

Wild Edible Plants in India

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Despite significant evidence base on quantifying ecosystem services, the role of biodiversity in supporting such services in diversified landscapes, and how indigenous communities exploit, utilize and manage plant resources in a biocultural regime, remains understudied. A sum total of 172 WEPs comprising 60 vegetables, 70 fruits, seeds and nuts, 23 underground tubers and 19 mushrooms were collected, consumed, and surplus were marketed by the communities. On average, the number of wild edibles collected annually by households were in the following quantities: 40–240 kg leafy vegetables, 125–386 kg flowers, 120–250 kg fruits, 12–125 kg legumes, 24–120 kg tubers, 5–35 kg mushrooms. Among ethnic groups, the Baiga primitive community utilized 70–90% followed by Gonds (58–81%), Kols (52–78%), Oraons (43–79%), and other communities (38–68%) in different zones. WEPs have contributed to 5–24% (Rs 3559–12,710) of household income, which was highest in the core zone and lowest in the transition zone. It was observed that WEPs were complemented the diets rather than being a substitute for staple foods. They supplied only 3.7–8.3% of energy and 1.1–4.9% protein requirements; however, they significantly supplemented ascorbic acid, thiamine, calcium, and iron by 38.1–73%, 13.7–35.4%, 17.2–29.1%, 2.6–13.5%, respectively. Significantly higher quantities of nutrients were supplemented in the core zone compared to other zones. WEPs were currently underutilized (less intake) especially in buffer and transition zones, complementing the staple foods and partially supplementing the essential macro- and micro-nutrients. However, these have the potential to fulfill the dietary needs and ensure balanced nutrition, if consumed in recommended portions and sizes.

biodiversity

food security

ecosystem services

Sustainable Development Goals (SDG)

wild edible plants

1. Introduction

Mainstreaming biodiversity and ecosystem services into food production systems involves strong trade-offs and is critical for balancing livelihoods, culture, habitability, and ecological diversity across heterogeneous landscapes. Biodiversity plays an indispensable role in the maintenance of ecosystem services interlinked to complex socio-economic and biocultural regimes of indigenous communities who have unique values, traditions, beliefs, and lifestyles ^{[1][2][3]}. Wild edible plants (WEPs) constitute an important part of household food baskets and form an integral part of traditional ethnic foods across the world, as a looming food crisis warrants exploiting all food resources including WEPs, which are often considered as famine foods significant among aboriginal communities due to their unique sensory acceptability, socio-cultural and spiritual values, recreation and health benefits ^{[4][5][6][7][8]}. In recent decades, due to increasing modernization and globalization, the nutritional, ecological, socio-

economic, and livelihood benefits of WEPs are well recognized [9][10][11] but are still underrated, neglected, and underutilized in many regions [12]. Undermining the wealth of wild foods impacts the provisioning services of ecosystems and preserving traditional knowledge systems interconnected to indigenous food supply chains that need to be understood in changing lifestyles and environment [13]. However, alarming rates of degradation of productive ecosystems and erosion of cultural diversity across the regions disrupting ecosystem services not only affect the livelihood support of underprivileged indigenous communities but also degenerate the traditional knowledge [14]. Although dietary change, increased investment, policy reforms, biotechnology, and many other proposed solutions hold promise, understanding changing local ethnobotanical knowledge and how communities facilitate ecosystem service delivery can substantially help in biomanipulation and mainstreaming biodiversity conservation in heterogeneous tropical landscapes [3][15].

India has one of the largest concentrations of indigenous people comprising ~104 million people represented by 705 ethnic groups among whom 75 are vulnerable tribal groups. These tribal groups derive multiple products and services from wild habitats [16][17]. The indigenous communities are undisputedly considered to be the weakest marginalized sections of the society facing the brunt of poverty, illiteracy, and backwardness. Despite several ambitious welfare and food security programs having been launched, the expected benefits cannot reach targeted masses due to ineffective implementation and consciousness and, consequently, a large number of indigenous people are subject to food insecure, malnourishment and prone to epidemics not only impeding socio-economic progress but also distressing cultural development [18][19]. Furthermore, WEPs not only contribute to traditional foods but also compliment the culinary value of routine foods and understanding cultural preferences toward different ecosystem services is of great importance as WEPs use has special significance from cultural and nutritional perspectives and prioritizing conservation and/or domestication of vulnerable species. It can also lead to proper planning of rural development through exploiting species having marketing potential and also identifying nutritious species for promoting household income and combating the menace of malnutrition [20].

WEPs have become critical for the sustenance and household income of these groups; moreover, the lower returns from farms necessitate the diversification of income from the sale of WEPs. However, unscientific, concentrated, and over-exploitation of few species degenerating the native diversity of WEPs, while increasing rates of deforestation, epidemics of pests and forest fires in the last few years caused severe genetic erosion disrupting the cultural and traditional food habits resulting in an increase of the incidences of malnutrition and chronic diseases especially among the children and women of indigenous communities. Up until now, very little comprehensive work has been made on the diversity and utilization of WEPs; moreover, studies were concentrated on traditional knowledge for primary health care using herbal drugs in Central India [21][22]. Nevertheless, there has been growing interest in recent years in sustainably exploiting the wild edible resources beyond food and therapeutic uses and intended to understand the local nutrition, dietary diversity, income generation, folklore medicine and safeguard food security through diversification. Indigenous communities meet their diverse demands from surrounding biodiversity and cultural landscape-rich areas of Achanakmaar-Amarkantak Biosphere Reserve (AABR) falling in Central India mainly inhabited by Baiga, Gond, Kol, and Oraon communities who possess significant knowledge about bioresources and their use. Documenting such valuable information is vital for the maintenance of

ecosystem services, traditional knowledge, cultural heritage, regulating bio-piracy, biodiversity conservation, development of rural industries, education, employment generation, and ecotourism [23].

2. Wild Edible Plants in India

Disruption in ecosystem services from dwindling WEPs resources that contribute to social, cultural, environmental and economic development poses a serious threat to the food and nutritional security of indigenous people. Several studies suggested developing resilient food production and supply systems and promote the sustainable use of traditional foods, which should be seriously considered while formulating policies, practices, technologies, and strategies that lead to the conservation and sustainable development of WEPs. These resources provide valuable provisioning services securing food, timber, firewood, medicine, other NTFPs and ensuring sustained income and supplementing food in famine times and nutrition for underprivileged indigenous communities in India [24][25][26]. Our study documented a range of wild edible plant sources yielding leafy vegetables, shoots, flowers, fruits, tubers, roots, legume pods, mushrooms, etc. were diversely utilized by ethnic communities in the AABR region of Central India, which are congruent with reports of studies conducted elsewhere [27][28][29]. Arinathan et al. [29] reported a total of 171 wild edible plants representing 67 families were extensively used by the Pallayaris tribe in the Western Ghats region of Tamilnadu, southern India. A wide range of plant parts such as rhizomes, corns, tubers, bulbils, and roots of 19 species, stem pith and apical meristems of 12 species, leaves of 54 species, flowers of 10 species, unripe fruits 41 species, ripe fruits of 64 species and seeds and kernels of 45 species were consumed raw or cooked as a vegetable. Similarly, Sandriyal and Sandriyal [27] recorded 192 species of wild edible plants were consumed and 47 were sold in local markets by indigenous communities in the Sikkim Himalayan region of India. Ghorbani et al. [30] recorded 173 species representing 64 families and one species of lichen (*Ramalina* sp.) were used as WEPs in Yunnan, southwest China, while, Kala [31] documented the use of only 73 WEPs species by indigenous and other communities in Chhattisgarh, India. All these studies show that the number and frequency of WEPs species used vary according to geographic location, abundance, traditional knowledge, shortage in conventional foods, and the socio-cultural and economic conditions of communities.

Among the communities, the Baigas collect and consume a large number of wild edible resources in different food groups compared to Gonds, Kols, Oraons, and other communities in AABR. The ethnic differences in collection and utilization of WEPs were also widely reported across the world, which was perceived as diverse cultural and environmental settings rather than economic conditions [11][25][27]. Termote et al. [32], while comparing the traditional knowledge of WEPs among three ethnic communities in the Tshopo district of DR Congo, reported that utilization and traditional wisdom of WEPs were culturally highly diverse between ethnic groups. Our results further corroborated with fact that Baigas utilized 30% of wild edible species for food and fruits, in the Baigacheck area in Dindori district of MP in central India [33]. A high frequency of WEPs consumption by the Baiga community in the core region could be attributed to their rich traditional knowledge, religious and customary needs, moreover, they were well acquainted with how efficiently WEPs could be utilized for food, and income generation in their socio-cultural milieu. The ethnicity and locational differences in utilization of WEPs were widely recognized, which has

been mainly attributed to the socio-cultural background rather than diversity and accessibility as utilization patterns of WEPs were driven by culture, traditions, knowledge and biogeographical factors [34].

3. Conclusions

A total of 172 WEPs providing leafy vegetables, fruits, seeds, nuts, roots, shoots, rhizomes, tubers, mushrooms, etc. were utilized as a source of foods by indigenous communities across different zones of AABR, Central India. The study showed that people living in core and buffer areas of AABR mostly rely on wild edibles supplementing the requirements of food and nutrition. Baiga, an underprivileged primitive community, possess more traditional knowledge on diverse uses of WEPs, thus exploiting comparatively a higher number of wild edibles for meeting household food and nutritional needs. The study revealed that livelihoods and economy are intricately linked to traditions and values that are deeply rooted in the culture of Baigas, Gonds, Pradhans, Oraons, Kols of the AABR, while WEPs contributed significantly to the household incomes of these communities; however, the income levels were much lower in transition and buffer zones. The middlemen were key players, exploiting poor communities by procuring the valuable WEPs at nominal prices; therefore it is suggested to develop appropriate mechanisms and evolve institutional arrangements for marketing of WEPs at assured support prices at least for a range of popular commodities so that legitimate benefits could be realized. The processing and value addition of wild flowers, fruits, nuts, mushrooms, etc. needs to be promoted through cooperatives or self-help groups of communities that could not only increase quality, shelf life but also ensure higher income than current levels. The study also indicated that diets of indigenous communities were cereal-based, while the consumption of other commodities was in inadequate quantities, whereas WEPs were supplementing food, essential macro- and micro-nutrients. Nonetheless, the present levels of intake appear to be inadequate but they have potential to meet the total dietary needs if taken in recommended portions and sizes, which will not only add dietary diversity but also overcome the nutrient deficiencies especially in core and buffer zones, where both indigenous populations and WEPs are largely concentrated. The unscientific approach and overexploitation leading to degeneration of valuable wild edible fruit-yielding species like aonla, char, mahua, tendu, bohar etc. affect their frequency and abundance, therefore suitable management interventions were suggested to conserve the vulnerable species by involving the indigenous communities. Moreover, the illegal expansion of agriculture into forested landscapes also eroding the diversity of WEPs in AABR. The Forest Rights Act (2006) will provide a solution to permanent land tenure to communities and discourage the evil practices affecting the abundance and diversity of WEPs. In situ and ex situ conservation measures could help in regeneration and preservation of endangered and threatened species, which can ensure financial incentives to local stakeholder communities through JFPM, REDD⁺ and MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act, 2005) programmes. The management and promotion of WEPs systematically and sustainably would not only improve food and nutritional security but also build socio-economic resilience and create novel opportunities for bioprospecting of potential resources. However, sensitive policies and programmes should be evolved to ensure fair and equitable sharing of benefits between communities of AABR and users of biological resources and indigenous knowledge.

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