

# The socio-economic importance of wild vegetable resources and their conservation: a case study from China

Xiaobo Zou<sup>1</sup>, Fengqiu Huang<sup>2</sup>, Limin Hao<sup>3</sup>, Jiewen Zhao<sup>1</sup>, Hanpin Mao<sup>1</sup>, Jiachun Zhang<sup>3</sup> & Shuyan Ren<sup>4</sup>

**Summary.** In the Xiangxi region of western Hunan province, China, 335 taxa belonging to 87 families and 119 genera are utilised as wild vegetables. In order to take advantage of this naturally occurring resource we examined the horticultural and the associated socio-economic aspects of these taxa. Wild vegetables, as the mainstay of human diet and Chinese traditional medicines, have played an important role in the daily life and income of local ethnic groups for centuries. We examine candidate species for their prevalence and their potential to offer returns, for example in cereal production and tourism, and indicate horticultural management and processing technologies which may exploit wild vegetable availability.

**Key Words.** China, seed plants, western Hunan, wild vegetable, Xiangxi.

## Introduction

Wild vegetables are receiving renewed attention with the recognition that they could become useful parents in breeding programmes, convenient sources of income, and vehicles for improved nutrition and increased food supply. Moreover, due to the absence of residues from pesticides or fertilisers and to their high nutritious value, wild vegetables have become a commercial crop with ever increasing market potential. However, acceptance and utilisation of wild vegetables is currently constrained by lack of knowledge about these species, their nutritive value, toxicity issues, methods of preparation and preservation, as well as their strongly localised importance (Chen *et al.* 1999; Zhu & Chen 2000; Huang *et al.* 2005; Chen *et al.* 2006; Zhou *et al.* 2008; Wang *et al.* 2009b). This has resulted in some concerns that the current neglect and under-utilisation of wild vegetables might lead to their genetic erosion. Some authors have suggested that protection of wild vegetables may only become sustainable by promoting their utilisation (Zhu & Chen 2000; Xu *et al.* 2004; Wang *et al.* 2009a).

A sensible starting point is to document indigenous knowledge of the diversity and uses of traditional vegetables, including the wild varieties. Comprehensive descriptions will require information on genetic resource conservation and use, agronomic and horticultural potential, consumer preferences and marketing. In addition, policy frameworks will be needed to

promote the use of these vegetables and hence maximise their economic value (Chen *et al.* 1999; Zhu & Chen 2000; Wang *et al.* 2009a).

The objectives of this study were to determine how many wild vegetable taxa there are in the Xiangxi region of western Hunan province and to document their distribution and utilisation. This provides a basis for policy-making and identifies where future research may be directed.

## Study Area

The Xiangxi region includes Xiangxi Tujiazu Miaozu Autonomous Prefecture, Zhangjiajie Prefecture and some parts of Huaihua Prefecture. Xiangxi covers an area of about 3500 km<sup>2</sup>, and is located at the eastern border of the Wuling Mountains in the eastern region of the Yungui Plateau (Fig. 1). Its geographical position is between 27 – 30° N and 109 – 111° E, with altitudes ranging between 500 – 1000 m a.s.l. The terrain is hilly to mountainous. The climate is subtropical, with annual mean temperatures of c. 15 – 17°C and having mild winters. The average annual precipitation is 1300 – 1500 mm. In a particularly scenic area in north-western Hunan, China established Zhangjiajie National Forest Park, its first such national forest park. The park is especially known for its quartz-sandstone rock formations sculpted by natural erosion.

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<sup>1</sup> Jiangsu University, Zhenjiang, Jiangsu, China. e-mail: zou\_xiaobo@ujs.edu.cn

<sup>2</sup> The Hunan Academy of Agricultural Science, Changsha, China.

<sup>3</sup> The Research Center of China Hemp Materials, Beijing, China.

<sup>4</sup> Hunan Provincial Science & Technology Department, Changsha, China.



Fig. 1. Study area and field trips were carried out in 16 ethnic villages ● and 10 vegetable markets ▲ throughout Xiangxi during 2007 – 2008.

Xiangxi is an area rich in cultural diversity and biodiversity, and due to the close relationship with the natural forest, all native ethnic groups have developed knowledge systems related to the use and conservation of natural resources. Wild vegetables are traditionally an important resource for these ethnic groups' subsistence (Chen *et al.* 1999; Zhu & Chen 2000). More than 30 ethnic groups, including Miao, Tujia, Yao and Dong have been settled in this area for many millennia. Each of the ethnic groups follows its own traditional culture. The economy of these ethnic groups is mainly based on subsistence farming, with about 90% of its total labour force directly or indirectly engaged in agriculture. Mixed crop and livestock farming is the common practice of the inhabitants. In addition, collection and foraging of wild plants plays an important role in their livelihood.

## Materials and Methods

Field trips were carried out in 16 ethnic villages and 10 vegetable markets throughout Xiangxi during 2007 – 2008 (Fig. 1). Detailed studies, including botanical collections and ethnobotanical interviews, were carried out in 10 villages of three ethnic groups (six Miao, two Tujia and one Dong). A total of 107 local people participated in the interviews, including women and men between the ages of 22 and 87. They provided useful information on plants and their common names, seasonal availability, forms of use, processing requirements, storage qualities and economic value of some of the wild vegetable taxa. A detailed study of markets included information about the vendors and their relation to the vegetable products. Plant specimens were collected and catalogued, with the seeds of some specimens subject to laboratory analysis.

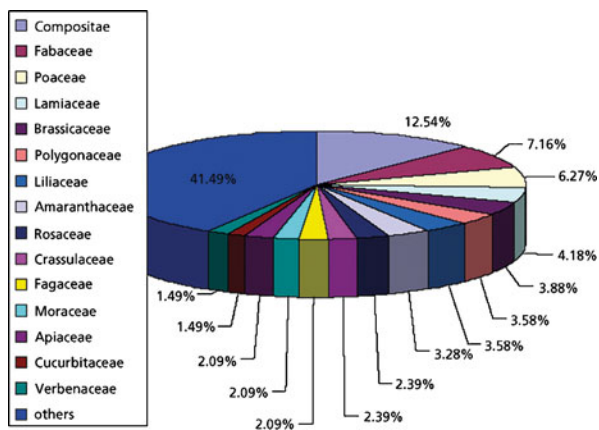


Fig. 2. The 15 dominant families among wild vegetation of seed plant in Xiangxi.

## Results and Analysis

### Diversity of species

Altogether, 335 taxa were found in Xiangxi in this survey. They belong to 119 genera in 87 families. At the family level, over 50% species are in the 15 families which are shown in Fig. 2 and Table 1. Compositae (42 species) has the highest numbers of wild vegetable species (Table 1). Table 1 also shows the representative taxa in the top 15 families with the majority of the taxa endemic to Xiangxi. Only 41 of the taxa are exotic. 50 taxa were recorded in all of the 16 ethnic villages, 199 taxa were recorded in more than eight ethnic villages, while only 86 taxa were recorded in one or two villages. A total of 228 taxa, accounting for 68% of the total plants found, are distributed in wild or semi-wild habitats, while 107 species are cultivated or semi-cultivated in home gardens (Table 2A). Here, 'wild habitats' refers, in most cases, to natural forest stands with comparatively high diversity of tree and associated plant species, even though most forests near the villages show many signs of disturbance and degradation. 'Semi-wild habitats' refers to open forestland and fallow areas, as well as to boundary areas along fields, footpaths, tractor roads, and rivers. The 335 taxa found in this survey include 209 herbaceous taxa (62.4%), 103 tree taxa (30.7%) and 23 vines (6.9%) Table 2B.

### Multiple roles of wild vegetables

Wild vegetables have played an important role in the daily life and diet of local ethnic groups for millennia. For the majority of the wild vegetable taxa found (251 or 74.92%), are utilised for their leaves (including leaf and other parts such as fruit and flower as the edible part), followed by flowers (6.27%), fruits (3.58%) and roots (11.64%, including earthnut, tuber, and rhizome), as shown in Fig. 3. Although many seeds of these wild taxa are edible, the seeds of only 12 taxa are actually eaten (Table 2C). More than 85% of the species are used directly as vegetables, and some of them are added as condiments or supplements to vegetable dishes. These wild vegetables provide millions of consumers with important micronutrients, such as vitamins and minerals needed to maintain health and promote immunity against infections. Compared to conventional, cultivated species, wild vegetables are hardy, require less care, and are a rich source of micronutrients. The multiple roles of wild traditional vegetables as both food and medicinal sources have been widely known by ethnic groups. Chinese traditional medicines are based on these wild vegetables. Some vegetables and fruits have been demonstrated as having antibacterial activities, such as *Clerodendrum cyrtophyllum* Turcz., *Gastrodia elata* Blume, *Iris lactea* Pall. var. *chinensis* (Fisch.) Koidz. etc. Furthermore,



**Table 1.** Plant taxa in Xiangxi of value to local livelihoods.

Family	Number of taxa found	Examples
Amaranthaceae	11	<i>Alternanthera sessilis</i> , <i>Amaranthus spinosus</i> , <i>Celosia cristata</i> , <i>Celosia argentea</i> , <i>Amaranthus hybridus</i>
Apiaceae	7	<i>Foeniculum vulgare</i> , <i>Oenanthe javanica</i> , <i>Cryptotaenia japonica</i> , <i>Daucus carota</i> var. <i>carota</i>
Brassicaceae	13	<i>Capsella bursa-pastoris</i> , <i>Rorippa indica</i> , <i>Brassica oleracea</i>
Compositae	42	<i>Taraxacum mongolicum</i> , <i>Sonchus oleraceu</i> , <i>Kalimeris indica</i> , <i>Arctium lappa</i> , <i>Youngia japonica</i>
Crassulaceae	8	<i>Sedum elatinoides</i> , <i>Stellaria media</i> , <i>Arenaria serpyllifolia</i> , <i>Silene conoidea</i>
Cucurbitaceae	5	<i>Gynostemma pentaphyllum</i> , <i>Momordica cochinchinensis</i> , <i>Trichosanthes kirilowii</i>
Fabaceae	24	<i>Kummerowia striata</i> , <i>Astragalus sinicus</i> , <i>Pueraria phaseoloides</i> , <i>Pueraria lobata</i> var. <i>lobata</i> , <i>Vicia kulingiana</i> , <i>Wisteria sinensis</i> f. <i>sinensis</i>
Fagaceae	7	<i>Castanea mollissima</i> , <i>Castanea seguinii</i> , <i>Castanea henryi</i> , <i>Castanopsis eyrei</i>
Lamiaceae	14	<i>Pogostemon cablin</i> , <i>Perilla frutescens</i> var. <i>frutescens</i> , <i>Leonurus japonicus</i> , <i>Ocimum basilicum</i> var. <i>basilicum</i> , <i>Mentha canadensis</i>
Liliaceae s.l.	12	<i>Hemerocallis citrina</i> , <i>Lilium brownii</i> var. <i>viridulum</i> , <i>Polygonatum cyrtoneura</i> , <i>Asparagus cochinchinensis</i> , <i>Polygonatum odoratum</i>
Moraceae	7	<i>Morus alba</i> var. <i>alba</i> , <i>Ficus pumila</i> var. <i>pumila</i>
Poaceae	21	<i>Phyllostachys heterocycla</i> cv. <i>pubescens</i> , <i>Phyllostachys heteroclada</i> f. <i>heteroclada</i> , <i>Phyllostachys bambusoides</i> f. <i>bambusoides</i>
Polygonaceae	12	<i>Polygonum humifusum</i> , <i>Polygonum japonicum</i> var. <i>japonicum</i> , <i>Rumex acetosa</i> , <i>Reynoutria japonica</i> , <i>Fallopia cynanchoides</i> var. <i>cynanchoides</i>
Rosaceae	8	<i>Agrimonia pilosa</i> var. <i>pilosa</i> , <i>Potentilla lineata</i> , <i>Rosa rugosa</i> , <i>Rosa chinensis</i>
Verbenaceae	5	<i>Vitex negundo</i> var. <i>negundo</i> , <i>Vitex negundo</i> var. <i>cannabifolia</i>

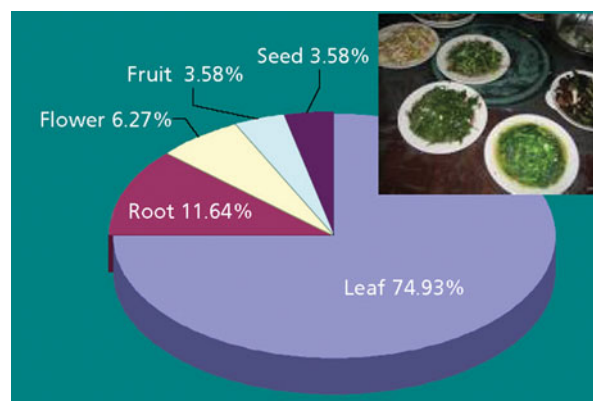
wild vegetables have been reported to contain comparatively high amounts of Vitamins A and C. These, and other antioxidant micronutrients present in fresh fruits and vegetables, promote good health by assisting in the prevention of cancer and high blood pressure, stimulating the immune system, improving drug metabolism and tissue regeneration. Vitamin-specific studies have also concluded that wild vegetables are a good source of folate with concentrations ranging between 0.10 and 0.96 mg/g in blanched vegetables. Hence, they could make an important contribution to combating micronutrient malnutrition as well as providing food security.

As living standards improve there is an increased demand for safe, healthy food. The origin and quality of food is of increasing public concern. To achieve this aim,

**Table 2.** Preliminary statistics showing growing environment, habit and parts utilised of wild vegetables in Xiangxi. *N* = number of species; *N/T%*, number of species/total wild-vegetable species, expressed as a percentage.

Feature	<i>N</i>	<i>N/T (%)</i>
<b>A. Growing environment</b>		
Wild & semi-wild	228	68.06
Cultivated & semi-cultivated	107	31.94
<b>B. Growth habit</b>		
Herb	209	62.4
Woody	103	30.7
Vine	23	6.9
<b>C. Parts utilised</b>		
Leaf	251	74.92
Root	39	11.64
Flower	21	6.27
Fruit	12	3.58
Seed	12	3.58

environmentally sustainable agricultural processes must be employed. Wild vegetables contributing a large market in China may assist in this objective. We found 153 of the wild vegetable taxa during surveys at 10 vegetable markets in Xiangxi (Fig. 1). Of the 153 taxa recorded, 84 have been identified as wild vegetables, 69 as cultivated ones. The income generated from the sales of wild vegetables accounts for 33.1% of the total income from vegetable sales. Apart from the local markets, there are other outlets for wild vegetable trade and marketing in Xiangxi. Wild vegetables are, for example, an important local product for tourists. More than 3 million tourists visit Xiangxi annually for its unique culture and scenery. More than 80 restaurants cook mainly with wild vegetables for tourists in Fengfang City alone. Therefore tourists consume a substantial portion of wild vegetables in this area. The great demand for wild vegetables has been stimulating the

**Fig. 3.** Edible parts of wild vegetables of seed plants.

increase in both the wild collection and the cultivation of wild vegetables in Xiangxi since the early 1990s.

### Discussion

Rural communities in Xiangxi are extremely knowledgeable about local plants, in particular about wild vegetables. Ethnobotanical studies are crucial for the documentation and assessment of local uses of plant resources (Xu *et al.* 2004). Unfortunately, wild vegetables are currently underutilised, and have been neglected by researchers and policy makers. Their promotion and integration into human diets could assist in their protracted use and consequent conservation. However, the chemical, nutritional and toxicological properties of local wild vegetables, the bioavailability of micronutrients present in these and their modification by various processing techniques still need to be properly established and documented before their use as an alternative dietary source can be advocated. Even though wild vegetables form an integral part of traditional agricultural systems, current research still appears to be focused on the popular or commonly used species, some of which may have already been fully or partially domesticated (Xu *et al.* 2004). Therefore, it is vital that more research is conducted on potentially exploitable wild taxa. This would promote their increased utilisation, thereby simultaneously contributing to conserving their genetic resources. Such research could commence with the collection and databasing of traditional knowledge and information on the distribution and use of wild vegetables in rural communities.

With detailed research in the future, we expect that more taxa used as wild vegetables by indigenous people will be recorded. The use of wild vegetable resources is of great benefit for the local people, particularly for poorer communities in mountain areas, with limited land resources for intensive cash crop cultivation and poorer infrastructure. An increased stable income from wild vegetables would also increase the perceived value of natural forests.

Improved marketing of wild vegetables by local people and to tourists could eventually result in new attitudes toward the protection of the remaining natural forests outside the large nature reserve areas. New marketing opportunities and monitoring instruments for sustainable harvesting of wild vegetables should be identified and implemented. Opportunities for integrated cultivation of wild vegetables under natural or cultivated forest canopies should also be evaluated.

The increasing awareness of environmental change and its impact on human health raises demands for 'clean' and healthy food in China. Prices are higher for wild vegetables than for cultivated ones, as wild

vegetables are rich in proteins, amino acids, and vitamins and they are found to be tastier than cultivated vegetables. This attitude is found especially among people from urban areas, who essentially come as visitors to Xiangxi. Thus tourists are an important target group for advanced wild vegetable marketing. Organic vegetables have become very popular and are an extremely promising market. However, wild vegetables are essentially only available at local markets, although fresh wild vegetables are now being transported to urban markets. Processing of wild vegetables and the introduction of new products should be explored. Since wild vegetables are only seasonally available and highly perishable, suitable processing and storage techniques need to be applied to conserve their micronutrients. Seasonality can be partly overcome by blanching, which is usually the primary step in the processing of vegetables, before drying and storage. Numerous studies have examined the effects of drying on retention of nutrients in leafy vegetables, but information on the changes during storage of dehydrated leaves is still lacking and would benefit from advanced processing techniques.

There is high potential for domesticating wild vegetables. For instance, some woody species, such as *Actinidia chinensis* Planch., *Aleurites fordii* Hemsl., *Castanea mollissima* Blume, *Diospyros kaki* L. f., *Morus alba* L., *Toona sinensis* (Juss.) M. Roem. and *Zanthoxyllum bungeanum* Maxim., are highly suitable for cultivation in the local environment. Although it may take several years to obtain a profit from cultivation, woody species have a higher market value. These species could improve the forest canopy and are good for sustainable agricultural development in hilly to mountainous areas.

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