

Full Length Research Paper

Promoting nursery enterprise in high altitude villages: A participatory approach for conservation and commercialization of Himalayan threatened medicinal plants

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Conservation of threatened species through cultivation is anticipated to be helpful in sustainable supply of raw material of high value Himalayan medicinal plants. However, adequate production of planting material of medicinal plants is essential for promoting mass scale cultivation of potential species and also, it can be a profitable enterprise for rural communities. Utilization of traditional agro-ecological knowledge possessed by rural communities living in mountain areas, strengthening existing practices, involving community based non-government organizations (NGOs) for development of planting material of medicinal plants and facilitation in terms of technical and financial support from an institutions, may be valuable for domestication of threatened medicinal plants. A pre-proposal based program for developing planting material of two The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) species (*Saussurea lappa* and *Picrorhiza kurrooa*), three locally threatened species; *Aconitum heterophyllum*, *Allium stracheyi* and *Pleurospermum angelicoides*, and one species in high demand (*Carum carvi*) was used with decentralized or participatory approach. The planting material was developed by farmers and community based non government organizations in some high altitude villages of district Chamoli, Uttarakhand, India. On the basis of estimated achievement, it was observed that, the planting material of *P. kurrooa*, *S. lappa*, *C. carvi* and *A. stracheyi* was developed up to satisfactory level (up to 40.00 to 94.42% by 21 farmers in 12 villages through strengthening of existing nurseries and 45.00 to 93.33% by 5 NGOs in 4 identical villages through establishment of new nurseries) in two years.

Key words: CITES species, cultivation, decentralized, optional crops, planting material.

INTRODUCTION

Medicinal plants are provisioning ecosystem service with direct economic benefits (Maestre Andrés et al., 2012).

Acceptability of plants derived medicines as safe and low cost alternative as compared to the prescribed medicines

has extended their demand (Hoareau and DaSilva, 1999; Lange, 2004). Collection and trade of medicinal plants from wild habitats in Indian Himalayan region (IHR) has considerable contribution in the economy of rural poor living in developing countries (Olson and Larson, 2003). Imperfect functioning of collection and inadequate regeneration are recognized as key reasons for dwindling status of potential Himalayan medicinal plants (Olson, 1998; Bhadula et al., 2000). In order to prevent wild harvesting and encourage conservation of threatened medicinal plants through cultivation, the Ministry of Commerce, Government of India has imposed prohibition on wild collection, inland trade and export of 29 medicinal plants (also termed negative list) either in crude form or plants product that could be separated in its ingredients (Anon, 2000). Because of dwindling status, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has listed *Saussurea costus* and *Picrorhiza kurrooa* in its Appendices I and II, respectively (CITES, 2012). Also, recent Conservation Assessment and Management Prioritization (CAMP) exercise for Himalayan medicinal plants has categorized *Aconitum heterophyllum* as critically endangered and *Allium stracheyi* and *Pleurospermum angelicoides* as vulnerable (Ved et al., 2003).

A. heterophyllum Wall ex. Royle (Monkshood, Vern. Atis; Ranunculaceae), *A. stracheyi* Baker (Himalayan seasoning Allium, Vern. Faran; Alliaceae), *C. carvi* L. (Caraway, Vern. Kala Jira; Apiaceae), *P. angelicoides* L. (Vern. Gandrayan; Apiaceae), *P. kurrooa* Royle ex. Benth (Gentian or Hellebore, Vern. Kutki; Scrophulariaceae) and *Saussurea lappa* (Decne) Sch. Bip. Syn. *S. costus* C. B. Clarke (Costus, Vern. Kuth; Asteraceae) are among low volume-high value globally significant medicinal plants (GSMPs) of Indian Himalaya (Olson, 1998; Kuniyal et al., 2005; Olson and Larson, 2003; Anon, 2009; Butola and Samant, 2010; Negi, 2012; Kuniyal and Sundriyal, 2013; Kuniyal et al., 2013). Annual availability of *A. heterophyllum* in India is about 50 to 75 ton; thus, any other additional demand of this species in Indian herbal pharmaceuticals is fulfilled through import from neighboring countries such as Pakistan and Nepal. On the other hand, nearly 33% requirement of *P. kurrooa* in Indian herbal pharmaceutical industry is met through import from other countries (Anon, 2009). However, in 2007 to 2008, a total 5700 kg roots of *Saussurea costus* having an approximate economic value of US \$19703.23; (US\$ 1.00 = Rs 53.24 as on 24, September, 2012) were exported from India to European Union (EU) countries

(Anon, 2009). Also, a total, 297,570.00 kg seed of *Carum carvi* from India was exported during 2003 to 2004 to 2007 to 2008 (Anon, 2009). Thus, cultivation of these species for supporting regional economy may be a useful optional agricultural activity in Himalayan Mountains.

It is encouraging that the techniques for propagation of these species are available; as, *C. carvi*, *P. angelicoides* and *S. lappa* are propagated through seeds (Kuniyal et al., 2005; Negi, 2012) while; *Aconitum* sp., *Allium stracheyi* and *P. kurrooa* are propagated through seeds and vegetative methods (Nautiyal et al., 2001; Kuniyal et al., 2003; Negi, 2012). Therefore, production of planting material and mass scale cultivation of these species can be undertaken without much difficulty. Estimated achievements of such an implemented decentralized and participatory approach based nursery development program for some threatened Himalayan medicinal plants in some mountain villages of Chamoli, Uttarakhand, India, with its SWOT analysis and some useful suggestions for future are reported in this communication.

MATERIALS AND METHODS

Criteria adopted for feasibility assessment and possible framework

Prior to implement this program, it was assumed that, possibly wild collection of medicinal plants in Indian Himalayan region (IHR) is discouraged due to the enforcement of conservation acts. Therefore, possible cultivation of threatened as well as valuable species will be useful for economic development in mountain villages. Sufficient availability of planting material is fundamental for cultivation of rare and endangered species. Generally, the public sector (centralized or governments) that have meager infrastructure and fewer staff, will not be able to fulfill such a practical requirement of plantlets and seeds in unreachable and remote locations of this newly established hill state. Selection of innovative farmers and nearby working community based nongovernment organizations (NGOs), those deserving some traditional or technical expertise, and considering appropriateness of habitats for usual growth of selected species, were considered as feasibility parameters.

After assessing feasibility, the framework for implementation of this program was considered likewise: (i) Initially the planting material of threatened and high value species should be produced by native farmers and NGOs from available mother stock through strengthening of existing nurseries and development of new nurseries, (ii) Strength, weakness, opportunities and threats (SWOT) analysis for strengthening of indigenous practices and new establishment will be a useful tool for assessment of initial situation, performance and future implications, (iii) Development of planting material in adequate quantity, cultivation with clusters approach and enough production of raw material will offer opportunities for extension, research, value addition, effective marketing and overall improvements through collective efforts of research, marketing and

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financial institutions and, (iv) In future, developed nurseries and subsequent cultivation will be assisted by research institutions for development of new cultivars (high yielding, short gestation period and resistant varieties), subsequently, on-farm trials will serve as ideal sites for investigation on disease instances, productivity, risks and risk cover mechanism, and cost benefits analysis.

Strategy and execution

A pre-proposal based grant (received for an approximate period of 18 to 24 months) for up-scaling production of the planting material of *A. heterophyllum*, *A. stracheyi*, *C. carvi*, *P. angelicoides*, *P. kurrooa* and *S. lappa* through 18 to 24 months) for up-scaling production of the planting material of *A. heterophyllum*, *A. stracheyi*, *C. carvi*, *P. angelicoides*, *P. kurrooa* and *S. lappa* through strengthening of existing nurseries (already developed by innovative farmers, either with any kind institutional support or self-innovativeness or as upholding of customary practices), and establishment of new nurseries through community based non-government organization (possibly in identical places) was utilized. This program was implemented in high altitude villages (2350 to 2566 m asl) of district Chamoli, Uttarakhand (established as separate small hill state on 9 November, 2000, covers 53,483 km² total geographical area, located along 28° 44' N to 31° 28' N and 77° 35' E to 81° 01' E, having 34,662 km² forest area and this state is located in the north part of India, western Himalaya). Pre-proposal based grant for this program was received under National Agriculture Development Program (Rashtriya Krishi Vikas Yozna; a Centrally Assisted Scheme of the Government of India).

Before implementation, reconnaissance was conducted in geographically and floristically potential high altitude villages in three administrative blocks of district Chamoli (Uttarakhand, India), namely; (i) Dewal, (ii) Ghat and (iii) Joshimath. Inhabitants of Dewal and Ghat blocks are indigenous, while in a part of Joshimath block migrant communities known as *Bhotias* inhabit during April to October. However; both indigenous and migrant villagers practice similar traditional agro-pastoral activities including sheep rearing, cultivation of traditional food crops and newly initiated cultivation of medicinal plants as optional crops. The villagers of Ghes (2566 m asl), Himni (2500 m asl), Kuling (2350 m asl) and Wan (2550 m asl) in Dewal block are experienced in development of planting material and cultivation of *P. kurrooa* and *S. lappa*. Innovatively, some farmers of this area have also started seed germination trials of *A. heterophyllum* in the fields. Villagers of Kanol (2550 m asl) and Sutol (2900 m asl) in Ghat block are familiar with the cultivation of *S. lappa* from more than 7 to 8 decades. Some villagers in this area were also interested for cultivation of *P. kurrooa* and *A. heterophyllum*. The migrant villagers of Niti (3450 m asl), Gamshali (3350 m asl), Kailashpur (3000 m asl), Malari (3200 m asl), Jhelum (3000 m asl), Khiron (3000 m asl) and Tolma (2600 m asl) in Joshimath block are accustomed with traditional cultivation of *Allium stracheyi* and *Carum carvi* since immemorial. Some farmers in this area also expressed willingness for development of planting material of *Pleurospermum angelicoides*.

On the basis feasibility assessment in selected areas; *A. heterophyllum*, *P. kurrooa* and *S. lappa* were prioritized for Dewal and Ghat blocks and *A. stracheyi*, *C. carvi* and *P. angelicoides* were prioritized for Joshimath blocks (Figure 1). After on-site verification of accomplishments and innovativeness, experienced farmers were motivated to submit an application for financial support that has to be disbursed after representation by seekers and recommendations of evaluation committee constituted by Herbal Research and Development Institute (HRDI). On the other hand, applications were invited from experienced NGOs for

establishment of new nurseries in selected area through open advertisement published in regional newspapers. Area under any kind of legal ownership, availability of mother stock for proposed species and experience in development of nursery of medicinal plants were considered as preliminary criteria's by evaluation committee for granting financial support. Targets, which means what quantity of planting material is to be produced during two years was also determined by evaluation committee. Gross financial assistance for soil and land development, procurement of mother plants, construction of shade house, development of irrigations facility, compost pits, protection and fencing, and management costs was granted to the beneficiaries. Average amount of gross assistance granted to different beneficiaries is provided in Table 1. Total 21 programs for strengthening of existing nurseries and 5 for establishment of new nurseries by NGOs were sanctioned after recommendations of evaluation committee. The beneficiaries were suggested to provide help to local farmers either to provide planting material at no cost or technical knowhow during the implementation period of the program; however, providing planting material to other farmers at no cost was not mandatory. Also, frequent technical help to farmers and NGOs was provided by Herbal Research and Development Institute (HRDI). Strength, weakness, opportunity and threat (SWOT) analysis for nursery strengthening and establishment programs in due course of implementation was worked out through initial decision situation as suggested by Houben et al. (1999).

Reported information on development of planting material through participatory approach is based on annual monitoring and reports of the work submitted by each beneficiary. Presented estimates on production of planting material in both programs were made through randomly applying 1 × 1 m quadrat during the monitoring and field verification. Distribution of free planting material to other farmers from these nurseries in respective area is based on exact counts of plants and actual number of beneficiaries. In order to draw clarity in targets and achievements, data related to individual applicants were suitably analyzed. Physical and financial targets and achievements of strengthening of existing nurseries and establishment of new nurseries programs are presented in Table 1. Presented data are average of achievements against the physical and financial targets allotted to the individual beneficiaries and NGOs.

RESULTS

Estimated achievements

Approximately 84.45 to 94.42% achievements were estimated for production of planting material of *P. kurrooa* and 78.13 to 92.90% for seed production of *S. lappa* through strengthening program in the villages located in Dewal and Ghat blocks against allotted targets in two years (Table 1). On the other hand, nearly 86.80% seedlings of *A. stracheyi* and 87.76% seeds of *C. carvi* were produced against allotted targets in the villages selected in Joshimath block through strengthening program during entire implementation period (Table 1). The performance for production of planting material of *A. heterophyllum* either in strengthening of existing nurseries or in nursery establishment programs was poor. Developments of planting material of *P. angelicoides* through strengthening of existing nurseries also do not register encouraging



Figure 1. Nursery strengthening activities in different villages of district Chamoli, India, (a) Seedlings of *Aconitum heterophyllum* (Ghes), (b) *Allium stracheyi* (Tolma), (c) Ripened seeds of *Carum carvi* (Niti), (d) Nursery of *Picrorhiza kurrooa* (Ghes), (e) *Saussurea lappa* (Kanol), (f) A farmer developing seedlings of *Picrorhiza kurrooa* (Ghes), (g) Seedlings of *Pleurospermum angelicoides* raised under nursery establishment program in Khiron village, (h) Selected remote village in the moist temperate area, and (i) Another village in the dry temperate area.

achievements (Table 1). Establishment of new nursery programs were able to achieve approximately 66.67 to 80.00% planting material production against allotted targets for *P. kurrooa* and around 31.25 to 45.00% for *S. lappa* in remote villages of Ghat and Dewal blocks during two years (Table 1). Achievement for production of planting material of *A. heterophyllum* too was very poor in nursery strengthening programs (Table 1). Approximately 46.67, 50.32 and 66.67% estimated achievements were recorded for *C. carvi*, *A. stracheyi* and *S. lappa*, respectively in nursery establishment programs in the villages selected in the Joshimath block (Table 1). On the basis of estimate, approximately 93.33% achievement was recorded for production of planting material of *P. angelicoides* through nursery establishment programs in

selected villages in Joshimath block (Table 1). Despite not to be compulsory, considerable quantity of seedlings and seeds were provided by these beneficiaries and organizations to other villagers in respective area during first and second year (Table 1). The performance for development of planting material in nursery establishment programs was relatively slow in first year, but strengthening of existing nurseries programs performed well even in the first year.

Strengths, weaknesses, opportunities and threats (SWOT) analysis

SWOT analysis of both programs that is, strengthening of

Table 1. Villages, number of beneficiaries, area under nursery activities, financial support to the applicants, species wise targets and area and nursery wise estimated achievements from strengthening and establishment programs.

S/No.	Administrative block (altitude of selected villages and general environmental conditions)	Programs (strengthening of existing nursery and establishment of new nursery)	No. of beneficiaries (villages)	Average area under nursery activities in respective area and collectively for all species (ha.)	Average financial support per beneficiary, Rs. (US \$ @ Rs.53.24 = US\$1.00)	Species targeted (beneficiaries)	Average targets per beneficiary (no. of plants/kg seeds)	Average of estimated achievements in two year (%)	Average free planting material distributed for promoting cultivation in respective area (total farmers) ^d	
									1st year	2nd year
1	Dewal (2350 to 2566 m asl, moist temperate)	Strengthening	9 (4)	0.52	2,11,000.00	Ah ^a (5)	1,00,000	23.00	-	-
						Pk (7)	1,85,714	94.42	20,000 (25)	20,000 (43)
						Sl ^b (5)	32.00	78.13	1.00 (6)	-
		Establishment	1(1)	1.15	5,00,000.00	Ah (1)	2,00,000	15.00	-	-
						Pk (1)	2,50,000	80.00	-	1,00,000 (7)
						Sl (1)	20.00	45.00	-	-
2	Ghat (2550 to 2900 m asl, moist temperate)	Strengthening	4 (3)	0.78	2,50,000.00	Ah (4)	1,93,750	12.90	-	-
						Pk (4)	68,750	85.45	-	62,000 (44)
						Sl (4)	10.00	92.90	1.43 (7)	3.00 (50)
		Establishment	1 (1)	2.00	10,00,000.00	Ah (1)	4,00,000	7.50	-	-
						Pk (1)	6,00,000	66.67	1,10,000 (13)	-
						Sl (1)	80.00	31.25	-	5.00 (40)
3	Joshimath (2600 to 3450 m asl, dry temperate cold desert area)	Strengthening	8 (5)	0.65	2,22,000.00	Ah (4)	1,00,000	0.50	-	-
						As (7)	1,78,571	86.80	27,500 (28)	-
						Cc ^c (6)	29.17	87.76	-	-
		Nursery Establishment	3 (2)	1.07	4,50,000.00	Sl (1)	100.00	40.00	3 (89)	4.00 (16)
						Pa (1)	1,00,000	7.50	-	-
						Ah (3)	2,20,000	5.30	-	20,000 (15)
Establishment	3 (2)	1.07	4,50,000.00	As (3)	2,58,334	50.32	-	-		
				Cc (2)	30.00	46.67	-	-		
				Sl (2)	30.00	66.67	-	2.00 (10)		
					Pa (2)	75,000	93.33	25,000 (10)	-	

^aAh: *Aconitum heterophyllum*, As: *Allium stracheyi*, Cc: *Carum carvi*, Pa: *Pleurospermum angelicoides*, Pk: *Picrorhiza kurrooa*, Sl: *Saussurea lappa*, ^{b & c}:Seed production was allotted target and ^ddistribution of plating materials, although it was not mandatory, however, applicants were asked to provide technical or in kind help to other farmers.

existing nurseries and establishment of new nurseries indicated that, the villagers living in same villages are living from generation to generation and have good knowledge of local geophysical and climatic conditions. This knowledge is an advantage for promoting optional agricultural activities. Manpower as household members remains available as domestic agricultural labor for existing nurseries owners; low costs for development of infrastructure and familiarity of local climatic events were also useful strength of farmers selected for strengthening of existing nurseries. NGOs selected for establishment of new nurseries were competent for acquiring innovative knowledge. NGOs were competent enough for motivating native communities and development of linkages (Table 2). Failure for constant encouragements, inability to collate modern knowledge together with traditional knowledge and poor living conditions, those possibly enforcing rural villagers for finding instant benefit were observed as main weakness of rural farmers in due course of implementation of this program. High investment in development of infrastructure, many activities and fewer possibility of continuing such programs after completion of financial support (program period) were analyzed as crucial weakness of the NGOs selected for establishment of new nurseries (Table 2). Cultivation of MAPs as an optional crop and possibly better economic returns were observed as useful opportunity for rural villagers. On the other hand, there are options for NGOs for emerging as regional level associate in MAPs sector (Table 2). Lack of market information system (MIS) may be less supportive for farmers' initiative. Also, NGOs may shift their focus from such activities; if they feel financial stress after this program is over. Considerable SWOT analyses of this program are presented in Table 2.

DISCUSSION

Conservation and cultivation of Himalayan medicinal plants is key priority in the Indian Himalayan region (Nautiyal et al., 2001; Kuniyal et al., 2003, 2005; Butola and Vashistha, 2013). Utilization of traditional knowledge of indigenous and migrant communities for developing planting material of high value and threatened species namely *A. stracheyi*, *C. carvi*, *P. kurrooa* and *S. lappa* has proved its effectiveness. Seeds of *C. carvi* and *S. lappa*, and seedlings of *A. stracheyi* and *P. kurrooa* were produced in good quantity. Although, the extent of success was varied among strengthening and establishment programs and generally strengthening programs having some starting material for production of planting material performed better since initial stage. It was also noted that the institutional nurseries (centralized) for these species in this region are few; therefore, it is not possible to meet high demand of planting material

required for vast area. Comparatively, the cost of planting material developed through participatory (decentralized) approach will be less as compared to the centralized nurseries. Involvement of farmers, both either indigenous or migrant and community based nongovernment organization (NGOs) will be helpful in cultivation of wild Himalayan medicinal plants. This approach will also play a role in conservation of threatened medicinal plants. It is important to note that the villages located in the vicinity of high altitude areas in Indian Himalayan Region are described at suitable sites for cultivating high altitude medicinal plants (Kuniyal et al., 2003).

During the course of implementation of this program, decentralized approach was observed to have potential for raising planting material of *A. stracheyi*, *C. carvi*, *P. kurrooa* and *S. lappa*. Investigations on *A. heterophyllum* for production of planting material should be continued. Other reasons for low performance of production of planting material of some species under this program were scarcity of mother stock (*P. angelicoides*) and poor understanding of physiological behavior of seeds germination, as it was observed for *A. heterophyllum*. Upholding traditional cultivation of *A. stracheyi* and *C. carvi* by migrant communities is a valuable traditional technique for conservation of germplasm, besides its economic benefits. Organizations selected for establishment of new nurseries were observed to dedicate higher resources in initial establishments like development of infrastructural, thus their performance was slow in the beginning. In addition, due to short growth season, high altitude areas are also less supportive for agricultural activities.

Cultivation of these species in mass scale may be expected in future. Proximal availability of planting material and quick planting of selected species will possibly reduce mortality and will be also useful for receiving relatively more time in prevailing short growth season. Success of such programs will act as a promoter in developing likelihood for cultivation, because the locally induced motivation will be high. Selected applicants deserved the wide range of strength and opportunity, besides some weakness and threats. However, opportunities will be always there for cultivation of medicinal plants, since, Himalayan medicinal plants are unique ecosystem service having direct economic benefits (Olson and Larson, 2003). Involvement of indigenous communities also may be worthy adaptive management strategy for valuable resources (Armitage, 2003). Due to reluctance of professionals or because of any other reason, if conservation attempts are distracted, then some confident decisions are needed and possibly participatory approach will work better (Weirsum et al., 2006; Noss et al., 2012). Also, some specific and acceptable mechanism for implementing new policies for conservation of resources through community participation

Table 2. Strengths, weaknesses, opportunities and threats (SWOT) analysis of strengthening of existing nurseries and establishment of new nurseries under decentralised and participatory approach.

Strength		Weakness		Opportunities		Threats	
Nursery strengthening	Nursery establishment	Nursery strengthening	Nursery establishment	Nursery strengthening	Nursery establishment	Nursery strengthening	Nursery establishment
Traditionally local farmers are accustomed with traditional agro-ecological knowledge	Can access and sometime deserve more technical knowledge due to wider exposures	Constant technical helps is required to the farmers	The organisation may not be from same village, thus local acceptance is poor	Options are there to adopt medicinal plants as optional cash crops in addition to nursery activities	Performance of organisation will be helpful for gaining acceptance and speciality	Farmers may be discouraged if planting material remains stacked in nurseries	Organisation may discontinue work if financial assistance is over in a given time period
Farmers are aware about habitat specificity of locally growing medicinal plants	Able to motivate communities for optional farming and thus such initiatives may taken in another locations	Unable to collate modern knowledge together with traditional knowledge	Most of the organisations are not exclusive expert of medicinal plants and works in multiple fields	Opportunities for socio-economic upliftment are more due to available market	The organisation may establish federations of growers at village level and may become an associate	Production of planting material for selected species may be harmful due to ever changing requirements	Organisation may adopt another rural development activity due to their choice for multiple sector mandates
Native inhabitant are familiar with local changes in climatic event	NGOs are capable to develop the network for marketing and linking financial institutions	Poor living conditions are prevailing, thus natives are eager for immediate benefits	High infrastructure, manpower cost in beginning become a stress	Competition will emerge within village for production of quality planting material	Strong network could be established by NGOs as efficient outcomes is received	The farmers in similar area may not adopt these crops, if once any nursery grower is discouraged	The failures of any organisation will hinder in developing the confidence for future to other organisation
Low cost for infrastructure and rental due to some existing facilities	Confident as an organisation for management and taking risks	In absence of marketing information system, unable to find local, regional and global requirements	Organisations may discontinue such activities if the program is over or financial support is over.	If the practice continues, it will open options for on-farm investigations on multiple aspects	Linkage development for the involvement of research and financial institutions will be facilitated	Devoid of constant and instant technical support, the farmers may withdraw their attention completely	Organisation may leave farmers in debt of financial organisations
Low manpower cost due to habitual in agricultural activities, thus resources are used with affectivity	Ability to develop linkages with marketing and financial institutions	Doubts are there, whether the practice will be transferred from one to another generation	Multiple sector based activities of any organisation will turn them to adopt another program that offer high better financial support and comfortable work	Strong practical knowledgebase will be developed for future	Value links development may be achieved through participation of organisations	Still meagre information is available on pathology, breeding and genetic improvement, the farmers will be unable to develop the variety of wide competence	Locally experienced failure of organisations will be disseminated in wide area, thus promoting institutions and follower farmers will be in question

needs to be devised (Petursson et al., 2011).

Cultivation of threatened and high value medicinal plants is useful for their constant supply as well as for conservation. Mass scale cultivation of threatened medicinal plants needs sufficient production of planting material. Responsible organizations may not be able for production of planting material on a mass scale. Also, financial crisis may act as constraint for natural resources management in poor and developing region. Feasibility assessment, suitable framework and participation of indigenous communities (decentralized or participatory approach) may be useful for developing planting material of high value Himalayan medicinal plants. Based on estimated achievements of this program it is recommended that the decentralized approach is effective for development of the planting material of some high value Himalayan medicinal plants. However, strong political will and specialized skill will be an incentive for conservation of biological diversity and socio-economic upliftment of poor people (Chhatre and Saberwal, 2005).

Conclusion

Out of the six species targeted for development of planting material through decentralized and participatory approach in this program, planting material for four species (*A. stracheyi*, *C. carvi*, *P. kurrooa* and *S lappa*) was developed up to satisfactory level. Is shift needed on the policies for extension programs on medicinal plants? Why? Medicinal plants species successfully grown by farmers may be handed over to them for development of planting material from available mother stock. Research institutions may undertake on farm investigations on development of new varieties, pathology, productivity, risks and risk cover mechanism, certification and quarantine or development of suitable techniques for other species like *A. heterophyllum* or any other that still need efforts for production of planting material for successive cultivation. Also, habitat conservation strategies for dwindling species need to be ensured for availability of mother stock. Preliminarily, at nursery level, financial institutions may think and come forward for incurring investments, which will be valuable for making nursery programs bankable in terms of investment and return.

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Conflict of Interest

Authors declare that there is no conflict of interest.

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