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Nutritional Security and Biodiversity Conservation with Sea Buckthorn (*Hippophae Spp.* L.): An Underutilized Species of Himalayan

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Abstract: Sea buckthorn *(Hippophae Spp. L.)* is a deciduous and multipurpose species of fragile high mountains belonging to the family Elaeagnaceae. It has attracted attention world over due to its multipurpose values. Since, the Himalayas suffer from a high level of land degradation, desertification and soil erosion and show distinct signs of un-sustainability, decreasing soil fertility and a high degree of instability. It's 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. The abundant naturally growing Sea buckthorn ecotypes are of diverse genetic makeup with diverse biochemical and nutritional expressions. Fruit of Sea buckthorn is a storehouse of different Vitamins and important bioactive substances. The sustainable management of these traditionally used plants not only helps to conserve nationally and globally important biodiversity but also provide critical resources to sustain livelihoods with nutritional security. But, due to the lack of proper scientific study this plant remain underutilized and had gain little attention by scientific researchers and local community. This paper aims to explore the economic and ecological hidden potentials of sea buckthorn that exactly benefits rural Himalayan ensuring nutritional security and biodiversity conservation. Further, the paper disseminates the case study findings of women cooperative involved in sea buckthorn production and processing in Mustang district of Nepal. Apart from exploring the benefits and creating awareness about sea buckthorn, this paper provides best suggestions.

Keywords: Sea Buckthorn, Himalayan, Nutritional Security, Biodiversity Conservation, Underutilized

1. Introduction

Plant biodiversity represents the primary source for food, feed, shelter, medicines and many other products and means that make life on Earth possible and enjoyable (UNEP 1995). Sea buckthorn (*Hippophae Spp.),* 2n=24, is mainly used for economic and ecological purposes and rich in its biodiversity. According to the latest study, there are 15 species and subspecies in Hippophae, but only 4 subspecies are being used. It is a spin scent, dioecious, nitrogen fixing, actinorhizal, wind pollinated plant (Jeppsson and Gao, 2000), deciduous, thorny willow-like pioneering, shrubby or with luxuriant foliage and strong root system belonging to family Elaeagnaceae and can retain the soil from erosion. *Hippophae* species are fast growing, hardy woody plant often used in prairie conservation programmes (Schroeder, 1988), which is able to grow and survive well with low precipitations (300 mm), in soils with pH of 9.5 and 1.1% salts and can be planted even in marginal soils (Rongsen, 1990). It grows naturally between 3000–5000 m.a.s.l. (Raina et al. 2012).

Sea buckthorn plants are extremely hardy and exhibit vigorous root growth, they could play a significant role in ecological rehabilitation. It's 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. The general decline of these crops may erode the genetic base and preventing the use of distinctive useful traits in crop adaptation and improvement. In the context of global climate change, food and nutritional security and biodiversity conservation, it is very urgent to conserve and explore the

hidden potential of sea buckthorn for the sake of Himalayas and people living there. The present study was done to gather the dispersed knowledge about the significance of the plant in terms of nutritional and bio-diversity conservation. The case study findings conducted at Mustang district, will flourish some idea and situations that may help in the future program formulation. Also, in-depth study of some more aspects of the plant is still lacking because of time constraints.

2. Materials & Methods

For the result derivation, a review was done from different journals, papers, reports and proceedings explaining about the Sea buckthorn. Especially review was conducted to gather the findings on nutritional and bio-diversity conservation aspects of sea buckthorn in the Himalayas. Also, one case study was conducted on December 2014, at Muktinath Multipurpose Cooperative ltd, Mustang, Nepal using personal interview method. Simple questionnaire and checklist was administered in that process for information collection.

3. Results

3.1. Sea Buckthorn and Nutritional Security

Sea buckthorn fruits are among the most nutritious found in the plant kingdom. The importance of the plant is based on the nutritional value of the berries. The whole plant (fruits, roots, leaves and stem) are economically important. Fruit of this plant is quite rich in vitamin C (300-2400 mg/100g), vitamin A, E and K, protein, organic acid, carotenoids, flavonoids and steroids, which have been used in countries like Russia, CIS states, Mongolia and China for the production of several medicines, cosmetics and food products (Rongsen 1992).

The berries contain an essential oil and high concentration of vitamins A, B1, B2, B6, C, and E. Other important components such as carotene, fatty acid, palmitin, palmitolein acids, β-sitosterol have been used in therapeutic allocations (Bernath and Foldesi, 1992). Vitamin concentration, especially C and E are as high as 360 mg/100 g and 160 mg/100 g of fruit weight, respectively. Sea buckthorn is also rich in flavonoid, carotenoid, and water and fat soluble vitamins (Wolf and Wegert, 1993). Studies have shown that its fruit is 5-16 times rich in vitamins C than any other fruit and vegetable (Abbas, 2017). Sea buckthorn is an ancient, relatively obscure medicinal plant that has recently been discovered to have previously unappreciated health benefits. Its berries are extraordinarily rich in vitamins and numerous antioxidant chemicals, and both the juice and extracts are useful for the preparation of a wide range of dietary supplements and fortified foods. It is a great source of vitamins, antioxidants, phytonutrients, essential minerals, folic acid, amino acids and carotenoids, and it is a complete source of the good fats we know as omega fatty acids, making it a great anti-inflammatory (Lee, 2017).

From the nutritional point of view sea buckthorn is ahead of well-known crops contributing to nutritional security (Table 1).

Table 1. *Mineral Elements and Amino acid contents of Sea buckthorn dried berries and juice.*

Content	Average	Reference	Amino Acid (mg/100g)	Average	Reference
Carotenoids (mg/100g)	1167	Zhang *et al*., 1989	Aspartic acid	3.72	Chen, 1988
Vitamin E (mg/100g)	64.4	Ma *et al*., 1989	Threonine	6.24	Chen, 1988
Cadmium (mg/kg)	No trace	Chen, 1988	Serine	5.31	Chen, 1988
Calcium (mg/kg)	3119.3	Chen, 1988	Glutamic acid	2.65	Chen, 1988
Copper (mg/kg)	No trace	Chen, 1988	Glycine	0.64	Chen, 1988
Iron (mg/kg)	3264.3	Chen, 1988	Alanine	2.50	Chen, 1988
Lead (mg/kg)	1.215	Chen, 1988	Cysteine	0.82	Chen, 1988
Magnesium (mg/kg)	2222.2	Chen, 1988	Valine	2.85	Chen, 1988
Manganese (mg/kg)	93.68	Chen, 1988	Methionine	1.12	Chen, 1988
Potassium (mg/L)	100 - 806	Tong*et al*., 1989	Tryptophan	0.51	Chen, 1988
Zinc (mg/kg)	30.44	Chen, 1988	Isoleusine	0.97	Chen, 1988
Chromium (mg/kg)	2.54	Chen, 1988	Leucine	1.94	Chen, 1988
Cobalt (mg/kg)	0.01-0.09	Chen, 1988	Tyrosine	1.79	Chen, 1988
Molybdenum (mg/kg)	7.29	Chen, 1988	Phenyl alanine	3.21	Chen, 1988
Nickel (mg/kg)	4.99	Chen, 1988	Histidine	1.06	Chen, 1988
Strontium (mg/kg)	5.15	Chen, 1988	Lysine	3.49	Chen, 1988
Sodium (mg/kg)	18-89.9	Chen, 1988	Arginine	0.47	Chen, 1988
Vanadium (mg/kg)	2.73	Chen, 1988	Proline	12.28	Chen, 1988

Table 2. *Comparison of Vitamins content of sea buckthorn with other fruits and vegetables (mg/100gm).*

Crop species	Vit. A	Vit. B1	Vit. B2	Vit. C
Sea buckthorn	11.0	0.04	0.56	300-1600
Kiwi fruit	-	-	-	100-470
Orange	0.55	0.08	0.03	50.0
Tomato	0.31	0.03	0.02	11.0
Carrot	4.0	0.02	0.05	8.0

(Source: Rongsen, 1990)

Potassium is the most abundant of all the elements investigated in berries or juice (Chen, 1988). Similarly, Sea buckthorn juice is rich in various free amino acids, Vitamin E and carotenoids. Chen (1988) detected 18 kinds of free amino acids in juice of Chinese sea buckthorn (Table 1).

3.2. Sea Buckthorn as Nitrogen Fixer

The vigorous vegetative reproduction and the strong complex root system with nitrogen-fixing nodules make sea

buckthorn an optimal pioneer plant in soil and water conservation and reforestation for eroded areas (Yang and Kallio, 2002). The tap roots are 4m long whereas horizontal roots are 10m, which help in binding the soil and control soil erosion, thus it is named as plant engineering. It improves soil fertility by adding Phosphorus and organic matter in the soil in addition to nitrogen (Ali et al., 2013).

Stobdan et al., (2008) reported the total nitrogen, phosphorus and organic matter in pure sea buckthorn forests are 0.074%, 0.064%, and 1.3%, respectively, more than the amounts in waste mountain land (0.060%, 0.055% and 0.952%, respectively).

Table 3. *Effect of Sea buckthorn leaves on soil physical and chemical properties.*

Years	PH	Electrical Conductivity (dsm^{-1})	Nitrate-Nitrogen (ppm)	Organic matter (%)	Texture
0	7.58	0.38	2.58	0.90	Sandy loam
6	7.51	0.33	2.33	1.10	Sandy loam
8	7.41	0.30	1.83	0.80	Sandy loam
10	7.55	0.23	10.32	1.65	Sandy loam

3.3. Sea Buckthorn and Bio-diversity Conservation

Mountain ecosystems are most susceptible to human impact. They need conservation and improvement to maintain their ameliorating impact on downstream ecosystems, fresh water resources and social conditions. Rongsen, (1992) stated that under sea buckthorn forests several species of birds (*Crosoptilon manchurian, Turdus ruficollis*, etc) thrive on its fruits; many carnivorous animals (*Canis lupus, Vulpes vulpes, Felis bengalensis*, etc.) catch prey and take shelter in its forests. Edible fungi and rabbits can be trapped for food from these forests. It was even used for combating the desertification (Heshmati, 2011).

Enescu, 2014 reported that the invasive behavior of sea-buckthorn, its extensive use in several areas and the intensive efforts to reclaim and ameliorate different types of terrains affected especially by water or wind erosion with this species in many regions worldwide, have led to its spread and naturalization on large areas.

The specificity of this shrub is that it may withstand extremes in temperature, from −43 to +40 Degree Celsius. It is considered an air-pollution-, drought- and frost-tolerant plant (zielinska, 2017). Further, Rongsen, (1992) stated that the species is considered a pioneer species and it colonizes open sites like abandoned agricultural lands, infertile wastelands, riversides, hilltops, slopes and rocky lands. Characters such as wide ecological adaptation, fast growth, strong coppicing and suckering habits coupled with efficient nitrogen fixation (60-180 Kg/ha/year) make sea buckthorn well suited for soil conservation, soil improvement and marginal land reclamation studies have shown that this species promotes the growth of poplar, pine and other trees in mixed stands and hence promotes in the wildlife production and management.

3.4. Case Study Report Based on Personal Communication with Ms. Kunga Gurung, President of Muktinath Multipurpose Cooperative Ltd., Mustang, Nepal

Cooperative name: Muktinath Multipurpose Cooperative Ltd., Mustang, Nepal

Cooperative registered date: 2065 B.S. (2009 A.D.)

Total member: 57

Main aim of Cooperative: Sea buckthorn production and marketing along with increasing household income.

Cooperative had started cultivation of sea buckthorn from 2065 B.S. Now it is extended to total area of 420 ropani. Annually they harvest in an average 15 kg of berries and 12 litres of juice for processing from a ropani of land. Most of the processed juice is bottled and marketed from farm at NRs. 320 per litre whereas; some of the product is marketed to Kathmandu and Pokhara. In an average the cooperative sells the product worth NRs. 20 lakh in a year. About 11 rural farmers are employed for sea buckthorn farming in a year. In the establishment, District Agriculture Development Office, District Soil Conservation Office and District Office for Women and Children in Mustang provided the support but later Annapurna Area Conservation Project, Village Development Committee, Muktinath and HIMALI Project are providing great support to the farmers. Building, Machinery, Pulper, Bottle and Packaging cartoons, Storing drum etc. are the assets available with them. Income, employment, soil conservation, homemade medicines, bio-diversity conservation, women involvement etc. are the positive aspect that the farmers acquiring after the production of sea buckthorn. Irrigation was found as the most severe in the production process whereas, lack of necessary infrastructures and machines were hindering its extension and marketing. Ms. Kunga further explained that the income from sea buckthorn is higher as compared to other agricultural product like potato, buckwheat and even vegetables.

4. Conclusion & Recommendations

Sea buckthorn seems to be a promising plant having potential beneficiary role in improving income, nutrition and overall bio-diversity conservation especially in Himalayan region. The paper presented above is an effort to highlight the uses of *Hippophae* an ecologically, economically and nutritionally important plant which is also found in abundance in Nepal's Himalayan region but despite of this fact its true potential is still under explored. Due to the lack of a proper scientific and systematic study of this plant remains underutilized and only few people know the importance of this plant. This review and a case study report

may also help for upcoming researchers to work on this wonder species. Though sea buckthorn 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. Even sea buckthorn is available as a native plant in our mountains; the degree of its sustainable utilization is far below that of other countries that are doing very well on this plant. The key to unlock their true potential rests in our ability to harness their multiple uses, and traditional, single-use enhancement approaches are not the best way to achieve their full valorisation. Therefore, in-situ and ex-situ conservation approaches must be applied to guard against its removal from our mountain ecosystem.

References

[1] Abbas, M. (2017). Sea buckthorn, a miracle plant in gb. retrieved on 28 February. https://www.technologytimes.pk/sea-buckthorn-a-miracle-plant-in-gb/.

[2] Bernath, J. and Foldesi, D. (1992). Using Sea buckthorn oil in treating burns. *Sov. Med*., 11: 137-138.

[3] Chen, T. (1988). Preliminary research on the biochemical components of sea buckthorn oil from Gansu, China. Sea buckthorn 1, 35-38.

[4] Enescu, M. C. (2014). Sea-buckthorn: a species with a variety of uses, especially in land reclamation. Dendrobiology, 1 (72): 41-46.

[5] Heshmati G. A. (2011). Biological Models for Protecting Different Land Use in Arid Areas in China. Journal of Rangeland Science 1: 235–246.

[6] Hassan A., Razaq A., Perveen S. and Khan B. (2013). Nitrogen fixation by non leguminous plant sea buckthorn in semi arid climatic conditions of gilgit-baltistan. *Pak. J. Weed Sci. Res., 19 (3): 305 – 314.*

[7] Jeppsson, N., and Gao X. Q. (2000). Changes in the contents of kaempherol, quercetin and L-ascorbic acid in sea buckthorn berries during maturation. Agri. Food Sci. Finland, 9: 17-22.

[8] Lee, K. (2017). Sea buckthorn berry – the superfood to know about. Retrieved on 28 February. http://www.truewellnessbytrue.com/2017/01/18/sea-buckthorn-berry-superfood-know/

[9] Raina S. N., Jain S., Sehgal D., Kumar A., Dar T. H., Bhat V., Pandey V., Vaishnavi S., Bhargav A., Singh V., Rani V., Tandon R., Tewari M., Mahmoudi A. (2012). Diversity and relationships of multipurpose sea buckthorn (Hippophaë L.) germplast from the Indian Himalayas as assessed by AFLP and SAMPL markers. Genetic Resources and Crop Evolution 59: 1033–1053. http://dx.doi.org/10.1007/ s10722-011-9742-1

[10] Rongsen, L. (1990). Seabuckthorn resource and its underexploited potential in the Himalayan region. Mountain Farming System (MFS) Series No. 12. ICIMOD, Kathmandu, Nepal.

[11] Rongsen, L. (1992). Sea buck thorn: a multipurpose plant species for fragile mountains. Occasional paper No. 20, ICIMOD, Nepal, 63 p.

[12] Schroeder, W. E. (1988). Planting and establishment of shelterbelts in humid severe-winter regions. Agric. Ecosyst. Environ. 22 (23) 441-463.

[13] Stobdan, T., Angchuk, D. And Singh, S. B. (2008). Sea buckthorn: an emerging storehouse for researchesrs in India. Current Science 94: 1236-1237.

[14] Tong, J., Zhang, C., Zhao, Z. Yang, Y. and Tian, K. (1989). The determination of physical-chemical constants and sixteen mineral elements in sea buckthorn raw juice. Proceeding of International Symposium on Sea Buckthorn *(H. rhamnoids.* L), Xian, China.

[15] UNEP. (1995). Global Biodiversity Assessment. United Nations Environment Programme University Press, Cambridge, UK.

[16] Wolf, D. and Wegert, R. (1993). Development of cultivars and growing techniques for sea buckthorn.

[17] Yang, B. R. and Kallio, H. P. (2002). Composition and physiological effects of sea buckthorn (*Hyppophae rhamnoides*) lipids. *Trends in Food Science and Technology,* 13: 160-167.

[18] Zhang, P., Ding, X., Mao, L. and Li. (1989). Anti tumor effects of fruit juice and seed oil of *(Hyppophae rhamnoides* L*.)* and their influences on immune function. *Proc. Int. Symp. Sea buckthorn* (*H. rhamnoides* L.), Xian, China, 373-380.

[19] Zielin´ska, A.; Nowak, I. Abundance of active ingredients in sea-buckthorn oil. Lipids Health Dis. 2017, 16, 95. [CrossRef] [PubMed].

Biography

Binod Ghimire (Corresponding author) awarded Master of Science in Agricultural Economics from Tribhuvan University, Nepal in 2012 AD. He has completed his Bachelor of Science in Agriculture from same university. Currently he is working as Agriculture Extension Officer for Ministry of Agricultural Development, Nepal. He has one book, 7 scientific papers and more than 10 publications in different national and international journals and newsletters. Mr. Ghimire shows great interest in R&D of Agriculture sector including soil sustainability, food security and climate change. For training purpose and as a presenter he has visited India and Thailand.