Royal Government of Bhutan

Ministry of Agriculture and Forests

Department of Forests and Park Services

Social Forestry and Extension Division

Case study
Rural enterprise development of NWFPs

Wild harvest of Paris polyphylla

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Foreword

The role of non-wood forest products in Bhutan has evolved over the years from subsistence to commercialization; from small scale, domestic use to items of trade and export. A good number of enterprises have risen in recent times, which utilize NWFPs in one form or another and have found markets internally as well as through export. Products such as essential oils, herbal teas, soaps, to name a few, are of NWFP origin, manufactured within Bhutan and entering competitive markets around the world. Rural communities have also had their capacities developed to apply basic processing techniques to their harvests to reap better returns than previously possible.

As these upcoming enterprises rely on mostly wild NWFPs at the moment, it is important that we understand the value chains that make up these products and reduce the pressure on natural resources; to ensure their sustainability in the long run. Required interventions must be learned in order to avoid depleting our resources and provide long term benefits to those in more disadvantaged parts of the country.

Regarding this, the Social Forestry & Extension Division has carried out case studies for various key non-wood forest products in order to better understand and highlight the constraints faced in sustainably managing and trading these, said NWFPs. These case studies were carried out though literature review, followed by primary data collection through interviews and focus group discussions with traders & harvesters in select areas of Bhutan and finally analysing these acquired data to come up with results and insights.

It is therefore my pleasure, to impart the knowledge gained through these extensive exercises so that the future of Bhutan's NWFP resources as well as NWFP based enterprises may be secured and significant strides may be taken towards achieving economic self-sufficiency.

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1. Introduction

Paris polyphylla has a high international market demand being used as an important medicinal plant. In Traditional Chinese Medicine (TCM), the rhizome of *Paris polyphylla* is used as a component of topical medicaments for the treatment of boils, carbuncles, sore throat, venomous snake bite, and traumatic pain (Cunningham *et al.*, 2018). *Paris polyphylla* has also shown antibacterial action against *Bacillus dysenteriae*, *B. typhi*, *B. paratyphi*, *Escherichia coli*, *Staphylococcus aureus*, *Haemolytic streptococci*, *Meningococci* etc. and its rhizome contains anti-tumour active constituents (SFED, 2012). In Bhutan, however, *Paris polyphylla* is not used in traditional medicine, as it is not included in the *National List of Essential Medicines (2016)*[1]*.* There is also no indication that this will change anytime soon (MSPCL, 2018).

Paris polyphylla belongs to the family of Melanthiaceae. It is a rhizomatous perennial plant of up to 100 cm height. It has spider-like flowers with long, thread-like, yellowish green petals, which are followed by small, scarlet berries in autumn (SFED, 2012). *Paris polyphylla* is found in East Asia, including Bhutan, and occurs across a wide altitudinal range (100-3500 masl) in a variety of habitats (forests, bamboo forests, thickets, moist grasslands and stream-banks). It prefers shady, moist and old growth forest. Due to the slow growth and clumped occurrence of *Paris polyphylla* in moist, shady forests and high altitude, its wild harvest can be unsustainable (Cunningham *et al.,* 2018).

Until today, little is known about the geographic distribution, wild harvest and trade of *Paris polyphylla* in Bhutan. The plant has in the past been reported in various locations; Luentshe[2], Pemagatshel[3], Samdrup Jongkhar[245], Trashigang[123], Trashiyangtse[1], Bumthang[36] Trongsa[3], Zhemgang[7], Dagana[8], Punakha[3], Thimphu[39] and Wangdue[38]. Few years back, the commercial interest for *Paris polyphylla* started with Bhutanese traders exploring market opportunities due to the growing demand and increasing prices for *Paris polyphylla* in export markets (SFED, 2012).

Despite the legalisation of *Paris polyphylla*, the big majority of wild harvest and trade takes place illegally in Bhutan. This report intends to share a deeper insight in the unofficial wild harvest and trade of *Paris polyphylla* in

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[1] *http://www.health.gov.bt/wp-content/uploads/moh-files/2016/08/National-Essential-Medicines-List-2016.pdf*
[2] *BOIC 2015*
[3] *SFED, 2012*
[4] *Biodiversity.bt*
[5] *Subedi 2012a*
[6] *Wangchuk, 2017*
[7] *Rinchen, 2017*
[8] *Kuensel, 2017*
[9] *Dorji et al. 2018*

Bhutan. The main aim is to contribute to sustainable resource management and the regulation of current illegal practices in the country.

2. Methodology

Firstly, a literature review on the geographic distribution, wild harvest and trade of *Paris polyphylla* in Bhutan, and neighbouring countries (India, Nepal, China) has been conducted. Secondly, primary data was collected through interviews with collectors and traders of *Paris polyphylla* in selected locations in Bhutan. Focus group discussions, formal and informal interviews were held in the Gewogs of Merak, Trashigang; Bumdeling, Trashiyangtse; Tsengkhar, Luentshe; Ura and Chume, Bumthang as well as Langthel and Tangsibji, Trongsa. Further, individual interviews and informal discussions were held with people in Western Bhutan, especially in Wangdue, Haa and Thimphu. Due to the sensitive character of the information, the interviews and discussions were conducted with great confidentially. The main aim of this report is to highlight challenges towards sustainable resource management and trade of *Paris polyphylla* in Bhutan, and not to persecute involved and/or affected people by current illegal activities.

3. Results

3.1. History

Paris polyphylla is harvested from the wild for commercial purposes since almost 10 years (2008). Brokpa traders[10] learned about the value of *Paris polyphylla* as medicinal plant from traders in Arunachal Pradesh (India). The first years (2008-2010), *Paris polyphylla* was collected by highlanders in the Eastern parts of Bhutan and sold through Brokpa traders to traders in Arunachal Pradesh. Traders from Arunachal Pradesh, however, also started to source *Paris polyphylla* directly from collectors in Eastern Bhutan. Brokpa traders also showed samples of *Paris polyphylla* to people in other parts of Bhutan. In the following years (2011-2013), *Paris polyphylla* was increasingly also harvested in western regions, e.g. Haa, Thimphu and Paro. In the first years, the dried rhizomes of *Paris polyphylla* from across Bhutan were sold via Eastern Bhutan to traders in Arunachal Pradesh. Many new collectors and local traders of *Paris polyphylla* emerged on the Bhutanese market within few years; Merak (since 2008; for income generation 2010) Bumdeling (2009; 2016), Tsengkhar (2013; 2017), Chume and Tangsibji (2015; 2016), Wangdue (2015), Haa (2014) and Thimphu (2016). Since a few years (2014), however, the dried rhizomes of *Paris polyphylla* are sold directly to China, mostly via Western Bhutan (e.g. Paro,

[10] *Highlanders in Merak Gewog, Trashigang*

Haa). There has been an increasing demand and market prices for *Paris polyphylla* in China.

3.2. Folk taxonomy, geographic distribution and species diversity

There are different names for *Paris polyphylla* in Bhutan. Dou Sethochem, Dochu Kewa in Dzongkha, Thoksampa in Tshangla and Satuwa in Lhotshamkha (Kuensel, 2018). The interviewed collectors and local traders referred *Paris polyphylla* also to Togsum (Merak), Gechung (Bumdeling), Girchung (Ura), Rato (Chume) and Dho (Haa), respectively.

Paris polyphylla is found in the following Gewogs/locations according to the interviewed; Merak, Sakten, Lauri, Womrong, Cheula, Khaling, Bumdeling, Yangtse, Koma, Tsengkhar, Jarey, Madetso, Rodungla, Sengor, Shinkhar, Tsakaling, Saling, Nubi, Tangsibji, Dhur, Chume, Nubi, Lingshi, Kabesa, Dochula, Lamperi, Hokotsho, Phobjika, Kabji, Dortasa, Dorikha, Chelela, Tegola, Selela and Chapcha, and mostly in broad-leaved, mixed conifer, fir and hemlock and bamboo forests at various altitudes.

In Merak and Bumdeling, three types[11] of *Paris polyphylla* have been reported, whereas in Tsengkhar three and four types, respectively. In Chume people reported five types of *Paris polyphylla* while in Trongsa many types. Up to four types of *Paris polyphylla* were also reported in Thimphu, while only two types in Haa (Table 1). The findings on the geographic distribution and species diversity of *Paris polyphylla* in Bhutan are, however, subject to correction based on scientific studies.

Table 1: Species/varieties of Paris polyphylla observed in West, Central and Eastern Bhutan (subject to correction by scientific studies)

[11] *Different types may refer to different species and/or varieties of Paris polyphylla*

Species/variety of *Paris polyphylla*	**Picture**	**Locations of observation**
Paris polyphylla var. 1 Variety has 6-10 leaves in the first layer and 3-6 leaves in the seond layer. The leaves are lanceolate and the leave base is reddish in the first leave layer. The leaves are green-yellowish and have a main yellow vein. The carpel (female organ) and the stamen (male organ) are both yellowish. The variety has long yellow petals. The rhizome is around finger size.	 Picture: Kabesa, Thimphu	West: Kabesa, Thimphu (by authors), Haa (confirmed by collectors) Central: Chumphel, Bumthang (by authors), Trongsa (by Forestry Officals) East: Merak. Trashigang (by authors)
Paris polyphylla var. 2 (Similar if not same as var. 1) Variety has 8-9 leaves in the first layer and 3-5 leaves in the second layer. **The leaves are lanceolate-linear; long, parallel and very narrow.** The leave base is reddish. The leaves are green and have a **dominant main vein**. The carpel (female organ) and the stamen (male organ) are both yellowish. The variety has long yellow petals.	 Picture: Chumphel, Bumthang (cultivation)	Central: Chumphel, Bumthang (in cultivation from rhizome)

Paris polyphylla var. 3 Variety has 9-10 leaves in the first layer and 4-5 leaves in the second layer. **The leaves are lanceolate, long and very narrow,** and the leave base is reddish. The leaves of the first layer are dark-green, the leaves of the second layer light-green. The leaves have a **dominant main vein.** **The carpel (female organ) is reddish** and the stamen (male organ) is yellowish. **The variety has no petals.**	 Picture: Chumphel, Bumthang	Central: Chumphel, Bumthang (by authors), Trongsa (by Forestry Officals)
Paris polyphylla var. 4 (Similar if not same as var. 3) Variety has around 11 leaves in the first layer and 4 leaves in the second layer. **The leaves are lanceolate, long and very narrow. The leave base is yellowish.** The leaves of the first layer are dark-green, the leaves of the second layer light-green. **The leaves have a clear dominant main vein and are folded.** The carpel (female organ) and the stamen (male organ) are both yellowish. **The variety has no petals.**	 Picture: Chume, Bumthang (cultivation)	Central: Chumphel, Bumthang (by authors)

Paris polyphylla var. 5 Variety has 5-7 leaves in the first layer and 4-5 leaves in the second layer. **The leaves are lanceolate; big and wide,** and the leave base is reddish. **The leaves have a net of veins.** **The carpel (female organ) is reddish** and the stamen (male organ) is yellowish. The variety has long yellow petals. The rhizome is very big and the variety yields very high.	 Picture: Bumdeling, Trashiyangtse (Photo by Tandin Wangdi)	Central: Chumphel, Bumthang (confirmed by local collectors, in cultivation from rhizome), Nubi, Trongsa (by authors) Eastern: Merak, Trashigang (confirmed by local collectors as variety of lower altitudes), Bomdeling, Trashiyangtse (confirmed by Tandin Wangdi) **Variety is found in lower altitudes**
Considered by local communities as a variety of Satuwa **Species has 3 obovate leaves of big size with no leave base.**	 Picture: Chumphel, Bumthang	Central: Chumphel, Bumthang (by authors)
Considered by local communities as a variety of Satuwa **Species has 4 lanceolate leaves with no leave base. The laeves are dark-green and have wide withish veins.**	 Picture: Chumphel, Bumthang	West: Thimphu (confirmed by collectors), Haa (confirmed by collectors, but not harvested as it is considered duplicate) Central: Chumphel, Bumthang (by authors) Eastern: Merak, Trashigang (confirmed by local collectors)

According to people in Merak, *Paris polyphylla* which grows in open areas have bigger rhizomes compared to *Paris polyphylla* grown in the forest. In Luentshe and Trongsa, *Paris polyphylla* with bigger leaves is reported to have a bigger rhizome, as well as if they are found in bamboo forests. The biggest rhizomes can get up to 3 feet in size and weight 3 kg (fresh). In addition, the size of rhizome also depends on soil fertility; near cattle header places the rhizomes of *Paris polyphylla* are much bigger.

3.3. Current state of wild resources

The wild resources of *Paris polyphylla* are decreasing, very drastically, in all locations. The main reason is the increasing number of collectors and wild harvest of *Paris polyphylla*. On the one hand, there is lots of competition for wild resources among collectors, and on the other hand, sustainable harvesting practices are not followed and therefore the natural regeneration of the plant is undermined. Interestingly, collectors of *Paris polyphylla* are aware of the risks of unsustainable harvest and the deterioration of wild resources. In Merak, for example, some villagers started to cultivate *Paris polyphylla* in home gardens, mostly to harvest seeds for the future cultivation. In Bumdeling, NWFPs groups are also starting the cultivation of *Paris polyphylla* to reduce the pressure on local wild resources. In Chume, the cultivation of *Paris polyphylla* in home gardens has also been initiated by Forestry Officials. Nevertheless, more scientific research on the current state of wild resources in Bhutan is urgently needed.

3.4. Wild harvest and sustainable harvesting guidelines

3.4.1. Wild harvest (2018)

In Merak, the big majority of households is involved in the wild harvest of *Paris polyphylla*. So far, no permits were issued for harvesting *Paris polyphylla*, also not for the NWFPs groups which actually include *Paris polyphylla* in the Management Plan. In Bumdeling, the NWFPs groups Cheng and Longkhar have recently received their certificates, including for the management of *Paris polyphylla*. According to the interviewed there has been a rampant illegal collection of *Paris polyphylla* in in the past. The NWFPs groups, however, wish with the new Management Plans to harvest *Paris polyphylla* only in designated areas and to gradually retrain from wild collection through cultivation activities. In Tsengkhar, *Paris polyphylla* is also harvested from the wild since a few years. The NWFP group in Tsengkhar includes *Paris polyphylla* in their revised Management Plan and received collection permits for 150 kg dried rhizomes of *Paris polyphylla*. In Tsengkhar, around half of the households are currently involved in the wild harvest of *Paris polyphylla*. In Chume, more than half of the households are also involved in the wild harvest of *Paris polyphylla* while in Ura, only few villagers harvest *Paris polyphylla* and in limited quantities. *Paris polyphylla*

was recently included in the revised Management Plans of the NWFPs groups in Chume and cultivation activities were also initiated by Forestry Officials. Many villagers also started in recent years to harvest *Paris polyphylla* in Trongsa; in Nubi and Tangsibji, however, not in Langthel. In Western Bhutan (Thimphu and Haa), mostly housewives of army officials and civil servants are harvesting *Paris polyphylla* from the wild. The interviewed reported that there are up to 200-300 collectors in Kabesa area, while in Haa the majority of the households are also harvesting *Paris polyphylla* from the wild. The number of collectors of *Paris polyphylla* has increased in all localities in recent years. Furthermore, *Paris polyphylla* is mostly harvested by people in higher altitudes (cattle and yak herders), as the wild harvest often coincides with paddy transplantation and other agricultural works for famers in lower altitudes.

The quantity of *Paris polyphylla* which is harvested from the wild varies. In Merak, the average quantity may sum up to around 6-10 kg dried rhizome per household. The minimum reported quantity was 2 kg while the maximum 70 kg dried rhizome per household. The annual amount of *Paris polyphylla* harvested from the wild may thus sum up to several thousand kilos in Merak. In Bumdeling, *Paris polyphylla* has been harvested in larger quantities and for commercial purposes only in the last few years. The members of the NWFPs groups, however, did not harvest *Paris polyphylla* in 2018. In Tsengkhar, the collectors reported to harvest around 2-3 kg of dried rhizome while herding their animals. One household, however, harvested up to 25 kg of dried rhizome of *Paris polyphylla*. The NWFPs group in Tsengkhar harvested legally, based on permits, 150 kg dried rhizome. In Chume, one household harvested more than 50 kg dried rhizome, while the majority of households is harvesting at least few kg dried rhizome. In Thimphu and Haa, collectors reported to harvest around 6 kg dried rhizome every year.

Normally, *Paris polyphylla* is harvested from far away and remote sites; often in high altitude (few days walk away). The collectors form groups of 2-10 people and go several times (1-6) intentionally to the forest to harvest *Paris polyphylla* from the wild. From a household, men and women, and also sometimes children are harvesting *Paris polyphylla*. Interestingly, women also form women-only groups. The collectors stay in the forest from a few days up to three weeks, depending on the distance of the harvesting sites. The quantity of harvest depends upon luck; a lucky person can harvest up to 10-15 kg dried rhizome in a few days, but sometimes collectors also return empty handed (for what they feel shy!).

The interviewed also stated to harvest *Paris polyphylla* in neighbouring Gewogs (e.g. Sakten, Lauri, Koma), and in other Dzongkhags (e.g. Haa, Chukha, Wangdue, Gasa, Trongsa and Mongar) as well as across the

border in Arunachal Pradesh. On the other hand, the harvest of *Paris polyphylla* by outsiders was also mentioned by some villagers as a major challenge. Interestingly, collectors from Thimphu reported to harvest *Paris polyphylla* in eastern parts, e.g. Trongsa and Gasa, while collectors from Merak reported to harvest in western parts, e.g. Haa and Chukha. In Luentshe, taxi drivers reported to earn good money while driving collectors to upper altitudes while few collectors argued that the lack of vehicles is one of the limitations for harvesting *Paris polyphylla* from more faraway places.

3.4.2 Collection permits and illegal harvesting

So far, the majority of collectors are not applying for permits for the wild harvest of *Paris polyphylla. Paris polyphylla* is thus predominantly harvested unofficially and illegally. The main reason is referred to the mismatch in the time of harvest. *Paris polyphylla* is currently – throughout the country - harvested in spring and thus in direct violation to the sustainable harvesting guidelines. which allow wild harvest only in autumn (see 3.4.3).

Some NWFPs groups include *Paris polyphylla* in their Management Plans and could officially apply for harvesting permits. However, most of the NWFPs groups prefer to harvest without permits in the spring season. Moreover, also NWFPs groups which obtained legal harvesting permits did actually harvest *Paris polyphylla* in spring, and thus unofficially.

3.4.3. Unsustainable harvesting practices

Across the country, *Paris polyphylla* is harvested in spring, mostly from April to June. This is a direct violation of the sustainable harvesting guidelines which allow the wild harvest only in autumn, from October to November. Collectors, however, argue that in autumn they are not able to spot the plants as the above-ground parts die off. In spring, *Paris polyphylla* is flowering and thus easy to spot in the forest by the collectors. Most of the interviewed are aware that harvesting *Paris polyphylla* in spring is a direct violation of the sustainable harvesting guidelines. An interviewed collector formulated it as follows “what we do and what the government wants us to do doesn’t match”. Collectors strongly argue that due to the plant’s reproduction cycle it is impossible to adhere to the sustainable harvesting guidelines.

Moreover, due to intense competition among collectors, the harvest of *Paris polyphylla* takes place every year earlier, as everybody wants to be the first collector. This was also mentioned as reason of NWFPs groups to harvest already unofficially in spring; if they wait too long to harvest *Paris polyphylla* in their area, it may already have been harvested by outsiders. Some group

members argued that they prefer to “keep the wealth of wild resources in their village” instead of adhering to Government rules and risk outsiders harvesting earlier. Most NWFPs groups also indicated that they face difficulties to catch outsiders, as they usually enter the forest in the night and from other routes.

Moreover, collectors of *Paris polyphylla* are not applying at all sustainable harvesting guidelines, e.g. leaving some portion of the rhizome underground for germination and/or rotational harvesting. Collectors in all locations harvest the whole rhizome, also young plants (e.g. only first layer of leaves emerged), and often year after year in the same locations. To dig the rhizomes from the soil, small curved knifes and hoes are used. Furthermore, awareness on sustainable harvesting guidelines is very limited among collectors.

3.5. Processing and value addition

There is very limited processing of *Paris polyphylla* in Bhutan. Collectors dry the fresh rhizomes over fire directly at the harvesting sites in the forest or in the sun near their house. Drying of the rhizomes is key for good product quality. Sun drying is, however, often challenging because of rains during the harvesting season in spring and because the produce has to be hidden due to illegal harvesting. There are very different indications by collectors on the shrinkage of the rhizome while drying; for 1 kg dried rhizomes around 2.5 - 7 kg fresh rhizomes are needed. The shrinkage of the rhizome while drying and best product quality requires in any case further study.

According to collectors, the dried rhizomes of *Paris polyphylla* can be kept for one to two years. However, *Paris polyphylla* is normally sold immediately after harvest for two reasons; i) risk of storing illegal produce in the house and ii) because the product can get easily attacked by pests and diseases. Collectors usually sell their harvest as mixed bulk to traders. So far, there is no grading and sorting of *Paris polyphylla* by collectors. So far, local traders did not complain about the quality of dried rhizomes. However, mixing of rhizomes from several species, including duplicate species seems very prevalent in Bhutan. The alteration of rhizomes has been mentioned as the reasons for the recent drop in prices of *Paris polyphylla* in Bhutan (see. 3.6.2).

Finally, knowledge on value addition is practically inexistent in Bhutan. The big majority of interviewed were not aware how *Paris polyphylla* is used in traditional medicine and what happens with the dried rhizomes once they have reached China.

3.6. Market demand and trade

3.6.1. Market demand

Paris polyphylla has a high international market demand, especially in China, and to a lesser extend in India. In Bhutan, there is no market demand for *Paris polyphylla* as it is not used in traditional medicine. In Bumthang and Trongsa, however, the leaves of *Paris polyphylla* are traditionally used as vegetable in curry dishes.

3.6.2. Local prices and income of collectors (2018)

Reliable trade data for *Paris polyphylla* is difficult to obtain from Bhutan because the trade is carried out unofficially. *Paris polyphylla* is illegally harvested from the wild and then sold directly to China through illegal border trade. In the first years (2008-2013), *Paris polyphylla* was sold to local traders in Arunachal Pradesh (India), from where Indian traders resold it to China (and India). The price for 1kg dried rhizomes was as low as Nu. 200-500. In recent years (2014-2018), *Paris polyphylla* is sold to local traders, who resell it to Bhutanese export traders for illegal trade directly to China. In 2018, the local price for 1kg dried rhizomes had reached Nu. 6000-7600.

In Merak, collectors sold their dried rhizomes to local traders for Nu. 7430 and Nu. 7600 per kg, respectively. One collector, however, sold his produce directly to an export trader in Thimphu for Nu. 7700 per kg dried rhizomes. In Bumdeling, *Paris polyphylla* was sold to a local trader in Trashiyangtse for Nu. 7250 per kg dried rhizomes. In Tsengkhar, traders from West Bhutan and from Trashiyangtse are buying *Paris polyphylla.* A local trader paid, based on official permits, Nu. 6500 per kg for dried rhizomes to the collectors of the NWFPs group. Another local trader, however, paid Nu. 7000 per kg dried rhizome (no official permits). In Chume, the price for *Paris polyphylla* was reported to be Nu. 7000 per kg dried rhizomes, and normally, *Paris polyphylla* is sold directly to a trader in Haa. In Tangsibji, the price dropped below Nu. 7000 per kg dried rhizomes and the interviewed collectors did no sell their produce. In Nubi, collectors received Nu. 6000 per kg dried rhizomes. In both locations, collectors sold their produce to local traders at Sephu and Pelela in Wangdue. In Thimphu, the price was Nu. 6500 per kg dried rhizomes, while in Haa collectors could sell directly to Bhutanese export traders for Nu. 8000 per kg dried rhizomes. The collectors from Thimphu sold their produce to a local trader in Taba, Thimphu. Normally, collectors sell their produce to the local trader that offers the highest price. During harvesting season many local traders get in touch with collectors in order to make price offers. In general, local traders

collect the dried rhizomes from the collectors' house. Thus, the risk for collectors to sell dried rhizomes of *Paris polyphylla* is minimal.

In Merak, the average household income from *Paris polyphylla* sums up to Nu. 75,000 of an average harvest of 10kg of dried rhizomes. The interviewed collectors estimated that *Paris polyphylla* accounts to around 40% of household income for livestock keepers and up to 80% of household income for families with no livestock. According to collectors, *Paris polyphylla* allows to earn a lot of money in a short time period, while livestock rearing is more important in a long-term perspective. Collectors also reported that, thanks to the wild harvest of *Paris polyphylla,* their lifestyle is changing; new cars, new houses, improved diet etc. and that the villagers have become more equal, as the income of *Paris polyphylla* is not depending on household assets. In Bumdeling, the income of *Paris polyphylla* also accounts for up to 70% of total household income. The income from *Paris polyphylla* is also very important in Tsengkhar, as already from few kg dried rhizomes generate > Nu.15,000 for the household. According to the interviewed, the annual household income *of Paris polyphylla* can sum up to Nu.120,000 – 150,000. Interestingly, collectors argued that people in high altitudes become rich in comparison to people from lower altitudes, who are not able to harvest *Paris polyphylla* due to agricultural works. In Chume, collectors could earn in few weeks around Nu.30,000 - 70,000 by the wild harvest of *Paris polyphylla*. One household reported to have earned Nu.200,000 from *Paris polyphylla*. The spring season, the month of wild harvest of *Paris polyphylla,* has become very precious, as collectors are now able to buy televisions, refrigerators, sofas etc. Today, most of the houses in Chume are well furnished thanks to the additional income of *Paris polyphylla*. For an interviewed collector from Tangsibji, *Paris polyphylla* is the main source of household income. In only few weeks, collectors are able to earn more than 30% of their annual household income. In Thimphu and Haa, the annual income from *Paris polyphylla* sums up to Nu.38,000 and Nu.48,000, respectively. This is a very important contribution to household income, especially for the housewives of army personal and civil servants.

3.6.3. Local and national traders (2018)

There seems to be a multitude of local and national traders of *Paris polyphylla* in Bhutan. In Merak, two local traders bought 470kg and 750kg dried rhizome from collectors, and resold it to national traders in Paro, Trashigang, Trashiyangtse and Mongar. In average, the local traders in Merak earn around Nu.50-100 per kg dried rhizomes from the trade of *Paris polyphylla*. The local traders bought *Paris polyphylla* from collectors for Nu.7340 per kg dried rhizomes and resold to national traders for Nu.7500 per kg dried rhizomes. Their income from the trade of *Paris polyphylla* thus

summed up to Nu.32,900 and Nu.52,500, respectively. In Bumdeling, no local traders could be interviewed, however, collectors confirmed that the main local traders are from Trashiyangtse. The risk to get caught by Park Officials is very high in Bumdeling, and local traders are reported to change vehicles and travel by night to Trashiyangtse. So far, there were at least three reported cases of illegal trade of *Paris polyphylla* in Trashiyangtse. A local trader from Jarey bought around 476kg of dried rhizome for Nu.7000 and resold it to national traders in Dhur, Bumthang for Nu. 7100 per kg dried rhizome. With Nu. 100 profit per kg dried rhizomes trade, the income of the local trader summed up to Nu.47,600. Most local traders in Bhutan buy directly from collectors in the village and sell the produce to national traders. Normally, they know 3-4 national traders and sell to the trader officering the highest prices. In general, the national traders collect the produce from the local traders. The risk to trade *Paris polyphylla* across the country is considered for many local traders as too high. Most of the local traders are simple villagers, who earn some additional income by trading *Paris polyphylla* collected in their Gewogs.

3.6.4. Illegal export trade (2018)

According to the interviewed, it seems there are few national traders involved in illegal export trade from Bhutan. According to a local trader, there are two main Bhutanese export traders; in Trashiyangtse (trades through Tawang, India to China) and Haa (trades directly to China). National traders of *Paris polyphylla* were, however, mentioned in Trashigang, Trashiyangtse, Mongar, Bumthang, Wangdue, Thimphu, Paro and Haa.

A Bhutanese export trader in Haa trades annually more than 100 kg dried rhizomes of *Paris polyphylla* directly to China. Normally, the trader buys *Paris polyphylla* form collectors in Haa or from local traders (if they have proper legal permits) and then resells to the Chinese traders across the border. The export trader makes around Nu. 1000 profit per kg dried rhizome, buying *Paris polyphylla for Nu. 7500-8000* per kg dried rhizomes selling to Chinese traders for Nu. 8500-9000 per kg dried rhizomes. The main challenge for the export trader is the availability of sufficient cash to pre-buy the dried rhizomes from collectors and/or from local traders in Bhutan. The export trader owns more than 20 horses, and besides trading medicinal plants (incl. shen shamo, dunkhur) the trader also supplies the army camp and provides horses for tourism. In 2018, the trader sold at least 150 kg dried rhizomes of *Paris polyphylla* to China; in four trips of two days walk. Thus, the income summed up to at least Nu. 120’000 for the trade of *Paris polyphylla*. Some collectors shared that some export traders sell at least 700-800 kg dried rhizome of *Paris polyphylla* every year to China and earn more than Nu. 5’000’000. The export trader in Haa argues

that the illegal export trade of *Paris polyphylla* to China is easy and fast money, however, involves a huge risk. Moreover, the cross-border trade from Paro may have increased drastically, as with the new farm road it is only a three hours walk to the Chinese border. Interestingly, none of the interviewed traders was aware of the prices of *Paris polyphylla* in China. Some traders heard that the price trickles and is Nu. 18'000-28'000 per kg dried rhizomes on the Chinese market.

Official trade permits for *Paris polyphylla* are only issued in autumn but most of the produce is traded at the time of harvest in spring. The majority of trade takes thus place illegally and without official permits. Some traders may, however, store the illegally harvested dried rhizomes of *Paris polyphylla* until autumn and then opt for legal trade permits. The long-term storage of illegally harvested dried rhizomes is, however, very risky too. The main reason for not obtaining legal trade permits is thus the mismatch in the availability of produce and legal harvesting and trading period. Furthermore, the non-existence of trade permits for China (in contrast to India) are another reason for illegal trade. Interestingly, some export traders are reported to issue trade permits for India for security, however, sell their produce through black market directly to China.

Highlanders in the border regions are often helping the export traders (based on small commissions), as they are familiar with the Chinese traders across the border. Interestingly, the cross-border trade often takes place as barter. *Paris polyphylla* and other produce from Bhutan are traded against Chinese produce such as blankets, shoes, etc. The illegal trade of *Paris polyphylla* thus contributes to fill Bhutanese shops with Chinese products (once sold in shops in Bhutan the products are considered legal). Sometimes, however, the cross-border trade takes also place in exchange for money, while Chinese traders also pay in Indian rupees. Moreover, when the Nathu la Pass[12] was still closed Bhutanese traders could make lots of money with cross-border trade. Now, the illegal trading among the three countries China, India and Bhutan has decreased according to export traders. However, export traders are normally not sharing about their illegal cross-border activities and this information has to be dealt with caution.

[12] Pass between Sikkim, India and Tibet Autonomous Region, China

3.6.5. Price drop in 2019

In 2019, the wild harvest of *Paris polyphylla* may have decreased across the country.
According to various collectors and traders the price of dried rhizomes of *Paris polyphylla* dropped drastically to Nu.3000-5000 per kg dried rhizomes. The main reason was mentioned as the alteration of quality due to mixing of *Paris polyphylla* with duplicate species. In Merak, collectors argued that especially collectors in Bumthang are mixing dried rhizomes of various species. The best quality of *Paris polyphylla* was reported by traders from Merak, mostly because collectors don't mix the dried rhizomes with duplicates. According to an export trader, another reason for the drop of prices is also the start of mass cultivation *Paris polyphylla* in China. Therefore, this year *Paris polyphylla* may rather be sold to Indian traders.

However, some collectors already harvested > 20 kg dried rhizome in 2019. Others were not yet sure, if to harvest or not, while others harvested only limited quantities of 2-3 kg dried rhizomes. Collectors mostly expect prices of at least Nu.7000-8000 per kg dried rhizomes in order to generate income for the wild harvest of *Paris polyphylla.*

4. Discussion

Until today, no study has been conducted on the geographic distribution and species diversity of *Paris polyphylla* in Bhutan. China is the centre of species diversity with 22 species and 12 endemic species of *Paris polyphylla* (Cunningham *et al.,* 2018). The findings of this study suggest a diversity of 4-5 species of *Paris polyphylla* in Bhutan. This is supported by the fact that 4-5 species of *Paris polyphylla* have been reported in Chinese regions north of Bhutan (Cunningham *et al.,* 2018). However, further research on the geographic distribution and species diversity of *Paris polyphylla* in Bhutan is indispensable.

In many regions worldwide, species of *Paris polyphylla* are threatened, often by combined factors of habitat loss and destructive commercial harvest, sometimes compounded by limited geographic distribution (Cunningham *et al.,* 2018). Wangchuk indicates that the abundance of *Paris polyphylla* seems to be decreasing at an alarming rate in Bumthang (Wangchuk, 2017). The findings of this study confirm decreasing wild resource of *Paris polyphylla* throughout Bhutan. The collectors of *Paris polyphylla* harvest increasingly younger plants and from more faraway and remote locations. This may be a result of the strong competition among collectors and unsustainable harvesting practices. Dorji *et al*. also stated that strong competition has resulted in overharvesting of *Paris polyphylla* in Bhutan (Dorji *et al.,* 2018). *Paris polyphylla* was abundantly found in the

wild before the start of mass exploitation for commercial purposes in Bhutan (Paul *et al.,* 2015) and in Nagaland (India) (Deb et al., 2015). Furthermore, *Paris polyphylla* has not yet been assessed for the global IUCN Red List and CITES[13]. In China, however, four species of *Paris polyphylla* are listed as critically endangered, five species as endangered, one species as vulnerable, and seven species are considered near threatened (Cunningham *et al.,* 2018). An assessment on the status of wild resources in Bhutan has yet to be done.

The wild harvest of *Paris polyphylla* has been legalized in Bhutan with collection permits issued by the Ministry of Agriculture and Forests (MoAF) based on the Forest and Nature Conservation Act 1995. Today, there are two ways of legal harvest; i) through an approved Community Forest (CF) management plan and ii) through an approved NWFP management and marketing plan (SFED, 2011). Despite the fact that several CF and NWFP management groups listed *Paris polyphylla* in their Management Plans there is currently no legal harvesting in the country. The main reason is the difficulty of collectors to adhere to the sustainable harvesting guidelines for the wild harvest of *Paris polyphylla* in Bhutan.

The Social Forestry and Extension Division defined harvesting guidelines as follows: i) harvesting period from October to November ii) some portion of the rhizome has to be kept in the ground and iii) no harvest before seed dispersal (SFED, 2011). In addition, CF and NWFP management groups are obliged to: i) announce the starting date of harvest and ii) ensure equal harvest from the forest area as well as the application of harvesting guidelines through group-wise harvesting. Moreover, rotational harvesting; a forest area is divided in a number of collection areas which are harvested in rotation, is suggested as additional management tool (SFED, 2012). The Department of Forests and Park Services issued an office order that anyone found harvesting *Paris polyphylla* without permit or outside the harvesting season would be penalized. The office order states that any individual found collecting illegally *Paris polyphylla* must be dealt as per the provisions of the Forest and Nature Conservation Rules 2006, section 82(5) which states a fine of minimum Nu. 5000 to Nu. 50,000 depending on the degree of the offence. In addition, the offender needs to compensate the amount of *Paris polyphylla* collected illegally at fair market value (Nu. 3000/kg for dry and Nu. 1000/kg for fresh rhizomes) (SFED, 2015).

Today, the quantities of *Paris polyphylla* harvested from the wild may sum up to several thousands of kilos annually. The number of collectors increased in recent years drastically and has reached several thousand across Bhutan. Moreover, harvested quantities vary from 2-70 kg dried rhizomes per household, which translates in hundreds of thousands of

[13] IUCN Red List and CITES

plants harvested every year. Wangchuk, for example, estimated that collectors in Bumthang harvested about 125 kg of *Paris polyphylla* from 2010 until 2015, which translates in more than 12'500 plants harvested from the wild (Wangchuk, 2017).

Despite clearly defined guidelines, the absolute majority of *Paris polyphylla* is harvested without permits and thus illegally. All interviewed collectors confirmed to harvest *Paris polyphylla* before seed dispersal in spring, from March to June, and in direct violation of the sustainable harvesting guidelines. Wangchuk also confirms, that *Paris polyphylla* is harvested during summer season (Wangchuk, 2017). The time of harvest in spring is the main reason for harvesting *Paris polyphylla* without legal permits. According to collectors, it is not possible to spot *Paris polyphylla* in autumn as per sustainable harvesting guidelines, as the plants die off. This fact has been uniformly confirmed by all interviewed collectors and is also highlighted in various studies on the reproduction of *Paris polyphylla* (Madhu, et al., 2010). The plant parts above ground die off in October to November until next germination from the rhizome in spring (SFED, 2012). Collectors unanimously agreed that they would opt for legal permits of *Paris polyphylla*, if permits were issued for the spring season. As long as permits are for the autumn season, collectors will continue to harvest *Paris polyphylla* illegally in spring when they are able to spot the plant. Without adapting the harvesting time, it will therefore be quite impossible to control the wild harvest of *Pairs polyphylla* in Bhutan, and illegal harvest will remain dominant.

The authors of this study thus suggest legalising the harvest of *Paris polyphylla* in late spring, when the plants are visible. The legalisation of the wild harvest of *Paris polyphylla* in spring should, however, only be allowed along rigorous sustainable harvesting practices. The random harvest of *Paris polyphylla* and the uprooting of the whole rhizomes, also from young plants, has been shown as one of the key factors for downsizing the population in Nagaland, India (Deb *et al.,* 2015).

The following revised sustainable harvesting guidelines are suggested; i) harvest season starting in late spring, e.g. June, ii) leave part of the rhizome underground and iii) introduction of rotational harvest. Bapu and Nimasow argue, that April is the rapid growth period of *Paris polyphylla* and that harvesting in early spring is directly affecting the plant population. The start of the harvesting period in June would, however, allow the plants at least to grow and flower. In addition, collectors should be encouraged to leave a small portion of the rhizome underground in order to help conserving the plant for future generations (Bapu and Nimasow, -). Finally, rotational harvesting may help to sustain the resources. A rotation of seven

years is recommended as it takes at least few years for *Paris Polyphylla* to mature (SFED, 2012).

Collectors in Bhutan are aware of the risks of decreasing wild resources. Some collectors in Merak, for example, have started the cultivation of *Paris polyphylla* in order to keep seeds for future cultivation. Across Bhutan, there is increasing interest to start the cultivation of *Paris polyphylla* for income generation. In Samdrup Jongkhar the cultivation of *Paris polyphylla* started back in 2012. However, *Paris polyphylla* is today cultivated mainly in China, and to lesser extend in Arunachal Pradesh (India) and Nepal. In China, *Paris polyphylla* is cultivated in the high-altitude areas of Yunnan, Sichuan, Guizhou, Hunan and Guangxi provinces, and traditionally in agroforestry systems. “Natural fostering”, a form of enrichment planting into natural habitats, is also being implemented in China. Moreover, the increasing interest in the cultivation of *Paris polyphylla* for sale of rhizomes has also generated a market demand for its seeds (Cunningham *et al.,* 2018). Experiences from Nagaland (India) show, however, that *Paris polyphylla* grown in artificial habitats (with similar altitudes and temperatures as in the natural habitats) faced difficulties to flower and to form fruits and seeds (Deb *et al.* 2015). The domestication and inclusion of *Paris polyphylla* in agroforestry and community forestry systems could further enhance rural economy and contribute towards the conservation of *Paris polyphylla* while meeting its market demand (Paul *et al.,* 2015). However, before promoting the cultivation of *Paris polyphylla* at large scale, there is the urgent need for more research on species diversity, cultivation and market demand of *Paris polyphylla* in Bhutan.

Paris polyphylla is traded as a medicinal substance and exported in the forms of dried rhizome and/or extract of dried rhizome as individual articles and/or as active ingredients of finished herbal medicinal products, especially proprietary Chinese medicines. Products include the crude drug (dried whole or cut rhizomes) and extracts, for example Rhizoma Paridis Powdered Extract (PE) at drug-to-extract concentration ratios (DER) of 4:1, 10:1 or 20:1 (w/w). For the latter, this means that 20 kg of dried rhizome are needed to manufacture 1 kg of PE (Cunningham *et al.,* 2018).

In Bhutan, *Paris polyphylla* is solely exported in the form of dried rhizome. There is currently no value addition. Collectors of *Paris polyphylla* only remove the roots and sprouts while also no further grading of the rhizomes is carried out. In general, the rhizome should show a number of clear spirals like in screws (every year one spiral is formed in the rhizome if grown under good soil conditions), while the preferred length is unclear (SFED, 2012). They rhizomes are generally sold dry and are either dried on fire or in the sun. The findings of this study suggest different shrinkage of the rhizomes while drying (2.5 – 7 kg fresh rhizome = 1 kg dried rhizome),

however, according to literature around 4 kg of fresh rhizome are required to get 1 kg dried rhizome (Subedi, 2012b; Basar, 2014).

Moreover, the substitution of *Paris polyphylla* with rhizomes from several *Paris* and other rhizome species has been reported also in Bhutan. According to Cunningham, the substitution occurs due to the rising price and scarcity of *Paris polyphylla* in the wild (Cunningham *et al.,* 2018). China is at the centre of demand for *Paris polyphylla*, with local depletion of populations causing a "ripple effect" onto several other species that are harvested and traded as substitutes for *Paris polyphylla* (Cunningham *et al.,* 2018).

Since the 1980s, there has been a 400-fold increase in the market price paid in China for *Paris polyphylla* rhizomes, from 2.7 Chinese Yuan (CNY) per kg in the 1980s to a market price of 1100 CNY per kg in 2017 (= ca. Nu. 11'000) (Cunningham *et al.,* 2018). The high demand in China for *Paris polyphylla* has stimulated wild harvest neighbouring countries such as Bhutan, Nepal and Vietnam. Cross-border trade for dried rhizomes of *Paris polyphylla* occurs at two different scales. Firstly, trade from Nepal (and possibly from Bhutan and Sikkim) to the two range states that have the largest traditional medicine trade in the world: China and India. Secondly, in China, where *Paris polyphylla* is widely used as an ingredient in several very successful herbal products (Cunningham *et al.,* 2018).

The trade of *Paris polyphylla* in Bhutan is mostly informal. *Paris polyphylla* is sold to buyers in India and China (BIOC, 2015), as there is no domestic market demand for *Paris polyphylla* in Bhutan. Menjong Sorig Pharmaceuticals Corporation Limited is not sourcing *Paris polyphylla* as it is not used in traditional medicine in Bhutan. Moreover, there is no indication that this will change anytime soon (MSPCL, 2018). Due to the illegal nature of most trade, collectors get low prices compared to export prices (SFED, 2012; Cunningham *et al.,* 2018). A common concern expressed by collectors is the lack of a proper market. Most of the dried rhizomes are bought by intermediaries, leading to a lack of transparency and highly fluctuating prices for *Paris polyphylla* (Dorji *et al.*, 2018).

The findings of this study suggest a price development around Nu. 4300 (2015), Nu. 5500 (2016), Nu. 6500 (2017) to Nu. 7000 (2018). Interestingly, despite a significant investment in the cultivation of *Paris polyphylla* (reflected in a lucrative market for the seeds) there was no sign of a drop in the price until 2018 (Cunningham *et al.,* 2018). However, prices differ among locations; Nu. 6000-8000 per kg dried rhizome in 2018. Prices were the highest in Merak and Haa (> Nu. 7500), while they were lower in other locations in Bhutan. Roy *et al.* observed that the prices gradually decrease throughout the season of *Paris polyphylla* when more people start collecting

the rhizome (Roy *et al.,* 2018). The authors did not observe the same, as many collectors sell to the buyer that offers the highest price at the time of harvest. Currently, the collectors of *Paris polyphylla* sell the dried rhizomes as fast as possible as it is risky to store illegal produce. With the formation of NWFPs groups collectors hope to legalise the wild harvest of *Paris polyphylla* and be able to store the dried rhizomes at home and sell whenever the price is high.

Table 2: Price development of Paris polyphylla (dried rhizome)

Year	Price in Nu. per kg dried rhizome	Location	Source
2008	266	wholesale India	DoFPS, 2012
2011	1950	wholesale India	DoFPS, 2012
2012	1875 (3000 NRS./kg)	Kathmandu, Nepal	Subedi, 2012a
2013	1500	Merak, Bhutan	Kuensel, 2013
	1800	Arunachal Pradesh, India	Kuensel, 2013
2015	4500	Trashiyangtse, Luentshe, Bhutan	BIOC, 2015
	3500-4000	Arunachal Pradesh, India	Paul *et al.,* 2015
2017	5100	Bhutan	Kuensel, 2017
	5000	Thimphu, Wangdue, Bhutan	Dorji *et al.,* 2018
2018	5000-6000 (early season)	Arunachal Pradesh, India	Roy *et al.,* 2018

The annual income from the wild harvest of *Paris polyphylla* ranged from a minimum Nu. 15'000 to a maximum of Nu. 200'000. Many collectors could earn around Nu. 50'000-70'000 from the wild harvest of *Paris polyphylla*. The majority of collectors confirmed the great importance of this additional income for the wellbeing of their household. According to Dorji *et al.,* households (Thimphu and Wangdue) earned between Nu. 900 and Nu. 25,000 per year depending on the quantity of *Paris polyphylla* harvested (Dorji *et al.*, 2018). A report in Kuensel, however, indicated that households in Bhutan earn at least Nu. 40'000 from selling the rhizome of *Paris polyphylla* (Kuensel, 2017). In any case, the income for the wild harvest of *Paris polyphylla* is important for rural households in Bhutan and therefore current illegal activities cannot be neglected.

The findings of this study suggest that there are a multitude of traders in Bhutan; collectors sell the dried rhizomes to local traders who resell it to national traders and/or export traders. However, due to the nature of illegal trade it remains difficult to find information about the magnitude of trade of *Paris polyphylla* in Bhutan. Fact is, that only a total of 656kg *Paris polyphylla* was supplied through legal permits in 2016 and Nu. 61'680 revenues were generated through Royalty (Nu. 15 per kg) (DoFPS 2016; 21). In 2017, only 482kg of *Paris polyphylla* was legally supplied and a Royalty of Nu. 7'288 generated (DoFPS, 2017; NSB, 2018). The authors strongly suggest that this is just a very small proportion of trade compared to illegal trade activities currently occurring in the country. Bapu and Nimasow suggest that there are around 20 – 25 middlemen in eastern

Bhutan and on average, one middleman collects about 100 – 300 kg of fresh rhizomes (= 25-75 kg dried rhizomes) (Bapu and Nimasow, -).

A way to control the trade of *Paris polyphylla* could be through public auctions organised by the Government, as already done for other commodities (e.g. Cordyceps) in Bhutan. Public auctions could promote transparency of quantities, prices and qualities of *Paris polyphylla* traded in Bhutan, as well as generate revenues through Royalty. In addition, Forestry Officials also requested more directives from Head Office for patrolling during spring, the harvest period of *Paris polyphylla*, to catch and penalize illegal traders. Nevertheless, in order to implement sustainable harvesting guidelines and control illegal trade, awareness rising and capacity building among collectors is key.

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