Wild edible plants collected by Hani from terraced rice paddy agroecosystem in Honghe Prefecture, Yunnan, China

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Abstract

Background: The Hani people in the Honghe Prefecture of Southeastern Yunnan, China, have practiced terraced rice paddy farming for more than 1300 years. These rice fields, combined with the surrounding forests and water systems, form a special agroecosystem that has attracted both tourists and scientists. For centuries, the local people have traditionally collected wild edible plants (WEP) from the agroecosystem, but this unique traditional practice in this area has never been reported.

Methods: Ethnobotanical fieldwork was conducted in four counties (Yuanyang, Honghe, Jinping, and Lüchun) between 2014 and 2019. Local self-identified Hani people (186) were interviewed, and information concerning local WEP species was obtained, documented, and analyzed. Plant samples and voucher specimens were collected for taxonomic identification.

Results: A total of 224 WEP species, belonging to 90 families and 170 genera, were recorded as used by the Hani people in Honghe. The most common WEP parts used include fruits, stems, and leaves, and the most common preparation methods include eating as a potherb (wild vegetable) and eating fresh. Some WEPs, like *Phyllanthus emblica* and *Dioscorea subcalva*, have unique preparation methods. The use-value (UV) and frequency of utilization index (FUI) of WEP species were analyzed. The 20 WEP species with the highest UV were noted as particularly important to the Hani people’s daily life in Honghe.

Conclusion: A large majority of these WEP species possess tremendous economic potential for future development. However, the diversity of WEP species, the associated traditional knowledge, and the broader agroecosystem are facing challenges such as biodiversity loss and pollution from chemical pesticides and fertilizers. This study may help local people to recognize the value of local WEP species and associated traditional knowledge, as well as provide ethnobotanical information for the future development of this tourism region.

Keywords: Hani terraced rice paddy fields, Wild edible plants, Ethnobotany, Hani ethnic group
For example, Zhu et al. [6] carried out a series of experiments in the terraced rice paddy fields in Honghe Hani and found that crop heterogeneity could solve the vulnerability of monoculture crops to disease; Li et al. [7] studied the agricultural soils by molecular methods and revealed the dynamics of organic matter in Yuanyang Terrace. However, there have been no studies on the wild edible plants (WEP species) collected and consumed by the Hani people in Honghe Hani terraced rice paddy system. In addition to scientific interest, the Honghe rice terraces have attracted more than 20 million tourists since 2014 [8]. Due to their interests in local foods, tourists have driven a demand for WEP species on the menus of local restaurants.

The Hani people speak their own language, which does not have a traditional writing system. After 1957, a set of writing characters of the Hani language based on Latin was invented with the help of the Chinese government and linguists [8].

About 1300 years ago [9], the Hani people migrated to Southeast Yunnan and began the cultivation of rice paddies in terraced hillside fields, forming a sustainable agroecosystem consisting of four major components: forests, villages, terraced rice paddies, and river systems (Fig. 1) [10, 11]. The evergreen forests control the water in the soil, acting like a natural reservoir to maintain the water year long, and also provide water for the villages and terraced rice paddies in lowlands through water channels built by Hani people [10]. Also, the hot and humid valley climate frequently generates a thick fog that helps to maintain moist air throughout the year. This unique four element-based Hani agroecosystem ensures a stable water supply. Consequently, the Hani terraced rice paddy fields did not suffer any significant damage from the historic 2009–2010 drought in China [2, 12].

Due to this unique and complex agroecosystem, together with its rich biodiversity, much traditional ethno-botanical knowledge has been developed and accumulated by the local people, especially knowledge about WEP species. Since WEP species have not been domesticated and grown on a large scale, they must be obtained from the natural environment in order to be used as food [13, 14].

In some parts of Yunnan, there has been a rapid replacement of complex agroecosystems by intensive monocultures of commercial crops, such as bananas, which is often accompanied by the use of inorganic herbicides and pesticides [15]. Rising awareness and concern about the possible health effects of pesticides and herbicides on human health has dramatically increased demand for organic foods in China [15]. This interest extends to WEP species as they are wild harvested. For example, many WEP species have made their way into ethnic minority recipes found on high-end restaurant menus. Consequently, some WEP species have tremendous market potential and are particularly popular in tourist areas because of their perceived advantages of being pesticide-free, naturally grown, high in nutrients, and fresh in taste [13, 16]. According to a Web of Science search of bibliometric and mapping knowledge domains, WEP species have always been an essential hotspot

![Fig. 1 The construction of the Hani terraced rice paddy field agroecosystem](image-url)
in ethnobotanical research [17]. WEP species in the Hani terraced rice paddy agroecosystem are often used to supplement daily food resources or to help to overcome seasonal food shortages [18]. Additionally, some WEP species possess medicinal properties that may help protect indigenous people against diseases [18, 19].

Although the Hani people have lived in the Honghe Hani terraced rice paddy system for centuries, their traditional knowledge and associated biodiversity are rapidly being lost due to socio-economic changes and access to modern technologies [4, 11]. Consequently, decreasing traditional knowledge will likely lead to a decrease in biodiversity, especially the diversity of WEP species [20]. Therefore, saving local traditional knowledge and protecting biodiversity are urgent [21]. To our knowledge, no previous studies have documented the WEP species in Hani terraced rice paddy agroecosystems. Thus, this investigation on the WEP species in Hani was conducted. This study recorded traditional knowledge of WEP species, which may protect it from disappearing in a rapid-developing era. The related research results may also provide scientific guidance for WEP species consumption, information of economic benefit to local communities for future sustainable development, and application of WEP species.

Methods

Study area

Before the field survey, a literature review was conducted to obtain information about the region of Hani terraced rice paddy fields, including climates, topography, vegetation types, and culture [22]. During 2014–2019, ethnobotanical studies were carried out in four counties (Yuanyang, Lüchun, Honghe, and Jinping), which cover more than 47,000 ha, including most of the area containing Hani terraced rice paddy fields (Fig. 2) [23]. All study sites and their visit times are recorded in detail in Table 1. In consideration of local landscape diversity, this investigation was conducted in almost every landscape of this agroecosystem, including farming areas, forests, villages, home gardens, and water source areas [23]. Additionally, local markets in different villages and counties were surveyed repeatedly, as the
markets often reflect the wide variety of local knowledge in daily life [24].

Data collection, voucher specimen collection, and data analysis
A variety of different ethnobotanical and social science methods were used to collect data about the WEP species in this region. These methods included participatory rural appraisal (PRA), direct observation, semi-structured interviews, key informant interviews, and focal group discussions (Fig. 3) [4, 25, 26]. In total, 186 native Hani people, including 160 people older than 50 years of age, were interviewed. Seventy of them were male, and 116 were female. They were mostly local farmers, and many of them collected WEPs to sell in local markets. The primary content of the interview consisted of “5W + H” questions (i.e., questions concerning what, when, where, who/whom, why, and how the subjects utilize WEP) [24, 26, 27]. With the assistance of Hani local experts, voucher specimens were gathered from different habitats around the study sites. Plant species were identified by Dr. Chunlin Long, Dr. Bo Liu, and Ms. Jun Yang. The voucher specimens were deposited at the College of Life and Environmental Sciences at the Minzu University of China in Beijing.

The data collected in the Honghe area was collated into an inventory containing all the WEP species and related information. The use-value (UV) of each WEP was calculated to evaluate the relative importance of each plant based on the number of times cited and the number of informants [28, 29]. The formula for UV is

$$\text{UV} = \frac{\sum \text{U}_i}{N}$$

$\text{U}_i$ is the times cited by each informant for a certain WEP, while $N$ is the total number of informants [29]. The frequency of utilization index (FUI) of WEP species was graded according to the frequency of consumption by local people. FUI can also reflect the degree of closeness between WEP species and the local community [29]. The FUI scores range from 0 to 5 and varied by the consumption frequency (Table 2) [29].

| County name | Village and township |
|-------------|----------------------|
| Honghe County | Lüshuge Village, Jiayin Township | 2 |
| Honghe County | Lonajia Village, Jiayin Township | 1 |
| Honghe County | Baohua Township | 2 |
| Jinping County | Xiongjia Village, Adebo Township | 2 |
| Jinping County | Shuiyan Village, Ma’andi Township | 2 |
| Lüchun County | Lüchun County | 2 |
| Lüchun County | Lagu Village, Sanneng Township | 1 |
| Jinping County | Xiaoxinjie Township | 1 |
| Jinping County | Niujiaozhai Township | 1 |
| Jinping County | Qingkou Village, Xinjie Township | 1 |
| Jinping County | The junction of Lüchun County and Yuanyang County | 1 |

Fig. 3 Focal group discussion (a) and Hani women in a local market (b)
The recorded edible parts of WEP species (4.5%) (Table 4).

There were 80 species of herbaceous plants (50.9%), including trees (30.4%) and shrubs (20.5%).

According to Table 5, edible fruit is the most popular group (98 species, 43.8%). These are usually consumed freshly without processing, which is the second most common food preparation method for the Hani WEP species (Table 6). Also, fruits can be consumed in several different ways. For example, Anomum maximum fruits are used locally as a natural spice that can help infirm people regain their appetite; the fruits of Ligustrum sinense are used by the local Hani people to brew a unique alcoholic drink, and Canarium album’s fruits can be preserved into pickles.

Ten species of bamboo shoots can be made into different dishes that are high in nutritious fibers. Some WEP species in the Honghe region can also be used as natural flavoring agents (16 species), nuts (12), tea substitutes (11), liquor-brewing ingredients (8), grain substitutes (2), and special tofu (2). Exceptionally, there is only one species, Capparis masaikai, that is used as a natural sweetener by local communities. The locals usually remove the seed coat and chew the kernel directly. C. masaikai contains high levels of mabinlin, a sweet protein with 400 times the sweetness of sucrose but with meager calories, and consequently, this plant has a high potential for future application in the food industry [34].

**Two special cases of WEP species**

During our investigation, some unique cases of utilizing and processing WEP species were observed. In the Honghe area, Phyllanthus emblica bark is prepared in an unusual way (Fig. 4a). Local Hani people collect the P. emblica from mountainous forests, remove the branches, and peel off the outer layer of bark, grating off the bitter-tasting inner bark by using pottery shards. Traditionally, they adjust the bitter taste by mixing rice porridge paste with the tender inner bark. Then, the grated inner bark is mixed with roasted ribs, sliced pork liver, salt, and spices and eaten as a traditional dish. Besides its culinary use, P. emblica is also used medicinally for its potential anti-microbial, antioxidant and anti-tumor, hypolipidemic, hypoglycemic, and antihypertensive properties [35].

The traditional preparation of Dioscorea subcalva in cuisine is also distinctive. Local women first peel the thin skin from the D. subcalva tubers (Fig. 4). They then use a special tool to grate the peeled tubers into a container with a hot water-ash solution. When the solution has cooled, all of the grated tubers congeal into a sticky and elastic clump. These clumps can be cut into slices and stir-fried with meat. In another use of D. subcalva,
| Scientific name                              | Vernacular Name | Life form | Family name | Parts used | Preparation and uses                              | Study sites                       | Voucher number | FUI   | UV    |
|----------------------------------------------|-----------------|-----------|-------------|------------|---------------------------------------------------|-----------------------------------|----------------|-------|-------|
| **Gymnospermae**                             |                 |           |             |            |                                                   |                                   |                |       |       |
| Gnetum montanum Markgr.                      | Wo ni ai xi     | Liana     | Gnetaceae   | Seed       | Cooked thoroughly and eaten (kernel)              | Lüchun County                     | 201,606-19     | 0.6   | 0.21  |
| Gnetum pendulum C.Y.Cheng                    | Mang dao        | Liana     | Gnetaceae   | Seed       | Cooked thoroughly and eaten (kernel)              | Lagu Village, Sanmeng Township    | HHD-31         | 0.5   | 0.16  |
| **Angiospermae**                             |                 |           |             |            |                                                   |                                   |                |       |       |
| Kadsura coccinea (Lem.) A.C.Sm.              | Hei lao hu      | Liana     | Schisandraceae | Fruit     | Ripe fruits are eaten fresh                       | Lüshuge Village, Jiayin Township  | 201,610-04     | 2.4   | 0.44  |
| Houputynia cordata Thunb.                    | Pa huo          | Herb      | Saururaceae | Rhizome    | Potherb or flavoring agent                        | Lagu Village, Sanmeng Township    | HHD-54         | 4.5   | 0.89  |
| Piper betle L.                               | Fa qie wei niu  | Liana     | Piperaceae  | Leaf       | Flavoring agent                                   | Lonajia Village, Jiayin Township  | 201,506-39     | 2.7   | 0.55  |
| Michelia hedyosperma Y.W.Law                 | Ma la           | Tree      | Magnoliaceae | Seed       | Flavoring agent                                   | Lagu Village, Sanmeng Township    | HHD-39         | 2.8   | 0.44  |
| Alphonsea mollis Dunn                        | Tree            | Annonaceae |             | Fruit      | Ripe fruits are eaten fresh                       | Lonajia Village, Jiayin Township  | 201,506-35     | 2.0   | 0.57  |
| Litsea akeensis var. sasakii (Kamik.) J.C. Liao | Mo ye la pi    | Shrub     | Lauraceae   | Fruit      | Flavoring agent                                   | Shuixian Village, Ma'andi Township| 201,511-12     | 2.0   | 0.54  |
| Litsea cubeba (Lour.) Pers.                  |                 | Shrub     | Lauraceae   | Fruit      | Flavoring agent                                   | Shuixian Village, Ma'andi Township| 201,511-13     | 2.8   | 0.46  |
| Litsea pungens Hemsl.                        | Si bi a si      | Tree      | Lauraceae   | Fruit      | Flavoring agent                                   | Baojia Township                   | 201,511-43     | 4.9   | 0.92  |
| Acorus gramineus Aiton                       | Ji xiang        | Herb      | Acoraceae   | Leaf, rhizome | Flavoring agent                             | Shuixian Village, Ma'andi Township| 201,511-13     | 2.8   | 0.46  |
| Amorphophallus konjac KKoch                  | Jia mo          | Herb      | Araceae     | Tender leaf, tuber | Making "tofu"                      | Niujiaozhai Township             | 201,606-09     | 2.9   | 0.43  |
| Colocasia gigantea (Blume) Hook. f.          | Bo ju           | Herb      | Araceae     | Petiole    | Potherb (cooked thoroughly)                      | Xiaoxinjie Village               | 201,506-06     | 4.0   | 0.80  |
| Sagittaria trifolia L.                       | Wo qi           | Herb      | Alismataceae| Tender leaf, rhizome | Potherb (stewed or stir-fried)              | Xiaoxinjie Village               | 201,610-24     | 2.4   | 0.46  |
| Dioscorea cirrhosa Lou.                      | Ai la ma a si   | Liana     | Dioscoreaceae| Tuber     | Cereal substitute in famine time                | Xiaoxinjie Village               | 201,506-05     | 2.4   | 0.43  |
| Dioscorea subcalva Prain et Burkii           | Mo mo mang      | Liana     | Dioscoreaceae| Tuber     | Making “tofu” (similar to konjac tofu)           | Lagu Village, Sanmeng Township    | HHD-45         | 2.6   | 0.46  |
| Heterosmilax yunnanensis Gagnep.             | Guo ge niao, a  | Shrub     | Smilacaceae | Tender leaf | Potherb (blanched in boiled water, then soaked in cold water for days. Usually stir-fried or made into soup) | The junction of Lüchun County and Yuanyang County | 201,506-08     | 2.7   | 0.47  |
| Caryota urens L.                             | Ha da a bo      | Tree      | Areaceae    | Flower    | Snack (inflorescence sap is sweet)               | Lüshuge Village, Jiayin Township  | 201,610-13     | 0.9   | 0.20  |
| Commelina benghalensis                       | A wei ya        | Herb      | Commelinaceae| Tender    | Potherb (boiled for 5–10 min)                     | Lüchun                           | LB-27          | 2.0   | 0.49  |
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI UV |
|-----------------|-----------------|-----------|--------------|------------|----------------------|-------------|----------------|--------|
| Forsk. mo       | Leaf, tender stem | Commelinaceae | Whole plant | Min, then soaked in water to debitterize | County | | |
| Commelina diffusa Burm.f. | Nuo niu pao | Herb | Whole plant | Potherb (usually stewed with pork) | Lüshuge Village, Jiayin Township | 201,610-15 | 2.9 0.42 |
| Streptolirion volubile Edgew. | Mo dui dui han | Herb | Tender stem, leaf | Potherb (made into soup) | Xiaoxinjie Township | LB-16 | 2.2 0.56 |
| Monochoria vaginalis (Burm.f.) C.Presl | Mi zuo wa, a bei bei za, e za, e bi ra | Herb | Stem and leaf | Potherb | Lugu Village, Sanmeng Township | HHD-48 | 2.0 0.47 |
| Musa acuminata Colla | Ruo a pao ruo a wo | Herb | Fruit, flower, pith part | Fruit: eaten fresh; flower and pith part: cooked as potherb | Baohua Township | 201,511-44 | 3.8 0.70 |
| Musa itinerans Cheesman | Herb | Musaceae | Flower, young bract | Potherb | Xiaoxinjie Township | LB-14 | 2.6 0.41 |
| Amomum maximum Roxb. | Sa jia hong bi | Herb | Zingiberaceae | Fruit | Lüshuge Village, Jiayin Township | 201,610-12 | 2.7 0.52 |
| Hedychium coronarium J.Koenig | A ci a ye | Herb | Zingiberaceae | Flower, shoot | Lüshuge Village, Jiayin Township | 201,506-53 | 2.3 0.45 |
| Zingiber striolatum Diels | Herb | Zingiberaceae | Flower | Potherb (usually stewed or stir fried) | Lüshuge Village, Jiayin Township | 201,610-22 | 3.0 0.73 |
| Acidosasa hirtiflora Z.P.Wang and G.H.Ye | Bamboos | Poaceae | Shoot | Bamboo shoots | Shuiyan Village, Maandi Township | 201,511-20 | 0.1 0.12 |
| Chimonobambusa yunnanensis Hsueh et W.P. Zhang | Bamboo | Poaceae | Shoot | Bamboo shoots | Shuiyan Village, Maandi Township | 201,511-22 | 1.0 0.18 |
| Chimonocalamus membranaceus Munro | A ha a bi | Bamboo | Poaceae | Shoot | Bamboo shoots | Xiongjia Village, Adeb Community | HHD-015 | 0.6 0.17 |
| Dendrocalamus peculiaris Hsueh and D.Z.Li | Bamboo | Poaceae | Shoot | Bamboo shoots | Shuiyan Village, Maandi Township | 201,511-23 | 0.8 0.25 |
| Indosasa singulispicula T.H.Wen | Bamboo | Poaceae | Shoot | Bamboo shoots | Lonajia Village, Jiayin Township | 201,506-43 | 0.1 0.15 |
| Indosasa sinica C.D.Chu and C.S.Chao | A xiu a bo | Bamboo | Poaceae | Shoot | Shuiyan Village, Maandi Township | 201,511-17 | 0.6 0.06 |
| Melocalamus arrectus T.P.Yi | A ha a bo | Bamboo | Poaceae | Shoot | Shuiyan Village, Maandi Township | 201,511-18 | 0.6 0.09 |
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | UV |
|-----------------|-----------------|-----------|-------------|------------|----------------------|-------------|----------------|-----|-----|
| Phyllostachys nigra var. hemonis (Mitford) Rendle | A mao a bo | Bamboo | Poaceae | Shoot | Bamboo shoots | Shuiyan Village, Ma’andi Township | 201,511–21 | 0.9 | 0.04 |
| Schizostachyum funghornii McClure | A che | Bamboo | Poaceae | Shoot | Bamboo shoots | Shuiyan Village, Ma’andi Township | 201,511–19 | 0.5 | 0.25 |
| Akebia trifoliata (Thunb.) Koidz. | Liana | Lardizabalaceae | Fruit | Ripe fruits are eaten fresh | Lüshuge Village, Jiayin Township | 201,610–05 | 1.9 | 0.54 |
| Parabaena sagittata Miers | Hua na wei niu | Liana | Menispermaceae | Leaf | Potherb | Shuiyan Village, Ma’andi Township | 201,511–28 | 2.5 | 0.55 |
| Mahonia bealei (Fortune) Pynaert | Shi shi, sou shou | Shrub | Berberidaceae | Fruit, stem | Stem: liquor brewing; fruit: eaten fresh | Lonajia Village, Jiayin Township | 201,506–46 | 2.6 | 0.52 |
| Helicia nilagirica Bedd. | Kong bai a bo | Tree | Proteaceae | Seed | Cooked seeds are used as grain substitute | Shuiyan Village, Ma’andi Township | 201,511–01 | 2.7 | 0.58 |
| Dillenia indica L. | Xi shi a di | Tree | Dilleniaceae | Fruit | Ripe fruits are eaten fresh | Qingkou Village, Xinjie Township | 201,506–13 | 2.8 | 0.41 |
| Acacia pennata (L.) Willd. | Tuo bo ji niu | Liana | Fabaceae | Tender leaf | Potherb | Baohua Township, HHD-25 | 3.4 | 0.65 |
| Bauhinia acuminata L. var. candida (Roxb.) Voigt | Du bie a lo | Shrub | Fabaceae | Flower, young pod, seed, tender leaf | Potherb, seeds: cooked thoroughly and eaten (kernel) | Xiaoxinjie Township, LB-17 | 2.9 | 0.40 |
| Chamaecrista mimosoides (L.) Greene | Herl | Fabaceae | Tender leaf | Tea substitute | Qingkou Village, Xinjie Township | 201,506–19 | 201,506–13 | 0.5 | 0.14 |
| Chamaecrista nictitans (L.) Moench subsp. patellans (DC. ex Coll.) H. S. Irwin et Barneby var. glabrata (Vogel) H. S. Irwin et Barneby | Herb | Fabaceae | Tender leaf | Tea substitute | Lüchun County, LB-18 | 1.2 | 0.30 |
| Gleditsia sinensis Lam. | A si ni ma a hong | Tree | Fabaceae | Tender leaf | Potherb | Lüshuge Village, Jiayin Township | 201,610–20 | 2.7 | 0.48 |
| Parochetus communis D.Don | A wo la qian | Herb | Fabaceae | Flower | Potherb (stir-fried) | Lüchun County, LB-28 | 2.6 | 0.48 |
| Semna tora (L.) Roxb. | Herb | Fabaceae | Flower, leaf, young fruit, seed | Potherb, seed: substitute of coffee | Lüchun County, LB-28 | 2.6 | 0.48 |
| Tadehagi triquetrum (L.) H.Ohashi | Qian ka a bo | Shrub | Fabaceae | Tender leaf, tender stem | Tea substitute | Lagu Village, Sanmeng Township, HHD-43 | 0.7 | 0.23 |
| Tamarindus indica L. | Bi qian a si | Tree | Fabaceae | Fruit, tender leaf | Fruit: eaten fresh or made into compote; tender leaf: potherb (blanched before) | Niujiaozhai Township | 201,606–08 | 2.5 | 0.56 |
Table 3 Inventory of WEP species in Honghe terraced rice paddy system (Continued)

| Scientific name                             | Vernacular Name | Life form | Family name | Parts used | Preparation and uses                          | Study sites                  | Voucher number | FUI | UV  |
|---------------------------------------------|-----------------|-----------|-------------|------------|-----------------------------------------------|-----------------------------|----------------|-----|-----|
| *Fagopyrum dibotrys* (D.Don) H.Hara         | A za ca sa      | Herb      | Polygonaceae| Root       | Potherb (usually made into soup)               | Xiongjia Village, Adebo Township | 201,506–04  | 2.2 | 0.57|
| *Polygonula falax* Hemsl.                   | Ha pa ha ma     | Shrub     | Polygalaceae| Flower, tender leaf | Potherb (usually made into soup)               | Lonajia Village, Jiayin Township | 201,506–52  | 2.3 | 0.47|
| *Polygonum cupitatum* Buch.-Ham. ex D.Don   | A za za ni      | Herb      | Polygonaceae| Tender leaf | Potherb (usually made into soup)               | Xiongjia Village, Adebo Township | 201,506–03  | 2.0 | 0.46|
| *Polygonum hydropiper* L.                   | An ji ba qian   | Herb      | Polygonaceae| Tender leaf, tender stem | Potherb                                        | Qingskou Village, Xinjie Township | 201,506–24 | 2.8 | 0.54|
| *Polygonum molle* D. Don                    | Qian ge a si    | Shrub     | Polygonaceae| Fruit      | Ripe fruits are eaten fresh                   | Baohua Township             | 201,511–33  | 2.2 | 0.50|
| *Polygonum perfoliatum* L.                  | A qian la qian a pa | Herb | Polygonaceae| Fruit      | Ripe fruits are eaten fresh                   | Xiaoxiinjie Township        | 201,506–37  | 2.0 | 0.58|
| *Reynoutria japonica* Houtt.                | Suan gan tong   | Herb      | Polygonaceae| Tender stem | Potherb                                        | Lonajia Village, Jiayin Township | 201,506–37  | 1.8 | 0.38|
| *Xanthophyllum yunnanense* C.Y. Wu          |                 | Tree      | Polygalaceae| Fruit      | Ripe fruits are eaten fresh                   | Lushuge Village, Jiayin Township | 201,610–07  | 2.7 | 0.42|
| *Crataegus pinnatifida* Bunge               | Si pu a si      | Tree      | Rosaceae    | Fruit      | Ripe fruits are eaten fresh                   | Baohua Township             | 201,511–37  | 1.8 | 0.38|
| *Fragaria vesca* L.                         | O lu jia ba a si | Herb | Rosaceae    | Fruit      | Ripe fruits are eaten fresh                   | Lushuge Village, Jiayin Township | 201,610–08  | 2.1 | 0.44|
| *Pyrus calleryana* Decne.                   | Si peng a si    | Tree      | Rosaceae    | Flower, fruit | Fruit: eaten fresh; flower: potherb (soaked in water to dibitterize, then stir-fried, made into soup or salad) | Lonajia Village, Jiayin Township | 201,506–41  | 2.0 | 0.54|
| *Pyrus xerophila* T.T.Yu                    | A pei pei zi zuo | Tree | Rosaceae    | Fruit      | Ripe fruits are eaten fresh                   | Luchun County               | 201,606–22  | 2.7 | 0.49|
| *Rubus ellipticus var. obcordatus* (Franch.) Focke | Huo wo       | Shrub     | Rosaceae    | Fruit      | Ripe fruits are eaten fresh                   | Luchun County               | 201,606–21  | 2.7 | 0.38|
| *Rubus multibracteatus* H. Lév. and Vaniot  |                 | Shrub     | Rosaceae    | Fruit      | Ripe fruits are eaten fresh                   | Lagu Village, Sammem Township | HHD-33       | 1.9 | 0.58|
| *Rubus parvifolius* L.                      | A guo luo a bei | Shrub     | Rosaceae    | Fruit      | Ripe fruits are eaten fresh                   | Qingkou Village, Xinjie Township | 201,506–15  | 2.5 | 0.56|
| *Elaeagnus conferta* Roxb.                  | Ba pen luo niu  | Shrub     | Elaeagnaceae| Fruit      | Ripe fruits are eaten fresh                   | Lonajia Village, Jiayin Township | 201,506–30  | 2.5 | 0.41|
| *Antocarpus lacucha* Buch.-Ham. ex D. Don   | A niao niao bei | Tree      | Moraceae    | Fruit      | Ripe fruits are eaten fresh                   | Lushuge Village, Jiayin Township | 201,610–09  | 2.9 | 0.57|
| *Antocarpus tonkinensis* A.Chev. ex Gagnep. | Ci gan gan nü   | Tree      | Moraceae    | Fruit      | Ripe fruits are eaten fresh                   | Lonajia Village, Jiayin Township | 201,506–29  | 2.3 | 0.47|
| *Broussonetia papyfera* (L.) L’Herex Vent.  | Ma san          | Tree      | Moraceae    | Flower, tender | Potherb                                      | Niujiaozhai Township        | 201,606–16  | 2.0 | 0.44|
| Scientific name                     | Vernacular Name | Life form | Family name | Parts used             | Preparation and uses                      | Study sites                        | Voucher number | FUI  | UV  |
|------------------------------------|-----------------|-----------|-------------|------------------------|-------------------------------------------|-------------------------------------|----------------|------|-----|
| *Ficus auriculata* Lour.           | Mu gua cai      | Tree      | Moraceae    | Fruit                  | Ripe fruits are eaten fresh               | Lüchun County                       | 201,606–23     | 3.4  | 0.68|
| *Ficus hederacea* Roxb.            | Jia ni ni bai   | Shrub     | Moraceae    | Fruit                  | Ripe fruits are mixed with salt and eaten fresh | Shuiyan Village, Mal'andi Township | 201,511–16     | 1.9  | 0.55|
| *Ficus henryi* Warb. ex Diels      | A niao niao xiu | Tree      | Moraceae    | Fruit                  | Fruits eaten fresh or liquor brewing      | Baohua Township                     | 201,511–40     | 1.7  | 0.41|
| *Ficus hirta* Vahl                 | Ji zi o si      | Shrub     | Moraceae    | Fruit                  | Ripe fruits are eaten fresh               | Lagu Village, Sanmeng Township      | HHD-34         | 2.0  | 0.38|
| *Ficus irisana* Elmer              | Qì pu            | Tree      | Moraceae    | Fruit                  | Ripe fruits are eaten fresh               | Xiongjia Village, Adebo Township    | HHD-012        | 1.8  | 0.39|
| *Ficus oligodon* Miq.              | Xi bo ai xi     | Tree      | Moraceae    | Fruit                  | Ripe fruits are eaten fresh               | Lüshuge Village, Jiayin Township     | 201,610–02     | 2.1  | 0.46|
| *Ficus pandurata* Hance            |                 | Shrub     | Moraceae    | Fruit, seed            | Fruit: eaten fresh; seed: roasted and eaten (kernel) | Lüchun County                       | 201,606–28     | 2.1  | 0.48|
| *Ficus racemosa* L.                | A niao niao na  | Tree      | Moraceae    | Fruit, seed            | Fruit: eaten fresh; seed: roasted and eaten (kernel) | Lüchun County                       | 201,606–27     | 2.1  | 0.51|
| *Ficus semicordata* Buch.-Harms. Ex Sm. | Hu gan da pa | Tree      | Moraceae    | Fruit                  | Ripe fruits are eaten fresh               | Lagu Village, Sanmeng Township      | HHD-35         | 2.4  | 0.44|
| *Ficus tikoua* Bureau              | Wei chao lao e  | Liana     | Moraceae    | Fruit                  | Ripe fruits are eaten fresh               | Xiaoxinjie Township                 | LB-01          | 2.0  | 0.48|
| *Debregeasia longifolia* (Burm.f.) Wedd. | Mao ma  | Shrub     | Urticaceae  | Fruit                  | Ripe fruits are eaten fresh               | Lonajia Village, Jiayin Township     | 201,506–31     | 2.1  | 0.51|
| *Debregeasia orientalis* C. J. Chen | O ce bu         | Shrub     | Urticaceae  | Fruit, leaf, tender stem | Leaf and stem; potherb; fruit: eaten fresh | Baohua Township                     | HHD-19         | 2.5  | 0.55|
| *Elatostema involucratum* Franch. and Sav. | Luo bu. a bo | Herb      | Urticaceae  | Tender stem, leaf      | Potherb                                  | Niujiaozhai Township                | 201,606–13     | 1.9  | 0.40|
| *Gonostegia hirta* (Blume ex Hassk.) Miq. | Pa qian a bo   | Herb      | Urticaceae  | Tender stem, leaf      | Potherb                                  | Lüchun County                       | LB-22          | 2.1  | 0.54|
| *Lecanthes pedunculans* (Wall. ex Royle) Wedd. | A che pa  | Herb      | Urticaceae  | Whole plant            | Potherb (usually made into soup)         | Baohua Township                     | HHD-30         | 2.2  | 0.48|
| *Castanopsis calathiformis* (Skan) Rehder and E.H.Wilson | A ba a bo | Tree      | Fagaceae    | Seed                  | Roasted and eaten (kernel)               | Baohua Township                     | HHD-20         | 0.8  | 0.18|
| *Castanopsis carlesii* var. spinulosa W.C.Cheng and C.S.Chao | Che qian a bo | Tree      | Fagaceae    | Seed                  | Roasted and eaten (kernel)               | Niujiaozhai Township                | 201,606–10     | 0.5  | 0.17|
| *Castanopsis indica* (Roxb. ex Lindl.) A.DC. | Che si a bo | Tree      | Fagaceae    | Seed                  | Roasted and eaten (kernel)               | Lüchun County                       | LB-21          | 0.8  | 0.05|
| *Castanopsis mekongensis* A.Camus   |                | Tree      | Fagaceae    | Seed                  | Roasted and eaten (kernel)               | Shuiyan Village, Ma’andi Township   | 201,511–24     | 0.7  | 0.20|
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | LV |
|----------------|----------------|-----------|-------------|------------|----------------------|-------------|----------------|-----|----|
| *Lithocarpus megalophyllus* Rehder and E.H.Wilson | A biu a bo | Tree | Fagaceae | Fruit | Ripe fruits are eaten fresh | Baohua Township | 201,511–34 | 2.8 | 0.46 |
| *Myrcia esculenta* Buch.-Ham. ex D. Don | | Tree | Myricaceae | Fruit | Fruits eaten fresh or liquor brewing | Niujiaozhai Township | 201,606–06 | 2.0 | 0.41 |
| *Gynostemma pubescens* (Gagnep.) C.Y.Wu | Ka kui zha ha | Herb | Cucurbitaceae | Leaf, tender stem | Tea substitute | Lonajia Village, Jiayin Township | 201,506–44 | 0.2 | 0.18 |
| *Hemsleya macrosperma* C.Y.Wu | A za ku xi | Herb | Cucurbitaceae | Tender leaf | Potherb | Xiongjia Village, Adebo Township | 201,506–02 | 2.5 | 0.40 |
| *Hodgsonia macrocarpa* (Blume) Cogn. | Zha qi gu lu | Liana | Cucurbitaceae | Seed | Eaten directly, or used for pressing oil | Shuiyan Village, Ma’andi Township | 201,511–02 | 1.9 | 0.48 |
| *Momordica cochinchinensis* (Lour.) Spreng. | Bei ba na | Liana | Cucurbitaceae | Tender stem, leaf | Potherb | Shuiyan Village, Ma’andi Township | 201,511–30 | 2.9 | 0.44 |
| *Salacia sessiliflora* Hand.-Mazz. | A ka la ma a bo | Shrub | Celastraceae | Fruit | Ripe fruits are eaten fresh | Lüchun County | 201,606–25 | 2.6 | 0.41 |
| *Oxalis corniculata* L. | Suan ji cao | Herb | Oxalidaceae | Stem, leaf | Potherb: blanched in boiled water, then soaked in cold water for 2 h | Niujiaozhai Township | 201,606–01 | 2.3 | 0.47 |
| *Elaeocarpus decipiens* F.B.Forbes and Hemsl. | Na ci ci ha | Tree | Elaeocarpaceae | Fruit | Ripe fruits are eaten fresh | Shuiyan Village, Ma’andi Township | 201,511–08 | 1.9 | 0.58 |
| *Garcinia cowa* Roxb. ex Choisy | Huang xin shu | Tree | Clusiaceae | Fruit | Ripe fruits are eaten fresh | Baohua Township | 201,511–35 | 2.0 | 0.47 |
| *Garcinia multflora* Champ. ex Benth. | Qiu guo a si | Tree | Clusiaceae | Fruit | Ripe fruits are eaten fresh | Niujiaozhai Township | 201,606–02 | 2.4 | 0.42 |
| *Garcinia xanthochymus* Hook.f. ex T.Anderson | A bu. bu. qie | Tree | Clusiaceae | Fruit | Ripe fruits are eaten fresh | Niujiaozhai Township | 201,606–04 | 2.1 | 0.52 |
| *Cratoxylum cochinchinense* (Lour.) Blume | Jiu ge ge qia | Tree | Hypericaceae | Tender leaf, young fruit | Tender leaves: tea substitute; young fruit: flavoring agent | Niujiaozhai Township | 201,606–11 | 2.2 | 0.49 |
| *Cratoxylum formosum* subsp. *pruniflorum* (Kurz) Gogelein | A on a bo | Tree | Hypericaceae | Tender leaf | Tea substitute | Lagu Village, Sammeng Township | HHD-44 | 0.9 | 0.25 |
| *Curculigo capitulata* (Lour.) Kuntze | Ma ni zu se | Herb | Hypoxidaceae | Fruit, tender leaf, tender stem | Fruit: eaten fresh; leaves and stem: potherb | Baohua Township | HHD-18 | 2.0 | 0.56 |
| *Curculigo sinensis* S. C. Chen | Mei la pia jia | Herb | Hypoxidaceae | Fruit | Ripe fruits are eaten fresh | Baohua Township | 201,511–36 | 1.9 | 0.56 |
| *Passiflora wilsonii* Hemsl. | Ba ze | Liana | Passifloraceae | Fruit | Ripe fruits are eaten fresh | Shuiyan Village, Ma’andi Township | 201,511–04 | 2.5 | 0.51 |
| *Flacourtia ramontchi* L’Hér. | A zi long jie a bo | Shrub | Salicaceae | Fruit | Ripe fruits are eaten fresh, or made into jam, or preserved | Lüshuge Village, Jiayin Township | 201,610–10 | 2.4 | 0.58 |
| *Baccaurea ramillifera* Lour. | Si suo a si | Tree | Phyllanthaceae | Fruit | Ripe fruits are eaten fresh | Lonajia | 201,506–4.2 | 0.89 |
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | UV |
|-----------------|----------------|-----------|-------------|------------|----------------------|-------------|----------------|-----|-----|
| Phyllanthus emblica L. | Bo can xi ka, xi qia ha | Tree | Phyllanthaceae | Bark, fruit | Fruit: eaten fresh; bark: scraping off the inside tender bark to make dishes | Lüchun County | 201,606–29 | 4.9 | 0.90 |
| Rotala indica (Willd.) Koehne | En ni a bo | Herb | Lythraceae | Tender shoot | Potherb | Lüshuge Village, Jiayin Township | 201,610–16 | 2.2 | 0.42 |
| Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne | Herb | Lythraceae | Tender leaf, tender stem | Potherb | Baohua Township | HHD-27 | 2.1 | 0.52 |
| Cleistocalyx operculatus (Roxb.) Merr. and L.M.Perry | Tree | Myrtaceae | Fruit | Ripe fruits are eaten fresh | Lonajia Village, Jiayin Township | 201,506–27 | 1.6 | 0.56 |
| Decaspernum parvillotum (Lam.) A.J.Scott | A gong gong ni a bo | Tree | Myrtaceae | Fruit | Ripe fruits are eaten fresh | Lonajia Village, Jiayin Township | 201,506–28 | 2.4 | 0.38 |
| Syzygium fluctatile (Hemsl.) Merr. and L.M.Perry | Me ran me xiu na ci a bo | Shrub | Myrtaceae | Fruit | Ripe fruits are eaten fresh | The junction of Lüchun County and Yuanyang County | 201,506–09 | 1.6 | 0.49 |
| Syzygium yunnanense Merr. and L.M.Perry | O ho | Tree | Myrtaceae | Fruit | Ripe fruits are eaten fresh | Lüchun County | 201,606–24 | 2.8 | 0.45 |
| Medinilla radiciflora C.Y.Wu ex C.Chen | Shrub | Melastomataceae | Fruit | Ripe fruits are eaten fresh | Shuiyan Village, Ma’andi Township | 201,511–03 | 2.4 | 0.39 |
| Medinilla septentrionalis (W.W. Sm.) H.L. Li | Qian ben er a si | Shrub | Melastomataceae | Fruit | Ripe fruits are eaten fresh | Niujiaozhai Township | 201,606–05 | 2.8 | 0.48 |
| Melastoma affine D. Don | Bei bai | Shrub | Melastomataceae | Fruit | Ripe fruits are eaten fresh | Xioaxinjie Township | LB-04 | 2.2 | 0.46 |
| Melastoma normale D. Don. | Yang er ba cui | Shrub | Melastomataceae | Fruit, leaf | Ripe fruits are eaten fresh | Lüchun County | 201,606–20 | 2.6 | 0.47 |
| Osbeckia opipara C.Y. Wu et C. Chen | Bi ji | Shrub | Melastomataceae | Root, stem | Potherb (usually stewed with meat) | The junction of Lüchun County and Yuanyang County | 201,506–11 | 2.2 | 0.57 |
| Canarium album (Lour.) DC. | Bei le a si | Tree | Burseraceae | Fruit | Ripe fruits are eaten fresh, or preserved | Shuiyan Village, Ma’andi Township | 201,511–10 | 2.3 | 0.40 |
| Canarium pimela K.D.Koenig | Si mo a si | Tree | Burseraceae | Fruit | Ripe fruits are eaten fresh, or preserved | Niujiaozhai Township | 201,606–07 | 2.4 | 0.44 |
| Canarium strictum Roxb. | A bo ma da i | Tree | Burseraceae | Fruit | Ripe fruits are eaten fresh, or preserved | Baohua Township | 201,511–42 | 2.5 | 0.46 |
| Cheirodendron aspleniifolium (Roxb.) B. L. Burtt and A. W. Hill | Gei ha a bo | Tree | Anacardiaceae | Fruit | Fruits eaten fresh or liquor brewing | Baohua Township | 201,511–41 | 2.2 | 0.55 |
| Dracaenophyllum duperreanum Pierre | A zi ren a | Tree | Anacardiaceae | Fruit | Ripe fruits are eaten fresh, or preserved | Lagu Village, Sanmeng Township | HHD-37 | 2.3 | 0.49 |
| Mangifera sylvatica Roxb. | Tree | Anacardiaceae | Fruit | Ripe fruits are eaten fresh | Qingkou Village, Xinjie | 201,506–14 | 2.0 | 0.40 |
Table 3 Inventory of WEP species in Honghe terraced rice paddy system (Continued)

| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | UV |
|-----------------|-----------------|-----------|-------------|------------|----------------------|-------------|-----------------|-----|----|
| *Rhus chinensis* Mill. | Ha da da xiu | Tree | Anacardiaceae | Fruit | Preserved fruit | Lonajia Village, Jiayin Township | 201,506-42 | 2.8 | 0.53 |
| *Arytera littoralis* Blume | Ta mo si song | Tree | Sapindaceae | Shoot | Potherb | Lonajia Village, Jiayin Township | 201,506-48 | 2.6 | 0.52 |
| *Acronychia pedunculata* (L.) Miq. | | Tree | Rutaceae | Fruit | Flavoring agent | | | |
| *Tetradium austrosinense* (Hand.-Mazz.) Hartley | | Tree | Rutaceae | Fruit | Fruits are edible and used for pressing oil | Xiaoxinjie Township | 201,506-07 | 1.6 | 0.47 |
| *Zanthoxylum bungeanum* Maxim. | A zao | Tree | Rutaceae | Fruit | Flavoring agent | Xiongjia Village, Adebo Township | HHD-013 | 2.4 | 0.48 |
| *Zanthoxylum scandens* Blume | | Shrub | Rutaceae | Fruit | Flavoring agent | Lonajia Village, Jiayin Township | 201,506-38 | 2.3 | 0.43 |
| *Zanthoxylum simulans* Hance | | Shrub | Rutaceae | Fruit | Flavoring agent | Lagu Village, Sammeng Township | HHD-38 | 2.3 | 0.44 |
| *Ailanthus altissima* (Mill.) Swingle | Qi la wu ha | Tree | Simaroubaceae | Tender leaf | Potherb | Lonajia Village, Jiayin Township | 201,506-50 | 1.8 | 0.41 |
| *Bombax ceiba* L. | | Tree | Malvaceae | Flower | Potherb | Lagu Village, Sammeng Township | HHD-49 | 2.2 | 0.42 |
| *Microcos nervosa* (Lour.) S.Y. Hu | | Tree | Malvaceae | Fruit | Ripe fruits are eaten fresh | Baohua Township | 201,511-38 | 2.3 | 0.45 |
| *Sterculia brevissima* H.H.Hsue | Sa qiu huo bi | Shrub | Malvaceae | Seed | Roasted and eaten (kernel) | Xiongjia Village, Adebo Township | HHD-017 | 0.1 | 0.21 |
| *Sterculia lanceolata* Cav. | Sa qiu huo bi | Tree | Malvaceae | Seed | Roasted and eaten (kernel) | Xiongjia Village, Adebo Township | HHD-016 | 0.1 | 0.16 |
| *Sterculia pexa* Pierre | Ni hei gei zi a bo | Tree | Malvaceae | Seed | Stir-fried | Lagu Village, Sammeng Township | HHD-41 | 2.5 | 0.56 |
| *Capparis masaikai* H. Lév. | | Liana | Capparaceae | Seed | Natural sweetener | Qingkou Village, Xinjie Township | 201,506-20 | 0.8 | 0.2 |
| *Crataeva unilocularis* Buch.-Ham. | Man nei luo ba | Tree | Capparaceae | Tender stem, leaf | Made into pickles (preserved) | Lushuge Village, Jiayin Township | 201,610-14 | 3.9 | 0.75 |
| *Stixis suaveolens* (Roxb.) Pierre | | Liana | Capparaceae | Fruit, tender leaf | Fruit: eaten fresh; tender leaves: tea substitute | Lüchun County | 201,606-30 | 2.2 | 0.42 |
| *Capsella bursa-pastoris* (L.) Medik. | A zu o qi | Herb | Brassicaceae | Tender stem, leaf | Potherb | Lü shuge Village, Jiayin Township | 201,610-19 | 2.7 | 0.45 |
| *Gynostemma pentaphyllum* (Thunb.) Makino | | Herb | Brassicaceae | Tender stem and leaves | Potherb or tea substitute | Lonajia Village, Jiayin Township | 201,506-46 | 2.0 | 0.49 |
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | UV |
|-----------------|----------------|-----------|-------------|------------|----------------------|-------------|----------------|-----|-----|
| *Nasturtium officinale* R.Br. | Xi yang cai | Herb | Brassicaceae | Tender leaf | Potherb | Xiaoxinjie Township | LB-10 | 3.4 | 0.66 |
| *Rorippa islandica* (Oeder) Borbás | Herb | Brassicaceae | Tender leaf | Potherb (boiled for 5–10 min, then soaked in water to remove pungent taste) | Lagu Village, Sanmeng Township | HHD-53 | 2.4 | 0.50 |
| *Erythropalum scandens* Blume | Ha jia ha na bei ying | Liana | Olacaceae | Tender stem, leaf | Potherb | Xiaoxinjie Township | LB-15 | 2.1 | 0.52 |
| *Korthalsella japonica* (Thunb.) Engl. | De la | Shrub | Santalaceae | Fruit | Ripe fruits are eaten fresh | Lonajia Village, Jiayin Township | 201,506–33 | 1.7 | 0.39 |
| *Pyrularia edulis* (Wall.) A. DC. | A ke ke ran a si | Tree | Santalaceae | Fruit | Ripe fruits are stewed or stir-fried | Niujiaozhai Township | 201,606–12 | 2.3 | 0.50 |
| *Myosoton aquaticum* (L.) Moench | Qian chu ama | Herb | Caryophyllaceae | Tender leaf, tender stem | Potherb | Xiaoxinjie Township | LB-11 | 2.2 | 0.46 |
| *Amaranthus spinosus* L. | Wo zu wo niu | Herb | Amaranthaceae | Tender leaf, tender stem | Potherb | Qingkou Village, Xinjie Township | 201,506–21 | 2.5 | 0.53 |
| *Amaranthus lividus* L. | | Herb | Amaranthaceae | Leaf, stem | Potherb | Lagu Village, Sanmeng Township | HHD-52 | 2.2 | 0.47 |
| *Amaranthus viridis* L. | La huo pa ní | Herb | Amaranthaceae | Tender leaf, tender stem | Potherb | Lüshuge Village, Jiayin Township | 201,610–23 | 3.6 | 0.61 |
| *Chenopodium album* L. | Ge xia wo niu | Herb | Amaranthaceae | Shoot | Potherb | Baohua Township | HHD-28 | 2.3 | 0.49 |
| *Phytolacca acinosa* Roxb | Kan bo | Herb | Phytolaccaceae | Leaf | Potherb | Qingkou Village, Xinjie Township | 201,506–22 | 2.3 | 0.44 |
| *Portulaca oleracea* L. | Yi ca mo ní | Herb | Portulacaceae | Tender leaf, tender stem | Potherb | Lagu Village, Sanmeng Township | HHD-51 | 1.8 | 0.52 |
| *Dendrobenthamia hongkongensis* (Hemsl.) Hutch. | | Tree | Cornaceae | Fruit | Fruits eaten fresh or liquor brewing | Baohua Township | 201,511–39 | 1.9 | 0.56 |
| *Dendrobenthamia melanotricha* (Pojark.) W.P. Fang | | Tree | Cornaceae | Fruit | Ripe fruits are eaten fresh | Shuiyian Village, Ma’andi Township | 201,511–06 | 2.5 | 0.47 |
| *Nyssa javanica* (Blume) Wangerin | | Tree | Cornaceae | Fruit | Ripe fruits are eaten fresh | Shuiyian Village, Ma’andi Township | 201,511–07 | 2.3 | 0.44 |
| *Swida macrophylla* (Wall.) Sojak | | Tree | Cornaceae | Fruit | Used for pressing oil | Xiaoxinjie Township | LB-06 | 2.0 | 0.51 |
| *Pouteria grandifolia* (Wall.) Baehni | | Tree | Sapotaceae | Fruit | Ripe fruits are eaten fresh | Xiaoxinjie Township | LB-02 | 1.9 | 0.52 |
| *Diospyros lotus* L. var. mollissima C.Y. Wu | | Tree | Ebenaceae | Fruit | Fruits eaten fresh, making liquor or vinegar | Lonajia Village, Jiayin Township | 201,506–36 | 2.4 | 0.58 |
| *Embelia ribes* Burm.f. | | Shrub | Primulaceae | Fruit | Fruit: eaten fresh; shoot: | Shuiyian | 201,511–23 | 2.3 | 0.42 |
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | UV |
|-----------------|----------------|-----------|-------------|------------|---------------------|-------------|----------------|------|-----|
| Embelia subcoriacea (C. B. Clarke) Mez | Shrub | Primulaceae | Fruit | Ripe fruits are eaten fresh | Niujiagzhai Township | 201,606–03 | 2.1 | 0.42 |
| Maesa montana A. DC. | Ke tu a bo | Shrub | Primulaceae | Leaf | Tea substitute | Lüchun County | LB-20 | 0.2 | 0.39 |
| Maesa parvifolia A. DC. | Shrub | Primulaceae | Leaf | Tea substitute | Lüchun County | LB-19 | 1.4 | 0.37 |
| Camellia pitardii Coh.-St. | Shrub | Theaceae | Petal | Potherb | Lüshuge Village, Jiayin Township | 201,610–21 | 2.7 | 0.40 |
| Embelia subcoriacea (C. B. Clarke) Mez | Shrub | Primulaceae | Fruit | Ripe fruits are eaten fresh | Niujiagzhai Township | 201,606–03 | 2.1 | 0.42 |
| Maesa montana A. DC. | Ke tu a bo | Shrub | Primulaceae | Leaf | Tea substitute | Lüchun County | LB-20 | 0.2 | 0.39 |
| Maesa parvifolia A. DC. | Shrub | Primulaceae | Leaf | Tea substitute | Lüchun County | LB-19 | 1.4 | 0.37 |
| Camellia pitardii Coh.-St. | Shrub | Theaceae | Petal | Potherb | Lüshuge Village, Jiayin Township | 201,610–21 | 2.7 | 0.40 |
| Actinidia kolomikta (Rupr. and Maxim.) Maxim. | A zi ku nu | Shrub | Actinidiaceae | Fruit | Ripe fruits are eaten fresh | Lonajia Village, Jiayin Township | 201,506–32 | 2.5 | 0.54 |
| Saurauia napaulensis DC. | Tree | Actinidiaceae | Fruit | Ripe fruits are eaten fresh | Baohua Township | 201,511–32 | 2.7 | 0.58 |
| Saurauia napaulensis DC. var. montana C. F. Liang and Y. S. Wang | Tree | Actinidiaceae | Fruit | Ripe fruits are eaten fresh | Lüshuge Village, Jiayin Township | 201,610–01 | 2.8 | 0.39 |
| Saurauia tristyra var. hekouensis C. F. Liang and Y. S. Wang | A nuo xi | Tree | Actinidiaceae | Fruit | Ripe fruits are eaten fresh | Xiaoxinjie Village, Jiayin Township | LB-05 | 2.7 | 0.42 |
| Gaultheria leucocarpa Bl. var. crenulata (Kurz) T.Z.Hsu | Xie | Shrub | Ericaceae | Leaf | Potherb (made into soup) | Xiaoxinjie Village, Jiayin Township | LB-09 | 2.1 | 0.48 |
| Gaultheria longibracteolata R.C.Fang | Ye lan mei | Shrub | Ericaceae | Fruit | Ripe fruits are eaten fresh | Shuiyan Village, Ma’andi Township | 201,511–09 | 1.9 | 0.45 |
| Vaccinium bracteatum Thunb. | Ha na | Shrub | Ericaceae | Fruit | Ripe fruits are eaten fresh | The junction of Lüchun County and Yuanyang County | 201,506–10 | 2.5 | 0.55 |
| Pittosporopsis kerrii Craib | Ha piao mei che | Shrub | Icacinaceae | Fruit, seed | Fruit: eaten fresh; seed: roasted and eaten (kernel) | Lagu Village, Sanmeng Township | HHD-40 | 2.3 | 0.55 |
| Canthium horridum Blume | Ha da da nue | Shrub | Rubiaceae | Fruit | Ripe fruits are eaten fresh | Shuiyan Village, Ma’andi Township | 201,511–05 | 2.4 | 0.51 |
| Hedyotis tenelliflora Blume | Gu suo na ci | Herb | Rubiaceae | Whole plant | Potherb (made into soup) | Lagu Village, Sanmeng Township | HHD-42 | 2.0 | 0.55 |
| Amalocalyx yunnanensis Tsiang | Liana | Apocynaceae | Fruit | Young fruit slices are eaten fresh with the source made by pepper and salt | Lagu Village, Sanmeng Township | HHD-32 | 2.0 | 0.55 |
| Dregea volubilis (L.f.) Benth. ex Hook.f. | Ku cai | Liana | Apocynaceae | Flower, tender leaf | Potherb | Xiaoxinjie Township | LB-12 | 3.0 | 0.72 |
| Melodinus henryi Craib | Ke se pah | Liana | Apocynaceae | Fruit | Ripe fruits are eaten fresh | Lüshuge Village, Jiayin Township | 201,610–06 | 2.6 | 0.45 |
| Lithospermum erythrorhizon Siebold and Zucc. | Tender stem, leaf | Potherb | Baohua Township | HHD-26 | 2.0 | 0.50 |
Table 3 Inventory of WEP species in Honghe terraced rice paddy system (Continued)

| Scientific name                | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI  | UV |
|--------------------------------|-----------------|-----------|-------------|------------|----------------------|-------------|----------------|------|----|
| Lycium yunnanense Kuang and A.M.Lu |                 | Shrub     | Solanaceae  | tender stem | Potherb              | Lonajia Village, Jiayin Township | 201,506–47 | 2.0 | 0.46 |
| Solanum nigrum L.              | Wo lun          | Herb      | Solanaceae  | Tender leaf, fruit | Fruit: eaten fresh; tender leaf: potherb | Xiongjia Village, Adebao Township | HHD-014 | 2.3 | 0.42 |
| Solanum torvum Sw.             | Si ma ma ha     | Shrub     | Solanaceae  | Root       | Potherb (usually stewed) | Xiongjia Village, Adebao Township | HHD-018 | 2.9 | 0.46 |
| Ligustrum sinense Lour.         | Ci kong ba deng a bo | Tree     | Oleaceae    | Fruit      | Liquor brewing       | Lagu Village, Sanmeng Township | HHD-46 | 0.6 | 0.05 |
| Rhynchotechum obovatum (Griff.) B.L. Burtt | | Shrub | Gesneriaceae | Fruit | Ripe fruits are eaten fresh | Lüshuge Village, Jiayin Township | 201,610–03 | 1.7 | 0.39 |
| Plantago asiatica L.           | Ka pae ca       | Herb      | Plantaginaceae | Whole plant | Potherb              | Xiongjia Village, Adebao Township | 201,506–01 | 2.3 | 0.51 |
| Plantago asiatica L. subsp. eros a (Wall.) Z. Y. Li | Ka pae ca | Herb | Plantaginaceae | Tender leaf | Potherb (usually stewed or made into soup) | Baohua Township | HHD-22 | 2.8 | 0.53 |
| Plantago depressa Willd.       | Ha pa yu cai    | Herb      | Plantaginaceae | Whole plant | Potherb (soaked in water and sir-fried) | Xiaoxinjie Township | LB-08 | 2.3 | 0.55 |
| Mayodendron igneum (Kurz) Kurz | A ci ma ha nen  | Tree      | Bignoniaceae | Flower     | Potherb              | Lüchun County | LB-23 | 2.8 | 0.43 |
| Clinopodium chinense (Benth.) Kuntze | Zhaun zhuan cai | Herb | Lamiaceae  | Tender leaf, tender stem | Potherb | Lagu Village, Sanmeng Township | HHD-50 | 2.4 | 0.44 |
| Mentha canadensis L.           | Wo zhi zhima    | Herb      | Lamiaceae  | Tender leaf, tender stem | Flavoring agent | Shuiyan Village, Ma'andi Township | 201,511–11 | 4.6 | 0.75 |
| Rabdosia coetsoides C.Y.Wu     | Nu ha ma        | Herb      | Lamiaceae  | Whole plant | Tea substitute or cooked with meat (Potherb) | Shuiyan Village, Ma'andi Township | 201,511–15 | 0.7 | 0.23 |
| Helwingia japonica (Thunb.) F.Dietr. | Huo tie tie du  | Shrub     | Helwingiaceae | Tender stem, leaf | Potherb (blanched in hot water, then soaked in cold water before cooking) | Niujiaozhai Township | 201,606–18 | 1.9 | 0.53 |
| Campanumoea javanica Blume     | A mi nan guo    | Liana     | Campanulaceae | Fruit | Ripe fruits are eaten fresh | Lagu Village, Sanmeng Township | HHD-36 | 1.6 | 0.56 |
| Lobelia angulata G.Forst.      |                 | Herb      | Campanulaceae | Tender leaf, tender stem | Potherb | Shuiyan Village, Ma'andi Township | 201,511–31 | 1.8 | 0.42 |
| Adenocaulon himalacum Edgew.   | Bu lü wu hu     | Herb      | Asteraceae  | Tender leaf | Potherb | Niujiaozhai Township | 201,606–15 | 1.8 | 0.45 |
| Bidens pilosa L.               | Hei ni zuo ge mo | Herb      | Asteraceae  | Tender leaf | Potherb (stewed until it is tender) | Qingkou Village, Xinjie Township | 201,506–26 | 2.0 | 0.53 |
| Cirsium japonicum (Thunb.) Fisch. ex DC. | Che pei a gong | Herb | Asteraceae | Root | Stewed with pork for nourishing | Baohua Township | HHD-21 | 2.9 | 0.43 |
| Scientific name | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites | Voucher number | FUI | UV |
|-----------------|----------------|----------|-------------|------------|---------------------|-------------|----------------|-----|-----|
| Crassocephalum crepidioides (Benth.) S. Moore | O mi o sa | Herb | Asteraceae | Tender leaf | Potherb | Baohua Township | HHD-29 | 3.9 | 0.76 |
| Eclipta prostrata (L.) L. | A ji mei, a ge wo chi | Herb | Asteraceae | Tender leaf | Potherb | Qingkou Village, Xinjie Township | 201,506–25 | 2.2 | 0.49 |
| Gnaphalium affine D. Don | A mi sha chu | Herb | Asteraceae | Leaf, stem | Potherb | Qingkou Village, Xinjie Township | 201,506–23 | 2.1 | 0.42 |
| Ipomoea polycarpa Cass. | Herb | Asteraceae | Tender leaf, tender stem | Potherb (blanched before eating and making salad) | Lüchun County | LB-26 | 3.9 | 0.75 |
| Lactuca serriola L. | Herb | Asteraceae | Tender leaf, tender stem | Potherb | Xiaoxinjie Township | LB-13 | 2.8 | 0.52 |
| Lagedium sibiricum (L.) Sojak | E si lao gong zi | Herb | Asteraceae | Tender leaf, tender stem | Potherb | Shuiyan Village, Ma’andi Township | 201,511–29 | 2.8 | 0.54 |
| Lagdera pterodonta (DC.) Sch.Bip. ex Oliv. | Wo sa la ma | Herb | Asteraceae | Whole plant | Potherb (blanched in hot water, then soaked in cold water before cooking) | Lüchun County | LB-25 | 2.9 | 0.51 |
| Viburnum dilatatum Thunb. | Pu tong a bo | Shrub | Adoxaceae | Fruit | Fruits eaten fresh or liquor brewing | Qingkou Village, Xinjie Township | 201,506–16 | 2.7 | 0.51 |
| Dipsacus asperoides C.Y.Cheng and T.M.Ai | Pao tou cao | Herb | Caprifoliaceae | Tender leaf, root | Potherb (Usually stewed with pork or made into soup) | Baohua Township | HHD-23 | 2.7 | 0.51 |
| Valeriana jatamansi Jones | Ye zuo zuo pu | Herb | Caprifoliaceae | Flower, root | Flower: eaten fresh (Potherb); root: stewed for nourishing | Lonajia Village, Jiayin Township | 201,506–40 | 1.7 | 0.51 |
| Acanthopanax trifoliatus (L.) Voss | Jiu duo | Shrub | Araliaceae | Tender stem | Potherb | Lüchun County | LB-24 | 2.5 | 0.50 |
| Eleutherococcus senticosus (Rupr. et Maxim.) Maxim. | Shrub | Araliaceae | Tender stem, leaf | Potherb | Lüshuge Village, Jiayin Township | 201,610–18 | 2.3 | 0.42 |
| Centella asiatica (L.) Urb. | Ban chao wo ba | Herb | Apiaceae | Tender leaf, tender stem | Potherb | Shuiyan Village, Ma’andi Township | 201,511–27 | 3.0 | 0.58 |
| Eryngium foetidum L. | Ga la ya so | Herb | Apiaceae | Tender leaf, tender stem | Flavoring agent or stir-fried (potherb) | Qingkou Village, Xinjie Township | 201,506–18 | 1.9 | 0.52 |
| Ligusticum chuanxiong S.H.Qiu, Y.Q.Zeng, K.Y.Pan, Y.C.Tang, and J.M.Xu | Tong e jian sa | Herb | Apiaceae | Tender leaf | Flavoring agent or stir-fried (potherb) | Qingkou Village, Xinjie Township | 201,506–17 | 2.6 | 0.53 |
| Gomphrena paniculata (L.) D.C. | Zha su | Herb | Apiaceae | Tender leaf, tender stem | Potherb | Niujiaozhai Township | 201,606–14 | 4.3 | 0.82 |
| Sanicula astrantiifolia H. Wolff ex Kretschmer | Xiao hei yao | Herb | Apiaceae | Whole plant | Potherb (usually sir-fried) | Lonajia Village, Jiayin Township | 201,506–54 | 2.9 | 0.48 |

Pteridophyta
local people scrape off the exudate from its tuber and apply this exudate directly onto wounds for wound healing [36, 37]. The exudate has high polysaccharide content and possesses good antioxidant bioactivity [36, 37].

The UV and FUI value of WEP species in the Honghe area
Quantitative analyses were calculated to determine the local importance of each wild edible species. The use values (UV) and frequency of utilization indices (FUI) of each species were calculated. The 20 WEP species with the highest UV are listed along with their average FUI in Table 7.

*Litsea pungens* had the highest UV and average FUI (Table 7). Because of its unique flavor and positive effects on human health, it has become the most commonly used edible species as a spice. Some local people even use the oil extracted from this species to repel mosquitoes. Based on both local medical theory and scientific research, *L. pungens* can help to promote appetite and improve digestion [38]. *Mentha canadensis* is also a popular spice among local people, especially for cooking meat. However, its average FUI value and UV are relatively lower than for *L. pungens*. The second highest UV belongs to *Phyllanthus emblica*, while its average FUI value is similar to that of *L. pungens*. The high UV and average FUI values of

| Scientific name                  | Vernacular Name | Life form | Family name | Parts used | Preparation and uses | Study sites                                      | Voucher number | UV \(\text{FUI} \) |
|----------------------------------|-----------------|-----------|-------------|------------|----------------------|-------------------------------------------------|----------------|-----------------|
| *Lygodium digitatum* C. Presl    | Ha da da xiu    | Liana     | Lygodiaceae | Tender stem| Potherb              | Lushuge Village, Jiayin Township                 | 201,610–17     | 2.5 0.54        |
| *Pteridium aquilinum* var.       | Ye qie          | Herb      | Dennstaedtiaceae | Shoot    | Potherb              | Shuiyian Village, Ma'andi Township               | 201,511–26     | 2.7 0.45        |
| latiusculum (Desv.) Underw. ex A. Heller |               |           |             |            |                      |                                                 |                |                 |
| *Castanopteris thalictroides* (L.) Brongn. | Da lie          | Herb      | Pteridaceae | Shoot      | Potherb              | Niujiaozhai Village                              | 201,606–17     | 2.6 0.47        |
| *Callipteris esculenta* (Retz.) J. Sm. ex T. Moore and Houlston | Herb | Athyriaceae | Tender leaf | Potherb |                      | Lagu Village, Sammeng Township                   | HHD-47         | 2.5 0.56        |
| *Callipteris esculenta var. pubescens* (Link) Ching | Herb | Athyriaceae | Tender leaf | Potherb |                      | Baohua Village                                   | HHD-24         | 1.8 0.56        |
| *Gymnocarpium remotepinnatum* (Hayata) Ching | Ha | Herb | Athyriaceae | Tender leaf | Potherb |                      | The junction of Lüchun County and Yuanyang County | 201,506–12     | 2.1 0.58        |
| *Parathelypteris glanduligera* (Kunze) Ching | Ha da | Herb | Thelypteridaceae | Shoot | Potherb | Lonajia Village, Jiayin Township                  | 201,506–49     | 2.7 0.56        |
| *Marsilea quadrifolia* L. | He dou a ya mo | Herb | Marsileaceae | Tender leaf | Potherb | Shuiyuan Village, Ma'andi Township                | 201,511–25     | 3.3 0.59        |

The order of plant species in this table is followed by the APG IV system, gymnosperms classification system (1978), and Qinrenchang fern plant classification system (1978)

**Table 4** Life forms of WEP species in Honghe terraced rice paddy system

| Life form | Records | Percentage |
|-----------|---------|------------|
| Herbs     | 79      | 35.3%      |
| Trees     | 68      | 30.4%      |
| Shrubs    | 46      | 20.5%      |
| Lianas    | 21      | 9.4%       |
| Bamboo    | 10      | 4.5%       |

**Table 5** Edible parts of WEP species in Honghe terraced rice paddy system

| Part used            | Records | Percentage |
|----------------------|---------|------------|
| Fruit                | 98      | 43.8%      |
| Stem and leaf        | 83      | 37.1%      |
| Shoot                | 18      | 8.0%       |
| Seed                 | 18      | 8.0%       |
| Flower (petal, bract)| 16      | 7.1%       |
| Whole plant          | 8       | 3.6%       |
| Root                 | 6       | 2.7%       |
| Rhizome              | 3       | 1.3%       |
| Tuber                | 3       | 1.3%       |
| Bark                 | 1       | 0.4%       |
P. emblica may be attributed to its juicy and tasty fruits and its special cultural property: its tender bark is consumed in every October Festival and God Walled Festival.

Several other plants were found to be popular as wild vegetables in our study area based on their high UV and average FUI, including the following: Acacia pennata, Ixeris polycephala, Amaranthus viridis, Centella asiatica, Colocasia gigantea, Crassocephalum crepidioides, Dregea volubilis, Elatostema involucratum, Houttuynia cordata, Oenanthe javanica, and Zingiber striolatum. For example, H. cordata is the most common wild vegetable in Southern China. Many modern scientific studies have indicated that this species possesses excellent anti-microbial, anti-cancer, anti-inflammatory, and immunoenhancement bioactivities [39, 40]. C. gigantea is also a popular food plant, especially in Southwest China, and we found that the stem of C. gigantean contains high levels of nutrients and no heavy metals [41]. In addition, the inflorescence of Musa acuminata and Zingiber striolatum and the fruits of Ficus auriculata, Baccarea ramiflora, and Musa acuminata are all relatively popular and important in local daily life.

The effect of WEP species on communities’ economic income

Based on our interviews with key informants in local markets, the trading volume of WEP species was on a very small scale (less than 15 yuan each stall), which means selling WEP species could only bring a small income supplement and was usually unstable for local people. Therefore, driven by economic profits, many villagers have switched from growing rice to other economic plants like bananas in Hani terraced rice paddy fields. Many Hani informants reported that planting bananas can bring more income than growing rice. While in the short term, Hani farmers can get a higher income by growing bananas; they have to dry the rice paddy fields before planting bananas, which is against the Hani traditional ideas of sustainability. In doing so, the original construction and wetland habitats, as well as biodiversity, will be destroyed in the long term. Nevertheless, according to our observations, drying rice paddy to plant others was shown in different places in the Honghe region, especially in Jinping County.

The sources of and threats to the diversity of WEP species in the Honghe region

Our investigation revealed the diversity of WEP species in the Honghe area. Several reasons contributing to local biodiversity and WEP diversity have been analyzed.
The varied natural geographic environments and weather conditions are two of the main reasons for the diversity of WEP species. Secondly, the sustainable landscape structure constructed by the locals, including the four critical elements of forests, villages, terraces, and rivers, has a robust regulating ability, particularly for the regulation of essential water resources. Additionally, with the guidance of abundant traditional knowledge concerning reasonable agricultural management, excellent ecological benefits have been made to improve and maintain stability and biodiversity in the whole agroecosystem. Some Hani taboos, village regulations, and non-

| Scientific name       | Preparation and uses                        | FUI | UV  |
|------------------------|--------------------------------------------|-----|-----|
| Litsea pungens         | Flavoring agent                             | 4.9 | 0.92|
| Phyllanthus emblica    | Fruit: eaten fresh; bark: special dishes    | 4.9 | 0.90|
| Baccara ramillora      | Ripe fruits are eaten fresh                 | 4.2 | 0.89|
| Houttuynia cordata     | Potherb or flavoring agent                  | 4.5 | 0.89|
| Oenanthe javanica      | Potherb                                     | 4.3 | 0.82|
| Colocasia gigantea     | Potherb (cooked thoroughly)                 | 4.0 | 0.80|
| Crassocephalum crepidioides | Potherb                                            | 3.9 | 0.76|
| Crateva unilocularis   | Made into pickles (preserved)               | 3.9 | 0.75|
| Mentha canadensis      | Flavoring agent                             | 4.6 | 0.75|
| Ixeris polycephala     | Potherb                                     | 4.0 | 0.75|
| Zingiber striolatum    | Potherb                                     | 3.0 | 0.73|
| Dregea volubilis       | Potherb                                     | 3.0 | 0.72|
| Musa acuminata         | Fruit: eaten fresh; flower and pith part: potherb | 3.8 | 0.70|
| Ficus auriculata       | Ripe fruits are eaten fresh                 | 3.4 | 0.68|
| Nasturtium officinale  | Potherb                                     | 3.4 | 0.66|
| Acacia pennata         | Potherb                                     | 3.4 | 0.65|
| Elatostema involucratum | Potherb                                           | 3.3 | 0.65|
| Amaranthus viridis     | Potherb                                     | 3.6 | 0.61|
| Marsilea quadrifolia   | Potherb                                     | 3.3 | 0.59|
| Centella asiatica      | Potherb                                     | 3.0 | 0.58|

Fig. 5 The relationship between local biodiversity and its effect factors
governmental agreements, as well as local religious beliefs like the worship of the mountain deity and magic woods, have restrained the behaviors of local people and protected the surroundings.

However, the stability of Hani terraced rice paddy fields, which has been maintained for centuries, is now facing a series of challenges (Fig. 5). In our research area, traditional rice planting methods have been damaged by modernization. Based on our investigation, local young people prefer to work in urban areas to make more money instead of doing farm works in their hometowns. Traditional knowledge related to farmland management is only mastered by the older generation and is fading away rapidly (Table 3), and 18% of recorded species lack local Hani names. One reason for this lack of local names is that the Hani people are traditionally illiterate so that traditional knowledge can only be passed on orally by generations, so this knowledge is vulnerable to loss via acculturation. Although a writing system of the Hani language has been in place since 1957, it has not been widely adopted in the Hani communities. In addition, large-scale growing of hybrid rice requires less use of traditional agricultural methods and instead relies on pesticides and chemical fertilizers. Furthermore, the excessive exploitation of natural resources and the drying and changing of traditional rice terraces fields into economic fields are becoming increasingly frequent in the Honghe area nowadays. These phenomena are leading to a sharp decrease in the diversity of traditional knowledge and local biodiversity, which might damage the agroecosystem in this region [42, 43].

Since 2013, when the Hani agroecosystem was elected into the UNESCO World Heritage List, tourism has increased markedly. In 2015, the tourism industry generated about 191.5 billion yuan and accounted for about 70% of local government revenues (out of 275.6 billion yuan). However, the local villagers have obtained minimal economic benefits from the local tourism industry. The traditional agroecosystem cannot sustain the daily food needs of the local people anymore. The Hani are now turning to the tourism industry, which may help to protect the traditional knowledge and biodiversity in this agroecosystem.

Conclusion
An ethnobotanical study on WEP species from the Hani terraced rice paddy agroecosystems in Southeast Yunnan, China, was conducted. Two hundred and twenty-five species (belonging to 170 genera and 90 families) of wild edible species and the information of their life forms, edible parts, and preparation methods were documented. Based on our analysis, the most widely eaten parts of WEP species are fruits, stem, and leaves. The most common processing methods for WEP species are cooking them as a potherb or eating them fresh. These results are closely related to the local lifestyle and reflect the local biodiversity. The use values (UV) of WEP species were also calculated, and the 20 species with the highest use value were listed. Compared with other WEP species, these 20 species are relatively more important to local daily life, and Litsea pungens, a local common natural spice, is the most popular WEP based on its high UV metric.

The reasons for local biodiversity and the challenges for local agroecosystem have been analyzed. This agroecosystem is facing severe problems concerning natural resource conservation, environmental protection, and the economic development of local communities in this agroecosystem. Prestigious designations like UNESCO World Heritage Site have helped to promote ecotourism, which has begun to improve the livelihood of local people while sustaining the operation of this agroecosystem.

In conclusion, there are abundant plant resources in the Hani terraced rice paddy field system because it is an ancient sustainable agroecosystem. However, in modern times, this region has suffered a series of threats. It is, therefore, critical to develop an effective way to protect it and to ensure its sustainability for its inhabitants.

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Authors' contributions
CLL conceived and designed the study. BSL, CLL, BL, HZZ, HKZ, XL, LIM, YZW, YJB, XBZ, JQL, and JY conducted data collection. CLL, BL, and JY identified wild edible plants. BSL interpreted and analyzed data and wrote the draft manuscript. All authors read and approved the final manuscript.

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Not applicable.

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The authors declare that they have no competing interests.
