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Ethno-Indicator Plants of Paddy Season in the Bumdeling Region of Trashi Yangtse, Bhutan

Nythri Tshering[1] **and Namgay Rinchen**[2]

[1]*Department of Forest Science, College of Natural Resources, Royal University of Bhutan, Thimphu, Bhutan*
[2]*Department of Environment and Climate Studies, College of Natural Resources, Royal University of Bhutan, Thimphu, Bhutan*

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Corresponding Author: **Nythri Tshering** | E-Mail: **(nythripenjor@gmail.com)**

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ABSTRACT

Ethno-season indicator plants are those plant species used in the locality to indicate the onset of different seasons through careful observation of their phenophases. This report presents 8 indicator plants that people of the Bumdeling region use for paddy cultivation. Paddy is the staple crop in the region, and various plant phenophases are used as indicators for paddy cultivation. Through interviewing elders from the region, Magnolia campbelii, Prunus persica, Pyrus paschia, Cardiocrinum giganteum, Rosa brunonii, Lyonia ovalifolia, Elaeagnus parvifolia, and Prunus ceresoides are the indicator plants used for paddy cultivation. This information on the ethno-indicator plants may help preserve traditional knowledge and understand plants' response to climate change.

Keywords: *Bumdeling, Ethno-Indicator plants, Paddy Cultivation, Traditional knowledge.*

Introduction

Plants are integral parts of human civilization. They provide mankind with basic food, shelter, clothes, and medicines [8, 34,28]. Plants also serve the purpose of indicating environmental pollution. The different tribal groups used different plants as indicators of seasons and ecological processes 23[13,,25].The traditional knowledge of ecological indicators and calendars associated with seasonal variation serves as a baseline for understanding indigenous practices along with climatic variation [25,33]. Traditional and Indigenous ethnoecological knowledge used for ecological signals to conduct seasonal activities has been in harmony with climatic variations so far '"[10,20,33,23]. Indigenous elders use traditional knowledge to decide the time and season for various seasonal and annual activities by observing certain phenology and behavior of specific plants and animals[13,25,33].

Predominantly, communities closely associated with forest rely on plants as indicators for seasons to predict the environmental changes [2,13]. Seasonal activities are scheduled based on indicator plant species for bountiful harvest [13,22] and considered as authentic indicator for various agriculture activities '"[10,20]. Samati & Begum, [22] reported that *Pnar* tribe of Jaintia Hills district, Meghalaya, India still uses plant species as indicator to systematize seasonal activities to harvest maximum rice productivity and other crops. It includes species like *Butea buteiformis* (Voigt) Grier. & Long, *Castanopsis indica* A. DC., *Castanopsis tribuloides* (Sm.) DC., *Phoenix humilis* Royle ex Becc. & Hook. f., *Pinus kesiya* Royle ex Gord., *Quercus serrata* Thunb., *Schima wallichii* (DC.) Korth are used by *Pnar* tribes [22]. Mao-Naga tribes of Manipur, India commonly used floral species like *Bombax cieba* L., *Bambusa* spp, *Hedychium ellipticum* Buch. - Ham. ex Sm., *Prunus persica* (L.) Batsch., *Prunus carmesina* H. Hara., *Bauhinia purpurea* L. and *Mantisia spathulata* (Roxb.) Schult. as indicators for the onset of summer paddy plantation and to start potato, maize, cabbage and other cash crop cultivation in their region[2,13].

Studies mentioned that floral phenological characteristics like leaf fall, leaves formation, flowering, fruiting and fruit ripening, tubers formation and faunal behaviors like courtship, mating, egg laying and hatching, migration and appearance of a specific species as indicators [2,13, 20, 22, 25]. Physical indicators like moon, temperature, wind, rainfall, and day length are widely used indicators to predict annual seasons '"[2,10,13,20,22,25]. Specific phenological characteristics are used to indicate daily activities like sowing, cultivation, harvesting and poaching by *Karbi* tribes of Assam [25], *Mao-Naga* tribes of Manipur [2,13], farmers and pastoralists of east Africa [20]. The farmers and pastoralists uses a combined Traditional knowledge of meteorological, biological, and astrological indicators to forecast local weather conditions to decide agriculture activities and livestock production '"[10,20].

With globalization, traditional knowledge about plants is losing rapidly among different tribes '—[1, 3,4]. Acculturation of cultures, forest destruction, habitat change of tribal people [16,17,25] socio-economic and land use changes [10,23], government policies '—[4] and disinterest shown by younger generations [8,34,17] are the major threat for its fast disappearance in and around the globe and Bhutan in particular. The preservation and protection of ethnobotanical knowledge is important due to its significant contribution in the identification and protection of cost-effective and sustainable management of environments [5]. It is considered as science of survival ––[19].

This utilitarian knowledge is an experiential aptitude of tribes developed and passed from generation. It constantly evolves with response to environmental changes[3].

The orally exchanged or passed traditional knowledge is in the hands of elders [18,24]. And the death of older generation could lead in the depletion of such imperative information. It can vanish after their deaths [21]. Therefore, resources from ethnic society and their traditional knowledge in these areas can be conserved through proper documentation with sound scientific research ––[19].

Numerous ethnobotanical studies documented from different parts of Bhutan are mostly inclined towards the traditional uses of plants in medicines –[7,11,29, 31,30] with around 637 species of medicinal plants listed [11], wild edible plants as food; 98 species [14], 62 species [26], 172 species [14], 60 species of edible plants [27], and 52 species of edible fruits [34],and other traditional uses of plants in socio-cultural and religious activities [8] across Bhutan. However, there has been very little documentation on traditional uses of plants as seasonal indicators. Furthermore, there is a lack of scientific documentation of ethno-ecological studies from Bumdeling region. Previous study on ethnobotanical knowledge of local communities of Bumdeling wildlife sanctuary documented 165 species used in handicrafts, as vegetables, fodder, fibres, dyes, in tea making and treating different ailments. The study also mentioned that the flowering of *Cardiocrinum giganteum* indicates the sowing time for rice and millet in the area[32].

Bumdeling region has no script of its own and lack written records or literature regarding the traditional use of plants. The knowledge and wisdom were transferred from one generation to another through oral traditions. This poses such culture and ethnic knowledge vulnerable to cultural dilution and losing ethnic identity '[9,13,17] despite its preservation and current practices. The whole region follows different seasonal activities and cultivation schedules of crops based on indicator plants. The region believes that plants have been nature's own calendar for successive years, and it indicates different phenophases of plants, changing with various climatic conditions. Such practices make it reliable as a perfect seasonal indicator for agriculture works in the region. This study is thus aimed to document plants used as season indicators for the paddy cultivation season amongst farmers of Bumdeling gewog, Trashi Yangtse, Bhutan, with a particular reference to plant indicators used for paddy cultivation.

Methodology

a. Study site

The present study was conducted in the Bumdeling Gewog under the Trashi Yangtse District, Bhutan. Bumdeling Gewog lies in 27° 40′ 8.4″ Nlatitude and, 91° 26′ 31.2″ Elongitude situated at elevation of 1500 metres above sea within the Bumdeling Wildlife Sanctuary. It is the northeastern parts of Trashi Yangtse district sharing its boundary with the Tibetan Autonomous Region of China in the north, Arunachal Pradesh State of India in the east, Yangtse Gewog in the south and Khoma Gewog of Lhuntse district in the west. Bumdeling Gewog comprises of 18 villages, totaling c.a of 346 households covering an area of about 850.7 square kilometers. Three ethnic groups live in the region, viz. *dzalakha* speaking people, *Sharchogpa* speaking people in the south and *Bjob* community in the alpine zone. Paddy, maize, wheat, buckwheat, and millet are the major crops, and potato, and chilli is the most important cash crop in the region.

b. Sampling and Data Collection

Preliminary data on biological and physical indicators for predicting annual seasons were gathered through consultations with local elders from the Bumdeling region. Both male and female village elders were interviewed about their knowledge of the Folk Calendar, including associated flora, fauna, and environmental factors. Informed consent was obtained from participants, who were briefed on the study's objectives and assured that the research would not negatively impact their traditional knowledge. Key plant species used as seasonal indicators were identified with the assistance of local guides, and photographs were taken for documentation. These plants were collected, and identified, and their local vernacular names recorded. Information was cross verified with additional knowledgeable informants from different areas to ensure accuracy. The data presented in this report was compiled through firsthand fieldwork conducted between 2020-2024 across various locations in the Bumdeling region.

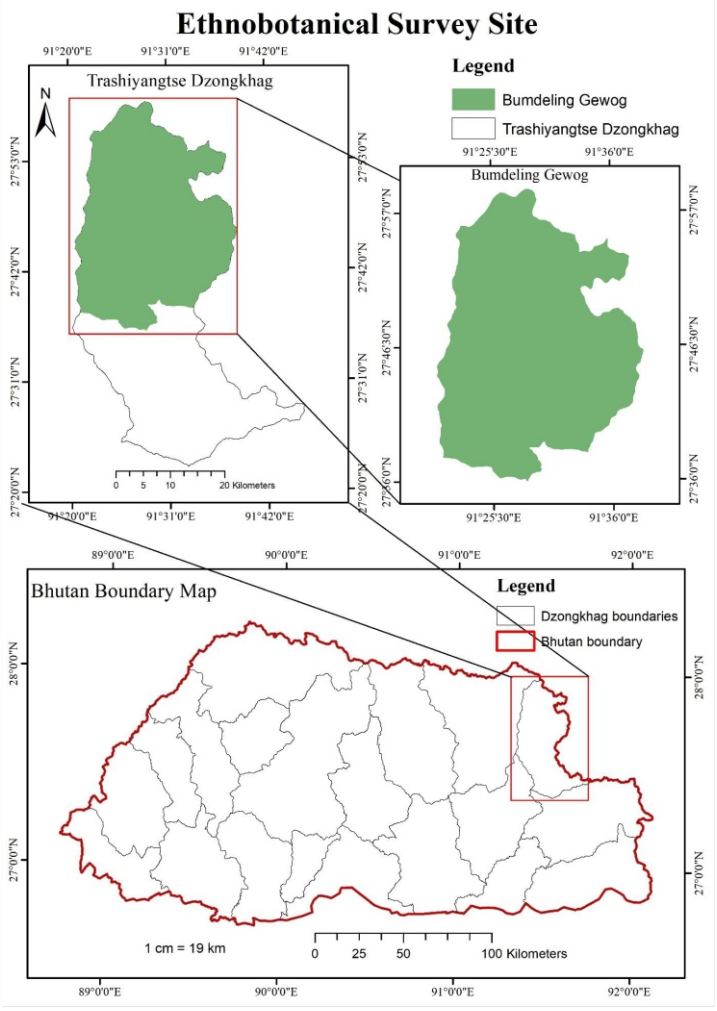

Figure 1: Ethnobotanical study site at Bumdeling block(gewog), under Trashiyangtse district.

Results and Discussion

Ethno- Ecological Indicator Plants

Sl. No.	Botanical Name	Vernacular name	Family	Habit	Phenophase	Indication and Activities
1	*Magnolia campbelii* Hook.f. & Thomson	*Ngang-Go- Mento*	Magnoliaceae	Tree	Flowering	On set of paddy cultivation works. Nursery bed preparation for paddy seed sowing.
2	*Prunus persica* L.	*Lo-Sum Khambu*	Rosaceae	Tree	Flowering	Opening of flower buds indicates the appropriate time of paddy sowing.
3	*Pyrus pashia* L.	*Lee-Toog*	Rosaceae	Tree	Flowering Fruit ripening	Flowering indicates delay for paddy sowing. Ripening of fruit indicates rice harvesting period.
4	*Cardiocrinum giganteum* var. *giganteum* (Wall.). Makino	*Auw-Tong-Lo-Tong*	Liliaceae	Herb	Shoot Sprouting	Sprouting of leaf buds indicates time for paddy field preparation. Flowering indicates onset of paddy transplantation.
5	*Rosa brunonii* Lindley.	*Baa-Tsang- Mento*	Rosaceae	Climbing Shrub	Flowering	Flowering signals paddy transplantation.
6	*Lyonia ovalifolia* (Wall.) Drude	*Saak-Shing*	Cornaceae	Tree	Sprouting of shoots	Indicates healthy growth and predicts bountiful harvest of paddy for the year.
7	*Elaegnus parvifolia* ex. Royle	*Daa-Mrep*	Elaeagnaceae	Shrub	Fruit ripening	Weeding time of Paddy
8	*Prunus cerasoides* Buch. - ex D. Don	*Khe-Glyek-Shing*	Rosaceae	Tree	Flowering	Indicates rice harvesting time and marks the end of paddy cultivation for season.

Note: *Vernacular name is provided in Dzalakha (Local dialect) spoken in the Bumdeling region, Trashi Yangtse, Bhutan.*

Magnolia campbelii Hook f. Thomson, locally known as *Ngang-Go Shing*, blooms as a sign that the Bhutanese 12thmonth, *Chung nge-pa loser*, is nearby. This marks the start of the New Year, *Gyalpai loser*, and the agricultural season. It is believed that the flowers of *M. campbelii* bloom in stages over the first three days of the 12th month. During this time, farmers prepare nursery beds for paddy sowing. The land is tilled, burned, and left undisturbed until sowing to sterilize the soil. The region's cold temperatures and frost during this period kill weeds and pathogens. Nursery preparation must be completed before *M. campbelii* is fully in bloom, as any delay risks pest and weed infestations in the seedlings.

Prunus persica (L.) Batsch, a peach variety locally known as *Lo-sum khambu* is commonly found in villages, kitchen gardens, and farmlands, serves as a local indicator of the spring season. The tree blooms in March, signaling the time to sow paddy seeds. Farmers aim to complete sowing before the flowers fall, as it is believed that seeds sown later will not mature in time for transplantation, potentially affecting the annual rice harvest.

Figure 2. Flowering plants used as an indicator for Nursery Bed Preparation and Rice sowing; 1. Magnolia campbelii; 2. Prunus persica; 3. Pyrus pashia. (Bhutan Biodiversity Portal, 2024).

Pyrus pashia L. flowers in mid-spring; late February to April[12], following *Prunus persica*, and signals a delay in the rice sowing season. Farmers who miss the peach flowering must sow paddy seeds before the pear tree is fully bloomed, however, it is believed to result in a lower harvest. Flowering also marks the season for sowing seeds of crops like millet (*Eluesine coracana*) varieties. Fruits ripe as early as August in the lower region and ends in December[12]. The ripening of local pear fruit signals the rice harvesting period. Both *Lo-sum khambu* (peach) and *Pyrus pyrifolia* (pear) have long been key indicators for rice cultivation and other crops in the region. Observing these trees is believed to ensure timely sowing and harvesting, particularly for rice.

Cardiocrinum giganteum (Wall.) Makino, commonly known as the giant Himalayan lily and locally as *Auw-tong-Lo-tong*, germinates in winter, with radicles and cotyledons emerging in late winter or early spring. Full growth is reached by late spring, flowering between early March and April [32]. When the plant grows to a hand span (approximately 15 -30 cm), it signals the right time for paddy field preparation. This marks the ideal period for ploughing and tilling, as the soil retains moisture and becomes loose, making it easier to work. Delays in tilling during this time are believed to promote weed growth, complicating paddy cultivation. The flowering of the plants signifies the onset of paddy transplantation.

Rosa brunonii Lindl. commonly known as the Himalayan rusk rose, is native to northern Pakistan, Kashmir, and southwest China [6]. Locally, it is called *Baa-tsang Mento*. The plant flowers from April, June to early July [6], signaling the optimal time for paddy transplantation. The region, covered in its fragrant white flowers, alerts farmers to begin transplantation, ideally when seedlings reach about adult's handspan (approximate 15 cm) in height. This timing ensures seedlings are not submerged in flooded fields for wet rice varieties and aids root stabilization for dry rice cultivation. Transplantation must be completed before the flowers fall, as delays are believed to reduce rice yield for the year.

Figure 3: Plants used as indicator for paddy field preparation and rice transplantation; 4. Cardiocrinum giganteum var. giganteum; 5. Rosa brunonii; 6. Lyonia ovalifolia. (Bhutan Biodiversity Portal, 2024).

Lyonia ovalifolia (Wall.) Drude, locally known as *Saak shing* or *Kharam shing*, is believed to signify good health for rice seedlings when its shoots sprout. It is thought that the presence of this tree near paddy fields protects crops from curses and evil influences. As a result, farmers plant sprouting twigs alongside seedlings to mark the completion of paddy transplantation. A protective symbol, called *kharam*, is carved from the tree trunk

and placed upright in the field. The tree trunk is also used to construct irrigation canals for watering paddy fields [32].

Elaeagnus parvifolia Wall. ex-Royle, commonly known as autumn olive and locally called *Dha-Mreep*, flowers from August to June, with fruit ripening from July to November. The ripening of its berries signals the optimal time for weeding paddy fields. Farmers rush to complete weeding before all berries ripen, as delays are believed to cause paddy weeds to flower and attract pests. Weeding is considered ineffective if not completed before the berries ripen, and failure to do so is thought to prevent further weed growth and deteriorates paddy health.

Figure 4: Plants used as indicators for paddy weeding and harvesting.7. Elaeagnus parvifolia; 8. Prunus cerasoides (Bhutan Biodiversity Portal, 2024).

Prunus cerasoides Buch. -Ham. ex D. Don, locally known as *Kheglyak shing*, grows abundantly on hills and slopes in the region. Its pinkish flowers bloom from October to mid-December, signaling the right time for paddy harvest. The blooming indicates paddy maturity, and harvest must be completed before the flowers fully open. Delays in harvesting are believed to result in yield loss due to cold, frost, and sometimes snow after flowering, marking the onset of winter and the end of the paddy cultivation season in the Bumdeling region.

Rice (*Oryza sativa L.*) is a staple crop in Bhutan, grown across all 20 districts of the country [35]. Paddy cultivation is categorized into three zones, with Bumdeling gewog falling under the warm-temperate high-altitude zone. This zone includes the valleys of Thimphu and Paro, higher altitudes in Wangdue and Punakha, and parts of other districts. It accounts for approximately 20% of the country's total rice area [35].

Due to the region's cold climate, only one rice crop is grown per year, requiring timely cultivation. In Bumdeling, rice is typically sown in March-April [35] coinciding with the flowering of *Prunus persica* and *Pyrus paschia*. Transplanting occurs in May-June [35] aligning with the bloom of *Rosa brunonii*, and harvesting takes place in October-November [35], when *Prunus cerasoides* are in flower. The flowering patterns of these indicator plants align closely with the paddy cultivation schedule, making them reliable references for farming practices in the region.

Additionally, the trunks of *Lyonia ovalifolia* and *Alnus nepalensis* are used for constructing irrigation canals, as the region receives limited rainfall (650-850 mm per year), and rice is cultivated as an irrigated crop [35] in Bumdeling region.

Conclusion

In Bumdeling region, Trashi Yangtse District, Bhutan, traditional knowledge of using indicator plants for paddy cultivation is still practiced, but it has not been documented in previous studies. With increasing rural-to-urban migration and younger generations undervaluing this orally transmitted ethnobotanical knowledge, it is essential to document these practices. Further, paddy is the staple food of the region and the country, and Bumdeling farmers continue to rely on plants as indicators for its cultivation.

Documenting this folklore science is important for preserving traditional knowledge and understanding the ethnoecological season indicator plants in the region. Additionally, such information on seasonal indicators for paddy cultivation can provide insights into the impacts of global climate change on future rice farming. Future documentation of ethno-season indicator flora and fauna species in the region will play a crucial role in maintaining the ethnic uses for the times to come.

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