



Commercial Cultivation and Sustainability of Pushkarmool (*Inula racemosa*), A Case Study from Keylong, Lahaul & Spiti, Himachal Pradesh, India

C. S. Rana^{1*} • Y.S. Negi¹ • L.P. Sawant¹ • Pankaj Prasad Raturi¹

¹Bio-resources Department, Dabur Research & Development Centre (DRDC), Dabur India Ltd. Plot No. 22, Site IV, Sahibabad-201010, Ghaziabad, U.P.

*Corresponding Author Email: drcsir@gmail.com

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Abstract: In the recent years demand of the medicinal and aromatic plants has grown rapidly because of accelerated national and international industrial interest on herbal and Ayurvedic products. Due to this increasing consumption and continued unsustainable collection from the wild habitats and dwindling cultivation practices, numerous high altitude medicinal plants are now on verge of extinction from the wild sources. Variable price status, production limitations, biodiversity rules & regulations and lack of trust among supply chain are preventing producers from taking up continued cultivation practices. *Inula racemosa* Hk.f. is one of them which belong to family Asteraceae locally known as *Manu* and traded as Pushkarmool. It is a rare perennial alpine herb having restricted wild habitats in India. Pushkarmool is widely used in traditional codified and non-codified medicines in India and Tibet. The species take two to three years for producing its yields as root parts for the Ayurvedic medicine and there is no sustainable way, harvesting practices for the conservation of this species. The present study explained steps followed by the private and public partnership. It is a case study which was started in the years 2007-08 by the LMS (Lahaul Medicinal Plant Society) and Dabur India Limited has jointly put the joint efforts to bring Pushkarmool under commercial cultivation. The LMS had played a key role in coordinating and mobilizing the self-help groups (SHGs), government and non-government organization and other institutions in the district Lahaul & Spiti to help privileged local farmers to link up with reliable markets of the raw material with a tie up with Dabur India Ltd, New Delhi. We can promote the cultivation of such medicinal plants by involving the local farmers and bringing these under cultivation which not only helps the conservation of the species, but this has also helped to provide the extra income to the local and native farmers and play a critical role in enhancing their livelihood. The study may be considered as test case for successful conservation by bringing species domestication for the commercial cultivation.

Keywords: Domestication • Cultivation • Conservation • Sustainable harvesting • Livelihood

Introduction

In the Himalayan region, use of the medicinal plants to cure and abate certain disease and ailments is an age-old practice starting from a situation when life-saving herbs from the wild habitats provided the shelters during emergencies and trauma (Arora *et al.*, 1980; Kaul, 1984; Aswal and Mehrotra, 1994; Kuniyal *et al.*, 2004; Rawat *et al.*, 2004; Rana *et al.*, 2010; Rathore *et al.*, 2022). The global estimated market for herbal drugs is nearly ₹ 300000 crores (Anonymous). It was estimated

that there are over 9500 herbal drugs manufacturing units in India. Total commercial demand of herbal raw drugs in the country for the years 2014-15 has been estimated at 512000 MT with corresponding trade value of about ₹7000 crore (Goraya and Ved, 2017). About 1178 medicinal plants species which form source of 1622 botanical recorded in trade. Of these 1178 species, 242 species are in high commercial demand (Goraya and Ved, 2017). Entire Himalaya has been known to a rich



repository of medicinal and aromatic plants. The forests in Himalaya have rich biodiversity, where medicinal and aromatic plants (MAPs) makes up a large part and largely deeds as reservoir for sourcing of the raw material (Rana *et al.*, 2010). The Indian Himalayan Region (IHR) consists endemic plants and home to more than 8000 vascular plants, of which 1748 are recognized for their medicinal aspects and prospects (Kaul, 1997; Rana *et al.*, 2010; Rathore *et al.*, 2022). Now a days, heavy extraction of these plants from the wild sources, loss of habitats by deforestation and excessive grazing pressure observed in the high-altitude meadows in the entire Himalayan region (Arora *et al.*, 1980; Rana *et al.*, 2010; Rathore *et al.*, 2022). National Medicinal Plant Board (NMPB) and State Medicinal Plant Boards (SMPBs) are jointly playing an important role to promote the cultivation and conservation of the elite MAPs in their respective capacities. MAPs are also playing an ever-important role in the health and subsistence economy of the rural people in India. Sustainability of plant species and their regulations for the conservation point of view is being monitored by the State Biodiversity Boards (SBBs) and National Biodiversity Authority (NBA).

Nowadays, some medicinal plants, known as the “backbone” of the traditional codified and non-codified medicine with high economic value are being utilized. *Inula racemosa* Hk.f. belongs to family Asteraceae locally known as “Manu” and mention as Pushkarmool in Ayurvedic text (Fig. 2, A-C). The species are found in restricted pockets in the Himalayas (Arora *et al.*, 1980; Rawat and Everson, 2011; Rathore *et al.*, 2022). It is a rare alpine herb having limited wild habitats in Himachal Pradesh and Jammu & Kashmir. Pushkarmool is widely used in traditional medicines in India and Tibet, in drug industry for its antispasmodic, anti-asthmatic and digestive properties along with use in

veterinary medicine. Earlier, *Inula racemosa* was listed as critically endangered (CR) and it was also listed in CITES-Appendix II among the 427 endangered plant species of Red Data Book (Rawat and Everson, 2011; Rathore *et al.*, 2022). Although, as per current IUCN red list it is not recognized the same which may be due to cultivation at larger scale. It was domesticated in the Lahaul valley in early parts of the twentieth century by progressive farmers and has been grown as a cash crop along with traditional food crops like buckwheat, maize, and several varieties of pulses including MAPs (Kuniyal *et al.*, 2004; Rawat *et al.*, 2004). Pushkarmool cultivation has declined considerably over the past 30 years (Rawat and Everson, 2011). Cultivation of the Manu was at its peak in 1960, when 13.5 hac were planted at Jahlma and 10.3 hac at Hinsia villages. Since then, the cultivation has decreased abruptly between 1980 and 2000 (Rawat and Everson, 2011). Since last decade and half onwards, local people are involved in the commercial cultivation as per market demand (Fig 1&2 A-D). Hence commercial cultivation of this species is important because it provides an additional income besides alternative source of supply and reduces over burden on the natural habitats. Habitat loss, combined with over-exploitation due to industrial needs by the pharmaceutical companies has led to disappearance of the species from many areas. Thus, there is a need for immediate conservation though *Ex-situ* and *In-situ* cultivation approach. To assist in the conservation of the species has been cultivated *ex-situ* with the combined efforts of industries and local promoters in the Himachal Pradesh (Fig. 2, E-F). Now a days, after formation (2008) and inauguration (2020) of the Atal Tunnel, Rohtang (Manali to Koksar) as national high way has opened tourism sectors which is increasing day by day and native people are focusing their interest towards vegetable



cultivation again as case crops and some other people are inclined towards hotel business and adventure expedition. The objective to present here the case study as a success story to replicate for another Himalayan critical plant species. In terms of availability, rate and regulation issue of the medicinal plant those are in low volume and high value. And which can be cultivate in the farmers' field by adopting scientific and social approach.

Keeping the facts in mind the other source of sustainable cultivation is required to full fill the demand and supply of raw materials to the herbal industry and conservation in any form. The present paper has presented here for the purpose of conservation, sustainable development and livelihood promotion.

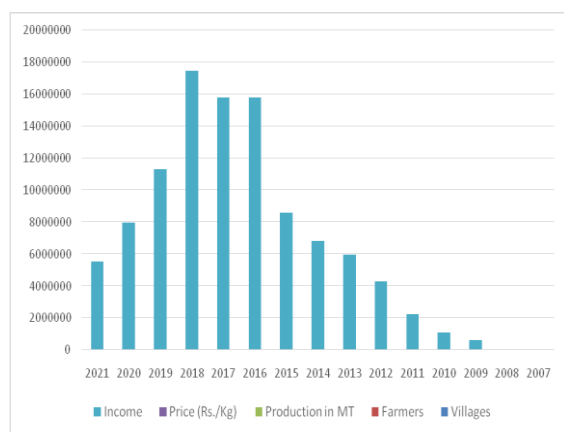


Fig 1: Pushkarmool commercial cultivation and income from the final produce.

Annual Demand and Chemical Composition

The natural habitats are declined due to over exploitation and habitats of Pushkarmool can see only in the agricultural field. Surprisingly, in Indian Himalaya its natural population are now restricted to Himachal Pradesh and Jammu & Kashmir only. Wild collection of this species is very limited and raw material comes in the market majorly from the cultivated sources (Goraya and Ved, 2017). The annual demand

(estimated annual trade) of this species is approximately 300-500 MT including (80-100 MT demand) Dabur India Ltd. The *Inula* species is used in relieving chest pain in the traditional medicine system of Ayurveda and Tibetan medicine (Sood *et al.*, 2001). The root forms an important ingredient of several poly herbal formulations for heart diseases and inflammatory conditions of spleen and liver disorder (Gholap and Kar, 2003; Kalsiet *al.*, 1989; Srivastava *et al.*, 1999; Rathore *et al.*, 2022). The roots are considered for cough, dyspnea, asthma, pleurisy, tuberculosis and chest pain especially pre cordial pain. Roots of *I. racemosa* contain inulin (10.1%), roylene (3%); and the root oil of the herb contains alantolactone which is widely utilized as an anathematic, antiseptic, expectorant (Bokadia *et al.*, 1986). The marker compounds are two major sesquiterpene lactones eudesmanolides i.e., alantolactone and isoalantolactone. Other active phytochemicals are inunolide (germacranolide), dihydroisoalantolactone, β -sitosterol, D-mannitol, dihydroxinunolide, neoalantalactone, inunolide, sesquiterpene lactone, and alantodiene (Gholap and Kar, 2003; Kalsiet *al.*, 1989; Srivastava *et al.*, 1999; Rathore *et al.*, 2022).

Study Area

The State Himachal Pradesh (Lat. 30°22'40"N to 33°12'40"N to E Long. 75°45'55" to 79°04'20") is well known for its unique topography and bio-resources. The state is blessed with abundant water resources in its five major rivers i.e., Chenab, Ravi, Beas, Satluj, and Yamuna, which emanate from the western Himalaya and flow through the state (Rana *et al.*, 2010). These snow fed rivers and their tributaries carry copious discharge throughout the year and flow with steep bed slopes and helpful for the irrigation requirement for cultivation. The state is very well known for representative, natural, unique, and socio-economically important biodiversity,



nearly one fourth of the total geographical area (55673 km²) of the state is under wasteland. The vegetation of the state comprises a rich biodiversity having a number of horticultural and agricultural crops. The study area comes under the district of Lahaul & Spiti of Himachal Pradesh, having its present administrative center in Keylong. The location itself is at a higher altitude of 3000m to 4500 m.asl and the town is built on the valleys (Aswal and Mehrotra, 1994).

Field Survey

Farmers in the study area have a tradition of practicing mixed farming systems (Rawat and Emerson, 2011). The primary cash crop are hybrids potato, cabbage, pea and pulses including some important MAPs such as *Arnebia euchroma* (Ratanjot), *Aconitum heterophyllum* (Atis), *Picrorhiza tungnathii* (Kutki), *Saussurea costus* (Kuth) and *Valeriana wallichii* (Tagar). However, the production of medicinal crops were declining in and around due to falling prices, competition with other high value horticultural crops, small average plot size, inadequate technology and market availability and recent invasion of the Chinese raw materials. Therefore, the cultivation of *Inula racemosa* has substantial scope as per increasing demand. It was domesticated in the Lahaul valley in the early parts of the twentieth century by progressive farmers and has been grown as a cash crop (Kuniyal *et al.*, 2004; Rawat *et al.*, 2004). Rawat and Everson (2011) has stated that Pushkarmool cultivation has declined considerably over the past 30 years. The cultivation of Manu was at its peak in the 1960s, when 13.5 ha were planted at Jhalma and 10.3 ha at Hinsal villages. Since then the cultivation has decreased sharply, especially between 1980 and 2000 (Rawat and Everson, 2011). Now, it was very difficult to introduce it again in new cropping systems at larger scale and this requires an improved agro-technique including availability of quality planting material, post-

harvest techniques, value addition and marketing etc. And identification and selection of crop based on local climatic conditions. Bio-resources department (BRD), Dabur India Limited and a regional farmer group namely “LMS” as Lahaul Medicinal Plant Society pursued a market-driven, farmer centered and environmental friendly approach to agricultural diversification with the cultivation of medicinal plant in the region that includes selection of crop, low-cost agro-techniques and continuing market demand. However, some farmers were unaware of the limited commercial importance of this crop future, making it necessary to conduct extension activities, such as exposure visits, to create farmer awareness about this potential economic opportunity. Exposure visit and training to the farmers of the selected villages were made possible with the help of village head. Quality planting materials (QPM) and post harvesting practices including long period storage and transportation of the produce was educated to the native people. Technical publications and information were prepared by BRD that explained cultivation practices and an arrangement of Buy- Back support to the old and new accompanying farmers. In this process, farmers were informed about the economic importance of this crop as a viable alternative to the traditional food crops in the district Lahaul & Spiti, HP.

Conservation Initiative

With local partners, Bio-resources department, Dabur India Limited has started the identification of the potential germplasm of the Manu (*Inula racemosa*) in Lahaul valley, Himachal Pradesh. Besides this various institutes like G.B. Pant Institute of Himalayan Environment and Development, Forest Department, Herbal Research and Development Institute and High Altitude Plant Physiology Research Centre are also working for the conservation activity. We have developed the



propagation techniques of the species by seeds and also trying to vegetative propagation. Besides this we have developed a nursery at Billing, Keylong for the distribution of Quality Planting Materials (QPM) to the local farmers groups. We had started in 2007 to distribute few thousand of seedlings to farmers of the Lahaulvalleys (Tinan, Gar, Todh, Patan, Mayad). They are providing the cultivated raw material and producing about 40-80 MT to industries on the yearly basis. Presently, we have developed the capacity and as results, we can distribute more than 5 to 10lakh seedlings to farmers of the villages of Keylong, Jalma, Rapy, Rashal, Shansha, Sito, Chhaling, Matgrha, Shalgra, Khanjar, Kirting, Gonla, Billing, Gumrang, Khansar, Tino, Kwaring and Dashrath. It has resulted more than 500 small and large scale farmers to cover more than 100 acres of the cultivation of Manu. Dabur has included LMS as the local partners which, is capable to mobilized the farmers and resulting to enhance the extra income of more than 500 farmers. Both parties are planting every year about 10 Lakh QPM to produce about 80 metric tons raw materials. This way we are conserving more than 10 lakh seedlings/ germplasm of this species in its natural habitat condition. The efforts helps to increase its population in the natural habitat beside, we have selected progressive farmers those are producing the seeds also for the next progeny and promote the continuous cultivation to maintain supply chain. The activity is in sustainable for more than 15 years because of a correct approach adopted by the LMS and Dabur with farmers for example providing all packages and practices of the species, providing the quality planting materials to the farmers, providing all handholding and post-harvesting techniques at Karga center to the growers and finally which is very important, a buy-back under the policy of contractual farming. These components are required for the

successful domestication of such critical species to start from the grass root level to reach up to the industrial level as an execution. This activity does not only fulfill to provide the raw materials to industries but, also provides a green livelihood to farmers too. If such activities increased to add more medicinal crops as case crop. It will help the Prime Minister initiative, Atam Nirvar Bharat and the time will come when we will be able to supply our surplus raw materials/Himalayan Jadi Buti to the foreign countries to earn more foreign revenue.

Results and Discussion

The population of Pushkarmool in the entire north western Himalayan range are observing a speedy decline of the habitats either natural or domesticated. Initially, only 5 villages with the FGs of 29 farmers were taken with 3000 QPM of Manu. Later on, with the time several other farmer groups were also incorporated in commercial cultivation. Maximum number of farmers (763) were involved in the cultivation during the year 2017, meanwhile minimum number of farmers were involved in the cultivation in 2007. However, it was starting year of the commercial cultivation, so we can consider the year 2021 as minimum number (112) of farmer's involve in the cultivation of Pushkermool/Manu. Maximum production (84 MT) of the raw materials (RM) was recorded in the year 2018 and minimum (39 MT) production was documented during the year 2021. Maximum (₹1Crore) income of farmers were obtained in the year 2018, meanwhile minimum income (₹6Lakh) was saw in initial phase during the year 2009 (Fig-1). From 2016 to 2018 maximum price (₹208) of the raw materials was observed and minimum (₹120-142) price has varied in the year 2021 due to irregular waves of COVID pandemic, lower consumption or supply from the neighboring foreign country or it may be due to illegal collection of raw material.

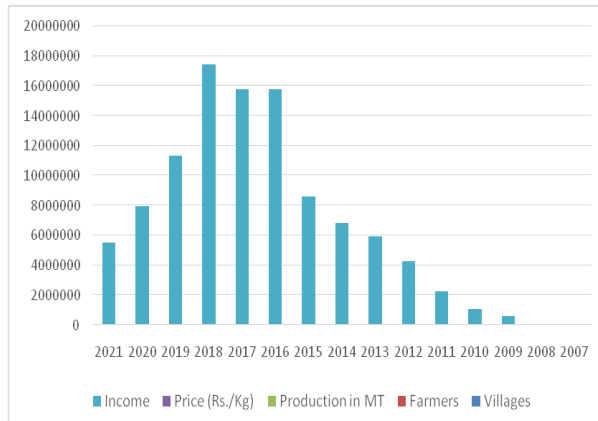


Fig 1: Pushkarmool commercial cultivation and income from the final produce.

As per literature (Sood *et al.*, 2001; Kuniyal *et al.*, 2004; Rawat *et al.*, 2004), Pushkarmool/Manu was domesticated in Lahaul valley in the early parts of the twentieth century by progressive farmers. The cultivation of Manu

was at its peak in the 1960s, when 13.5 and 10.3 hac were planted at Jahlma and Hinsia villages. According to Rawat and Everson (2011), its cultivation has declined considerably over the past 30 years. Since then the cultivation has decreased sharply, especially between 1980 and 2000 (Rawat and Everson, 2011). Since the majority of companies and buyers were located elsewhere in the country, they were not eager to enter into any type of formal agreement. Therefore, “LMS” has moved to find local and outside buyers and finally BRD has done to be receptive of creating a partnership between the local growers. The newly-established FGs were invited for an open discussion with this Society on behalf of BRD in order to address their grievances on the commercial cultivation and the decision was finalized to take the initiative for Pushkarmool cultivation on large scale as industrial requirements (Fig. 1, 2).



(A) Habit(cultivated) near to natural habitats



(B) Pushkarmool plant in Flowering season



(C) Domestic cultivation in a kitchen garden



(D) Rhizomatous roots of *Inula racemosa*/Manu



(E) Meeting with local farmers at Keylong,
Lahaul



(F) Meetings with Chhaling villagers, Mayad
valley

Figure 2: Glimpses of the Pushkarmool habit/habitats and meetings with progressive farmers.

Finally, they are capable to supply about hundred metric tons of the raw materials (RM). When this activity was launched in 2007, there were only two villages with a combined membership of about 12 farmers who were involved with the commercial cultivation of *Inula racemosa* in Keylong district. This group of farmers has produced initially about 5 MT of Pushkarmool which was supplied to company by “LMS” in 2009. A start has been given to him through BRD with cultivation of this species with some constraints which were limited. It was too small scale such as technical difficulties, availability of quality planting material, poor inputs and complex regulations and execution. But these constraints were removed later

through the help and services of LMS and Dabur such as availability of potential seed germplasm, shade net, technical inputs, registration of growers etc. Due to these efforts more villages and about 197 farmers were involved after five years successful cultivation and good price of the yields at that time which was higher side as expected in comparison to the traditional vegetables and fruit crops. The number of new villages and SHGs in this network was expected to increase rapidly as more and more farmers again become interested in Pushkarmool commercial cultivation. As a result of these extension activities, farmers soon became receptive to the idea of commercial cultivation of the Pushkarmool. Finally, inputs such as



seeds, QPM and organic manures were obtained through “LMS” on a cost sharing basis. The seeds and seedlings of *Inula racemosa* was procured and made available from Billing Nursery of the BRD at Billing village, Keylong. Finally “LMS” began by assessing the production potential of *Inula racemosa* in entire district while, at the same time, beginning to some organize farmers into progressive farmers group. The key in setting up these groups at the village level was to create the framework that could produce a substantial quantity of raw materials on a sustainable basis, thus making it economically viable for the company for continuous sourcing from the same group of farmers.

Conclusion

The step pursued by “LMS” to promote cultivation and development of sustainable market supply chain has achieved the goal by making large scale cultivation possible and most of the farmers agree to continue with cultivation of Pushkarmool. This initiative can help farmers give to extra revenue per acre (6-8 MT). This model of development has an important lessons to enhance the cultivation of high altitude threatened medicinal plants in the states of J&K and Uttarakhand. As the medicinal-plants trade based on cultivated material is not new in the state, various linkages are essential for quality cultivation which is not yet well developed. New approaches are needed to be strengthening the networks of the stakeholders involved in the medicinal plants chain thorough assessment of the economic viability and technical feasibility of the supply chain to be developed as per habit and habitats of MAPs. The present study is to be best example for the other interested state for the promotion of their livelihood and *Ex-situ* and *In-situ* cultivation cum conservation in view to recent regularity, LPC, availability and price risk of the IUCN red listed MAPs. It can be

concluded that *I. racemosa* is an imperative economical medicinal herb that is being used in various diseases and ailments not only by the traditional herbal healer but by the modern scientific community including herbal industry too. The herb is under threat and the population is declining in its natural habitat. So there is an urgent need for conservation of this species (Arora *et al.*, 1980; Kaul, 1984; Aswal and Mehrotra, 1994; Kuniyal *et al.*, 2004; Rawat *et al.*, 2004; Rathore *et al.*, 2022).

Therefore, cultivation of this species under semi-natural conditions can meet the demand of the pharmaceutical companies, while *ex-situ* and *in-situ* cultivation in the farmer fields could be undertaken for the conservation. It is very difficult to obtain the confidence of the local farmers to involve again in active participation in continuous farming of the Pushkermool (*Inula racemosa*), after formation and inauguration of the Atal Tunnel (Rohtang).

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