)

of fruit products is improved, demand will increase rapidly. If necessary, cooperatives could be started at the village level to carry out marketing activities for edible products prepared from wild plants. Problems such as lack of marketing skill, exploitation by middlemen, and difficulties in obtaining Food Product Order (FPO) permits from government authorities will have to be confronted, however.

Replicability

Scientific and technical know-how and other information related to extraction of juice and preparation of squash, jam, jelly, and sauce, and cost–benefit analyses were disseminated to many local NGOs and local people in Uttaranchal. Some local NGOs have brought *ames* (*Hippophae rhamnoides*) and many other wild fruit juices and squash into the local market (Figure 2). Squash made from *ames* costs only Rs 35 (US$ 1 = Rs 47) per 750 ml. Products made from wild fruits have become popular among local consumers and tourists. Some local people have also started preparing value-added edible products from wild fruits.

Outlook

If the people of Uttaranchal begin to derive economic benefits from the region's plants, the natural environment will automatically be conserved in situ, and links in the food chain of the ecosystem will be maintained. It is high time to undertake in-depth scientific research on precious, underutilized plant species with huge economic and ecological potential for sustainable development of the traditional societies inhabiting the high mountainous regions of Uttaranchal.

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