SEABUCKTHORN (Hippophae rhamnoides L.): A POTENTIAL PLANT FOR SUSTAINABLE DEVELOPMENT OF TRANS-HIMALAYAN LADAKH REGION, INDIA

Anand Kumar Katiyar, Desyong Namgail and Rohit Kumar

1. Introduction

Seabuckthorn (*Hippophae rhamnoides* L.) is an ecologically and economically important thorny shrub, which is widely distributed in the Himalayan region. The species is dioecious and wind pollinated. The female plant bears red, orange or yellow berry on two-year-old thorny twigs. Seabuckthorn berry is one of the most nutritious of all fruits and have immense medicinal properties. The plant is hardy and can withstand extreme temperatures. The shrub develops extensive root system having ability to fix atmospheric nitrogen.

All the species of the genus *Hippophae* are called Seabuckthorn. Seabuckthorn belongs to the family Elaegnaceae, which is in the major group *Angiosperms* (flowering plants). The genus *Hippophae* comprises of seven species. In India *H. rhamnoides* is the predominant species followed by *H. salicifolia* and *H. tibetana* which are being grown naturally. Ladakh remains the major site for natural Seabuckthorn resource with over 70% of the total area (13,000 ha) under Seabuckthorn in the country (Stobdan *et al.*, 2017). Using satellite data, it is estimated that area under pure Seabuckthorn is 7,184 ha while the area under mixed Seabuckthorn is 2,083 ha in Ladakh (Chauhan *et al.*, 2006).

2. Medicinal properties

Seabuckthorn has been used in traditional Tibetan system of medicine for centuries. The medicinal value of Seabuckthorn was recorded as early as the 8th century in the Tibetan medicinal classic rGyud Bzi (Four Text of Fundamental Tibetan Medicine). The three major species of Seabuckthorn has been established in Tibetan medicine as Sa-sTar for H. tibetana, Bar-sTar for H. rhamnoides and Nam-sTar for H. salicifolia. The classification is based on plant height. The 'Sa' means 'ground', 'Bar' means 'middle' while 'Nam' means 'sky'. Of these, Bar-sTar is the most commonly used species in Tibetan medicine (Gurmet, 2009). There are over a hundred popular Seabuckthorn-based formulations in various pharmacopoeias of Sowa Rigpa (Tibetan medicine), which is being practiced in Ladakh (Stobdan et al., 2013). In Ladakh region of India, even today Amchies (local traditional doctor) often prescribed preparations from Seabuckthorn for treatment of common problems like indigestion, throat infection, gynecological problem, ulcer, gastritis, bronchitis, acidity, diarrhea, hypertension, blood disorder, fever, tumor, gallstone, cough, cold, food poisoning etc. (Stobdan et al., 2013). Traditional uses of

^{*} Defence Institute of High Altitude Research, Leh-Ladakh - 194 101

the plant for treatment of various diseases have now been confirmed by laboratory and clinical studies. Seabuckthorn oil is used as a treatment of oral mucositis, vaginal mucositis, cervical erosion, duodenal ulcers, gastric cancers and skin ulcers (Li, 1999). The oil absorbs ultraviolet light and promotes health. Beneficial effects of Seabuckthorn on human health have been extensively investigated and substantiated by studies, suggesting a great potential of the plant for maintaining and promoting human health. The plant has gained the status of one of the most sought after plant in the pharmaceutical based industries.

3. Nutritional attributes

Seabuckthorn berries are among the most nutritious of all fruits. Fruit juice is rich in sugar, amino acids, organic acids, essential fatty acids, flavonoids, phytosterol, vitamins and mineral elements. Concentration of vitamins B₂, B₃, B₅, B_6 , B_{12} , C and E is much higher than other fruits such as apricot, banana, mango, orange and peach (Stobdan et al., 2010). Vitamin C represents a nutrient of major importance in Seabuckthorn because of its presence in large quantities ranging from 53-3,909 mg/100g (Stobdan et al., 2013). Presence of these antioxidant vitamins in high quantity indicates its strong antioxidant property. Seabuckthorn berries contain organic acids mainly malic and quinic acids together constituting around 90% of the fruit acids (Ma et al., 1989).

There are 24 minerals in Seabuckthorn juice,

including calcium, magnesium, phosphorus, iron, manganese, sodium, potassium and aluminum, among others. Potassium is the most abundant of all the elements. Mineral composition of berries from Indian trans-Himalaya revealed high amount of minerals including potassium (647.2 mg/l), calcium (176.6 mg/l), iron (30.9 mg/l), magnesium (22.5 mg/l), phosphorous (84.2 mg/l), sodium (414.2 mg/l), zinc (1.4 mg/l), copper (0.7 mg/l), manganese (1.06 mg/l) and selenium (0.53 mg/l) (Stobdan *et al.*, 2010). Eighteen kinds of free amino acids have been detected in Seabuckthorn juice of which eight are essential for human body (Sun *et al.*, 2002).

Seabuckthorn leaves contain many nutrients and bioactive substances such as carotenoids, free and esterified sterols, isoprenols and triterpenols. Flavonoids content in leaves ranges from 312-2100 mg/100 g of air-dried leaves (Chen et al., 1991). Protein is one of the important components in Seabuckthorn leaves. It contains approximately 15-20% proteins which has value in animal feed and can be used as a source of unconventional protein for human food. Leaves of female and male plants are reported to contain an average of 21.1 and 20.6 g protein /100 g dried leaf, respectively. Leaf protein content peaked during the middle of July and early August and began to decrease significantly in the middle of August. Therefore leaves should be harvested late July to early August for peak protein content (Li and Wardle, 2003).

4. Seabuckthorn as a means for sustainable development of Leh Ladakh

The Himalayan region is home to a number of endemic species and thus provides considerable scope for area-specific comparative advantages. However, indigenous resources with potential comparative advantages remain neglected and the path to development continues to be searched along conventional lines. Once considered a thorny menace, Seabuckthorn is now being seen as a means for sustainable development of the Himalayan region (Stobdan et al., 2017). Development of Seabuckthorn-based products has resulted in commercial spin-offs to the extent that demand for its berry from the region now outstrips the supply. With the increasing trend in demand for Seabuckthorn, the berry harvest from available resource is expected to increase to 1509 MT in 2030 from current 361.3 MT (Stobdan, 2016).

Seabuckthorn grows naturally in Himalayan region without much of human interference. Unlike many other fruit crops, systematic plantation and standard cultural practices are not followed. Therefore, Seabuckthorn of Himalayan origin is 'wild harvest' and does not contain traces of pesticide and other synthetic chemicals. After the transfer of a Seabuckthornbased technology by Defence Institute of High Altitude Research (DIHAR) to a private firm in year 2001, collection of berry has become an important income generating activity among local people. The collection period is short and the return is high. Large scale cultivation of Seabuckthorn has the potential to be a key means for sustainable development of cold desert of Ladakh. Systematic plantation of Seabuckthorn at a spacing of 3.0 x 1.0 m would accommodate 3300 plants (female: 2970; male: 330) per ha. Assuming that each female plant bear 5.0 kilogram berry every year, a total of 14.87 MT berry can be harvested annually per ha. In comparison, Seabuckthorn cultivar Jivko and Chuiskaya are reported to yield 19.0 and 25.1 MT/ha, respectively, when planted at a spacing of 3.0 x 1.0 m in Russia (Khabarov, 2003). If cultivation is done on 2500 ha in a planned manner the projected net income from Seabuckthorn alone is estimated to be Rs. 491 crore (US\$ 72 million) in the year 2030 (Stobdan, 2016). Income generation will increase many-fold if value added products are also manufactured in the region.

5. Value chain analysis of Seabuckthorn

A study, commissioned by the Directorate of Arecanut and Spices Development (DASD), Calicut under Mission for Integrated Development of Horticulture (MIDH), Ministry of Agriculture and Farmers Welfare, Goverment of India was carried out to analyse each link in the value chain of Seabuckthorn in Ladakh region and recommended ways to effectively use the existing resources for improved marketability of Seabuckthorn (Stobdan and Phunchok, 2017). The study also undertakes missing links that deter cultivation of Seabuckthorn in the region. The study was carried out through primary and secondary research. Primary survey involved personal interviews with berry collectors, farmers and processors. A structured

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open ended schedule was used to obtain data from Leh and Nubra Valley. Secondary research was done through available literature and documents available with Research Institute (DIHAR) and government agencies. Summary of the study is as below:

5.1.1 Seabuckthorn harvesting and processing in Ladakh

- * Approximately 500 tons of berry is harvested annually, which is less than 5% of the total available Seabuckthorn resource in the region. This is mainly due to short harvesting season, coincidence of harvesting period with that of other crops, and unorganized plantation, which all restrict harvesting of only a fraction of the available resource.
- * Berry is harvested by hand using 'beat the bush' method. Tip of a branch is held with one hand while beating with a stick with the other. Harvested berry is transported to the processing unit.
- * Majority of the Seabuckthorn stand is on land under the executive control of Forest Department. Strict regulation is in force regarding time and method of berry collection. Local communities require permission for berry collection from the Forest Department in the area under its jurisdiction.
- * Primary processing of Seabuckthorn berry is done in Ladakh and various components such as the pulp, seed and hull are sold to firms located outside the region for further value addition.

- Seabuckthorn berry collection has become an important activity in Ladakh region since year 2001. Berry harvesting is done for a short period of 20-30 days in September. Approximately 0.8% of the total populations of Leh district are directly benefitted from berry collection.
- Majority of the berry collectors are from the needy section of the society and women constitute 67.4% of the work force.

5.1.2 Value chain mapping and actors in Ladakh

- * The major actors in existing value chain are berry collectors, individual farmers, community, processors, Forest Department, commission agents, manufacturers, exporters and research institutes.
- Processors are amongst the most important actors in the value chain. They determine the price of berry and purchase raw material from the berry collectors. They also carry out the primary processing while various other components such as the pulp, seed and hull are sold to manufacturers or commission agents. There are twelve Seabuckthorn berry processors in Leh district.
- * Berry collectors are the most valued actors in Seabuckthorn value chain. They harvest berry from Forest/community/ private land. They sell the berry directly to the processors. Approximately 1,500 households are engaged in berry collection in Leh district.

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5.1.3 Constraints and intervention required in value chain

- Less than 5% of the natural Seabuckthorn available in Ladakh is being harvested. There is a need of a policy for converting the dense Seabuckthorn forest into productive stand.
- * Seabuckthorn berry harvesting is a tedious process. Currently berry is harvested by beating the bush method. The harvesting tools at R&D stages need to be studied in field conditions. Commonly used harvesters in other countries need to be studied in conditions of Ladakh.
- * Seabuckthorn berry is a delicate and highly perishable one. It needs to be processed the same day of harvesting. There is a need to develop cold chain facilities in major Seabuckthorn growing areas to prolong the time between harvest and processing.
- * Seabuckthorn harvested in Ladakh are wild harvest. Efforts need to be made to certify Seabuckthorn of Ladakh as organic. There is a need for GI tagging of Seabuckthorn of Ladakh origin.
- * Over 90% of the Seabuckthorn harvested in Ladakh are sold after primary processing.
 Government support is required in providing incentives for developing value added products in Ladakh.
- Market linkage for Seabuckthorn is poor.
 There are many small players in the value chain. In order to strengthen the market linkages there is a need to set up a single

window online system for providing information and services related to Seabuckthorn trade. Local entrepreneurs focus only on selling the raw material. Their risks taking capacity is low, and are fully dependent on demand for raw material from outside the region. Formation of 'Ladakh Seabuckthorn Cooperative Society' comprising of all the local entrepreneurs would strengthen their role in Seabuckthorn value chain.

There is a gap in demand and supply. Demand for Seabuckthorn far exceeds that of the supply capacity of the region. Intervention is required for increasing the raw material supply.

5.2 Potential of Seabuckthorn cultivation on vast barren land in Leh Ladakh

- * The vast barren land in the region can be brought under Seabuckthorn plantation either by planting along existing water resources or through lifting of water from the rivers. As per an estimate of the Forest Department, 2,500 ha of barren land can be brought under Seabuckthorn plantation without much investment in Leh district.
- * Cultivation of Seabuckthorn on 2,500 ha in Ladakh is projected to result in net income of Rs. 491 crore per annum from raw material harvesting and its primary processing. Income generation will increase many-fold if value added products are also manufactured in the region.
- * Farmers have shown keen interest in growing Seabuckthorn.



Field view of Seabuckthorn

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Seabuckthorn on fruits



Seabuckthorn in winter

5.2.1 Constraints and intervention required in Seabuckthorn plantation

- * Seabuckthorn is considered as forest crop. There are no policies or incentives to promote Seabuckthorn as horticultural crop.
- There is no standard package of practices for large scale Seabuckthorn cultivation.
 Works being done on experimental fields of research stations need to be carried out.
- * There is no released variety of Seabuckthorn in India. There is a need to initiate R&D on varietal development. Commercial varieties available in other countries need to be exploited for varietal trial.
- * Vast geographical areas in cold desert are barren primarily due to lack of irrigation. Area under forest cover is only 0.064% and total cropped area is just 0.2% in Leh district. Existing vast barren land can be converted into green patch by planting Seabuckthorn.

5.3 Policy Suggestions

Promote Seabuckthorn for National Security:

People living along the international border play key role in securing the border. However, in recent years a trend in migration of people living along the international border to the nearby Leh town has been observed due to economic reasons. Promotion of Seabuckthorn cultivation in villages along the international border will improve the socio-economic status of the villagers and discourage abandoning their settlement.

National mission on Seabuckthorn:

Developmental work on Seabuckthorn needs to be carried on mission mode. There

is a need to initiate a National Program on Seabuckthorn.

Promote Seabuckthorn as horticulture crop: Seabuckthorn is considered as a forest crop. The crop needs to be declared as a horticulture crop.

Organic certification and GI registration:

Seabuckthorn harvested in Ladakh are wild harvest and believed to be superior due to climatic condition of the growing areas. For all activities related to Seabuckthorn, organic certification may be made mandatory. Efforts need to be made for GI tagging of Seabuckthorn of Ladakh origin.

Value added products:

Over 90% of the harvested raw material is currently sold outside the region. There is an opportunity for development of value added products in the study area. Hence, government needs to create a favourable environment for the investors through partial support in the form of subsidies, training and skill development on value added products.

Convert thick forest into productive stand:

Less than 5% of the natural Seabuckthorn available in Ladakh is being harvested. There is a need to have a policy for converting the dense Seabuckthorn forest into productive stand.

Convert barren land into green patch:

Vast geographical areas in cold desert are barren primarily due to lack of irrigation. Area under forest cover is only 0.064% and total cropped area is just 0.2% in Leh district. There is a need to convert the vast barren land into green patch by planting Seabuckthorn.

Increase raw material:

Most of the processors and manufacturers reported non-availability of raw material for large scale commercial activities. Support is required for scientific cultivation of Seabuckthorn. Involvement of private players for large scale cultivation may also be considered.

Support local entrepreneurs:

The local processors are key players in the value chain. They are in need of financial assistance to create infrastructure facility to augment their business prospects.

6. Seabuckthorn under MIDH:

Based on the study 'Value chain analysis of Seabuckthorn (*Hippophae rhamnoides* L.) in Leh Ladakh', Seabuckthorn has been included as horticultural activity under MIDH scheme of Ministry of Agriculture and Farmers Welfare, Government of India in five Himalayan states *viz.* Jammu and Kashmir, Himachal Pradesh, Uttrakhand, Sikkim and Arunachal Pradesh in April, 2018. The scheme will benefit cultivators, processors, industries and research institutes.

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OBSERVANCE OF RASHTRIYA EKTA DIWAS (NATIONAL UNITY DAY) ON 31st OCTOBER, 2019

Rashtriya Ekta Diwas (National Unity Day) was observed in the Directorate on 31st October, 2019 to commemorate the birth anniversary of Sardar Vallabhbhai Patel. Rashtriya Ekta Diwas Pledge was taken by all staff of the Directorate on the same day at 11.00 hrs.



