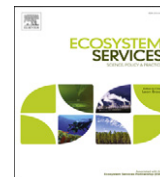




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Short communication

Conservation salvage of *Cordyceps sinensis* collection in the Himalayan mountains is neglected

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ABSTRACT

Traditional agriculture and animal rearing are central in the rural livelihood of Himalayan Mountains. Economically these activities are inadequate for fulfilling the better livelihood expectation. Therefore rural people depend on diverse short seasonal activities like collection of medicinal plants, timber trading and animals poaching etc. for obtaining economic benefits. In past few years, collection of *Cordyceps sinensis* in the Himalayan Mountains has been emerged as main short seasonal activity. This practice is more profitable as compared to the cultivation of key cash crops and some other activities. Because of attractive economic benefits, nearly 52.08 to 97.98% households of this region are involved in the short seasonal collection of *C. sinensis*. Development of *C. sinensis* in the Himalayan Mountains and economic benefit earned from its collection is valuable ecosystem service. Uncontrolled collection of *C. sinensis* will be critical for its sustainability. Hence rotational pattern for collecting *C. sinensis* will be useful for its long-term availability. Because of the shift in short seasonal activities of poor communities, collection of *C. sinensis* may be helping in conservation of globally significant medicinal plants (GSMPs), timber yielding trees and wild animals. However, impacts of this short seasonal activity on the population recovery of GSMPs, timber trees and wild animals need to be studied at habitat level. Economic benefits earned from short seasonal collection of *C. sinensis* and cultivation of key cash crops, suggestion for sustainable collection of *C. sinensis*, possible impacts after deviation from this practice and indirect salvage of this short seasonal activity for the conservation of other resources is discussed in this communication.

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1. Introduction

Cordyceps sinensis (Berk.) Sacc. Family Clavicipitaceae is also known as Yartsa gumba, Yartsa gunbu, Kida jadi, Keera ghaas, Tibetan wonder, Summer grass–Winter worm, a fungus specialized in digesting insect and Caterpillar fungus (Zhu et al., 1998; Sharma, 2004; Holliday et al., 2005). Originally the energetic property of *Cordyceps sinensis* was recorded by a Tibetan doctor Zurkhar Namnyi Dorje in the 15th century (Winkler, 2008a,b). The fungus parasitized caterpillar with fleshy leaf shaped aboveground structures (order Lepidoptera, family Hepialidae, *Hepialus armoricanus* and *Thitarodes*) is among well-known Fungal Traditional Chinese Medicines (FTCM) and health foods (Russell and Paterson, 2008). Currently, for the preparation of energetic and revitalizing formulations *C. sinensis* is in high demand (Devkota, 2006). *C. sinensis* is also used in the preparation of the medicines for asthma, renal injuries, bronchitis, cough, resistance of respiratory tract, blood pressure, anti-aging, weakness, immunity strengthening, malfunction of lungs and irregular menstruation (Devkota, 2006). Didanosine a nuetraceutical developed from

Cordyceps sp. is used to relieve the mental stress. An enumeration of the medicinally useful species of *Cordyceps* is presented by Russell and Paterson, 2008.

In the alpine environment of Himalaya (from 3300 to 4500 m a. s. l.), a caterpillar *Hepialus obliquifurcus* (Hepialidae) has been identified as host of *C. sinensis* (Sharma, 2004; Arora and Dhaliwal, 1997). During late autumn a caterpillar moth is parasitized by fungus which dies through early summer. Burrowed dead caterpillars with flashy leaf shaped aboveground structures are collected during May and June (Negi et al., 2006). *C. sinensis* is not an ingredient of Indian System of Medicines (ISM), however, its collection in the Himalayan Mountains has emerged as main short seasonal activity for earning attractive economic benefits (Garbyal et al., 2004). Development of *C. sinensis* in the Himalayan Mountains and its collection by native villagers for gaining attractive economic benefit may be categorized under provisioning ecosystem service with direct use economic value.

Indigenous communities in the Himalayan Mountains are accustomed to cultivate the food crops², vegetables³, oilseeds⁴ and certain cash crop⁵ (Mehta et al., 2010). Recently, cultivation of some

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E-mail address: cpkuniyal@rediffmail.com (C.P. Kuniyal).¹ Present address: G. B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643 Uttarakhand, India.² Wheat; *Triticum aestivum* Linn., Barley; *Hordeum vulgare* Linn., Amaranth; *Amaranthus caudatus* Linn., and Buckwheat; *Fagopyrum esculentum* Linn.³ Mainly lablab bean; *Lablab purpureus* Linn. also used as pulse.⁴ *Brassica juncea* Linn. and *B. campestris* Linn.⁵ Potato; *Solanum tuberosum* Linn.

threatened medicinal herbs⁶ and commercial cultivation of a traditionally grown culinary herb⁷ has received attention because of their increasing demands in the herbal pharmaceuticals. Animals rearing for milk, wool, plowing and farmyard manure (FYM) is also practiced by the villagers of this region. Low agricultural productivity coupled with restricted number of cash crops has enforced poor people's for searching new and profitable short seasonal activities. Aspiration for better livelihood opportunities by educated people may be expressed as migration toward cities and town for finding employments in service sector and less educated peoples may involve in collection of globally significant medicinal plants (GSMPs),⁸ trading of timber yielding trees⁹ and poaching of animal for medicinal body parts¹⁰. Therefore, the rural livelihood in the Himalayan Mountains is just survival oriented.

During the year 2000, either started by any observational event of economic benefits or an incidental finding of any shepherd? or a local? or the tourists guide?, collection of *C. sinensis* has shifted economic interests of the poor communities of Uttarakhand, Indian Himalaya. After that collection of *C. sinensis* has been emerged as an extensive short seasonal activity in the Himalayan Mountains (Sharma, 2004). Simultaneously the Uttarakhand government began the actions for harnessing economic potential of *C. sinensis* through participatory approach. In the year 2008 the rights for collection of *C. sinensis* and marketing (including transit permits for selling it outside the state) were granted to native villagers (Anon, 2008). Village level forest management councils (locally called as *Van Panchayats*) in the respective villages are allowed for issuing collection and transit permits. Also, the Department of Forest is authorized for regulating the trade of *C. sinensis*. Then the official prices for *C. sinensis* were fixed from Rs. 40,000.00 to 50,000.00/kg (Anon, 2008). Up to 2011 the unofficial prices for *C. sinensis* were increased to Rs. 300,000.00 kg (US\$ 6,111.22 @1.00 US \$=Rs. 49.09, as on September 30, 2011).

Tremendous increase in the prices of *C. sinensis* has enhanced its attractiveness among poor villagers. So in terms of economic benefits, collection of GSMPs, timber trading and poaching of wild animals has been less attractive to the poor people. Thus possibly the population of such plants and animals may be recovering in their habitats. It is envisaged that in recent circumstances short seasonal collection of *C. sinensis* may be helping in conservation of other resources, however, it needs to be quantified at habitat level. This communication presents economic benefits earned from short seasonal collection of *C. sinensis* and some regular activities. Also, attempt is made to describe the conservation salvages of the short seasonal collection of *C. sinensis* in the Himalayan mountains.

⁶ *Saussurea lappa* (Decne) Sch. Bip. (Asteraceae) and *Picrorhiza kurrooa* Royle ex Benth (Scrophulariaceae).

⁷ *Allium stracheyi* Baker (Alliaceae).

⁸ Monkshood aconite (*Aconitum heterophyllum* Wall ex. Royle), other aconite (*A. atrox* (Bruhl) Mukherjee and *A. violaceum* Jacq.), Allium or Himalayan seasoning chive (*Allium stracheyi* Baker), Himalayan angelica (*Angelica glauca* Edgew.), Himalayan arnebia (*Arnebia benthamii* (Wall. ex G. Don) Johnston), Tree turmeric or Indian barberry (*Berberis aristata* DC.), Rock foil (*Bergenia stracheyi* Hook. f. & Thomson), Marsh orchid (*Dactylorhiza hatagirea* (D. Don) Soo), Yam (*Dioscorea deltoidea* Wall. ex Griseb.), Gerard's Joint fir (*Ephedra gerardiana* Wall. ex Stapf), Fritillaries (*Fritillaria roylei* Hook), Indian gentian (*Gentiana kurrooa* Royle), Harris' orchid (*Habenaria intermedia* D. Don), Indian spikenard (*Nardostachys grandiflora* DC.), Himalayan peony (*Paeonia emodi* Wall ex. Royle), Love apple (*Paris polyphylla* Sm.), Gentian/Hellebore (*Picrorhiza kurrooa* Royle ex. Benth), Himalayan May apple (*Podophyllum hexandrum* Royle), Himalayan Rhubarbs (*Rheum australe* D. Don, *R. emodi* Wall. ex Meissn *R. mocroftianum* Royle), Chirata (*Swertia chirata* Buch.-Ham. ex C. B. Clarke) and Himalayan yew (*Taxus baccata* L.) occurring in the Indian Himalaya Region (IHR) area are regarded as GSMPs.

⁹ *Cedrus deodara* and *Abies spectabilis* are main timber trees in the Himalayan Mountains.

¹⁰ *Selenarctos thibetanus*, Himalayan black bear or Asiatic black bear is valued for bear's bile.

Materials and methods

Six representative villages namely; Himni (2475 m asl), Ghes (2315 m asl), Wan (2450 m asl), Kanol (2537 m asl), Sutol (2236 m asl) and Tolma (2625 m asl) in the district Chamoli, Uttarakhand, India (west Himalaya, 28°24'–31°28'E and 77°35'–81°05'N), were surveyed during June 2011 for evaluating economic benefits earned from regular activities viz. cultivation of regular and optional cash crops and practiced short seasonal activity (i.e. collection of *C. sinensis*). Collectively, more than 40% villagers from respective villages and some anonymous local traders were interviewed through a semi-structured and partially open-ended questioners. Information on production of main and optional cash crops, area under cultivation, crops duration, estimated production and prices per kilogram (Rupees/Kilogram; Rs./Kg) at village level were noted. Information was also noted on the short seasonal activity and its economic aspects. Total households living in the representative villages and households participating in the short seasonal activity (collection of *C. sinensis*), total individuals per household and individuals from each household participating in collection of *C. sinensis*, distance traveled for reaching to the temporary camping sites, days required to reach to the habitat of *C. sinensis*, average stay in the alpine areas, average multidirectional rummage area around camping sites, quantity of *C. sinensis* collected (gram/person) and probable rates (Rs./kg) offered by anonymous traders at village level were noted. Obtained values were analyzed for estimating the production of regular and cash crops, collection of *C. sinensis* at individual and household level, and gross profit obtained from regular and short seasonal activity.

Views of the villagers collecting *C. sinensis* were noted for understanding their opinion about present availability of *C. sinensis* and conflicts instances. What amount is earned through collection of some medicinal plants, timber trading and animals poaching was also noted. To assess the conservation salvages of *C. sinensis* collection in the Himalayan Mountains, opinions of the villagers' about changes occurred in the short seasonal practices after this short seasonal activity were also recorded.

2. Results

Nearly 52.08 to 97.78% households (HHs) in selected villages were engaged in the short seasonal collection of *C. sinensis* from the alpine areas (from 3300 to 4500 m asl). Average 2.23 to 3.87 individuals from respective HHs were taking part in short seasonal collection of caterpillar fungus. Normally 1.0 to 3.0 days are needed to reach to the caterpillars' habitat. During the stay of average 5.36 to 6.43 weeks in the camping sites, wide areas (average 6.00 to 19.00 sq.km.) are rummaged for collecting *C. sinensis*. At individuals level around 22.86 to 91.84 g (g) dried caterpillar is gathered, thus on the HHs basis, nearly 64.00 to 266.67 g *C. sinensis* is collected. Therefore, at HHs level average Rs. 19,200.00 to 80,000.00 (cf. to US\$ 391.12 to 1629.66) are earned from short seasonal collection of *C. sinensis*, (@ Rs. 3,00,000.00/kg, the unofficial procurement rates; but in practice during 2011). Details of the short seasonal collection of *C. sinensis* and associated benefit are presented in Table 1.

Comparable quantity of potato (888.89 to 1589.40 Kg/household) is produced in the selected villages. Thus, on average Rs. 10,667.67 to 19,072.85/household (cf. to US\$ 217.29 to 388.53) are earned from the cultivation of potato (Table 2). Cultivation cycle for potato is nearly 7.0 to 8.0 months. Also, in some of the villages, nominal earning is received from the cultivation of Kuth (grown for costus roots) and Kutki (grown for stolen and roots). Although the cultivation cycle of these threatened medicinal species is around 2.5 to

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