

**DRAFT DOCUMENT**

**ON**

**Road Map on Seabuckthorn Development in High Altitude  
Himalayas**



**(Cost: Rs. 1260.50 crores, Duration: 10 years)**

**For Submission to NMPB, AYUS, Govt. of India**

**(Based on discussion held during Plenary Session of 2<sup>nd</sup> National Conference of Seabuckthorn Association of India, held at Shimla on October 23-24, 2018)**

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# Seabuckthorn Association of India



(Reg. No. 821/2014)

- Dr. R.C. Sawhney,  
Ex Director, DRDO is  
President
- Prof. Virendra Singh is  
General Secretary
- Dr. Vijay Kumar Sharma  
is Treasurer



## National Conferences on Seabuckthorn in India

Sr.No.	International & National Conferences	By
1	International Workshop on Seabuckthorn, 2001, N. Delhi	CSK HAU, Palampur & DRDO
2	Conference on Seabuckthorn, 2003, N.Delhi,	DIPAS, DRDO
3	National Conference on Seabuckthorn, 2004	DIHAR, Leh
4	National Conference on Seabuckthorn, 2010	CSK HAU, Palampur
5	National Conference on Seabuckthorn, 2011	CSK HAU, Palampur
6	International Conference on Seabuckthorn, 2015, N. Delhi	Seabuckthorn Association of India, CSKHPAU & INMAS
7	1st National Conference of Seabuckthorn Association of India, 2017	DIHAR, Leh & SAI
8	2 <sup>nd</sup> National Conference of Seabuckthorn Association of India, Shimla 2018	SAI & HP Biodiversity Board
9	3 <sup>rd</sup> National Conference of Seabuckthorn Association of India, Delhi 2019	University of Delhi

# Environmental and socio-economic issues of cold deserts of Himalayas

- Spread in 75,000 sq. km area in north-west Himalayas
- About 40% geographical area, each of HP & Ladakh (J&K)
- High altitude zone (2000-4500 m asl)
- Extreme climatic conditions ( $-30^{\circ}\text{C}$ ), high rate of soil erosion, shortage of fodder, fuelwood, timber wood, scarcity of vegetation, low productivity of agricultural lands
- Siltation of rivers
- Faster melting of glaciers
- High altitude related health problems (Hypoxia, snow bites, UV radiation, memory loss)
- Migration of youths
- Dry temperate regions of UK, Sikkim and ArP also have similar conditions



# Willow is dying in Lahaul: Effect of global warming?



# Effect of climate change



# **Migration from Border Villages-major problem in border areas of country**

- As per Census 2011, of Uttarakhand's 1,053 villages have no inhabitants and another 405 have a population of less than 10 due to lack of job opportunities.
- A similar trend has been observed in the Ladakh & border areas of HP.
- Migration of youth—Serious national security threat in border areas bordering with China.

# Acclimatization of Army in High Altitude

- It takes 12 days in Acclimatization of Indian army for movement from low altitude to high altitude
- Chinese army takes 2 days due to use of seabuckthorn drugs.
- Rapid induction at high to extreme altitudes to defend borders of our country is associated with a variety of health problems like acute mountain sickness, high altitude pulmonary edema, high altitude cerebral edema, hypertension and frost bite. Prolonged residency under hypoxic environment can also lead to chronic mountain sickness.





# Seabuckthorn can be a part of solution to



1. **Global warming & Climate change**
2. **Slow the melting of glaciers**
3. **Check siltation of river and hydroelectric power stations**
4. **Conserve soil, water, biodiversity and wild life**
5. **Poverty & Unemployment**
6. **Nutritional security (multivitamins)**
7. **High altitude related health problems of army (Hypoxia, UV radiation damage, heart problems, memory disorders)**
8. **Loss of immunity, Heart problems, diabetes, skin diseases and gastric ulcer.**



# Seabuckthorn Plant: Main features

1. Member of *Hippophae* genus and Family *Elaeagnaceae*
2. It is a shrub (0.5-3 m) or small tree (4-9 m), nitrogen fixing, and thorny. It has a chilling requirement for fruiting.
3. *Three species, H. rhamnoides ssp. turkestanica (shrub), H. salicifolia (tree) and H. tibetana (undershrub) out of 6 species found in world.*
4. It is found in high altitude areas of Himalayas, China (2000-4500 m asl) and low altitude areas of Europe and Russia (50-100 and above m asl)
5. Fruits are reddish-orange to yellow of 15-35 g/100 weight
6. Root system goes vertically 3 m and 10 m horizontally with many generations of root turion seedlings.
7. Male and female plants are separate
8. Life span of 30-60 years
9. Fruit and leaves rich in vitamin C, E, K, A, carotenoids, flavonoids, sterols, omega fatty acids etc.

# Seabuckthorn conserving biodiversity



**42 families, 114 genera, 148 species of 11 trees, 10 shrubs, 127 herbs and 1 fern growing with seabuckthorn in Lahaul (Praveen Kumar *et al.*, 2011)**

# *Conservation of Wild Life:*

1. Seabuckthorn also plays an important role in the conservation of wild life.
2. About 50 bird species are entirely dependent on seabuckthorn fruits as a food and 80 bird species are partly dependent on seabuckthorn.
3. A number of wild animals take shelter in seabuckthorn stands for protection.

# Control of soil erosion



# Control of Soil Erosion

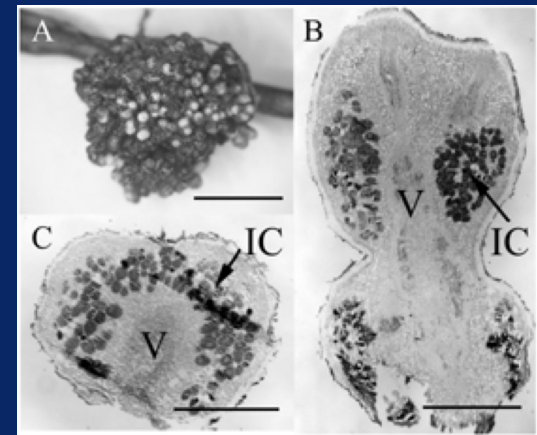
1. There are several success stories of control of soil erosion by seabuckthorn forests in China. In Shanxi province, China, 74 km of seabuckthorn forest was planted on the bank of yellow river, which decreased sediment discharge by 3-5 million tons/yr.
2. Seabuckthorn forest, when raised in a watershed area in Zhungar country, increased vegetation cover from 20 to 61%, soil erosion decreased from 40,000 to 5000 tons/km<sup>2</sup>/yr after 3 years of plantation in 1989.
3. In some of the areas it reduced soil erosion up to 96.6%. Seabuckthorn has been widely planted in over 30 lakhs ha on mountainous marginal lands by aerial seeding and artificial plantation in China and Mongolia.

# Seabuckthorn holding glaciers



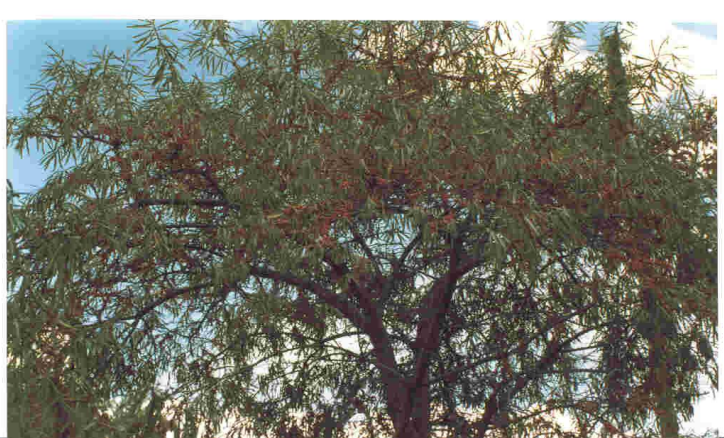
# Nitrogen fixation

- Seabuckthorn a member of nitrogen fixing family *Elaeagnace*
- Frankia bacteria fixes atmospheric nitrogen and improve soil fertility/properties
- **Fixes about 180 kg Nitrogen/ha/yr, equal to soybean**
- Nitrogen fixation help the plant in establishing in hostile /extreme conditions
- Fix atmospheric nitrogen **180 kg of nitrogen per ha per year**, which is equal to soybean.





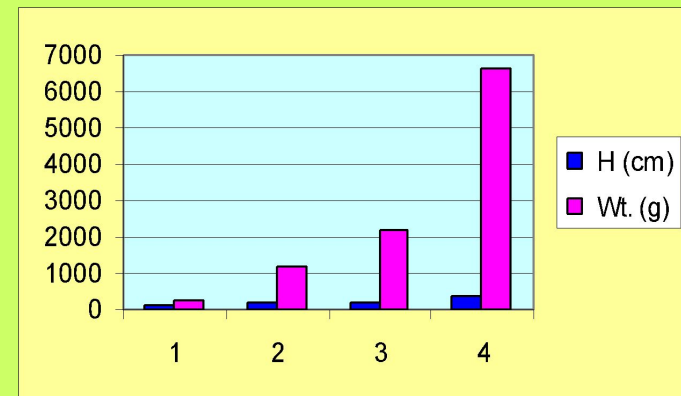
# Fuel wood value



- **6 yr old stand: 18 tons fuelwood/ha/yr**
- **1 kg wood: 4785 K. Cal**
- **1 Ton wood: 0.7 Ton Coal**

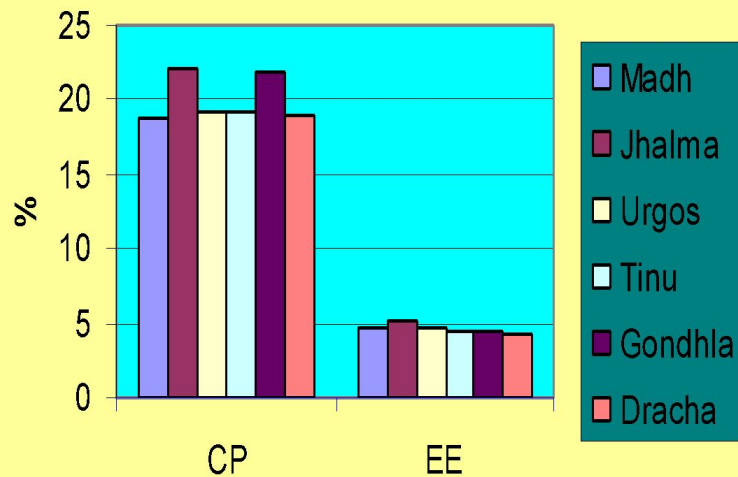
**(Shumao, 1988)**

**Singh & Dogra (1996)**



# Fodder values

1. Rich in Vit. C (250 mg/100g)
2. High in protein (18-23%)
3. High EE (3-6%)
4. Rich in flavonoids (3.8-4%) anti-oxidants



**Bark**      Pharmaceuticals



etics

**Leaves**      Pharmaceuticals



CS

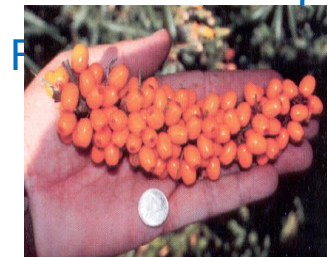
seeds

**Fruit**      **Oil**      Pharmaceuticals

Drinks

Food products

Cosmetics



s

Sports drinks

Health drinks

Juice

Food

Beverages

Brewery

**Oil**

Pharmaceuticals

Cosmetics

Residues

Animal feeds

**Seeds**



Pharmaceuticals

smetics

s Animal feeds

**Every part used**



# Vitamins and other phytochemicals

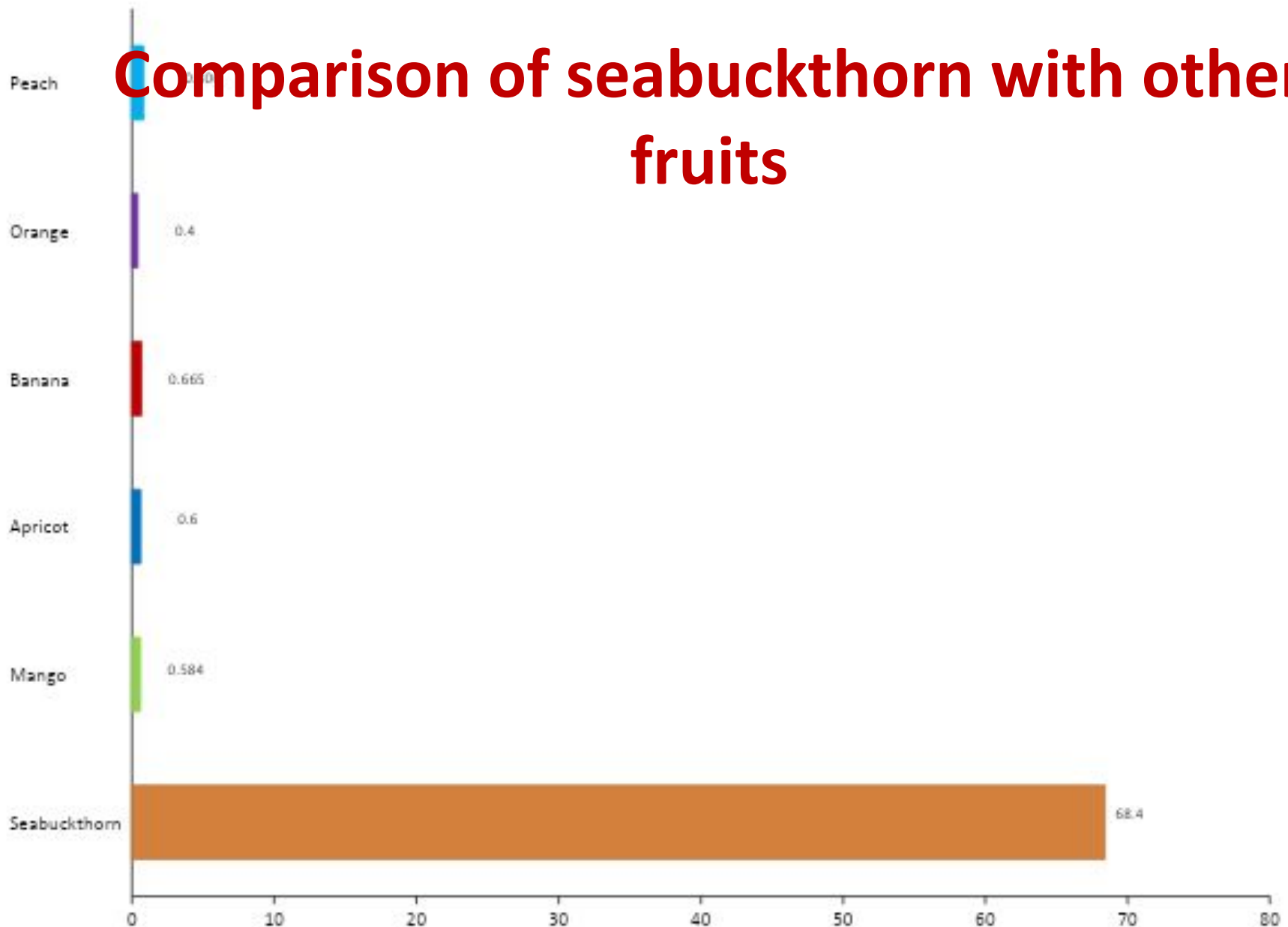
Medical Properties	Health Benefits
<b>Omega 3,6,7 &amp; 9</b>	Supports healthy Cardio Vascular Function Sustains Proper brain and nervous system function Promotes healthy skin & hair Supports healthy digestive system function Promotes healthy Urogenital lining
<b>Vitamins A,C &amp; E - Anti Oxidant</b>	Benefits Prostrate & Colon Health Contributes to Proper Brain & Nervous system functioning
<b>B - General Wellness</b>	Enhances Eye health & Better Vision
<b>D &amp; K - Necessary Vitamins</b>	Relieves Sore Joints
<b>Anti Oxidant Network</b>	Fights Cell Damaging Free Radicals Provides Anti Aging Benefits Supports Healthy Cell Reproduction Healthy Immune System Functioning And Cellular Rejuvenation Healthy Skin & Hair

Medical Properties	Health Benefits
<b>Flavonoides</b>	Helps fight cell damaging free radicals Assists in the process of healthy Cellular rejuvenation Healthy Immune System Function
<b>Carotenoids</b>	Beta Carotene -slowing the aging process lycopene - Maintain prostrates and colon cell health Zeaxanthin - Supports eye health
<b>Minerals</b>	Helps the body Produce Energy Helps the body support growth Supports Cell Reproduction & Rejuvenation



## Niacin

# Comparison of seabuckthorn with other fruits



# Comparison of seabuckthorn fruit pulp and seed oil with other oils

<i>Vitamins</i>	<i>Seabuckthorn Seed oil</i>	<i>Seabuckthorn pulp oil</i>	<i>Olive oil</i>	<i>Walnut oil</i>	<i>Wheat embryo oil</i>	<i>Corn oil</i>
Carotenoids (mg/100 g)	78.2	373.2	11.9	0.36	0.4	50.9
$\beta$ -carotene (mg/100 g)	2.5	82.2	nil	0.17	nil	0.29
Vitamin E (mg/100 g)	206.6	213.0	6.0	21.3	144.5	34.0

## Biological activities

Sr. No.	Activity	Assay	References
1	Antioxidant activity	DPPH-radical scavenging Ferric reducing antioxidant power (FRAP) assays	47
2	Hypolipidemic	In vivo	12
3	Antihyperglycemic	<i>In vivo</i> Streptozotocin-treated and high fat-diet-fed rats	11
4	Antihypertensive effect	In Sucrose-fed rats	10
5	Hepatoprotective	Protection against CCl <sub>4</sub> induced oxidative damage, <i>in</i> <i>vivo</i>	9
6	Immuno-modulatory effects	Against chromium(VI) induced Immunosuppression	7
7	Gastric ulcer	<i>In vivo</i>	7
8	Anti-inflammatory	RAW 264.7 cells	7
9	Anti-tumor activity	Against BEL-7402 cells	5
10	Anticarcinogenic		5

11	Antimicrobial activity	Against food-borne and clinical microorganisms	3
12	Protective effects mercury induced acute liver and kidney damage	<i>In vivo</i>	3
13	Antibacterial	Against <i>Bacillus cereus</i> , <i>Pseudomonas aeruginosa</i> , <i>Staphylococcus aureus</i> and <i>Enterococcus faecalis</i> .	3
14	Hypocholesterolemic, hypolipidemic and cholagogic action		3
15	Anti-atherogenic effects	<i>In vivo</i>	3
16	Anti-visceral obesity	<i>In vivo</i>	2
17	Cytoprotective	Against hydrogen peroxide and hypoxanthine-xanthine oxidase induced damage to BHK-21 cell Line	2



18	For treating myopia		2
19	$\alpha$ -Glucosidase Inhibitory Effect		1
20	POD (peroxidase), CAT and PAL enzyme activity		1
21	Hypobaric hypoxia induced cerebral Vascular injury		1
22	Adaptogenic activity	<i>In vivo</i>	1
23	Hemorrhoids, anal fissures, and inflammatory diseases of Mucous membrane of rectum		1
24	Pectinesterase activity		1
25	Antodotal		1
26	Treatment of oral cavity diseases		1
27	Treatment of psoriasis		1

# Seabuckthorn in traditional medicines

- The medicinal value of seabuckthorn was recorded as early as the 8<sup>th</sup> century in the Tibetan Medicinal Classic “*rGyudi Bzi*”.
- Mentioned in the **Amchis** (local traditional doctors) often prescribe preparations from seabuckthorn for treatment of common problems like indigestion, throat infection, gynecological problems, ulcer gastritis, bronchitis, acidity, diarrhea, hypertension, blood disorders, fever, tumor, gallstone, cough, cold, food poisoning etc.
- Mentioned as “**Amlavetas** “ in Ayurveda with medicinal values.

# Global Scenario on Seabuckthorn

- About 55 countries including China, Finland, Germany, Hungary, Mongolia, Nepal, Pakistan, Poland, Portugal, Romania, Russia, Sweden, have seabuckthorn.
- Total area of seabuckthorn is reported about 3.7 million hectare worldwide (both wild and cultivated). However, about 90% of world's seabuckthorn is found in China (30 lakhs ha plantation).
- There are over 250 seabuckthorn based products from 700 industries, in Chinese market.

# Global trade

- Global trade (70 countries) in seabuckthorn pulp, oil, seed, juice, tea, polyphenols and seabuckthorn based products
- Global business is about 3 billion USD, which is dominated by China.
- Seabuckthorn is a success story in China, Russia, Mongolia, Canada, USA, India, Finland etc.
- Seabuckthorn fruit and leaves are the raw material for the production of over 250 food, cosmetic and drug health products.

# Altai Region, Russia total 5,000 ha seabuckthorn orchards



*Main priority - health of people*



**Russian seabuckthorn**



**Elizaveta Panteleeva**

# 40 varieties bred in Russia



**'Botaniczeskaja'**



**'Nivelena'**



**'Plamiennaja'**



**'Podarok Sadu'**



**'Trofimowskaja'**



**'Augustinka'**

# SBT's plantation in Germany





# Finland import seabuckthorn from China and export products to 20 countries



*Massive Propagation (Mist system) in Sunwu, China*



# Successful plantations, no irrigation





Seabuckthorn plantation on fragile slope, Loess Plateau, China  
(30 lakh ha in 20 years)



# Control of soil erosion



# Study on introduction, planting, trial and popularization of seabuckthorn (22 varieties) in China

Some macro-fruit seabuckthorn varieties were introduced to the agricultural development zones of Karamay in 2003, which yield of individual plant is 9.6 kg.



# Farmers have become prosperous by raising Russian Seabuckthorn orchards, China





# Development of orchards on 30 lakh ha marginal lands of Forest Land in China



**China Conseco Seabuckthorn Co., LTD ,built one of the largest modern processing base, the capacity of seabuckthorn fruits processing can reach 50 thousands tons/a.**



**Factory In Ordos**

**Advanced Seabuckthorn flavonoids extraction technology  
Extract of seabuckthorn flavonoids can be raised from 35% to more than 90% purity**



**Seabuckthorn flavonoids extraction equipment  
Manufacturer workshop**



# International Conferences on Seabuckthorn

S.N.	Place/Country	Year
1	Xian, China	1989
2	Novoborsk, Russia	1993
3	Beijing, China	1995
4	Beijing, China	1999
5	New Delhi, India	2001
6	Berlin, Germany	2003
7	Beijing, China	2005
8	Quebec, Canada	2007
9	Barnaul, Russia	2009
10	Xining, China	2011
11	Postdam, Germany	2013
12	Delhi	2015
13	Taiyuan, China	2018



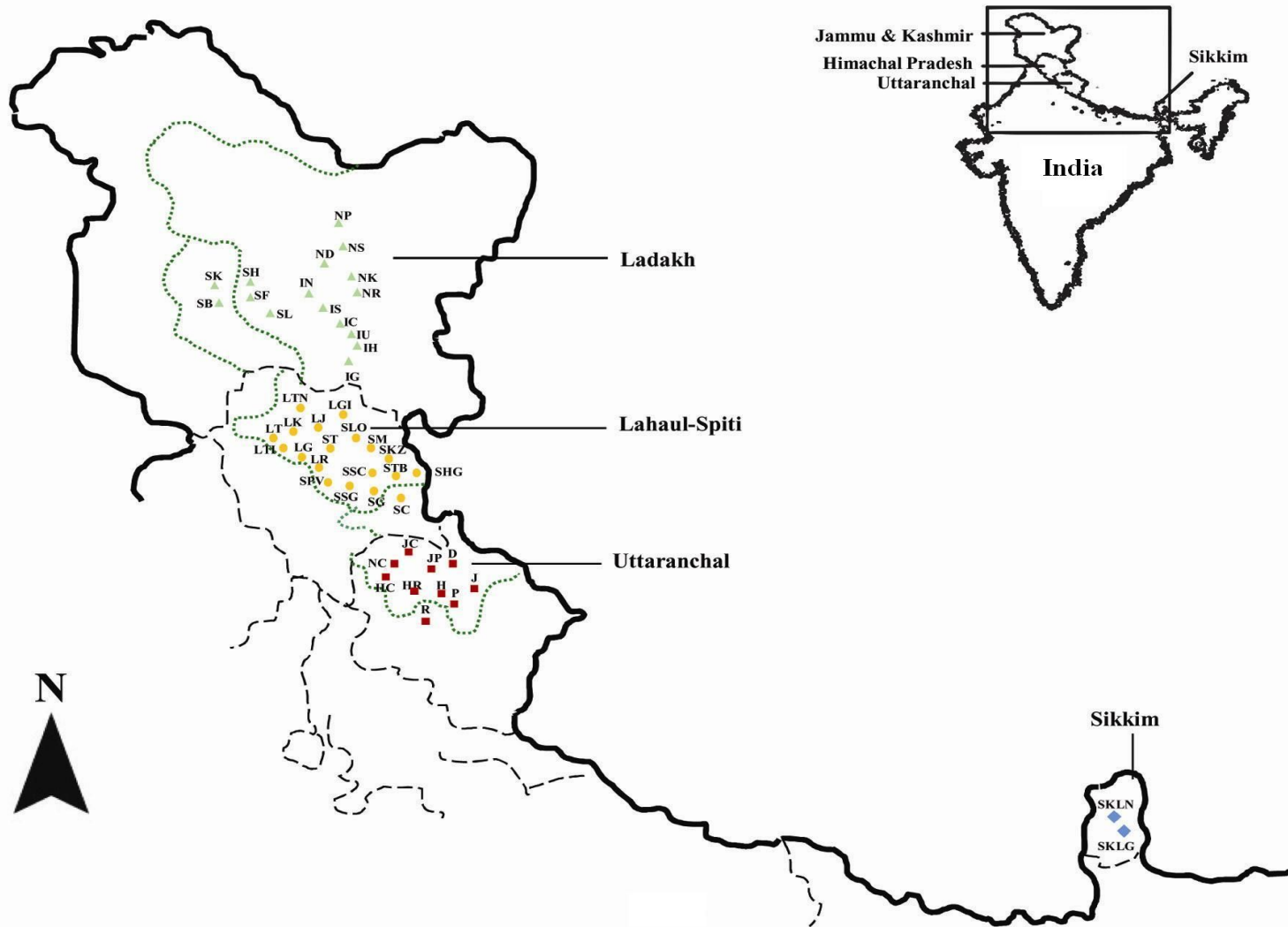
# 250 Seabuckthorn health products by 700 industries in China



# Indian Scenario

- Natural seabuckthorn is about **15500 ha**, in the cold desert regions of Ladakh (11,000 ha), HP (1200 ha), Uttarakhand (2000 ha), Sikkim (1000 ha), and Arunachal Pradesh (500 ha).
- Fruit collection from forest is 700 tons, demand for 2000 tons and rest imported from China and Pakistan. Demand will be 5000 tons in 2025.

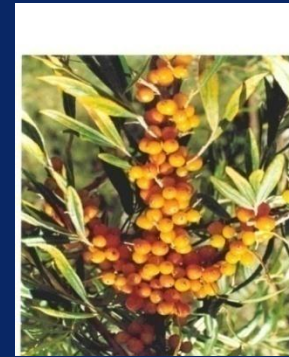
# Survey on genetic diversity in seabuckthorn in Indian Himalayas (Raina *et al.*, 2011)



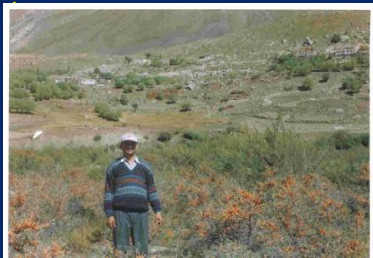
# Species of seabuckthorn in India



***H. salicifolia***



**Fruits of *H. salicifolia***



***H. rhamnoides* shrub**



**Fruits of *H. rhamnoides***



***H. tibetana* under shrub**



**Fruits of *H. tibetana***

SN	Areas of seabuckthorn	University & Institutes working on SBT
1	Resources development of seabuckthorn (Genetic diversity, varieties development & cultivation technology etc.)	<ul style="list-style-type: none"> <li>•HP Agricultural University, Palampur, HP</li> <li>•DIHAR (Defence lab), Leh (J&amp;K) GB Pant Institute of Himalayan Environment &amp; Development, Srinagar (UK)</li> </ul>
2	Veterinary research on Gastric ulcer, wound healing, antimicrobial agent, hepatic-protection and animal feed	HP Agricultural University (HPU), Palampur
4	High altitude related health problems (Hypoxia, snow bites, UV radiation, wound healing/burns, memory disorders, antioxidant)	DIPAS & INMAS (Defence labs), N.Delhi
5	Cardiovascular diseases	All India Institute of Medical Research (AIIMS), N.Delhi
6	Memory disorders, diabetes, cardiac arrest in elderly persons	Banaras Hindu University (BHU), Varanasi, UP
7	Food products & Anti-oxidant and anti-bacterial preparations	<ul style="list-style-type: none"> <li>•Central Food &amp; Technology Research Institute (CFTRI), Mysore</li> <li>•Defence Food Research Laboratory (DFRL), Mysore</li> </ul>
8	No of universities of universities/ institutes working on seabuckthorn in India	<b>30</b> (IHBT, Amity Univ., Delhi university, Chennai Univ., NIPER, JNU, etc.)



# Technologies developed by CSK HPKV, Palampur

- First University to have started work on seabuckthorn in 1993.
- 10 research projects of Rs. 600 lakhs.
- A team of 30 scientists of 12 Departments and 2 Stations, 80 RFs and 50 students worked technologies on “Development of Value chain on seabuckthorn” from nursery to processing.
- 140 publications and 7 books

# Propagation

- **Propagation from hardwood cuttings**
- Stem cuttings of 20 cm length and 1 cm diameter (from 2-3 yr old branch )
- Cuttings are treated with water for 24 hours and 500 ppm NAA and
- Cuttings are planted obliquely in polybags during April month.
- Polybags with soil mixture  
Soil:Sand:FYM:: 5:4:1 during April.



# Propagation from micro-cuttings

- Cuttings of 20 cm length and diameter of 4-5 mm (1 yr old)
- Cuttings treated with water for 24 hours
- Cuttings treated with 500 ppm NAA and Cuttings planted obliquely in polybags Polybags with Soil:Sand:FYM:: 5:4:1 in mid April under nursery conditions



# Propagation from softwood cuttings (300 plants from a tree)



# Propagation from tissue culture

- Multiple shoots developed on WPM with hormone combination: BAP 1.0 ppm+IAA 0.5 ppm,
- Maximum shoots of 14.6/explant in PI, decreased to 6.5 in PII.
- Maximum root induction (66.7%) was observed with IBA (1.5 ppm) on WPM rooting medium.



# Standardization of Cultivation

- **Standardized pit size:** 45x45x45 cm<sup>3</sup>
- **Standardized spacing:** 3.5 x 1.5 m<sup>2</sup> for slopy land or 4.0 x 2.0 m<sup>2</sup> for flat land, Pit size: 60 x 40 x 40 cm<sup>3</sup>
- **Pruning intensity:** 25% intensity includes the cutting of down growths, shaded, zig-zag type of branches, diseased branches and dead wood.
- **Weed management:** *Artemisia* (50 cm around seabuckthorn plant) or Black polythene (100 cm around seabuckthorn plant)
- **Nutritional requirement:** Apply 10-20 kg FYM, depending on soil fertility status.



# Control of seabuckthorn pests

- **Armored scale:** Agrospray oil @ 1.0%, Aceatmiprid @ 0.02%, Imidacloprid @ 0.0178%.
- **Eriophyid mite:** Pyromite @ 0.01% (Fenpyroximate 5%), Decomain @ 0.01% (Dicofol 18.5%).
- **Seabuckthorn psylla:** Malathion @ 0.025%, *Artemisia* leaf extract @ 7.5%, *Eupatorium* leaf extract @ 7.5%.



# Control of seabuckthorn diseases

- **Fruit rot:** Score (Difenconazole) @0.3% and Tilt (Propiconazole) @0.1%,
- **Powdery mildew:** Contaf (Hexaconazole5%) @0.1%,
- **Fusarium wilt:** Vitavax (Carboxin) @0.2%,
- **Alternaria leaf spot:** Score (Difenconazole) @0.3% and Contaf (Hexaconazole5%) @0.05%,
- **Rust:** Tilt (Propiconazole) @0.1%,
- **Cytospora canker:** Bavistin (Carbendazim)@0.1% .





## On campus training of farmers, Kukumseri, Lahaul



# OFF-CAMPUS TRAINING PROGRAMMES





**H.  
rhamnoides  
spp.  
turkestanica  
- Lingthi  
selection,  
Spiti**

# Indigenous *H. rhamnoides* spp. *turkestanica*

- Grows naturally in Lahaul-Spiti, Kinnaur in HP and Ladakh
- Thorny, small fruit (20 g/100) and low yielding (2-5 kg/plant)
- **Harvesting cost is very high (30 kg/person/day), hence economically rejected by farmers.**
- Suitable for control of soil erosion and biodiversity conservation on marginal land.
- Only wild should be planted: 90% female and 10% male.
- Fruit and leaves can be utilized.



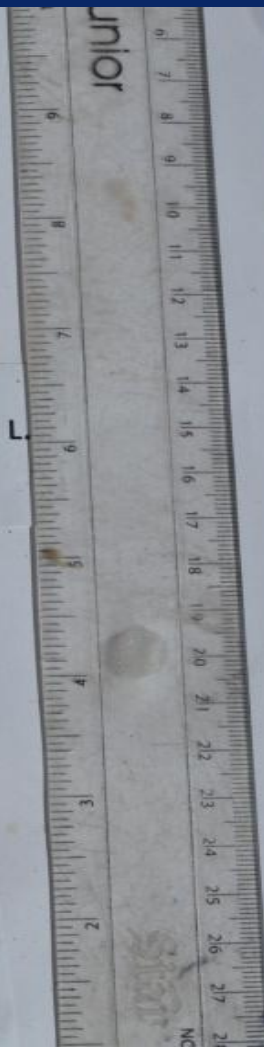
# Comparison of fruits of *H. rhamnoides* and *H. salicifolia*



*H. rhamnoides* sub sp. *turkistanica* L.



*H. salicifolia* D. Don.



# Selection of high yielding local cultivar

- “**Drilbu**” mild thorny, high yielding (5.5 kg fruits/plant) selection “Drilbu” of *H. salicifolia* (large fruit: 32g/100, rich in vitamin C>930 mg/100g)
- Selection for community land



**Plantation of Seabuckthorn on community land, Lahaul 120 ha (52% survival) (2010-13) under ICAR project**



# Germplasm Bank of seabuckthorn genotypes, Kukumseri

- 5 local genotypes of seabuckthorn (*H. salcifolia* and ssp. *turkestanica*)
- 2 exotic genotypes of seabuckthorn (ssp. *mongolica*).





# Germplasm bank, Kukumseri



# Potential of Russian seabuckthorn varieties

1. Mild thorny
2. High yielding (6-16 kg/plant)
3. Large fruit (40-110 g/100)
4. Long peduncle (5-10 mm),
5. High oil content (>4-9%),
6. Medium vitamin C (100-350 mg/100g)
7. High carotene (6-30 mg).
8. **Fruit harvesting easy and more profitable (150 kg/person/day)**



# Russian varieties at Kukumseri, Lahaul

<b>№</b>	<b>Name</b>	<b>Fruit yield, kg/plant</b>	<b>Mass of 100 fruits, g</b>	<b>Oil content, %</b>	<b>Vitamin "C", mg/100g</b>	<b>Carote-noids, mg/%</b>	<b>Plant height, m</b>	<b>Productivity, t/ha</b>
1	Zyrianka	10-11	64	5.0	110	9.9	2.5	11.4
2	Sibirsky Rumyanetz	10-11	65	4.1	86	27.0	2.5-2.7	11.0
3	Zarnitza	7-8	75	4.5	95	28.8	2.5-2.8	9.0
4	Zolotoy Kaskad	10-12	80	2.5	97	9.8	2.5	12.0
5	Krasny Fakel	10-12	70	5.7	162	24.0	2.5	12.0
6	Botanicheskaya Lubitelskaya		60-110	4,7	81	10,7	3-4	
7	Luchistaya		60	4,9	74,5	8,7	3	
8	Botanicheskaya	10	55-60					
9	Chuyskaya		89	6.2	134	13.7		18.0
10	37-89-321	5.3		1,5-3,0	37,5-103,		3.1	
11	Triumph	11	70-80	4.3	250	3.4	2.5	

# 12 Russian varieties under testing



# Mother orchard of Russian seabuckthorn HI-2



# Selection of high yielding cultivars

- **HI-2:**
  - Mild thorny
  - High yielding (5.4 kg/plant)
  - Large fruits (40g/100)
- **NX-12:**
  - Mild thorny,
  - high yielding (5.5 kg/plant)
  - Large fruits (35g/100).



Table variety-Himalayan grape (110 g/100),  
HPKV, Kukumseri, Lahaul (under testing stage)



# Performance of Harvesting Devices

Variety: H. Salicifolia

Parameters	Manual harvester				Traditional system
	Comb	Shaker	Wire clip	Wire clip with handle	
Capacity, Kg/h	5	5.5	5.2	6.5	3
Damage, %	20	15	25	23	40
Labour requirement, man-h/ kg	0.2	0.18	0.19	0.15	0.33
Cost of device, Rs	200	350	40	250	-
Cost of operation, Rs/kg	5	4.5	5	4	10





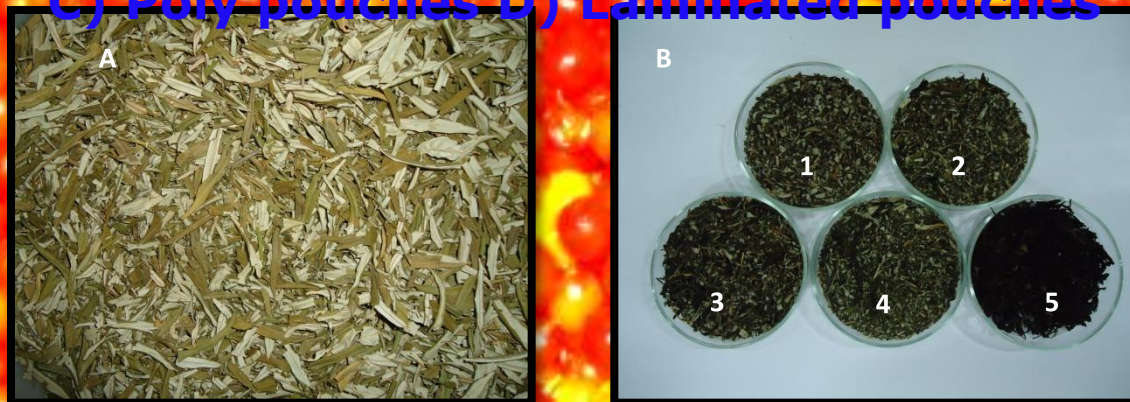


**Products Developed**

# Value Added Products

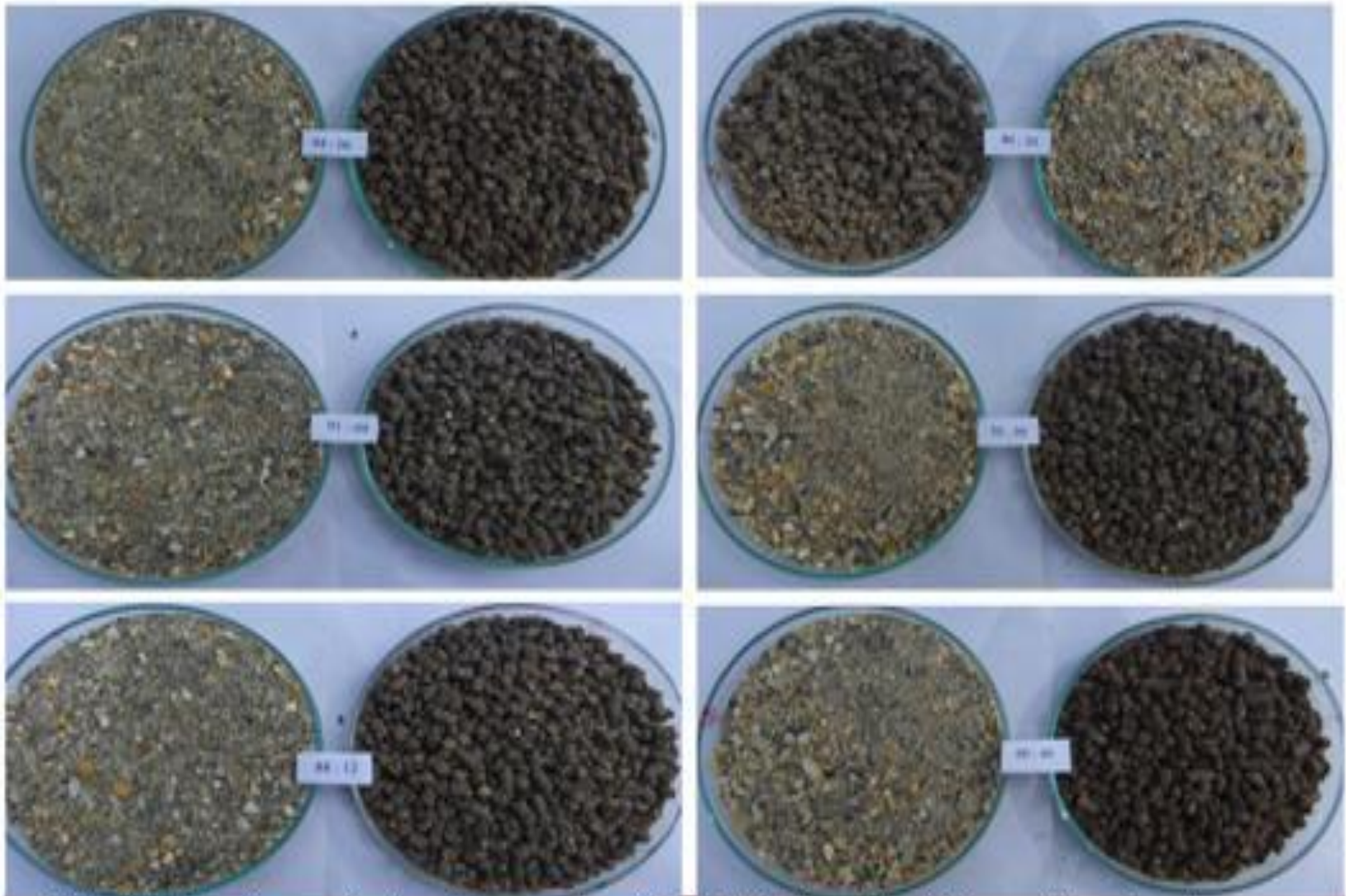


**Plate 1** Jam packed in different packaging materials A) Plastic jars B) Glass jars C) Poly pouches D) Laminated pouches



**Plate 2** A) Seabuckthorn leaves B) Different formulations of Seabuckthorn leaves tea

# Seabuckthorn feed for poultry & Animal

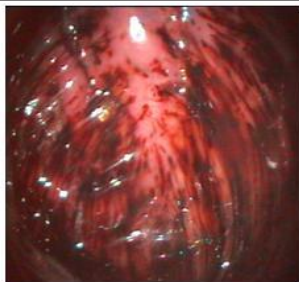




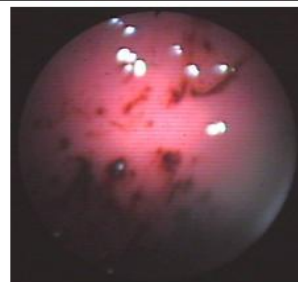

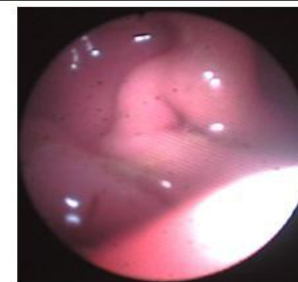
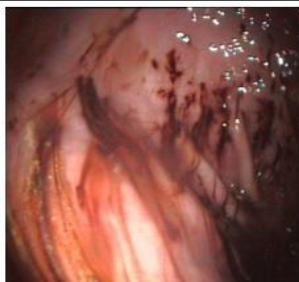


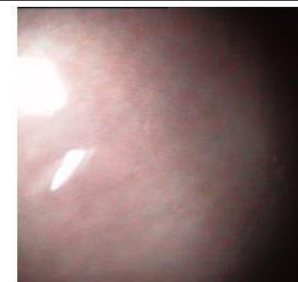
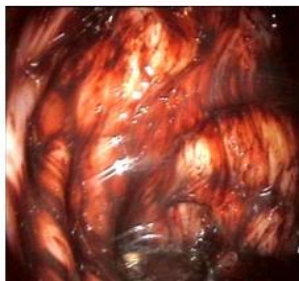



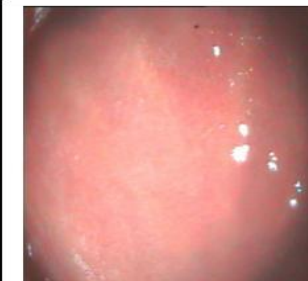


**Plate 3.3: Feed manufactured in mash and pelleted form for different treatment groups**

# Seabuckthorn in the healing and prevention of gastric erosions and ulcers in animals

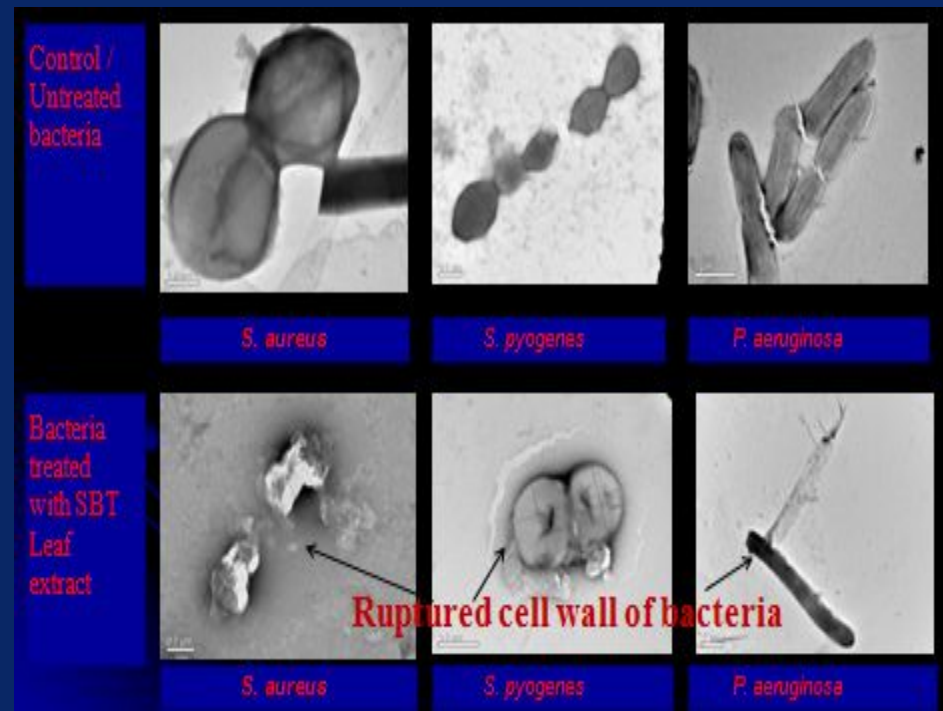
Group I	Group II	Group III	Group IV	Group IV
				
<p style="text-align: center;">Seabuckthorn oil @ 5ml b.i.d, p.o.</p>	<p style="text-align: center;">Misoprostol @ 200µg b.i.d, p.o</p>	<p style="text-align: center;">Sucralfate @ 10ml (1 Gm) b.i.d, p.o</p>	<p style="text-align: center;">Famotidine @ 20 mg b.i.d, p.o</p>	<p style="text-align: center;">Lansoprazole @ 30 mg b.i.d, p.o</p>

**Plate 2: Comparative representation of endoscopic score of GUE lesions in various groups of dogs during therapeutic trials**

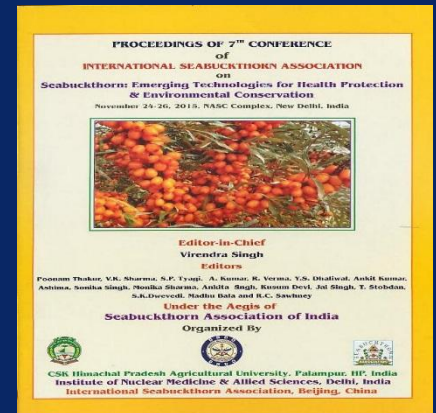
Groups	Pre-treatment	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day
Seabuckthorn oil					
Omeprazole					
Lansprazole					
Famotidine					

# Wound healing agents, Anti-microbial preparations

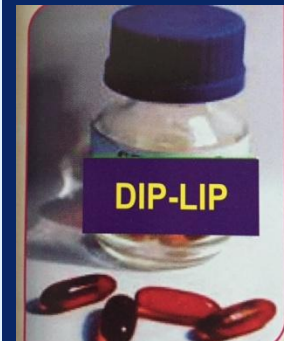
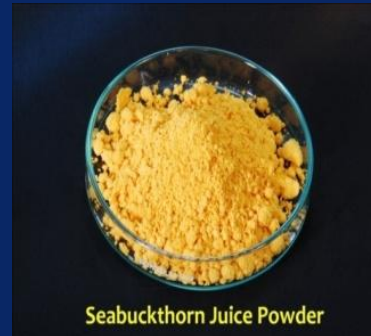
- Seabuckthorn leaf extract was found more effective for healing of infectious wounds than oil.
  - Leaf extract showed remarkable inhibition against *S. aureus*, *P. aeruginosa*, *P. mirabilis* and *S. pyogenes* while least inhibition was observed for *B. subtilis* and *K. pneumoniae*.
  - H. salicifolia* leaf extract showed higher inhibitory effect as compared to *H. rhamnoides* and *H. mongolica* against tested bacterial strains.
- The seabuckthorn preparations have utility in treating skin infections in the domestic animals.



# Thanks to NMPB, AYUSH for financial assistance for organizing International Conference on Seabuckthorn, Nov. 24-26, 2015, N. Delhi (HPKV & SAI)



# Health products by other R&D Institutions in India





# Seabuckthorn products in India

- Semi-Processing units: 10 in Ladakh, 4 in HP, 1 in UK and 1 Sikkim
- Farmers are paid Rs. 50/kg fruits in Leh and Rs.70 in HP
- 6 Manufacturing companies (Chandigarh Agritech, Baddi, HP, Bioasash, Sundernagar, HP & Faridabad, Zeon, Panotasahib, HP, Minchy,
- HP, Lehberry, Delhi, Synthite, Kochi, Kerala)
- 120 seabuckthorn food (60) cosmetics (55) and oil capsules (5)
- Oil extraction by Supercritical CO2 extraction, Baddi, Jaipur and Kochi.
- No sustainable supply to raw material, importing from China and Pakistan



# Challenges in development and utilization of resources

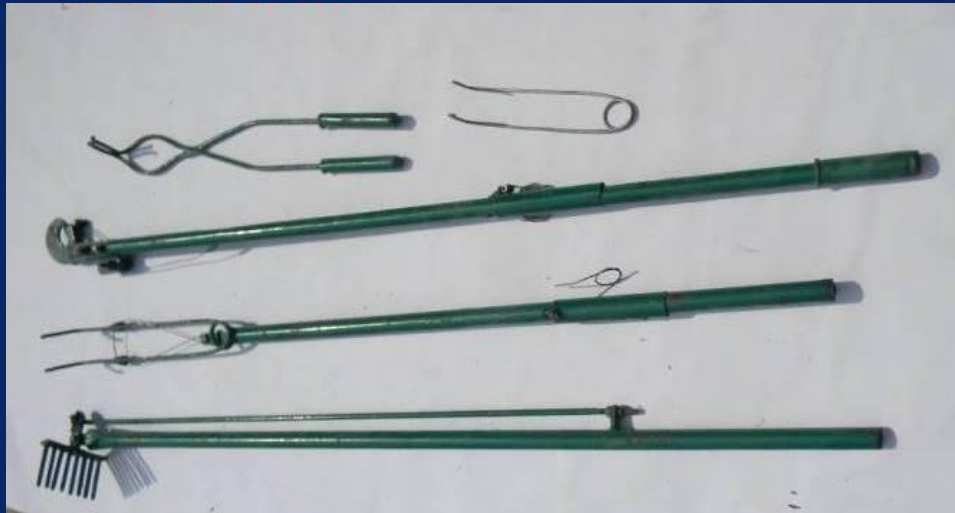
Sr.No.	Challenges	Solutions
1	Indigenous seabuckthorn not accepted by farmers under alley cropping systems	<ol style="list-style-type: none"><li>1. Introduce Russian seabuckthorn under alley cropping systems (4 x 2 m)</li><li>2. Introduce high yielding and mild thorny <i>H. salicifolia</i> (Drilbu) in community land</li><li>3. <i>H. rhamnoides</i> spp. <i>turkestanica</i> plantation only on waste lands for control soil erosion and biodiversity conservation, source of fruit, leaves and fuelwood.</li><li>4. Develop thornless forms through mutation.</li></ol>
2	Russian varieties are not successful in dry Spiti & Ladakh	<ol style="list-style-type: none"><li>1. Develop F1 between female Russian and local seabuckthorn</li><li>2. Import F1 form from Mongolia</li></ol>

# Lack of plantation technologies in dry sites with out irrigation

- Development of water gel method
- R&D collaboration with Israel, Mongolia and Chinese universities

# Development of farmer friendly harvesting tools

- Further improvement of tools developed by HPKV and other organizations



# Validation of therapeutic value of cultivated seabuckthorn using *in vitro* and *in vivo* studies

Species: *H. salicifolia* and Russian seabuckthorn

- Economics of harvesting and cultivation
- Identification of molecules
- Value addition
- Preclinical studies

# Toxicological and Clinical studies in the areas

## Priority areas:

1. Immunology
2. Cardiovascular
3. Diabetes

# Establishment of Centres of Excellences in 5 Himalayans States

- HP, UK, Sikkim and Arunachal Pradesh. Leh already has under Department of Horticulture.
- Proposal by HPKV, Palampur is ready for submission.

## Plan of Action for next 10 years

Sr.No.	Years	Activities	Remarks
1	1-2 years	<p>Constitution of Programme Implementation and Monitoring Committees</p> <p>Survey of land by Departments of Forest &amp; Horticulture, Constitution of Task Forces' of Stake holders, development of infrastructure, mass propagation and preparations for afforestation and cultivation, MOU with China, Russia, Germany and Mongolia on training, import of Germplasm of Seabuckthorn for cultivation in dry areas, Establishment of Seabuckthorn Research &amp; Training Centres in 5 states, Training of trainers in India and abroad , transformation of natural forest into productive stands</p>	<p>Preliminary surveys may be undertaken by the specialists from the society, based on which proposal may be made</p>
2	2-4	<p>Transformation of 3000 hac natural forest into productive stands, Mass propagation, cultivation of seabuckthorn in 30,000 ha land (25,000 ha by Department of Forest and 5000 ha by Department of Horticulture of 5 Himalayan states), economics, R&amp;D on propagation, cultivation, value addition and clinical trials</p>	<p>*Subject to suitable clarification/approval from MoEFCC, GoI</p>



# Plan of Action for next 10 years

Sr.No.	Years	Activities	Remarks
3	4-10	Organic certification, mass propagation and cultivation of seabuckthorn, R&D on cultivation, processing, marketing, and clinical trials, final out come report	
4	6-10	Establishment of modern semi-processing units and cold chain and processing and marketing by private sector	

**\*Note:** Transformation of 3,000 ha seabuckthorn natural forest (1000 ha in Ladakh in J&K, 500 ha in each of 4 states), is subject to suitable clarification/ permission from competent authority

## Policy Interventions Required: Seabuckthorn Afforestation and Cultivation

Sr.No.	Issue	Recommendations	Action
1.	<b>A minimum area of plantation of Seabuckthorn</b>	A minimum of 5000 ha in each of five Himalayan states, namely Jammu-Kashmir (Ladakh), Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh, a total of 25,000 ha may be brought under various schemes e.g. Compensatory Afforestation of Forest Department, as well as Horticultural schemes (MIDH etc.) (5000 ha) as the case may be.	Department of Forest & Department of Horticulture of five Himalayan states (HP, J&K, UK, Sikkim & AP), MOEFCC, Ministry of Defence, Ministry of Tribal Affairs and Ministry of Home Affairs.
2.	<b>Seabuckthorn a priority plant in cold desert and dry temperate Himalayas.</b>	Seabuckthorn may be declared as a priority plant for afforestation and cultivation in high altitude and cold desert border areas, a strategic region of the country. 90% seabuckthorn and 10% other tree species. e.g <i>Juniperous macropoda</i> in case of Lahaul-Spiti, may be planted.	Department of Forest of five Himalayan states (HP, J&K, UK, Sikkim & AP)

## Policy Interventions Required: Seabuckthorn Afforestation and Cultivation

Sr.No.	Issue	Recommendations	Action
3.	<b>Transformation of natural forest of seabuckthorn into productive stands</b>	A minimum of 3000 ha forest of seabuckthorn may be converted into productive stands in order to improve the fruit collection and income of farmers/harvesters (1000 ha in Ladakh, 500 ha in each of HP, UK, Sikkim and AP) in the first phase. However, in order to minimize the fruit wastage and to rejuvenate the forest, Department of Forest should aim to ensure 100 percent harvesting in a time bound manner in the next five years for livelihood improvement of local people.	Department of Forest of five Himalayan states (HP, J&K, UK, Sikkim & AP)
4.	<b>Farmers to carry out plantation and commercial use of Seabuckthorn on Forest land.</b>	Farmers may be empowered by developmental agencies financially and with rights of seabuckthorn plantation, management and fruit and leaves collection on marginal/waste/community lands and termed as commercial forestry.	AYUSH in five Himalayan states (HP, J&K, UK, Sikkim & AP)

## Policy Interventions Required: Seabuckthorn Afforestation and Cultivation

Sr.No.	Issue	Recommendations	Action
5.	<b>Involvement of stake holders.</b>	Stake holders (developmental agencies of Forest, Horticulture etc., R&D institutions, farmers, NGOs and private sectors) should be involved in policies, planning and execution of seabuckthorn cultivation/afforestation programmes.	Department of Forest & Horticulture of five Himalayan states (HP, J&K, UK, Sikkim & AP)
6.	<b>Subsidy</b>	AYUSH may extend the subsidy benefit from Rs.1.5 lakhs/ha to Rs.2.50 lakh/ha to farmers for cultivation of seabuckthorn on community land owned by Forest Department for commercial purpose, besides private land.	AYUSH

## Policy Interventions Required: Seabuckthorn Afforestation and Cultivation

Sr. No.	Issue	Recommendations	Action
9.	<b>Seabuckthorn in syllabus of Horticulture and Forestry subject.</b>	Seabuckthorn should be included in syllabus of Horticulture and Forestry subjects involving experts of local institutes/universities.	CSK HPKV, Palampur, UHF, Nauni and other R&D institutions in five Himalayan states (HP, J&K, UK, Sikkim & AP)
10.	<b>Long term funding of R&amp;D programs on seabuckthorn</b>	Funding agencies should launch special seabuckthorn long term schemes for research and development on seabuckthorn in a Mission Mode Programme.	AYUSH, Developmental agencies (Department of Forest & Department of Horticulture), MoEFCC, ICAR, DRDO, NHB, NMPB, DST, DBT, DST, CSIR etc.
11.	<b>Central Body</b>	National Seabuckthorn Research and Training Centre with Regional Centres of Excellences	R&D institutions in five Himalayan states (HP, J&K, UK, Sikkim & AP)

## B. Recommendations for “Special Package for Commercialization of Seabuckthorn”:

S.No.	Issue	Requirement	Action By
1	<b>Unambiguous classification of SBT as a horticultural crop</b>	<ol style="list-style-type: none"> <li>1. Due recognition by respective state Government</li> <li>2. Clarification regarding applicability of Mandi Tax</li> <li>3. Permission for unhindered movement from afforestation/ cultivation areas to processing units/receiving ends</li> </ol>	Department of Horticulture, Ministry of Agriculture, GOI and State Governments
2	<b>Fair &amp; defined protocols on commercial harvesting of wild SBT</b>	<ol style="list-style-type: none"> <li>1. Facilitation by Government by way of creation of passages / installation of lighting and facilitation for harvesting implements.</li> <li>2. Fixation of price of Seabuckthorn produce (fruit and leaves) by Forest Department to be paid by the harvesters / entrepreneurs.</li> </ol>	Forest Department in each of the states
3	<b>Creation of Primary Processing centers close to cultivation</b>	<ol style="list-style-type: none"> <li>1. Demonstrative units to be set up by Government or fostered by Government in a PPP model to take care of washing, cleaning, pulping / freezing of SBT fruit and its refrigerated transport to main land / intermediate storages</li> </ol>	Department of Horticulture in each of the growing states

## B. Recommendations for “Special Package for Commercialization of Seabuckthorn”:

S.No.	Issue	Requirement	Action By
4	<b>Fiscal Incentives for scientific cultivation of SBT as well as on Capital Investment for PHM &amp; Processing</b>	<ul style="list-style-type: none"> <li>▪ Simplified prompt mechanism for disbursement of financial assistance</li> <li>▪ Cultivation where buyback of fruits &amp; leaves is in place should get preference</li> </ul>	Ministry of Agriculture, GOI
5	<b>Refrigerated transportation</b>	<ul style="list-style-type: none"> <li>▪ Initial arrangements through existing Public Sector organisations – CONCOR or other state enterprises and / or through adequate freight subsidies on refrigerated movement.</li> <li>▪ Again simplified procedures for expeditious disbursement would be a must</li> </ul>	Ministry of Agriculture, GOI
6	<b>Enhancement in the extent of Existing fiscal incentives</b>	<ul style="list-style-type: none"> <li>▪ Level of financial support by MIDH – needs be enhanced to provide for difficult terrain and working conditions, new activity and chances of part failure.</li> <li>▪ From a present level of 50%, it should be increased to minimum 75%.</li> <li>▪ Maximum limit on subsidy should also be increased from Rs 4.0 crs. to a minimum of Rs5.0 crs. similar to MOFPI schemes</li> </ul>	Ministry of Agriculture, GOI.

## B. Recommendations for “Special Package for Commercialization of Seabuckthorn”:

S.No.	Issue	Requirement	Action By
7	Simplification and streamlining of procedures for release of Subsidy / Grant by MIDH to make it time bound and workable	<ol style="list-style-type: none"> <li>1. All subsidies / grants must be designed in such a way to ensure timely disbursement. For processing units, the Grant should be parked with the term lending institution and disbursed on pro rata basis by the bank along with the term loan under the overall watch of Ministry. Primary responsibility for timely disbursement should be with the term lending institution.</li> <li>2. The subsidy should be concurrent and not back ended to make it a real time help to the entrepreneur, similar to MOFPI schemes.</li> <li>3. Financial Assistance for existing units should be increased from Rs 1.0 crore at present to Rs 5.00 cr. (presently Rs 4.0 cr. for new units) for Seabuckthorn processing units, similar to Ministry of Food Processing Industries, Govt of India schemes.</li> </ol>	Ministry of Agriculture, GOI
8	Level playing field vis-à-vis imported pulps and products	<ul style="list-style-type: none"> <li>▪ FSSAI stipulations should apply to imported Fruit Berry, Fruit Pulp, Seed, Oils etc. so as to ensure a level playing field and safe guard local farmers and industry.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ministry of Food Processing Industries, GOI</li> </ul>



## B. Recommendations for “Special Package for Commercialization of Seabuckthorn”:

S.No.	Issue	Requirement	Action By
9	<b>Level playing field vis-à-vis imported pulps and products</b>	1. FSSAI stipulations should apply to imported Fruit Berry, Fruit Pulp, Seed, Oils etc. so as to ensure a level playing field and safe guard local farmers and industry.	Ministry of Food Processing Industries, GOI
10	<b>Government initiative for Organic certification and traceability</b>	1. Subsidised certifications to be arranged by Government to start with (initial 3 years) 2. Setting up of Agencies for Organic Certification and Traceability stamping by Government in PPP model.	MOFPI / APEDA
11	<b>Setting up of a few demonstrative units by Government or in PPP model</b>	1. Setting up of a few demonstrative processing units at strategic places by the Government to accelerate investments by local farmers / entrepreneurs and Corporate.	Ministry of Agriculture / MOFPI, GOI

# Input and return from investment of Rs. 250 crores on 5000 ha community land in HP

Sr.No.	Input	Rs
1	Cost of afforestation of seabuckthorn per ha	Rs.5.00 lakh
2	<b>Cost of afforesattion in 5000 ha</b>	<b>Rs. 250 crores</b>
b	Output	
1	Fruit rate @Rs./kg	Rs.75
2	<b>Fruit yield per ha/yr</b>	<b>2.00 tons</b>
3	<b>Fruit income per ha/yr</b>	<b>Rs.1.50 lakh</b>
4	Fruit yield in 5000 ha/yr	10,000 tons
5	Income from 5000 ha/yr	Rs.75 crores
6	Leaves rate @Rs./kg	Rs.300
7	Leaves production per ha	0.50 tons
8	Leaves income per ha	Rs.1.50 lakh
9	Leaves production in 5000 ha	2500 tons
10	Leaves income in 5000 ha	Rs.75 crores
11	Total gross income in 5000 ha	150 crores
12	<b>Gross income from 5000 ha in 25 years</b>	<b>Rs. 3750 crores</b>
13	Cost-benefit ratio	15

## Cultivation of improved seabuckthorn in 1000 ha orchards under Russian seabuckthorn

<b>a</b>	<b>Input</b>	
<b>1</b>	<b>Cost of cultivation per ha</b>	<b>Rs.5.00 lakh</b>
<b>2</b>	<b>Cost of cultivation in 1000 ha</b>	<b>Rs.50 crores</b>
<b>b</b>	<b>Out put</b>	
<b>1</b>	<b>Fruit rate per kg</b>	<b>Rs.75</b>
<b>2</b>	<b>Fruit production per ha</b>	<b>10 tons</b>
<b>3</b>	<b>Income from fruits per ha</b>	<b>Rs. 7.50 lakh</b>
<b>4</b>	<b>Fruit yield in 1000 ha</b>	<b>10,000 tons</b>
<b>5</b>	<b>Fruit income in 1000 ha</b>	<b>Rs. 75.00 crores</b>
<b>6</b>	<b>Leaves production per ha</b>	<b>0.50 ton</b>
<b>7</b>	<b>Leave rate per kg</b>	<b>Rs. 300</b>
<b>8</b>	<b>Leave income per ha</b>	<b>Rs.1.50 lakh</b>
<b>9</b>	<b>Leaves production in 1000 ha</b>	<b>500 tons</b>
<b>10</b>	<b>Income from leaves in 1000 ha</b>	<b>15 crores</b>
<b>11</b>	<b>Income (fruit + leaves) per ha</b>	<b>Rs.9.00 lakh</b>
<b>12</b>	<b>Total gross income in 1000 ha</b>	<b>Rs. 90 crores</b>
<b>13</b>	<b>Income in 1000 ha in 25 years</b>	<b>Rs. 2250 crores</b>
<b>14</b>	<b>Cost-benefit ratio</b>	<b>45</b>

# Overall Outcome (Rs. 1610 crores) in 5 States

1. Slowing the melting of glaciers, hence improved food security to the people.
2. Improvement of soil erosion and siltation of rivers, hence less floods in north India and more electricity generation especially during rainy season.
3. Improvement of biodiversity, soil water, and wild life conservation.
4. There will be increase of fruit availability from existing 700 tons to 79,500 tons of fruits and 16,500 dried leaves in 33,000 ha seabuckthorn plantation to private sector.
5. Over all, from a total investment of Rs. 1260 crores on seabuckthorn development in 33,000 ha land during 10 years, there will be a gross income of Rs.26,156 crores to farmers during next 25 years with a cost benefit ratio of 16.3
6. Employment generation for 1200 skilled and 20,000 semi skilled youths and 7,84,50,000 daily wages for labour forces in 5 Himalayan states through mass propagation, cultivation, harvesting, transport, semi-processing and processing, hence checking of migration of youths, national security in border areas.
7. Providing nutrition security to 45% children and 20% women suffering from malnutrition.
8. Providing health protection to 200 million Indians suffering from heart problems, diabetes, cancer and gastric ulcer etc.
9. Health protection and helping in early acclimatization of Indian army posted in high altitude along Indo-Tibet border areas of Himalayas.

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2. Singh, V. et al. 2015. Proceedings of 7<sup>th</sup> Conference of the International Seabuckthorn Association” on “*Seabuckthorn-emerging Technologies for Health Protection and Environmental Conservation*” held on Nov. 24-26, 2015, at New Delhi, India, 525p.
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**THANK  
YOU**

