Seabuckthorn(Hippophae Linn. sps.) – A potential Resource for Biodiversity conservation in Nepal Himalayas.

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Abstract:

Seabuckthorn (Hippophae L.) berry is very rich source of vitamins and it possesses a number of unique medicinal properties, which have a great potential to provide health-foods & a variety of medicines. However, despite rich under exploited potential, Nepal is yet to harness the rich potential of Seabuckthorn in producing foods, medicines, juices, and other cosmetic products where as countries like China & India are fully exploiting the rich potential of sea buckthorn. This plant is also equally important for firewood, fodder & serves as a soil binder species in cold deserts of Nepal Himalayas. This important bio resource is largely underutilized in Nepal. There are around 4 species of Sea buckthorn found in different countries but two (Hippophae Salicifolia and H. Tibetana) have been thriving at high altitude areas of Nepal Himalayas. China, India, Canada, and Russia have been pioneer countries using this wonder plant of the Himalayas in mountain-slope stabilization and pharmaceuticals purpose. There is ample opportunities to bring change in the livelihoods of high mountain people by utilizing this kind of hidden treasure of the Himalayas.

Key Words: Under exploited potential, peoples' awareness, status and distribution, medicinal properties, rural-livelihoods, Biodiversity, Nepal Himalayas.

Nepal in brief :

The kingdom of Nepal is situated on the lap of Himalayas with total land area of 147181 sq.km. of which 35% of the land area is covered by mountain Region ranging from 4877m. to 8848 (Mt. Everest) masl. It is basically located between the Tibetan plateau of China to the north and the lowland subtropical plains of India to the south. It has a population of 32.2 million (out of which 9 million live in poverty) with the population growth rate of

2.27% and GNP per capita of US$ 220. Nepal-occupying only 0.1% of the earth-is home to:

- 2% of all the flowering plants in the world.
- 8% of the world's population of birds (more than 848 species)
- 4% of mammals on earth (more than 175 species of mammals)
- 11 of the world's 15 families of butterflies (more than 500 species)
- 600 indigenous plant families
- 319 species of exotic orchids
- 2.2% of fresh water fish species in the world. (More than 180 species of fish).

Background

Seabuckthorn (*Hippophae* L.) is a deciduous & multipurpose species of fragile high mountains that belongs to family *Elaegnaceae*. The term *Hippophae* is derived from two Latin words Hippo meaning Horse and phae means to shine. Four species of it have been recognized namely *H. Salicifolia*, *H. tibitana, H. neurocarpa* and *H. rhamnoids* has been further subdivided into nine sub-species In Nepal, two species of *Hippophae* i.e. *H. Salicifolia* and *H. tibetana* area found. *H. Salicifolia* is distributed from 1800-3600 msl and *H. tibetana* from 3600-4200 msl (Gupta et al, 2000) (Please see table)

It is a hydrophilous plant, which grows in areas that receive 400-600 mm of annual precipitation. It is recorded to grow in the area where annual moisture ranges from 600-700 mm (Rongsen, 1992). It can naturally withstands an air temperature ranging from -10^0c (in winter) to 30^0c (in summer). It is, however, recorded to withstand a temperature from $+40^0$c to -40^0c in Finland. However the better germinatin rate can be seen at 24^0c - 26^0c temperatures during germination (Rongsen, 1992).

The Tree Improvement and Silviculture component of Nepal Forest Department funded by DANIDA has been taking lead role in the seabuckthorn development activities in high mountain areas like Manang, Mustang, Dolpa, Mugu and Rasuwa since 1996. Various trainings regarding

awareness and Juice preparation are already held for the benefit of rural poor of Nepal.

Materials and methods

Research field-experience gained from TISC project funded by DANIDA, literature reviews, personal contacts and professional knowledge and author's field observation while touring extensively seabuckthorn habitats in different parts of Nepal. Field-surveys conducted and information obtained from different agencies working specially on this underutilized plant species.

Salient features & genetic diversity of seabuckthorn:

It has the unique characteristic features, it has been selected as ideal plant for conservation of water and soil.

- The plant, a deciduous shrub in nature has been distributed throughout the temperate zone of Asia and Europe. This plant can be found up to 5200 meters and can withstand temperatures as low as -43^0c and as high as 40^0c.
- Its root system makes it suitable to be planted even in the fragile slopes. An observation made in most of the cultivated areas showed that a 5 years old plant has a tap root of about 5 meters deep.
- The plant can be considered very beneficial from the economic stand point. 1 ha of forests or natural stands can provide 750 to 1500 kg of fruits per year. The orange colored small fruit contains considerable amount of vitamin C which is 5 to 100 times higher than that contained in any other fruits & vegetables.
- The plant is highly appropriate for soil and water conservation. Few years back it has been proved to have high economic advantages of the plant. Generally, these plants grow wild and gets rotten in mountain areas. As the plant increase the fertility of the soil, farmers destroy these plants and normally cultivate potatoes and other food cropsGenetic diversity is the basis for plant adaptation, evolution and breeding. Seabuckthorn is extremely variable in height, from a small bush less than 50 cm to a shrub-tree more than 20 m high (Rousi 1971).

- Phonological studies show a clear clonal- Variations in growth, hardiness and height as per the geographical position, i.e. higher the latitude, shorter the growth period and plant height (Yao and Tigerstedt 1995).
- Its genetic characters such as wide ecological adaptation, fast growth, strong coppicing and suckering habit coupled with efficient nitrogen fixation makes this plant well suited in soil and water conservation, soil improvement and marginal lands reclamation. Studies have shown that this plant promotes the growth of poplars, pines and other tree species in mixed stands (lei et al. 1983, Bai 1984, shi et al 1987).
- In Canada, sea buckthorn is utilized in habitat restoration of wildlife, farmstead protection, erosion control, riparian protection and mineland reclamation (Schroeder 1990).

GEOGRAPHICAL DISTRIBUTION

The genus Hippophae is distributed between 27^0-69^0N latitude and 7^0-122^0E longitude in the world (Rousi 1971) seabuckthorn is a deciduous cold resistant thorny shrub which can thrive as bush or small-sized tree depending on the soil and moisture conditions. It occurs profusely in the temperate climate of Europe and Asia. Hippophae rhamnoids has an extremely wide distribution in Eurasia, China, Mangolia, Russia, Kazakhstan, Turkey, Romania, Switzerland, France, U.K. Finland, Sweden, Norway and Nepal.

It grows on hills & hillsides, in valleys and river-beds, along sea coasts and islands, in small isolated or large continuous pure or in mixed natural stands with other shrub or tree species (yao, 1994 , Schroeder and yao, 1995). The remaining species of Hippophae have a rather limited distribution and occur only in china and some neighboring countries along the Himalayan range (Rousi, 1971).

Hippophae is the native plant of the mountain region of Nepal. This is reported from the mountain-areas like Manang, Mustang, Humla, Jumla, Darchula, Dolpa, Rasuwa, and Baglung districts with altitudes ranging from 2000m to 4500m (Joshi, 1998, Vaidya 1999, gupta et al, 2001).

Table 1 :- Seabuckthorn occurrence by altitude & longitude .

District	H. Salicifolia (m)	H. tibetana (m)	Longitude
Manang	2100-3668	3300-4200	$83^0$40' –$84^0$34'
Mustang	2000-2880	2900-4000	$63^0$30'-$48^0$10'
Dolpa	2100-3850	3500-4500	$82^0$24'-$83^0$38'
Jumla	2100-3400	N/A	$81^0$28'-$82^0$18'
Mugu	2500-3400	N/A	$81^0$44'-$82^0$59'
Humla	2600-3500	3800-4200	$81^0$12'$82^0$10'

Table 2 : Local Uses of Seabuckthorn

Species	Local Name	Local Uses		
H. Salicifolia	Chichi	Additive foods	Medicines	Others
		Vinegar, Pickles, Juice & Jam	Swelling & nemoralg teeth stain	Timber (plough making) other agricultural implements
H. Tibetana	Tora	Vinegar, Pickles, Juice & Jam	Cole & Cough, Sking diseases, cutaneous eruption, breathing & digestive disorders, pain-relief, Asthma, Menstrual imegularity swelling & removal of teeth-stain.	Fuelwood, fencing, fodder, Intercropping, Fixative, Dye Polish for metallic Objects.

Table 3 : Physiographic Zones of Nepal

Physiographic Zone	Surface Area %	Elevation (M)	Climate
High Himal	23	Above 5000	Tundra Type & arctic
High Mountains	20	4000-5000	Alpine
		3000-4000	Sub-alpine
Mid-hills	30	2000-3000	Cool temperate monsoon
		1000-2000	Warm temperate monsoon
Low-lands		500-1000	Hot monsoon & sub-tropical
Terai & siwalik hills	27	Below 500	Hot monsoon & tropical

Source: LRMP (1986)

Table 4. : Comparison of the vitamin contents of seabuckthorn and other fruits & vegetables (mg/100g)

	VA	VB1	VB2	VP	VC	VK
Seabuckthorn	11.00	0.04	0.56	1000.0	300-1600	100-200
Cilicrosa roxburghii	4.83	0.05	0.03	2900.0	1000-3000	-
Kiwi Fruit (Actinidia sinensis)	-	-	-	-	100-470	-
Hawthorn	0.82	0.02	0.05	-	100-150	-
Orange	0.55	0.08	0.03	-	50.0	-
Tomato	0.31	0.03	0.02	-	11.8	-
Carrot	4.00	0.02	0.05	-	8.0	-

Source: Lu Rongsen 1990

ENVIRONMENTAL- REQUIREMENTS

Seabuckthorn belongs to the group of thermophilic plants. Ideal temperature for germination of seed is 24^0-26^0c. However, the plant can withstand temperatures as low as -43^0c and as high on 40^0c. Seabuckthorn can grow in areas where annual rainfall is 400-600 mm. Soil requirement of seabuckthorn is sandy and silt loam with good drainage (Rongsen, 1992 and Ghaffar, 1997).

In Nepal, H. salicifolia has been reported from altitude ranging from 1950m to 4100m by the National Herbarium, and 2900m to 4200m for H. tibetana (Nepal etal., 2000). The moisture gradient for this species has not been studied in Nepal, however, the 2 species are found to grow at annual precipitation less than 400 mm & above.

Seabuckthorn and its value for Biodiversity conservation:

Mountain ecosystems are most susceptible to human impact. They need conservation & improvement to maintain their ameliorating impact on down stream ecosystems, fresh water resources & social conditions.

Seabuckthorn forests in the mountain areas plays a vital role in the amelioration of different forms of life found on the mountain ecosystem. Seabuckthorn is used as a garden plant in many European countries and the Canadian prairies. Observations and filed-surveys show that many birds (see photo plate) and animals utilized seabuckthorn for food & shelter (Ma and Sun, 1986, Anonymous 1988). In Canadian prairies, seabuckthorn serve a valuable habitat for the sharp tail grouse, Hungarian partridge and pheasant (Schroeder, 1995)

Characters such as wide ecological adaptation, fast growth, strong coppicing and suckering habits coupled with efficient nitrogen fixation (60-180 Kg/ha/year) make seabuckthorn well suited for soil conservation, soil improvement and marginal land reclamation (rongsen, 1992) studies have shown that this species promotes the growth of poplar, pine and other trees in mixed stands & hence promotes in the wildlife production and management. Though seabuckthorn is a multipurpose and vital species for

mountain-rural poor, it is one of the least known and unexplored and underutilized plant species in Nepal Himalayas. Thus, urgent-works on this species are needed to study its ecology, distribution & utilization pattern in most of the mountain districts of Nepal.

Propagation works on seabuckthorn:

It can be propagated by means of direct seeding, seedlings and hardwood or softwood cuttings. Although, sea buckthorn holds a long history in different countries but no plantations existed for industrial purposes until few decades ago. It was introduced in the Botanical gardens of Europe as an ornamental tree. In china natural forests of seabuckthorn were transferred to high yielding forest in order to be able to provide raw material for industries by strip cutting & pruning. From last decades China & some European and other Asian countries have begun artificial plantation of seabuckthorn.

For plantation, the most important propagation techniques are seeds & vegetative means. Air seeding of seabuckthorn has proved very promising for large scale plantation in China.

In Germany, work is being done to develop new varieties of seabuckthorn, which would be rich in B-carotene & oil for special utilization (Gerhand et.al.2000). The varieties will be tested & propagated.

The following propagation techniques can be applied

- Intermediate strip cutting
- Cutting above the root-collar &
- Improvement cutting

Seabuckthorn – Its sustainable utilization and promotion of rural poor-livelihoods

The high mountain area in Nepal (where seabuckthorn natural stands are gregariously found) face severe development problems compared to the west of Nepal (Hilbert, 1997). In spite of that the area has until now received relatively little attention compared with the hill area and the low lands.

The natural resources of the area are in no way abundant. But one of the potential sources of income in the areas is the presence of seabuckthorn

stands. There are two species of seabuckthorn in Nepal, Hippophae Salicifolia (D. Don) and Hippophae Tibetana (Schlecht). Both provide a number of products to rural poor people living in the high hills & mountains and they fill important ecological niches. That is to say that management for a sustainable use & flow of benefits has not been considered & changes in the patterns of land-use have had a negative impact on the occurrence of these species.

The HMG/DANIDA, Tree Improvement Program (TIP) has partly after inquiry from ICIMOD, in early 1996 started a number of activities concerning the seabuckthorn development. The scope of this work is twofold. On the one hand it seeks to assist in conserving the existing seabuckthorn resources-especially in relation to the gene base. Besides, the program has started activities in order to help inspiring and organizing the commercial exploitation of the resource. This latter effort is done to increase the livelihood of the local poor people, which is the core of TIP's development objective, also stemming from the philosophy that a sustainable utilization of the species-appreciated by the rural poor is in the long run the best guarantee for a preservation of the resource ("Use it or loose it").

Income and employment opportunities from seabuckthorn

People from Manang and Mustang mountain areas of Nepal have started juice making & other products from seabuckthorn. There was approximately 4123 liters of sea buckthorn juice produced in Manang & Mustang worth NRs. 412300.00, last year (Source: field study 2001). And as estimated by an empirical study NRs. 35 goes to the labor for each liter of raw juice collected, so the total amount of labor generated in monetary term becomes NRs. 144305.00 (4123x35), which is equivalent to 577 labors day, paying at an average NRs. 250 for each. Thus the sea buckthorn activities run by TISC have been successful in generating new employment for rural poor and hence their enhancement of standard of living.

People have started to sell the products not only in the local markets of the mountain areas but some have started selling products in big cities like Kathmandu and Pokhara. Some hotels have included the seabuckthorn products in Menu and Menu-boards.

Local uses of seabuckthorn in Nepal

These days a wide range of seabuckthorn products have been formulated and marketed in China and Russia. However, in Nepal few Seabuckthorn products have been developed by RECAST (A University group) as sea buckthorn squash, jam, juice, powder, wine & fenugreek pickle (vaidya, 1999). But in Mustang & Manang the local people are still using this resource in traditional ways.

Conclusion and Recommendations

Conclusion – There is an immediate need to launch nationwide awareness campaign about the under-utilized potential about seabuckthorn since a majority of people living in mountain areas are unaware about its socio-economic benefits, even seabuckthorn is available as a native plants in our mountains, the degree of its sustainable utilization is far below that of other countries who are doing very well on this plant. Despite & large populations of this species in our mountains, it remains under-utilized due to the lack of further research and development. Since it is having a source of low-priced vitamins, as a source for generating cash income and as an option for stabilizing mountain slopes so at any cost this wonder plant of the Himalayas should be conserved & properly managed for the benefit of the burgeoning population. Further more, it has been used in curing different diseases and also used as ingredients of nutritive foods. Rural livelihoods of mountain people can be enhanced by engaging them in conserving and managing these renewable natural resource of their Himalayas. Human ignorance and past trends of forest destruction shows severe menace to the natural stands of seabuckthorn thereby affecting the Socio-economic condition of rural people. Seabuckthorn has many medicinal as well as economic and socio-cultural values if its conservation and development efforts are not practiced, it is likely to be extinct in years to come. Therefore, in-situ and ex-situ conservation approaches must be applied to guard against its removal from our mountain ecosystem.

Recommendations

The rural people can play a vital role in the management & sustainable utilization of seabuckthorn. To facilitate and to harness the under

exploited potential of seabuckthorn in Nepal the following steps are recommended for immediate attention from concerned quarters.

- To generate mass awareness-program about this plant through different means of media.
- To focus on field exposure and trainings.
- Establishment of demonstration units involving experts from highly experienced countries.
- Uses of seabuckthorn and its market value to be informed to the business-community and entrepreneurs through different media.
- Seabuckthorn should be given top priority in mountains so that its in-situ & ex-situ conservation would be ensured. This declaration should be done forthwith to recognize its medicinal and socio-economic values to rural people.
- Further studies on its ecology & distribution should be conducted in Nepal.
- Exchange visits of foresters, technologists, entrepreneurs and local farmers to China or other country for the further understanding and knowledge about this plant and its research & development.
- Plus tree selection and hence move forward to its genetic conservation activities.
- Identification of best-suited propagation techniques.
- Nursery of seabuckthorn should be established near its natural stands so as to avoid inbreeding and withering effects.
- Policies & legislation for seabuckthorn should be thoroughly analyzed & appropriate policies should be enforced.
- Participating-approach for in-situ conservation of species & ecosystem should be carried out.
- Initiate micro-credit programmes at grass root level.
- Involve NGO's, cooperatives and community based organizations for the sustainable utilization of seabuckthorn on larger scale.

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