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Trade and Sustainable Conservation of *Swertia chirayita* (Roxb. ex Fleming) h. Karst in Nepal

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Abstract

Swertia chirayita (Roxb. ex Fleming) H. Karst is one of the most important high-value medicinal plants of Nepal prized for its anti-diabetic, antimalarial, hepato-protective and anti-inflammatory properties. It is widely used as an important ingredient in medicinal preparations in Ayurveda, Unnani, Siddha, Tibetan and Chinese traditional medicine. Nepal is one of the main exporters of this important plant and the most significant importers are India and China. The large scale export of this plant has made it vulnerable in Nepal and there is an immediate need for its conservation. Detailed information on the current status of trade of this plant in Nepal is necessary to understand and make assumptions on its current market standing or future predictions of demand. *S. chirayita* is traded in 61 of the 75 districts of Nepal and constituted about 3% in the total medicinal plant traded in the fiscal year 2008-2009. Due to extensive collection of *S. chirayita* from the wild, there is a need for exploring alternative conservation options in order to preserve the remaining wild population. Sustainable harvesting and cultivation can help in its conservation. This paper briefly reviews the state of trade and sustainable conservation of this important medicinal plant in Nepal.

Key words: *Swertia chirayita*, trade, cultivation, sustainable use, sustainable harvesting

Introduction

Medicinal plant trade is one of the oldest trades of Nepal. The Himalayan medicinal plants from Nepal have been in high demand throughout the South Asian region since ancient times. It is reported that more than 80% of the rural Nepalese people depend on on traditional remedies that involve the use of local plants in various forms and combinations (Rajbhandary & Bajracharya 1994). Many important traditional practices of Eastern medicine including Ayurveda, Unani, Siddha, Chinese and Tibetan medicine (*Sowa Rigpa*) are practiced in Nepal (Phoboo *et al.* 2008). There are 1792 medicinal plants in Nepal (Baral & Kurmi 2006) out of which 49% are herbs, 29% trees, 14% shrubs, 8% climbers (Bhattarai & Ghimire 2006). Owing to their high demand, these plants have provided an supplementary source of income for the local population and in some villages of high mountains of Nepal, almost 50% of the population engages in collection and trade of medicinal and aromatic plants (MAPs) (Olsen & Helles 1997).

S. chirayita (Roxb. ex Fleming) H. Karst is one of the most important medicinal plants exported from Nepal. It is also known as *S. chirata* Buch. -Ham.; *Ophelia chirata* Grisebach., *Agathotes chirayita* Don., *Gentiana chirayita* Roxburgh and *G. floribunda* Don. It is the most significant medicinal plant belonging to the genus *Swertia* and family Gentianaceae (Joshi & Dhawan 2005). It is known by many local names. It is chiretta in English and chiraito in Nepali. Nepal is the main exporter of *S. chirayita* exporting more than 45% of the world's total volume (Barakoti 2004). Since the whole plant is used, dried whole plants are exported mainly to India and China (Phoboo *et al.* 2008). It is highly prized in India as a bitter tonic without astringency and aroma unlike other bitters (Bhargava *et al.* 2008). *S. chirayita* has many uses in major traditional medicines of Asia. The whole plant is extremely bitter and has hypoglycemic (Saxena *et al.* 1993), anti-helmintic, anti-inflammatory (Mandal 1992, Banerjee *et al.* 2000) and hepatoprotective (Chakravarty *et al.* 1994, Mukherjee *et al.* 1997). It is used in combination with other herbs or used individually for formulating medical preparations and tonics in Ayurvedic, Siddha, Unani, Tibetan and Chinese traditional medicine for different health problems. Due to its high demand, the current rate of depletion, over-exploitation and unsustainable

harvesting in the wild, is causing this plant to be increasingly scarce in the wild. It is therefore important to design effective sustainable plans for its conservation.

Distribution

This plant is found in the temperate region throughout the Himalayan belt extending from Kashmir to Bhutan between the altitudes of 1200-3000 m (Bhargava *et al.* 2008). It is found in the subtropical (1200 m) to alpine zone (3000 m) throughout western, central and eastern regions of Nepal in more than 40 districts out of 75 in Nepal (Bhattarai & Acharya 1998). The chief *S. chirayita* supplying districts are Sankhuwasabha, Tehrathum, Dhankuta, Illam, Panchthar, Rasuwa, Solukhumbu, Taplejung, Ramechap, Dolakha, Sindhupalchok, Gorkha, Dolpa, Rolpa, Salyan, Sinduli, Accham, Doti and Makwanpur (Bhattarai & Acharya 1998). It grows well in moist, semi-shade temperate forests usually in sloping hillsides (Phoboo *et al.* 2008). The plants are not abundant due to over-exploitation and open grazing, and are becoming increasingly difficult to find in the wild conditions (Phoboo *et al.* 2008). *S. chirayita* is usually found growing with other species of plant like *Anaphalis* spp., *Bidens* spp., *Eupatorium adenophorum*, *Centella asiatica*, *Viola* spp., *Polygonum amplexicaule*, *Rhododendron arboreum*, *Quercus* spp. and *Acer* spp. (Phoboo *et al.* 2008).

Medicinal importance

In Ayurveda, *S chirayita* is described as bitter (*tikta*) in taste and its thermal action defined as cooling (*shita*), easily digestible (*laghu*) and dry (*ruksha*) (Joshi & Dhawan 2005). The whole plant is extremely bitter and is used for chronic fever, malaria, anemia, bronchial asthma, liver disorders, hepatitis, gastritis, constipation, dyspepsia, skin diseases, worms, epilepsy, ulcer, scanty urine, hypertension, melancholia and certain type of mental disorder, secretion of bile, blood purification and diabetes (Banerjee *et al.* 2000, Karan *et al.* 1999, Rai 2003, Saha *et al.* 2004). It has been found to possess anti-tumor (Balasundari *et al.* 2005), hypoglycemic (Saxena *et al.* 1993), anti-helmintic, anti-inflammatory (Mandal 1992, Banerjee *et al*. 2000), hepatoprotective (Chakravarty *et al*. 1994), anti-pyretic properties (Bhargava *et al.* 2008), antiviral (Verma *et al.* 2008), anthelmintic (Iqbal *et al*. 2006), anticholinergic (Rafatullah *et al*. 1993), antimicrobial (Leslie & Chungath 1987), Central nervous system (CNS) depressant (Leslie & Chungath 1987), anti-hepatotoxic (Karan *et al.* 1999), analgesic (Alam *et al.* 2010), chemopreventive (Saha *et al*. 2004), antioxidant (Balasundari *et al.* 2005) and anti-diabetic (Suryawanshi *et al.* 2006) properties. It is also used in Ayurvedic industry as a constituent in an anti-cancer medication and in the skin tonic 'Safi' as well as in skin soaps and cosmetic products. This medicinal plant is usually

Table 1. Total districts from five development regions of Nepal where *Swertia chirayita* is traded (Source: Department of Forest 2009/2010)

S.N.	Eastern Development Region	Central Development Region	Western Development Region	Mid-Western Development Region	Far-western Development Region
1	Dhankuta	Dhanusha	Manang	Surkhet	Baitadi
2	Morang	Lalitpur	Lumjung	Dang	Darchula
3	Sunsari	Dhading	Rupandehi	Rukum	Doti
4	Udaypur	Sindhupalchok	Baglung	Kalikot	Bajhang
5	Okhaldhunga	Chitwan	Myagdi	Jajarkot	Kailali
6	Khotang	Makwanpur	Gorkha	Jumla	Bajura
7	Sankhuwasabha	Dolakha	Kaski	Humla	Accham
8	Solukhumbhu	Ramechaap	Argakanchi	Rolpa	Dadeldhura
9	Illam	Sindhuli	Parbat	Salyan	
10	Panchthar	Kathmandu	Tanahun	Pyunthan	
11	Taplejung	Nuwakot	Gulmi	Mugu	
12	Tehrathum	Mahotari	Syagja	Dolpa	
13	Jhapa	Rasuwa		Dailekh	
14	Bhojpur	Kavrepalanchok		Banke	

administered as concentrated infusion, tincture or as powder and fluid extract (Joshi 2008, Phoboo *et al.* 2008). It is also used in cosmetic industry as an ingredient in facial creams, cleasers, scrubbers and hair oil. This species was first introduced in the Edinburgh Pharmacoepoeia in 1839 and is reported in British and American Pharmacoepoeias to be used as an infusion or a tincture. It has also recently been reported to be effective as an insecticidal in killing larvae of *Aedys aegypti* mosquito (Mallikarjun *et al.* 2010).

Analysis of available data on trade of *S. chirayita*

According to the Department of Forest (DOF 2009/ 2010), *S. chirayita* is traded in 61 out of 75 districts in Nepal encompassing all the five development regions (Table 1).

In Nepal, about 90% of the medicinal plants traded are collected from the wild (Phoboo *et al.* 2008). *S. chirayita* is also mostly collected from the wild by the local collectors. The collected plants are then dried and bundled before they are sold to the local traders. The current market price (2010) of raw dried *S. chirayita* is Rs. 300 per kg while the local collectors are paid only Rs. 110 per kg and these are exported at a price of Rs. 400 per kg. The trade of *S. chirayita* usually consists of four levels of stake holders, the local collectors, the local trader, road head trader and the wholesaler. The local collectors had been paid as much as Rs. 800 per kg in the past according to traders in Kathmandu (Phoboo *et al.* 2008). Nepal is reported to trade more than 45% of the world's total volume of *S. chirayita* (Barakoti 2004, Saha 1999). Only about 1% of the *S. chirayita* is collected for local use, much of the local *S. chirayita* is exported to India for their Ayurvedic, Unani and Sidha medicinal market while some are exported to China, Malaysia, Singapore, Germany, Italy, France, Switzerland, Sri Lanka, Bangladesh, Pakistan, and USA (Phoboo *et al.* 2008). Almost all *S. chirayita* is harvested from the wild (Edwards 1996). According to the data from the Ministry of Forest, Nepal traded only about 66,806 kg of *S. chirayita* in 2008-2009. The major trading centers of *S. chirayita* are Hille, Dharan, Basanatapur, Nepalgunj, Birtamod and Trisuli (Bhattarai & Acharya 1998).

The highest volume of *S. chirayita* comes from East Nepal (Fig 2). In the last thirteen years, East Nepal contributed more than 50 % of the total *S. chirayita* traded in Nepal (Department of Forest 1996/1997-2008/ 2009). The highest amount of *S. chirayita* in the last thirteen years came from Taplejung (263,572 kg) and Tehrathum (213,837 kg) districts of East Nepal. There has been a general decline in volume of *S. chirayita* traded from Nepal in the last twelve years (1997-2009) although there seems to be slight increase in total volume in the last two years (Fig. 2). The total revenue generated by the Department of Forest from the taxes and duties levied on medicinal and aromatic plants (MAPs) in 2008/2009 was Rs. 38.9 million out of which the trade of *S. chirayita* generated Rs. 9.9 hundred thousand. At present, in some villages of high mountains, almost 50% of the population engages in collection and trade of MAPs (medicinal and aromatic plants) (Olsen & Helles 1997). *S. chirayita* constituted 3% of the total medicinal plant traded in Nepal in 2008/ 2009 (Fig. 4).

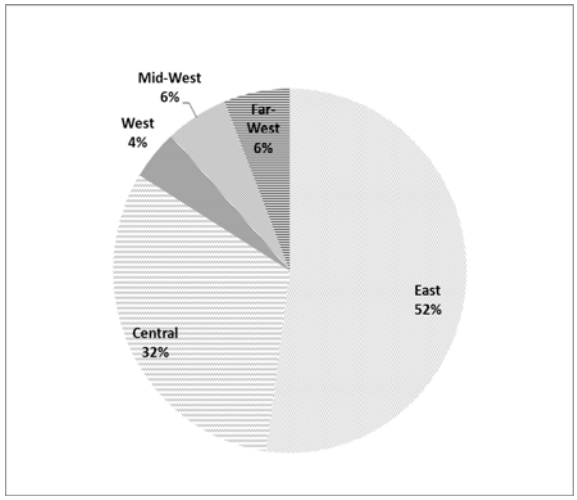

Fig. 2. Share of total *Swertia chirayita* traded in the last thirteen years (1996/1997-2008/2009) from five development regions of Nepal (Source: Department of Forest 1996/1997-2008/2009).

Adulterants

There are 31 species of Swertia found in Nepal (Joshi 2008). Although *S. chirayita* plays a dominant role in trade since it is considered to be superior in its medicinal properties in comparison to other species of *Swertia* (Rijal 2009), the trade of it is affected by adulterants. Species of *Swertia* other than *S. chirayita* are often mixed in with the bundled *S. chirayita* and

sold. Locally many species of *Swertia* including *S. angustifolia* and *S. nervosa* are used as substitutes for *S. chirayita* in case of its unavailability but in trade, adulteration causes problematic trade issues and product devaluation. Some of the main adulterants *of S. chirayita* are (Pant *et al.* 2000): *Andrographis paniculata* (green chirayita) Girach., *Exacum tetragonum* Roxb. *E. bicolor* Roxb., *E. pedunculatum* L., *Slevolgia orientalis* Griesb., *Swertia alata* Royle., *S. angustifolia* Buch. -Ham., *S. bimaculata* Hook. f. and Thoms., *S. ciliata* G. Don., *S. densifolia* Greisb., *S. elegans* Wight., *S. lawii* Burkill., *S. minor* Griesb., *S. paniculata* Wall., *S. multiflora* Dalzell.

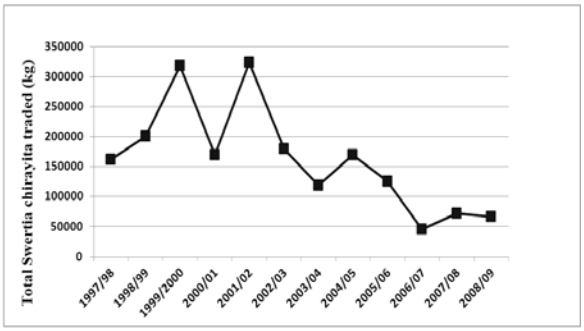

Fig. 3. Total volume of *S. chirayita* traded from Nepal (Source: DOF 1997/98-2008/09).

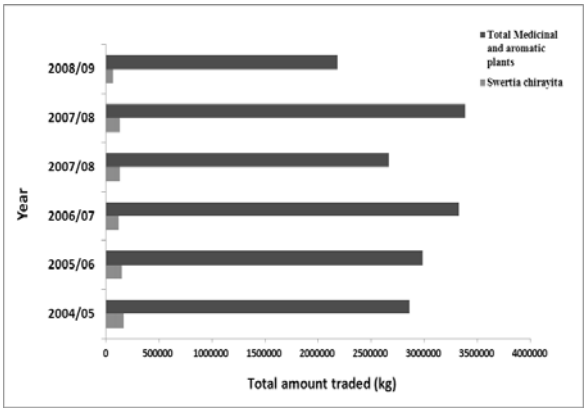

Fig. 4. Total volume of medicinal and aromatic plants and *S. chirayita* traded from Nepal in the last five years (2004/05-2008/09). (Source: DOF 2004/05-2008/09)

The adulterants are inferior to *S. chirayita* in terms of bitterness. *Andrographis paniculata* (local Indian name: Kalmegh) is also known as chiraita in India. This trade name has been a source of confusion for traders and other stakeholders in India and Nepal. Due to similarities in their therapeutic actions, *Andrographis paniculata* is suggested as a substitute for *S. chirayita* (Girach *et al.* 1994). While their therapeutic actions may be similar, the main phytochemicals reported in *A. paniculata* are kalmeghin, diterpes: andrographolide, andrographiside, neoandrographolide as well as panicolide, caffeic acid, chlorogenic acid and other polyphenolics (Li *et al.* 2007, Hossain *et al.* 2007). The main phytochemicals in *S. chirayita* on the other hand are xanthones, flavanoids, iridoid and secoiridoid glycosides (Pant *et al.* 2000). The true *S. chirayita* can be distinguished from other substitutes and adulterants by its intense bitterness, brownish-purple stem (dark color), stem that is rounded at the base and terete at the upper portion, continuous yellowish, pith, green petals with dark red distinct marking and double nectaries (Joshi & Dhawan 2005).

Cultivation

The need for cultivation of medicinal plants have been voiced for decades (Dobremez 1976) since cultivation can lead to constant supply of raw materials to the industry and local use and lessen pressure on the wild population. Cultivation is a sustainable alternative and offers the opportunity to overcome problems that are inherent in herbal extracts, misidentifications, genetic and phenotypic variability, extract variability and instability, toxic components and contaminants (Canter *et al.* 2006). The availability of the wild resource will depend on the ability of the community to balance harvest and conservation (Larsen & Olsen 2007). Although the cultivation of *S. chirayita* has been attempted in various parts of the country, these are often small scale-ventures of local farmers which may in time give way to more profitable cash or agriculture crops (Phoboo *et al.* 2008). There is a huge gap in information and lack of knowledge sharing especially on important issues like the possible market opportunities and future trade predictions. The local farmers are forced to deal with a very uncertain market since there is no fixed trade channel and demand and price fluctuates every year. The Agriculture Research Station at Pakhribas, Dhankuta, east Nepal has been promoting cultivation of *S. chirayita* for the last decade with limited success (Barakoti 2004).

Sustainable harvesting

A sustainable harvesting practice is necessary in order to conserve the remaining population *S. chirayita* in the wild. Since the whole plant is used, the whole plants are uprooted during collection and there is no proper method of collection of this plant. Most local villagers collect this plant when they notice the plant growing in the wild irrespective of the season. Since this plant is valuable, the plant is usually collected by the first person who comes upon it. *S. chirayita* is a biennial plant, spending its first year in a rosette stage. The second year, the internodes elongate and flowering takes place during July-September. After the seed sets during August-October, this plant dries up as the seeds are dispersed. The best time to harvest this plant is after seed set. This is also the sustainable harvesting method. Harvesting after seed dispersal ensures more plant multiplication in its habitat.

Sustainable conservation

Since the collection of *S. chirayita* is happening at a faster rate than its replenishment, it is important to devise sustainable conservation methods. Since this plant grows only in specific habitat and at a specific altitude (1500-3000 m), it is important to conserve its habitat although there are many in-situ management problems such as illegal collection, stealing, grazing and collection along with fodder. It is therefore important to raise awareness about sustainable harvesting of this plant to the local people. Other ways to over-come problems in-situ management may be the establishment of medicinal plant cultivation areas (small catchment areas) for replenishment of existing population, for sustainable harvesting (in-situ collecting), reserve for germplasm and for providing planting material (seeds and cuttings) for cultivation. Developing a strict management and monitoring of local areas with the help of locals and promoting cultivation in personal land as well as in community forests and other available land could also help in conservation of this plant. Other potential initiatives for conservation may be development of local user groups to oversee conservation and awareness raising campaigns to supervise collection and conservation of *S. chirayita* and helping local users groups to monitor the local trade channel to ensure fair and equitable trade as well as getting information about future demand and trade potential. Publishing research results and project activities, cultivation techniques, importance of this plant in popular booklets and posters using local language could help to spread awareness and disseminate more information about this plant. Participation of NGOs/ INGOs/ CBO in development of collector's group or local growers, groups, associations, cooperatives and forums will help the medicinal plant trade, its sustainable use and conservation. Development of *S. chirayita* farmers' cooperative will also help promote cultivation of this plant by helping in seed exchange, information sharing and collective bulk trade.

Collection of medicinal plants from wild will continue whether the resource is declining or not. The demand is likely to persist and other income generating activities are unlikely to be available in the rural areas. The collectors also may have less land and be less likely to engage in cultivation. Therefore, although cultivation is important for ensuing constant supply of raw materials and potentially fulfilling the market demand, it will not be the only factor that can control harvesting from the wild. In-situ conservation, sustainable use and cultivations should go hand in hand with community participation and government monitoring in order to have a successful conservation approach. Finding the right balance requires the cooperation of the locals devoid of which any plan or policy will fail. There is little biological, ecological, physiological, genetic and economic information on *S. chirayita*. It is difficult to make management plans without complete information therefore in-depth research into this plant is of immediate importance. The medicinal plant trade in Nepal is a trade that is shrouded in secrecy and often the traders refuse to talk about the actual amount they trade. The Government should have a good trade monitoring system in place for understanding the actual trade of this valuable plant.

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