Indian Journal of Plant Sciences ISSN: 2319–3824
An Open Access, Online International Journal Available at http://www.cibtech.org/jps.htm
2019 Vol. 8(2) April-June, pp.12-19/Lama et al.
Research Article

STATUS AND ECOLOGICAL PREFERENCES OF 'BODHICHITTA' (*ZIZIPHUS* SPECIES): A CASE STUDY FROM POKHARI NARAYANSTHAN VDC, TIMAL, KAVREPALANCHOWK, CENTRAL NEPAL

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ABSTRACT

Distribution and population status was investigated of high value rarely distributed plant *Ziziphus xiangchengensis* species, commonly called 'Bodhi' or 'Bodhichitta' in Nepal and China. The study was carried out in Pokhari Narayanthan VDC of Kavrepalanchok District, Central Nepal. Field observation, Desktop review, questionnaire survey and soil sample were analyzed to study the status, and ecology. PH, temperature, moisture content and conductivity were analyzed from the soil samples.

Altogether 353 trees of 'Bodhichitta' are reported from study area which was between the ages of 15 years to more than 100 years. This is the only natural population of the 'Bodhichitta' in Nepal. The species was found from 945 to 2001 m altitude with soil of temperature varying from 9^0c to 20^0c and EC from 204µs to 496µs between the slopes of 20^0 to 50^0. In lower slope, higher number of species was found. The tree favors slightly acidic soil of PH 5 to 6.32 and 3.48% to 9.46% of moisture content preferred for the growth of the plant. The plants are found favors to grow on sub-tropical zone of Nepal. The natural rare distribution and based on population study, the plant species was found rare and in limited geographical area.

Keywords: *Population ecology, Central Nepal, Bodhichitta, Ziziphus xiangchengensis*

INTRODUCTION

About 100 species of *Ziziphus* has reported from the world (Mabberley, 2008). Among them, six species are already reported from Nepal (NHPL, 2011), 17 species are from India (Bhandari and Bhansali, 2000), 12 species from China (Zao, 2007) and seven species from Bhutan (Grierson and Long, 1991).

Ziziphus xiangchengensis Y. L. Chen & P. K. Chou **(**as synonym: *Ziziphus buddhensis* Bhattarai & M.L. Pathak), commonly called 'Bodhichitta', 'Buddhamala' or 'Bodhi' in in China and Nepal is a sacred tree that religiously belongs to Buddhism and till date it is reported only from Nepal and China (Pathak et al. 2017). In Nepal, the plant is only naturally found in Timal region of Kavrepalanchok District (Bhattarai and Pathak, 2015). Besides its taxonomic finding, very few researches are carried out regarding germination of seed (Dorji *et al*., 2015). It is believed that few plants of 'Bodhichitta' were taken in Bhutan by a great Buddhist saint Thangtong Gyalpo (15th Century) from Nepal during his pilgrimage to the present Boudhanath temple (Dorji *et al*., 2015). The tree and seed both are known as 'Bodhichitta' or 'Buddhachitta Mala'. Local people of Timal region in Nepal call it simply as 'Mala', 'Frengba mala', or 'Buddha mala'. The seeds are used to make garlands, which are used by Buddhist people for worship to Lord Buddha for spiritual peace. Some people use garlands as ornamental too. Historically, the beads

originated from Guru Padhma Sambava. It is believed that Guru Padhma Sambava introduced '*Bodhichitta'* tree at cave Tongsum Kunda (Timal, Kavre District of Nepal) during his meditation in 8th century.

The plant is found in tropical and subtropical region in natural forest (Field Visit in August/September 2018 by Chengdu Institute of Botany (CDBI) team in west Sichuan; Plate 1) and cultivated land and grows on sandy and rocky fragile soil (Bhattarai and Pathak, 2015). One of the interesting facts about the plant is that local people of the west Sichuan (Xiangcheng) also called it 'Bodhi' and used as same purpose as in Nepal. The cultivated population is common in the west Sichuan. *Bodhichitta* is spiny, deciduous tree up to 15 m high and 40 cm in diameter. The tree is also used as fodder for cattle (Bhattarai and Pathak, 2015). The fruit is edible and yellowish brown in color but often not eaten. The fruit skin is smooth and glossy. There is less awareness about this plant as this plant is found in narrow region (Bhattarai and Pathak, 2015). The tree gained more popularity recently due to the high economic value of the beads which were made into a garland of 108 seeds (Pathak *et al.,* 2017)

Plate 1: *Ziziphus xiangchengensis* (Bodhichitta) at river bank in west Sichuan (Xiangcheng), China

The tree has an enormous religious and economic value. The fruits particularly inner stony endocarps, from this tree are used to make rosary beads for religious purposes by Buddhist since long time (Dorji *et al*., 2015). Also the seeds are used for making bracelet, locket, and necklace and as a fashion rather than spiritual value. Each seed has a remarkable facet called as "sura" or "mukh". The price of seed depends on the size of seed, number of facet and color of the seed. Smaller seeds are more highly priced than

larger ones, and a garland of 108 beads of high value seeds costs up to 2000 USD (NHPL, 2014/15). And generally golden color and higher number facet seeds are highly priced (Pathak *et al.*, 2017). In this context, we have investigated the real population scenario and its ecological preferences of this high value plant in Nepal based on field observation and interaction with local people.

MATERIALS AND METHODS

Study Area

The study was conducted in Pokhari Narayansthan VDC, Timal, Kavrepalanchowk District (Figure 1). It is 40 km apart from Dhulikhel (headquarter of district). Total population of the VDC was 2945 with male population 1379 and female population 1566 and the total household was 647 (CBS, 2011). The residents of the community are dominated by indigenous ethnic group Tamang. Other residents of the community are Dalit, Magar, Newar and Brahman.

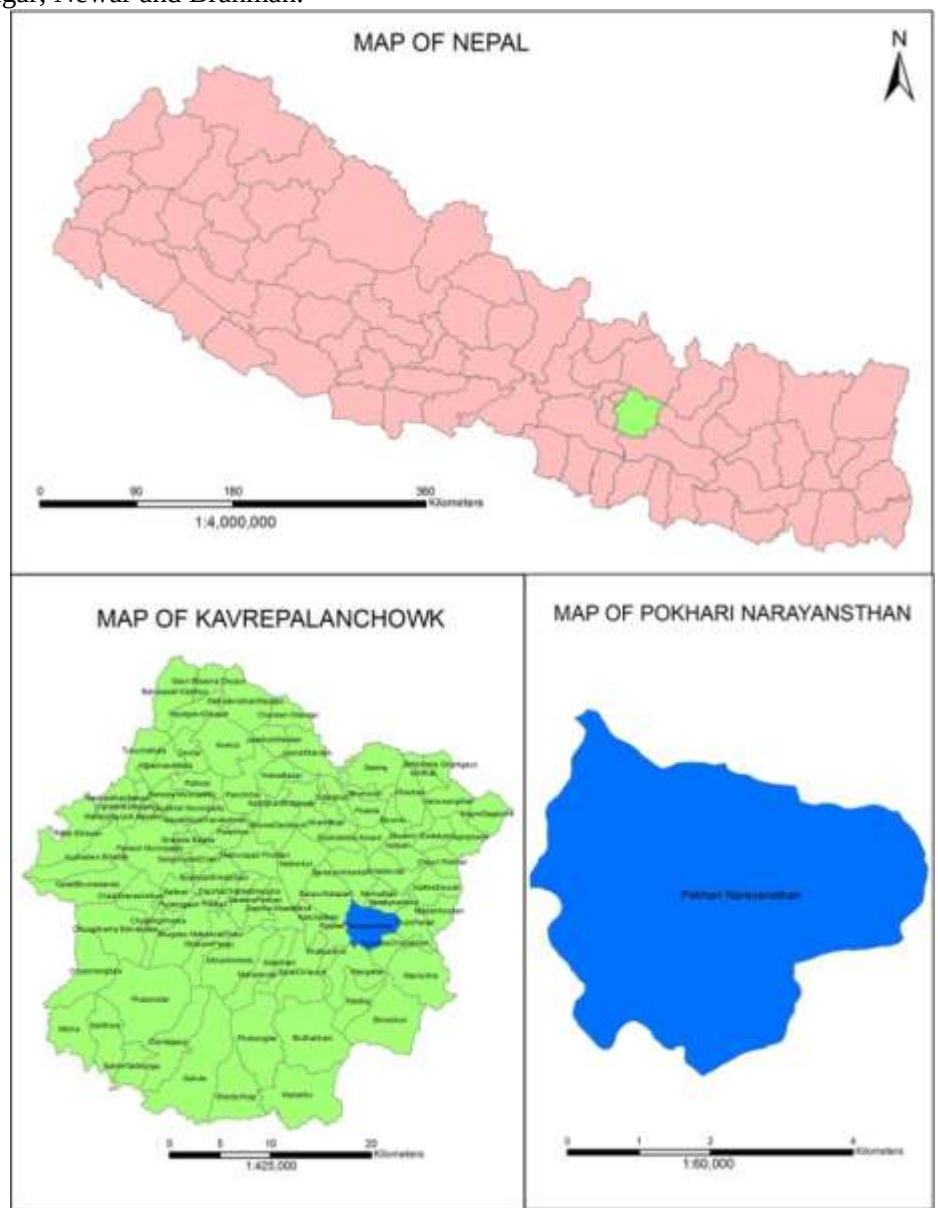


Figure 1: Study Area

Methods

In order to conduct the study, Systematic and integrated methodology was followed. The major elements of this methodology was based on primary information. However, some secondary information was also gathered. The primary data was collected by extensive field survey, public consultation, direct observation, key informant interviews and formal questionnaire survey. The questionnaire survey was conducted with local people related with the collectors of 'Bodhichitta' by designing checklist of open-ended and semi-structured questions for the collection of qualitative & quantitative information. To study the status of *Z. budhensis*, individual were counted covering the whole VDC by quadrate method, height of the trees and nature of the stand were also studied. PH, temperature, moisture content, and conductivity of soil were measured. The measurement was done within 10 m X 10 m quadrate in an N shaped form keeping *Z. budhensis* in the center of the quadrate. Location of the area, slope and aspect were also noted using compass and GPS. Secondary data regarding the research were collected from different published and unpublished literature in journals, articles, internet and other similar studies. National Herbarium and Plant Laboratories (KATH), Godawari, Lalitpur, was also visited for herbarium records of the plant. The collected data was summarized (Appendix I and II). The quantitative data were analyzed by using statistical tool Past 3.1 (Hammer *et al.*, 2001) and the simple regression was carried out to know the relation of distributed trees with different climatic factors like elevation, temperature, soil pH and soil moisture. The qualitative data were analyzed by descriptive measures.

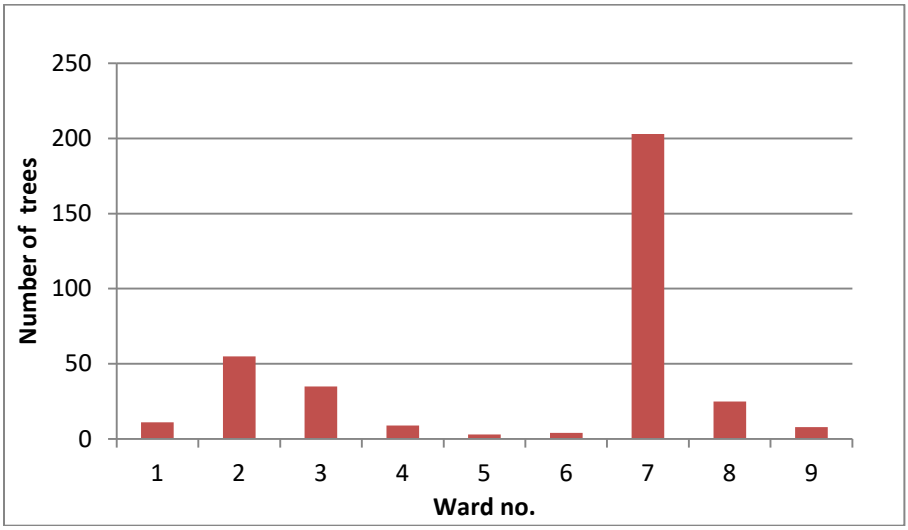


Figure 2: Distribution of *Z. budhensis* in different wards of Narayanthan VDC

RESULTS AND DISCUSSION

'Bodhichitta' tree was present in all the ward of Narayansthan VDC with a total number of 353 trees in all wards. With 203 individuals, ward No. 7 had the highest number of individual trees followed by ward No. 2 (55 trees), ward No. 3 (35 trees) and ward No. 8 (25 trees). Similarly, word No. 5 was found to have the lowest number of trees with only three individuals.

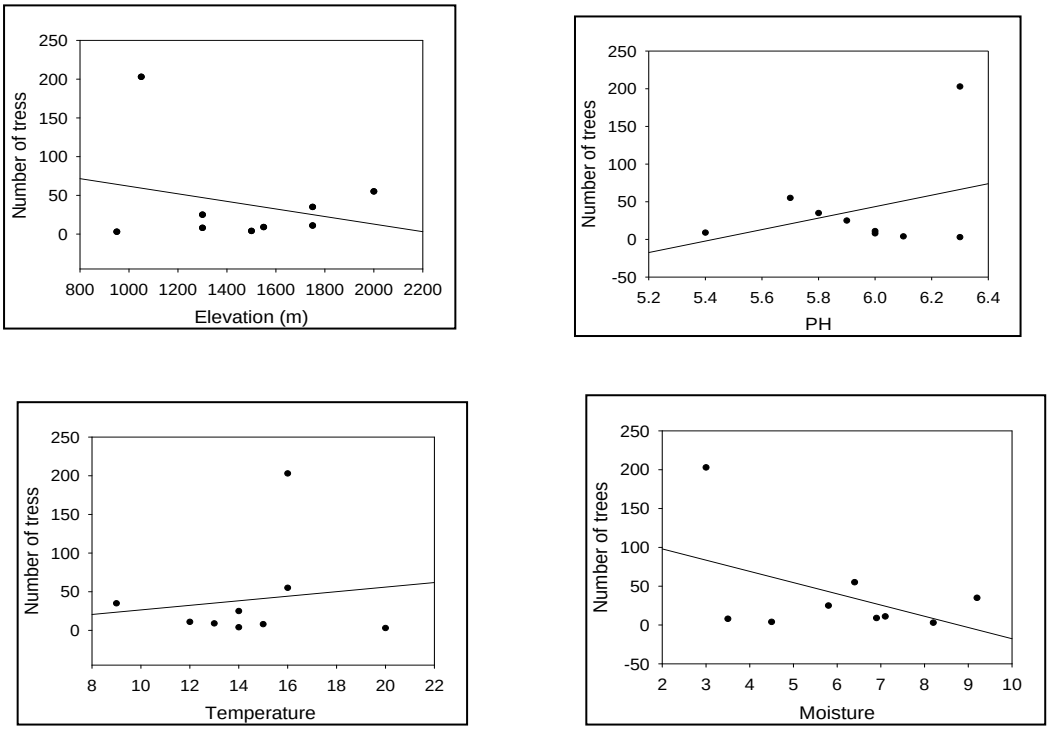
To study the ecology, various abiotic factors were studied. 'Bodhichitta' tree was recorded within the elevation range of 945 m to 2001 m above the sea level mostly in the SW and SE aspect. The highest range was recorded at Yangbel, ward No. 9 while the lowest elevation was recorded at Thilwal, ward No. 4. The lowest elevation recorded (945 asl) was lower than that of Bhattarai and Pathak (2015) where they have recorded this species at the lowest elevation of 1200 m. The study showed that this plant grows mainly on sandy soil and most of the species were found on the SE and SW aspect. This indicates that the plant prefer sunlight. The amount of moisture also affects the growth, as the high moisture favors the

growth. The moisture content ranged from 3.48% – 9.46% with the average soil moisture of 5.46% in winter. It is found in most of the site that the number of individual trees and moisture contents has positive relation. Exceptional case was seen in site 5 (Thilwal) and site 6 (Makuche). In site 5 (Ward No. 4) there was low number of plant but moisture was high due to recently irrigation practice performed in the area. And in site 6 (Ward No. 3) there is high number of plant but moisture is low, the reason behind this might be the altitudinal variation 1300 m to 1800 m in this site. Soil temperature ranged from 9^{o}C to 20^{o}C with an average of 14^{o}C. The pH of the soil in the study area was found from (5 - 6.5) which indicates that the plant favors to grow in slightly acidic soil. The slope of the area also affects the growth of the species. In low slope, the number of species was found higher. On measuring the electrical conductivity of the soil, it was found that the average electrical conductivity was 329.2 µs which indicate plant love to grow on less minerals containing soil. However, the types of minerals present in the soil were not studied and could be the future prospect for studies.

Table 1: correlation among environmental variables

	Elevation	Temp.	pH	EC	Moisture
Elevation	0	0.039056	0.020855	0.57304	0.33029
Temp.	-0.65691	0	0.093907	0.68217	0.4509
pH	-0.71215	0.5577	0	0.53467	0.27396
EC	-0.20339	-0.14852	0.22356	0	0.19405
Moisture	0.34408	-0.26982	-0.3835	0.44808	0

The positive significant relation of elevation was found between temperature and pH (Table 3). However, the number of trees showed just increasing or decreasing trend but no significant relation was observed with any environmental variables (Figures 3-6). It might be due to low number of data gathered.



Figures 3-6: The relationship of different climatic factors with number of trees found in the different wards

In this context, *Bodhichitta* considered as valuable plant among many people. The garlands of 108 seeds of this plant are used by Buddhist monk for worship to Lord Buddha. Smaller seeds are relatively highly priced compare to the larger ones, and a garland of high value seeds costs up to 500 thousand Nepalese Rupees. Mainly the seeds of *Z. budhensis* are export to china and also in other countries like Thailand, Bhutan, India, Japan, Taiwan, HongKong, Shreelanka etc.

CONCLUSIONS

From this study it can be concluded that 'Bodhichitta' or *Ziziphus xiangchengensis* (previously called *Ziziphus budhensis*is) is one of the valuable plants both ecologically and economically not only in Narayansthan VDC, Timal, Kavrepalanchowk but also for all over Nepal. Though the numbers of people are cultivating this species all over the Nepal now, the natural population is very low very and even the numbers of trees are countable. The farmers should encourage planting this tree in the suitable lands. Local government should take initiative and must encourage to the local people. The plant seemed to grow on lower slope and acidic soil is needed for the growth, pH ranging (5-6.5). 3.48% to 9.46% of moisture content is preferred for the growth of the plant. In recent times, *Bodhichitta* having high economic and medical value has become one of the major sources of income among the inhabitants of Pokhari, Narayansthan VDC. The study showed that the economic status of local people is dramatically changed due to this single plant and we recommend that the government should declare the pocket area of Bodhichitta to Pokhari Narayansthan VDC and should train the local people to make the 'Buddha mala' as main source of income to them.

ACKNOWLEDGEMENTS

Our special thanks go to Dr. Man Kumar Dhamala, Faculty, Central Department of Environmental Science for the support and respected prof. Dr. Kedar Rijal, Head of the Central Department Environmental Science, Tribhuvan University for continuous encouragement. We are equally thankful to Mr. Raju Chauhan, Mr. Dilip Rai, and Mr. Sabin Shakyafor help in GIS component of the research. Mr. Uddhab Prasad Mainali, Mr. Babu Lal Tamang, Mr. Jagat Tamang, and Mr. Sajan Lama, inhabitants of Pokhari Narayansthan VDC are also duly acknowledged for their support in fieldwork. Last but not least thanks goes to Ms Yu qi and Team from Chengdu institute of Biology for her remarkable help.

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Appendix I: **Number of trees found in each ward**

Ward no:	1	2	3	4	5	6	7	8	9	Total
Number of trees	11	55	35	9	3	4	203	25	8	353

Appendix II Data obtained from a quadrate sample

SN.	Site	Longitude/ Latitude	Elevation (m)	Direction	Slope	Soil sample			
						Temperature (^{0}c)	pH	Ec (µs/ cm)	Moisture content (%)
1.	S_1(Lama Tol) Ward no: 8	$27^0$30’777’’ N $85^0$44’218’’ E	1734	195^0 SW	25^0	12	6.0	272	7.14
2.	S_2(Yangbel) Ward no: 9	$27^0$31’924’’ N $85^0$43’290’’ E	2001	141^0 SE	20^0	16	5.72	204	6.40
3.	S_3(Thokre) Ward no: 7	$27^0$31’169’’ N $85^0$44’746’’ E	1759	340^0 NW	24^0	9	5.86	281	9.26
4.	S_4(Thokre Swara) Ward no: 7	$27^0$31’249’’ N $85^0$44’961’’ E	1552	115^0 SE	35^0	13	5.46	290	6.96
5.	S_5(Thilwal) Ward no: 4	$27^0$29’981’’ N $85^0$44’060’’ E	945	200^0 SW	40^0	20	6.30	299	8.28
6.	S_6(Makuche) Ward no: 3	$27^0$30’450’’ N $85^0$44’265’’ E	1487	140^0 SE	50^0	14	6.14	396	4.54
7.	S_7(Gimdi) Ward no: 6	$27^0$30’680’’ N $85^0$43’211’’ E	1057	260^0 SW	39^0	16	6.32	424	3.08
8.	S_8(Gimdi Paakha) Ward no: 5	$27^0$30’565’’ N $85^0$43’497’’ E	1304	260^0 SW	25^0	14	5.90	302	5.80
9.	S_9(Kokam) Ward no: 4	$27^0$30’243’’ N $85^0$44’293’’ E	1295	266^0 SW	24^0	15	6.01	328	3.52
10.	S_{10}(Pokhari) Ward no: 2	$27^0$30’801’’ N $85^0$44’328’’ E	1837	201^0 SW	25^0	11	5.70	496	6.48