BJNRD (2021), 8(1): 1-7
Bhutan Journal of Natural Resources & Development

Article

www.bjnrd.org

Open Access

ISSN 2409–2797 (Print)
ISSN 2409–5273 (Online)

DOI: https://doi.org/10.17102/cnr.2021.58

Knowledge, Attitude, Practice and Economic Benefits of *Paris polyphylla* in Mongar Gewog, Mongar, Bhutan

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Abstract

Paris polyphylla is harvested unsustainably in Asia. Lack of accurate information and adequate research on *P. polyphylla* in Bhutan is a challenge for its sustainability. This cross-sectional survey assessed local people's knowledge, attitude, practice, and economic benefits of *P. polyphylla* in Mongar Gewog, Bhutan. Face-to-face interviews using semi-structured questionnaires were conducted to collect data from 200 households selected via exponential non-discriminative snowball sampling technique in early 2020. The results showed that people are aware of the medical and commercial values of *P. polyphylla*. They are also aware of the declining population of *P. polyphylla* due to unsustainable harvesting. The respondents have high positive attitude towards conservation of the plant in their locality. However, their knowledge and attitude did not support their practice and belief. About 46% of households have started to domesticate the plant. Thus, this study recommends creating awareness on sustainable harvesting, researching the feasibility of domesticating on commercial scale, developing conservation strategies at the local level and enhancing economic local benefits of the plant.

Keywords: attitude, conservation, domestication, knowledge, *Paris polyphylla*, practice

Introduction

Among 7,000 species of vascular plants known in Bhutan, there are about 600 species of locally identified medicinal plants of which the traditional Bhutanese medicines use over 208 species (Wangchuk *et al.,* 2008). *Paris polyphylla* (Figure 1) is one of the highly sought after medicinal plants in the country. It is known as *Dochu Kewa* in Dzongkha (national language), *Thoksampa* in Sharchopkha (a local dialect in eastern Bhutan), and *Satuwa* in Lhotshamkha (a local dialect in southern Bhutan) (Pelden, 2017). It is categorized as Vulnerable by the International Union of Conservation of Nature (IUCN) Red List (Chauhan, 2020).

Paris polyphylla is a broad-leaved perennial herb growing up to 100 cm tall. Its stems are stout with creeping and segmented rhizomes. Its greenish flowers are like spider. It grows best in moist areas, drained and humus-rich soil, and dry and decayed organic matter (Deb *et al.,* 2015). It is found in tropical to temperate regions among bamboo thickets, grassy or rocky slopes, and stream banks (Mayirnao and Bhat, 2017). It propagates through seed and underground rhizomes (Chapagain *et al.,*

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Received: August 19, 2020
Accepted: June 30, 2021
Published online: August 30, 2021

2014). The plant's shoot dries and rhizomes remain dormant in winter, but it grows back in spring (Shukila, 2012). According to Deng *et al.* (2008), *P. polyphylla* also grows in Bhutan's neighboring countries including India, Nepal, China, Laos, Myanmar, Thailand, and Vietnam.

In Bhutan, *Paris polyphylla* grows in eastern, central, and western regions (Bhutan Trust Fund, 2017). The plant has drawn much attention in recent years due to its medicinal values in treating snakebites, insect bites, and boils (Shukila, 2012). It has significant market demand leading to illegal trading of rhizomes, particularly in Tibet, Nepal, Bhutan, and Darjeeling (Lepcha *et al.,* 2019). Fresh or dried rhizomes of *P. polyphylla* are traded (Chandra *et al.,* 2015). According to Subba (2016) and Deb *et al*. (2015), its demand in pharmaceutical industries is still not filled.

In Bhutan, people harvest *Paris polyphylla* haphazardly and prematurely and export illegally to China (Bhutan Trust Fund, 2017). Bhutan legalized the collection of *P. polyphylla* in 2015 to ensure sustainable and restricted harvesting (Bhutan Trust Fund, 2017). The official harvesting season is between October and November when rhizomes mature. However, due to its high commercial value, people harvest it unsustainably (Pelden, 2017). Therefore, understanding local people's perceptions on *P. polyphylla* would help in devising appropriate strategies to conserve the plant and benefit local people economically. Therefore, this study assessed local people's knowledge, attitude, practice, and economic benefits of *P. polyphylla* in Mongar Gewog, Mongar, Bhutan.

Figure 1: *Paris polyphylla* from the study area

Materials and Method

Study area

We conducted this study in the Mongar Gewog (sub-district) of Mongar district (Figure 2). Mongar Gewog lies at altitude ranging from 400 m to 4000 m above sea level (m asl) along the Thimphu-Trashigang highway (Tourism Council of Bhutan, 2019). The Gewog covers an area of 77 km^2 and comprises of six Chiwogs (sub-Gewogs): Themdangbi-Ketongri, Takchhu-Koenbar, Phosorong, Kedikhar, Wengkhar-Yakpogang, and Gyelposhing -Wangling. The Gewog has 674 households with a population of 5,889 people (2,939 male and 2,950 female) (National Statistics Bureau, 2017a). The Gewog experiences a subtropical in the south to temperate climate in the north. Farmers in the Gewog practice integrated farming, relying on agriculture products, forest resources, and livestock (Chetri *et al.,* 2018). Besides relying on forest resources, including fodder, wild mushroom, fern tops, firewood, bamboo, and cane shoots people also collect rhizomes of *Paris polyphylla* as an alternative source of income. Due to high demand for the *P. polyphylla*, it is common to see people harvesting the plant unsustainably. Although this problem is reported from Bhutan (Bhutan Trust Fund, 2017; Pelden, 2017), people's knowledge, attitude, practice, and economic benefits related to the plant are not understood adequately. This knowledge gap inspired the authors to conduct a study in Mongar on *P. polyphylla*.

Data collection and processing

Four out of six Chiwogs were selected purposively: Takchhu-Koenbar, Wengkhar-

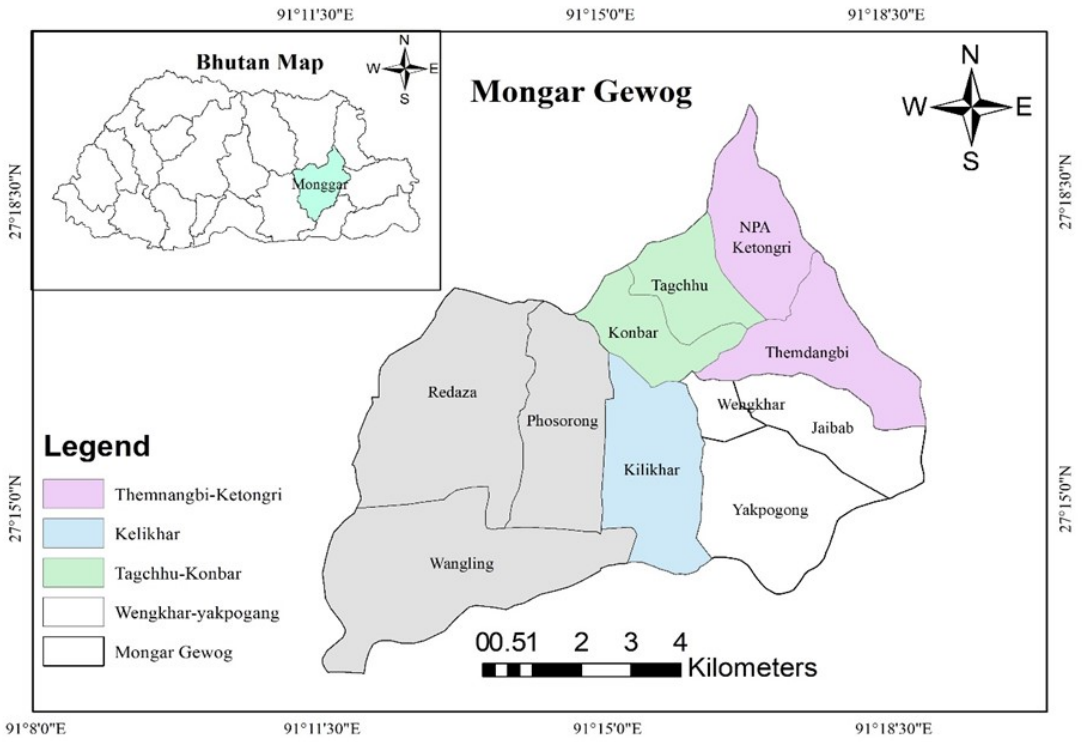

Figure 2: Mongar Gewog showing four selected Chiwogs

Yakpogang, Themdangbi-Ketongri, and Kedikhar (Figure 3). It is because *Paris polyphylla* is found and harvested only in these four selected Chiwogs. We identified households collecting rhizomes by using the exponential non-discriminative snowball sampling. This snowball sampling approach enables researchers to visit all potential households suggested by the first respondent. Snowball sampling was necessary as there was no record about households engaging in collecting *P. polyphylla*.

We used the thumb rule of 30% to determine the sample size of 203 households from 674 target households in the Gewog. Figure 3 presents the percentages of respondents sampled in each Chiwog. However, we excluded three households due to their incomplete responses. Therefore, data from 200 households were used in analyses.

We conducted face-to-face interviews using semi-structured questionnaires to collect the data. Households' heads – decision-maker in the households – took part in interviews. However, we interviewed another household member who is familiar with *Paris polyphylla*, during unavoidable circumstances. Respondents who can self-administered the questionnaire were limited due to the low literacy rate in rural areas (National Statistics Bureau, 2017b), necessitating face-to-face interviews.

The questionnaire was divided into two parts. The first part assessed people's knowledge, attitude, and practice of harvesting *Paris polyphylla*, while the second part assessed the economic benefits of the plant. Before the actual data collection, we pre-tested the questionnaire on ten randomly selected households from Kedikhar chiwog and edited to improve its clarity. We obtained verbal consent from all respondents. We analyzed data using descriptive statistics such as frequency, percentage, mean, and standard deviation, and present them using numbers of tables.

Results and Discussion

Profiles of respondents

As shown in Table 1, the age of most respondents (33%) were between 25 and 35 years, followed by above 45 years (32.5%), 35 and 45

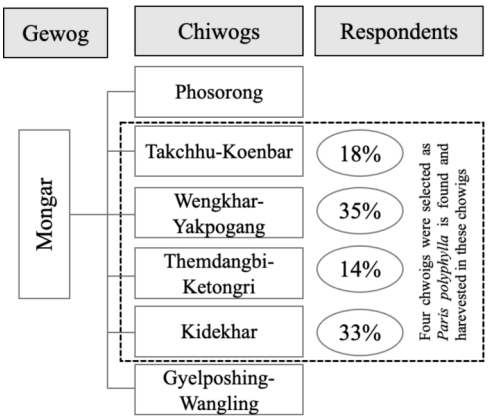

Figure 3: Sampling tree diagram

years (31%), and less than 25 years (3.5%). Respondents comprised of more males (57%) compared to females (43%). This finding shows that the households headed by men are higher (54.1%) compared to households headed by women (45.9%) in Bhutan agrees with the report of National Statistics Bureau (2017b). The majority (71%) of the respondents did not attend formal schooling, showing high illiteracy rate in the Gewog. Similarly, the National Statistics Bureau (2017b) also recorded lower literacy rate for youths and adults in rural Bhutan.

People's knowledge of Paris polyphylla

Paris polyphylla has gained popularity due to its diverse medicinal values (Shukila, 2012). Table 2 shows that 51% of the respondents knew about its commercial and medicinal values. Most respondents (86%) were also aware that the population of *P. polyphylla* decreased over the years in their locality. Every harvesting season, people have to travel farther in search of the plant (Bhutan Trust Fund, 2017) which is an indicator of its decline. Excessive extraction of the rhizomes is the main declining factor as per 52.5% of the respondents. Other reasons include unseasonal collection (17.5%), habitat destruction by people (15%), and cattle grazing (10%). However, 5% of the respondents were not aware of the declining population of *P. polyphylla*.

People's attitude towards Paris polyphylla

Except for 15% of the respondents, 85% of them perceived that *Paris polyphylla* is facing extinction threats (Table 2). Most respondents (91.5%) also perceived that *P. polyphylla* must be conserved and protected. Maximum (58.5%) respondents knew that the unseasonal collection of rhizomes is illegal. However, 41.5% of the respondents did not believe harvesting before officially approved months as unlawful. It implies a negative attitude towards conservation of threatened *P. polyphylla* among some respondents. Concerned authorities, therefore, ought to create awareness on conservation policies among local people. Altogether, results exhibit positive attitudes towards the conservation of *P. polyphylla* among people in the community.

Practice related to Paris polyphylla

The plant's optimal harvesting time is after flowering and seed dispersal around October (Madhu *et al.,* 2010; Shukila, 2012; Deb *et al.,* 2015). It is because rhizomes will be bigger and the yield will be more (Chapagain *et al.,* 2014; Chandra *et al.,* 2015; Subba, 2016). However, 94.5% of the respondents collected rhizomes before October, showing they harvest the rhizome prematurely (Table 3). Bhutan Trust Fund (2017) and Pelden (2017) noted that the increasing demand for rhizomes leads to premature and excessive harvest of the plant in Bhutan. Neighboring countries such as Nepal, India, and China

Table 1: Profile of respondents

Characteristics	Categories	Frequency	Percentage
Age	< 25	7	3.5
	25-35	66	33
	35-45	62	31
	> 45	65	32.5
Gender	Male	113	57
	Female	87	43
Formal schooling	No	142	71
	Yes	58	29

Table 2: People's knowledge of *Paris polyphylla*

Knowledge of *Paris polyphylla*	Categories	Frequency	Percentage
Knowledge on uses of *P. polyphylla*	Medicinal use	70	35
	Commercial use	28	14
	Both	102	51
Population of *P. polyphylla* has declined over the years	Yes	172	86
	No	28	14
Reason for declining *P. polyphylla* population	Over extraction	105	52.5
	Unseasonal harvesting	35	17.5
	Habitat destruction	20	10
	Grazing	30	15
	No idea	10	5

also harvest the plant prematurely and excessively (Chapagain *et al.,* 2014; Chandra *et al.,* 2015; Subba, 2016; Bhat *et al.,* 2017; Cunnigham *et al.,* 2018; Pyakurel *et al.,* 2018).

Ideally, people must leave certain parts of the rhizome for regeneration in the next germination season. However, most people (76.5%) dig up the entire rhizome. Unseasonal harvesting and complete removal of rhizomes are threats to the plant. Early harvests give the plant no time to flower and produce seeds. Yadav and Rajbhandary (2016) and Cunningham *et al.* (2018) also found that harvesters usually dig up the entire rhizome.

The increasing demand and scarcity of *Paris polyphylla* motivated 46% of the respondents to domesticate the plant. They domesticate the plant by collecting and transplanting rhizomes from the wild. Cunningham *et al.* (2018) observed that the cultivation of *P. polyphylla* using seed takes at least three years to flower and reach its maturity. It takes more than seven months to produce primary roots from seeds (Madhu *et al.,* 2010; Deb *et al.,* 2015; Bhat *et al.,* 2017). Therefore, Deb *et al.* (2015) and Bhat *et al.* (2017) recommended using rhizomes as the primary mode of regeneration for *P. polyphylla*. However, scholars should conduct similar research in the context of Bhutan's unique climate and geography.

Economic benefits of Paris polyphylla

Commercial harvesting of *Paris polyphylla* in Bhutan started in recent years due to increasing export markets (Bhutan Trust Fund, 2017; Pelden, 2017; Lepcha *et al*., 2019). P. *polyphylla* is exported primarily to China (Cunningham *et al*., 2018; Lepcha *et al*., 2019). People reported having collected the rhizomes amounting to two kilograms to twenty kilograms per season (Table 4). One kilogram of dried rhizome could earn between Bhutanese Ngultrum (Nu.) 4,000 and Nu. 8,000, whereas a kilogram of fresh rhizomes fetches between Nu. 800 and Nu. 1,500. Although the price of *P. polyphylla* is escalating in recent years (Chapagain *et al*., 2014; Yadav and Rajbhandary, 2016), respondents reported that it fluctuates every season depending upon

Table 3: People's attitude towards *Paris polyphylla*

Attitude towards *Paris polyphylla*	Categories	Frequency	Percentage
P. polyphylla is facing the threat of extinction	Yes	170	85
	No	30	15
P. polyphylla should be conserved	Yes	183	91.5
	No	17	8.4
Unseasonal collection of *P. polyphylla* is illegal	Yes	117	58.5
	No	83	41.5

Table 4: Economic benefits of *Paris polyphylla*

Economic benefits	Minimum	Maximum	Median	SD
Amount harvested per season (kg)	2	20	6	3.7
Amount earned per kg of dry rhizome (Nu)	4,000	8,000	5,000	488.6
Amount earned per kg of fresh rhizome (Nu)	800	1,500	1,000	123
Total amount earned per season (Nu)	2,000	90,000	7,000	12,231.70

their dealers. In a single harvesting season, respondents earned a minimum amount of Nu. 2,000 to a maximum of Nu. 90,000. According to Chapagain et al. (2014) and Chandra et al. (2015), a kilogram of rhizome fetches between Nepalese rupees (NRs.) 4,300 and NRs. 5,000 per kilogram, depending on size and quality. Therefore, *P. polyphylla* is an essential forest-product to earn income and create livelihood opportunities for those communities depending on natural resources.

Conclusions

Local people are aware of the medicinal and commercial values of *Paris polyphylla.* People are also aware of the declining population of *P. polyphylla* due to premature harvesting, over-harvesting, habitat destruction, and grazing. However, many respondents perceived that the collection of rhizomes before the official season is illegal and the species should be conserved. However, in practice, most people (78.5%) collected rhizomes between May and June, much earlier than the official seasons, i.e., September and October. Additionally, most people (76.5%) practice harvest by completely digging up the rhizomes. On the positive note, people could generate incomes from selling rhizome, and 46% of sample households have also started to domesticate the plant. We recommend that the concerned stakeholders should continue creating awareness on sustainable harvesting, strengthen monitoring and law-enforcement, and support research on the feasibility of large-scale domestication in Bhutan's context.

Acknowledgments

The authors acknowledge the valuable time and information provided by all the respondents. Our appreciation also goes to Mr. Sangay Dorji, Mr. Samten Wangchuk, and Ms. Tshering Dolkar for their supports.

References

Bhutan Trust Fund. (2017). *Threats and conservation of Paris polyphylla an endangered, highly exploited medicinal plant in the Himalayan Region*. <http://www.bhutantrustfund.bt>. Accessed 10 September 2019.

Chandra, K., Purohit, V.K. and Andola, H.C. (2015). Paris polyphylla smith: A medicinally important plant species is in high risk in Himalayan region. Medicinal Plants, 7(4): 292-295. DOI: https://doi.org/10.5958/0975-6892.2015.00043

Chapagain, S.P., Rai, J.K., Pathak, A. and Dahal, K. (2014). *Value Chain Analysis of Forest Products in Koshi Hill Districts of Nepal: Challenges and Opportunities for Economic Growth*. Kathmandu, ForestAction Nepal and Rural Reconstruction Nepal.

Chetri, B.K., Wangdi, P. and Penjor, T. (2018). Ethnomedicinal Practices in Kilikhar, Mongar. 1(2): 1-13. DOI: https://doi.org/10.9734/aprj/2018/v1i226275

Chauhan, H.K. 2020. Paris polyphylla. The IUCN Red List of Threatened Species 2020: e.T175617476A176257430. <https://www.iucnredlist.org/species/175617476/176257430>. Accessed 10 August 2021.

Cunningham, A.B., Brinckmann, J.A., Bi, Y.F., Pei, S.J., Schippmann, U. and Luo, P. (2018). Paris in the

spring: A review of the trade, conservation and opportunities in the shift from wild harvest to cultivation of Paris polyphylla (Trilliaceae). Journal of Ethnopharmacology, 222(3): 208-216. DOI: https://doi.org/10.1016/j.jep.2018.04.048

Deb, C.R., Jamir, S. and Jamir, N.S. (2015). Studies on Vegetative and Reproductive Ecology of Paris polyphylla Smith: A Vulnerable Medicinal Plant. American Journal of Plant Sciences, 06(16): 2561-2568. DOI: https://doi.org/10.4236/ajps.2015.616258

Deng, D., Lauren, D.R., Cooney, J.M., Jensen, D.J., Wurms, K.V., Upritchard, J.E. and Li, M.Z. (2008). Antifungal saponins from Paris Polyphylla Smith. Planta Medica, 74(11): 1397-1402. DOI: https://doi.org/10.1055/s-2008-1081345

Lepcha, D.L., Pradhan, A. and Chhetri, D.R. (2019). Population assessment and species distribution modeling of Paris polyphylla in Sikkim Himalaya, India. Biodiversitas, 20(5): 1299-1305. DOI: https://doi.org/10.13057/biodiv/d200508

Madhu, K.C., Phoboo, S. and Jha, P.K. (2010). Ecological Study of Paris Polyphylla Sm. An International Journal of Ecology, 17(23): 87–93. DOI: https://doi.org/10.3126/eco.v17i0.4121

Mayirnao, H.S. and Bhat, A.A. (2017). Evaluation of antioxidant and antimicrobial activity of Paris polyphylla SM. Asian Journal of Pharmaceutical and Clinical Research, 10(11): 315-319. DOI: https://doi.org/10.22159/ajpcr.2017.v10i11.20984

National Statistics Bureau. (2017a). *Bhutan population and housing census 2017*. <http://www.nsb.gov.bt/publication/files/PHCB2017_national.pdf>. Accessed 17 May 2019.

National Statistics Bureau. (2017b). *Bhutan Living Standards Survey 2017*. Royal Government of Bhutan. Thimphu, Bhutan.

Pelden, T. (2017). *Illegal Paris Polyphylla collection rampant*. Kuensel, pp.2 <http://www.kuenselonline.com/illegal-paris-polyphylla-collection-rampant/>. Accessed 5 June 2019.

Pyakurel, D., Bhattarai, S.I. and Ghimire, S. K. (2018). Trade and conservation of medicinal and aromatic plants in western Nepal. Botanica Orientalis: Journal of Plant Science, 11: 27–37. DOI: https://doi.org/10.3126/botor.v11i0.21029

Shukila, M.C. and A. (2012). Efficiency and Potency of *Paris polyphylla*, an ethno-medicinal plant of Mizoram. Journal of Science and Tchnology, 1(1): 2321–3388.

Subba, S. (2016). A Versatile Medicinal Plant Species Paris Polyphylla-At Lachung. 4(1): 54-57.

Tourism Council of Bhutan. (2019). <http://www.bhutan.travel/destinations/mongar>. Accessed 3 June 2019.

Wangchuk, P., Thinley, J. and Afaq, S. (2008). High altitude plants used in Bhutanese traditional medicine (So-ba-rig-pa). Ethnobotany, 20: 54–63.

Yadav, S. and Rajbhandary, S. (2016). Medicinal plants used against gastrointestinal disorders by the Tamang people in Rasuwa district, central Nepal. Journal of Plant Science, 10: 19-23. DOI: https://doi.org/10.3126/botor.v10i0.21019