Income generating plants of Keibul Lamjao National Park, Loktak Lake, Manipur and man-animal conflicts

M. H. Devi¹, P. K. Singh²* and M. Dutta Choudhury³
¹Department of Botany, Manipur College, Imphal-795008, Manipur, India.
²Department of Life Sciences, Manipur University, Imphal-795003, Manipur, India.
³Department of Life Science, Assam University, Silchar-788011, Assam, India.
*Corresponding author: Email: potsangbamk031@gmail.com
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Abstract
Keibul Lamjao National Park (KLNP), a Ramsar Site of International importance, is situated in the south-eastern corner of Loktak Lake, Manipur in North-eastern India. The park covers an area of 40 sq km. This study investigated the high potential income generating plants growing in KLNP. The paper enumerated 22 species of income generating plants belonging to 20 genera and 11 families (Poaceae 7, Zingiberaceae 3, Apiaceae 2, Polygonaceae 2 and one species each of Asteraceae, Convolvulaceae, Cucurbitaceae, Fabaceae, Hydrocharitaceae, Nelumbonaceae and Nymphaeaceae). Among the highly preferred income generating plants, some are also the natural food of the endemic Sangai deer (Rucervus eldii eldii McClelland) and other herbivore animals thereby bringing conflicts between human and animals. Overharvesting of these plants by the lake dwellers may cause serious competition for food to the animals thus aggravating their existence in the park.

Key words: Income generating plants, KLNP, Loktak, phumdi, Sangai deer

INTRODUCTION
Wetlands are important and one of the world’s most productive ecosystems. These areas play essential role for the health, welfare and safety of people living in or around it. Keibul Lamjao National Park (KLNP) is located between 24° 27' to 24° 31' N latitudes and 93° 53' to 93° 55' E longitudes at the south-eastern corner of the Loktak Lake covering an area of 40 sq km. This wetland has a unique type of floating mat, called phumdi, which is a heterogenous mass of soil, vegetation and organic matter at different stages of decay Devi et al. (2012b). It is the natural home of herbivorous animals viz., endangered Bro-antlered deer (Rucervus eldii eldii McClelland) locally known as Sangai, Wild boar (Lamok; Sus scrofa Linnaeus), Sambar (Rusa unicolor Kerr), Barking deer (Muntiacus muntjak Zimmermann) etc. The park supports many plants species including some income generating plants and also some faunal species. Several workers have surveyed these area and recorded many species. Among them, Deb (1961) listed 125 species; Bhatia (1981) recorded 159 species from Loktak area and Sinha (1990a, b) recorded 157 wetland species. Singh (2002) investigated the management of phumdis in Loktak lake and also reported the ethnobotanical uses of 24 species. Shyamjai (2002) reported 145 macrophytes from phumdis, whereas Trisal & Manihar (2004) reported 131 macrophytic species. Devi (2007, 2009) studied the
phumdi plants of the lake and also the consumable parts of wild plants. Devi et al. (2013a) studied important food plants growing in KLNP both for bro-antlered deer and also for human. Devi et al. (2012a, 2012b, 2013b,) also studied the traditional medicine from KLNP, fodder plants and also recorded 19 species of macrophytes for the area. L.D.A. (1996) took initiatives to save the lake against siltation by removing the unwanted phumdi. Anandale (1921) referred the lake as swampy due to these floating mats of vegetation. All wetlands have their values and benefits whether for fish production, agriculture, other food production, ground water recharge, recreation, water fowl habitat, flood control, etc. On the other hand, wetlands provide tremendous economic benefits. Among the wetlands, KLNP is also one of the most economically important wetland of Manipur. However, there is some cold-war for their livelihood between human invaders and the resident wild animals dependant on these macrophytes growing on the phumdi in KLNP.

**METHODOLOGY**

Extensive field surveys, recognition, collection and documentation on the uses of different macrophytic species were made with the help of Loktak Lake dwellers of the KLNP through discussion and consultation during the years 2009 to 2013. Information was also collected from plant collectors and the forest security guard of the KLNP. Highly potential plants for various purposes were growing in KLNP. Local people collect these plants throughout the year and sell those to generate some income to fulfil their daily needs for survival. During the present survey, the plant specimens collected and processed into mounted herbarium specimens following standard methods of Jain & Rao (1977). The specimens were identified with the help of different floras (Singh et al. 2000; Clarke 1889; Kaith 1932, 1936; Deb 1956, 1957, 1961 a,b; Singh & Arora 1978; Sinha 1987 a,b; 1996 a,b; Singh et al. 1988; Shyamananda 1991; Shamungou 1992; & Tombi 1992) in the Department of Life Sciences, Manipur University, Canchipur, Imphal and Botanical Survey of India, Eastern Circle, Shillong and were finally matched at ASSAM. The voucher specimens were deposited at the herbarium of Department of Life Sciences, Manipur University. Online data bases like The International Plant Names Index (www.ipni.org) and The Plant Lists (www.theplantlist.org) was referred for correct nomenclature and author citations.

**RESULTS AND DISCUSSION**

The present survey recorded 22 species of income generating plants from KLNP belonging to 20 genera and 11 families. Highest number of 7 species has been recorded for Poaceae, which is followed by Zingiberaceae (3 spp.), Apiaceae and Polygonaceae 2 species each and one species in each for the families Asteraceae, Convolulaceae, Cucurbitaceae, Fabaceae, Hydrocharitaceae, Nelumbonaceae and Nymphaeaceae (Table-1). Majority of the plants i.e. 18 species are emergent (E), 2 are rooted with floating leaves (RF); and one is submerged plant (S) (Table-1). Out of the 21 plant species, 14 are being marketed (M) and others are not marketed (NM) but are sold in bundles in a boat. *Hydrilla verticillata* (NM) however is sold at Rs. 40 – 100 per boat-full for covering fish during transportation and also as fish food. *Cymbopogon citratus* and *Imperata cylindrica* are used as thatching materials and are marketed at Rs.100 – 200 per boat-full.

Human interference creates disturbance to the animals living naturally in KLNP especially during the time of breeding. Villagers collect plants only to fulfil their needs, unaware of the fact that animals depend on these macrophytes. The scarcity of food affects the animals especially *Rucervus eldii eldii* which is endemic to Manipur.
Table 1. Some commonly available Income generating plants of KLN [Marketed (M) and Not Marketed (NM)]

<table>
<thead>
<tr>
<th>Plant Name [Family]; Local Name; Voucher specimen Acc. No.</th>
<th>Habit</th>
<th>Commercial Value (Rs.)</th>
<th>Ethnobotanical Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Alpinia nigra</em> (Gaertner) Burtt [Zingiberaceae]; <em>Pullei</em>; Acc. No. 000512</td>
<td>Emergent</td>
<td>10 – 20 per bundle of 3 – 5 plant parts (M)</td>
<td>Rhizome used in cough, fever and dizziness; young shoot &amp; rhizome used as vegetable and spice for its aromatic taste. Also used in socio religious purposes.</td>
</tr>
<tr>
<td><em>Centella asiatica</em> (Linnaeus) Urban [Apiaceae]; <em>Peruk</em>; Acc. No. 000835</td>
<td>Emergent</td>
<td>30 – 40 per bundle (M)</td>
<td>Whole plant is edible as vegetable; used against stomach ulcers, brain tonic, urinary trouble, digestive complaints, dysentery and as tonic.</td>
</tr>
<tr>
<td><em>Curcuma angustifolia</em> Roxburgh [Zingiberaceae]; <em>Yaiple</em>; Acc. No. 1316</td>
<td>Emergent</td>
<td>30 bundle (M)</td>
<td>Inflorescence used as vegetable, for its flavour &amp; taste; religious during Cheirouba.</td>
</tr>
<tr>
<td><em>Cymbopogon citratus</em> (de Candolle) Stapf [Poaceae]; <em>Charot</em>; Acc. No. 000837</td>
<td>Emergent</td>
<td>50 – 100 per boat-full for thatching (M) as fodder (NM)</td>
<td>Thatching and as fodder; leaves used to prepare local herbal lotion (<em>Chinghee</em>) and <em>Cymbopogon</em> tea (<em>Cytronella</em> tea), leaf-infusion is stimulant, antiperiodic.</td>
</tr>
<tr>
<td><em>Hedychium coronarium</em> J. Koenig [Zingiberaceae]; <em>Loklei</em>; Acc. No. 000819</td>
<td>Emergent</td>
<td>20 – 30 per bundle of rhizome and tender shoots (M)</td>
<td>Rhizome and tender shoots are edible with aromatic taste and used as fodder; rhizome in cough, fever and dizziness; young shoot and rhizome as vegetable, in religious ceremonies of Manipur.</td>
</tr>
<tr>
<td><em>Helichrysum luteoalbum</em> (Linnaeus) Reichenbach [Asteraceae]; <em>Phunin</em>; Acc. No. 1374</td>
<td>Emergent</td>
<td>10 per bundle (M)</td>
<td>Use as vegetable, leave paste is put on the fore head to reduce headache</td>
</tr>
<tr>
<td><em>Hydrilla verticillata</em> (Linnaeus f.) Royle [Hydrocharitaceae]; <em>Charang kokchaobi</em>; Acc. No. 000825</td>
<td>Submerged</td>
<td>40-100 per boat-full (NM)</td>
<td>Fish food and for covering fresh fish during transportation.</td>
</tr>
<tr>
<td><em>Imperata cylindrica</em> (Linnaeus) Raeschch [Poaceae]; <em>Eee</em>; Acc. No. 000846</td>
<td>Emergent</td>
<td>100-200 per boat-full (M)</td>
<td>High quality thatching material.</td>
</tr>
<tr>
<td><em>Ipomoea aquatica</em> Forsskal [Convolvulaceae]; <em>Kolmani</em>; Acc. No. 000822</td>
<td>Emergent</td>
<td>10-15 per bundle (M)</td>
<td>Tender shoot is edible.</td>
</tr>
<tr>
<td><em>Melothria purpusilla</em> (Blume) Cogniaux [Cucurbitaceae]; <em>Lamthabi</em>; Acc. No. 000847</td>
<td>Emergent</td>
<td>50-100 per bundle (M)</td>
<td>The plant is boiled about 15 min, the decoction to cure jaundice. This plant is not cultivated but plant is highly potential value.</td>
</tr>
<tr>
<td><em>Nelumbo nucifera</em> Gaertner [Nelumbonaceae]; <em>Thambal</em>; Acc. No. 000848</td>
<td>Rooted-floating</td>
<td>10-20 per bundle of fruit; 10-100 or 10-1000 per flower* (M)</td>
<td>Flower for religious purposes; tender leaves, rhizomes, flower, seeds are edible; mature leaves as a green plate.</td>
</tr>
<tr>
<td><em>Nymphaea rubescens</em> Wildenow [Nymphaeaceae]; <em>Tharo angouba</em>; Acc. No. 000850</td>
<td>Rooted-floating</td>
<td>10-15 per bunch (M)</td>
<td>Flower and flower stalks are edible.</td>
</tr>
<tr>
<td><em>Oenanthe javanica</em> (Blume) DC. [Apiaceae]; <em>Komprek</em>; Acc. No. 000820</td>
<td>Emergent</td>
<td>10-15 per bunch (M)</td>
<td>Tender shoot is appetizer and digestive, vegetable in raw and cooked, in religious ceremony</td>
</tr>
</tbody>
</table>
### Table-2. Plants which make conflicts between human and animals, based on the dependency of the plants growing in KLNP

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Consumed part by wild herbivores</th>
<th>Consumed part by man</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Alpinia nigra</em></td>
<td>Tender shoot &amp; rhizome</td>
<td>Tender shoot &amp; rhizome</td>
</tr>
<tr>
<td><em>Hedychium coronarium</em></td>
<td>Tender shoot &amp; rhizome</td>
<td>Tender shoot &amp; rhizome</td>
</tr>
<tr>
<td><em>Oryza rufipogon</em></td>
<td>Tender shoot &amp; inflorescence</td>
<td>Tender shoot &amp; inflorescence</td>
</tr>
<tr>
<td><em>Persicaria sagittata</em></td>
<td>Tender leaf</td>
<td>Tender leaf</td>
</tr>
<tr>
<td><em>Zizania latifolia</em></td>
<td>Tender shoot</td>
<td>Infected culm &amp; tender shoot</td>
</tr>
</tbody>
</table>

The important fodder plant species for healthy and better conservation of animals are *Hedychium coronarium, Alpinia nigra, Oryza rufipogon* and *Zizania latifolia* (Devi et al. 2013 a). Five plant species growing in KLNP are consumed both by the human and...
CONCLUSION

Lake dwellers have their own choice of collection among the income generating plants of the park throughout the year. Many of the highly preferred plants collected by them are the natural food of the herbivorous animals (Wild boar, Sambar, Barking deer, etc.) thereby, bringing conflicts between human and animals. Overharvesting of these plants may cause serious competition for food to the animals and will, certainly, endanger their existence. At the same time, the age old tradition as well as demand for survival of traditional communities needs to uphold to conserve and maintain the protected areas. Considering these various aspects, highlighting the importance of community based approach in reduction of overharvesting becomes relevant. The survival of the lake dwellers is the crisis of the biodiversity, which is intimately linked with the disappearance of ecological diversity and ultimately the struggles for the preservation of biodiversity. And, the conservation in KLNP will become meaningless and will lose its basic criteria to remain as a ‘Wildlife Sanctuary’!

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