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*Ethnobotany of wild plants sold on the Amazonian  
market: the case of Pucallpa*

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## **Abstract**

This ethnobotanical market survey was conducted to document diversity of products from wild plants on the “Bellavista” market of Pucallpa city in the Peruvian Amazon. The data were collected during the period between July-September 2014, through semi-structured interviews and direct observations of market stalls and gathering areas. All vendors (7) offering products from wild plants were interviewed. Sold wild plants are mostly represented by non-timber forest products. The study documented 138 non-timber forests products derived from 68 wild plant species, belonging to 38 families. Botanical and common names, plant part sold, form of the product, plant life form, main use and mode of plant preparation was recorded. Potential impact of wild plant species commercialization on their occurrence was discussed within this study. Among investigated species, *Mauritia flexuosa* (Arecaceae), *Spondias mombin* (Anacardiaceae), and *Uncaria tomentosa* (Rubiaceae) were identified to be potentially most threatened by over-harvesting from the wild due to the high market demand during the last five years. The collected data aims to contribute to further research focused on the commercialization of plant resources and their sustainable management around the Pucallpa city.

**Key words:** conservation, ethnobotany, market survey, non-timber forest products, Peruvian Amazon

## Abstrakt

Etnobotanický výzkum trhu byl proveden za účelem zdokumentovat diverzitu produktů z planých rostlin, zastoupených především nedřevními produkty, na trhu „Bellavista“ ve městě Pucallpa v peruánské Amazonii. Sběr dat proběhl v období od července do září 2014, prostřednictvím polostrukturovaných dotazníků a přímým pozorováním na trhu a v místech sběru planých rostlin. Rozhovory byly vedeny se všemi prodejci (7), nabízejícími produkty z planých rostlin. Celkem bylo popsáno 138 nedřevních lesních produktů, na trhu zastoupených 68 druhy planých rostlin, náležejících do 38 rostlinných čeledí. Získaná data zahrnují botanický název, místní název, prodávanou rostlinnou část, podobu v jaké jsou produkty nabízeny, jejich obecné využití a způsob přípravy. Práce zohledňuje aspekt zpeněžování planých rostlin na jejich výskyt ve volné přírodě. Ze studovaných druhů *Mauritia flexuosa* (Arecaceae), *Spondias mombin* (Anacardiaceae) a *Uncaria tomentosa* (Rubiaceae) byly identifikovány jako potenciálně nejvíce ohrožené zvýšeným sběrem z volné přírody, způsobeným nárůstem poptávky trhu v posledních pěti letech. Shromážděná data mají za cíl přispět k budoucímu výzkumu zaměřenému na zpeněžování a udržitelné zacházení s přírodními zdroji v okolí města Pucallpa.

**Klíčová slova:** ochrana přírody, etnobotanika, průzkum trhu, nedřevní lesní produkty, Peruánská Amazonie

## **Declaration**

I, Miroslav Mixa, declare that this thesis, submitted in partial fulfilment of the requirements for the degree of M.Sc., at the Faculty of Tropical AgriSciences of the Czech University of Life Sciences Prague, is wholly my own work unless otherwise referenced or acknowledged.

Prague .....

.....  
Miroslav Mixa

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## Foreword

It has been estimated around 20,000 species of vascular plants in the Peruvian Amazon. This is approximately 8% of all vascular plant species that exist in the world (Desmarchelier and Schaus, 2000). Plant species richness in the Peruvian Amazon is reflected in their use by local people, as at many places throughout the Peru it constitutes the prime resource for food, medicine, energy, craft, dye, fiber, art or ritual practices (De-la-Cruz et al., 2007).

Many of these resources are commercialized by local people on the local or regional markets throughout the whole Peruvian Amazon. Local markets often absorb a large portion of production and employ many local people either by selling or processing the products (Steele et al., 2015; Adam et al., 2013). Estimations talk about several thousands of species collected from the wild for number of different purposes worldwide (Myers, 1988). In the case of Peruvian Amazon, majority of the plant material sold on the local markets consists of plants collected in the wild (Bussmann and Sharon, 2009; Sanz-Biset et al., 2009). Wild plants commercialized on the local markets are most commonly represented by non-timber forest products (NTFPs). Previous ethnobotanical studies undertaken in the Peruvian Amazon have shown that people use and trade wide spectrum of NTFPs (Shackleton et al., 2011; Bussmann and Sharon, 2009).

Despite non-timber forest products collected from the Amazon rainforest started to attract attention of researchers, environmental organizations and ecologists at least since the late 1980s (Sills et al., 2011), no studies documenting diversity of non-timber forest products on the local markets of the Ucayali region have been published at an international level. Thus, this study aims to document diversity of wild plants and products from wild plants commercialized on the Bellavista market in Pucallpa, the administrative centre of Coronel Portillo Province of Ucayali Region, Peru.

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## **List of abbreviations**

CIFOR	Centre for International Forestry Research, Bogor, Indonesia
FAO	Food and Agriculture Organization by United Nations, Rome, Italy
INEI	Instituto Nacional de Estadística e Informática, Lima, Peru
MINAG	Ministerio de Agricultura Ucayali
NTFP	Non-timber forest product
UNESCO	United Nations Educational, Scientific and Cultural Organization, Paris, France

# **1. Introduction**

## ***1.1. Study area***

The Republic of Peru (República del Perú) is located on the Pacific coast of South America (Figure 1), along which it has 2,400 km of coast. With a surface area of 1,285,216 square kilometers Peru ranks as the largest of the Andean countries and the only one that borders all the others. It borders Colombia and Ecuador in the north, Brazil and Bolivia to the east and Chile to the south. Country ranges between 68° 39' and 81° 19' western longitude and 00° 01' and 18° 20' southern latitude (Vera, 2001). Peru is divided into 25 regions: Amazonas, Ancash, Apurimac, Arequipa, Ayacucho, Cajamarca, Callao, Cusco, Huancavelica, Huanuco, Ica, Junin, La Libertad, Lambayeque, Lima, Lima, Loreto, Madre de Dios, Moquegua, Pasco, Piura, Puno, San Martin, Tacna, Tumbes, Ucayali (INEI, 2007).

The fieldwork was carried out on “Bellavista”, the informal market of the city Pucallpa. Pucallpa is the administrative centre of Coronel Portillo Province and the capital of Ucayali Department. The city, with altitude of 154 meters above sea level, 8°23' of southern latitude and 74°31' of western longitude, lies on banks of the river Ucayali 860 kilometers east from Lima. Ucayali Department borders Brazil to the east, along an east-west gradient leading to the foothills of the Andes (Pimentel, 2004).



**Figure 1.** Location of Peru in South America and Ucayali Department with Pucallpa city in Peru.

## ***1.2. Peruvian Amazon***

Nearly 60% of Peru’s national territory is considered as a part of the Amazon. The Peruvian Amazon can be divided into three main regions: Ucayali, Loreto and Madre de Dios. Despite the relatively large area, the Amazon region of Peru is markedly different and isolated from the rest of the country. For centuries, the high Andes Mountains have made access to the lowland Amazon region difficult, but increased road access and improved airports have resulted in rapid colonization by settlers bound up with dramatic change of landscape during the last 35 years (White et al., 2005). New settlers often change the landscape through slash-and-burn agriculture, extract of forest products (including NTFPs), and, in many areas, establish pastures for livestock. Losses in terms of biodiversity and greenhouse gas emissions are of global-level concern as a consequence of such conversion (Fujisaka et al. 2000). The greatest rate of deforestation occur around population centres, such as Pucallpa (Oliveira et al. 2007), the capital of Ucayali region, where slash-and-burn agriculture has been a primary cause of deforestation.

In the Peruvian Amazon, only 5.5 % of the land area is protected in the form of national parks and forests or other form of *in situ* reserves (O'Neill et al., 2001). Peru is considered to be one of the 12 “mega-diverse” countries of the world (De-la-Cruz et al., 2007; Brako and Zarucchi, 1993); and with an exceptional number of endemic plants (cca 30% of Peruvian flora) make the forests a strong candidate for conservation support (Myers et al. 2000). Therefore one of the objectives of this thesis is to focus on impact of exploitation pressure on locally important wild species sold on the market of Pucallpa, Ucayali Region and highlight the necessity of regulated harvest of NTFPs from the wild.

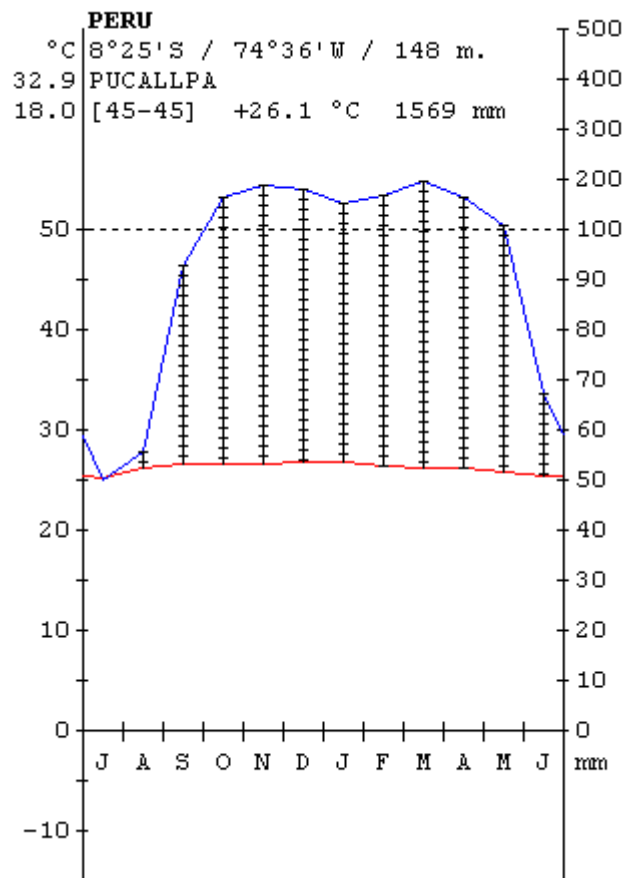
### ***1.3. Pucallpa, Ucayali Region***

#### **1.3.1. Environmental conditions**

The region is characterised by a hot and humid climate with only slight variation throughout the year (Figure 2). The rainfall ranges from 1,500 to 2,100 mm (a mean of 1,569 mm in Pucallpa with rainfall increasing to the west). Wet months are February – May and September – November; dry months are June – August and December – January. The mean annual temperature is 26.1°C, with a maximum of 32.9°C and minimum 18.0°C, with the mean annual relative humidity reaching 80% (MINAG, 2002; Rivas-Martínez, 2015).

Soils in the area include alluvial, seasonally flooded, riverine systems Entisols (Fluvisols according to the FAO/UNESCO classification system) called resting. Higher located areas dominate by well-drained forest areas of acidic (pH 4.4), Utisols (Acrisols according to the FAO/UNESCO classification system) called altura (Fujisaka, 2000).

The original vegetation is tropical semi-evergreen, seasonal forest, being currently largely affected by farming practices. Flatter areas near the city of Pucallpa are poorly drained and are called *aguajales* according to the local name for dominating palm *Mauritia flexuosa* (Fujisaka et al., 1999).



**Figure 2.** Climate diagram of Pucallpa (1996-2009), Peru. Adopted from Rivas-Martínez, 2015.

### 1.3.2. Population

Traditional settlement of people in the Ucayali region was in scattered villages along the Ucayali River, a tributary to the Amazon River. In the 1940s, a road connecting Lima to Pucallpa, the main city in Ucayali region was constructed. This opened up the area to settlement from other regions and to exploitation of natural resources. According to INEI (2007) population of Ucayali ranged about 16,000 inhabitants and since 1972, the population has almost tripled from 120,000 to 315,000 in 2004. The INEI census from 2007 (432,159 inhabitants), shows that the population is still rapidly increasing. Contemporary more than 80% of the population in the Ucayali is concentrated in Pucallpa or along the road to Lima (Pimentel et al., 2004).

There are four ecologically and demographically distinct subregions among the Ucayali region from where majority the NTFPs is extracted: the heavily populated Pucallpa subregion, including the road; the floodplain areas along the Ucayali, where the

indigenous Shipibo–Konibo and mixed-race population is concentrated; the upper regions of the Ucayali; and the isolated upland terraces in the Purus River Valley. These four subregions are highly integrated; many inhabitants migrate to different subregions at different times during the year to take advantage of income opportunities (Kutílková, 2008; Goy and Waltner-Toews, 2005).

## **2. Study background**

### ***2.1. Non-timber forest products***

Non-timber forest products (NTFPs) are any product or service other than timber that is produced in forests. They include fruits and nuts, vegetables, medicinal plants, resins, essences, range of barks and fibres and a host of other palms and grasses. Over the past two decades, governments, conservation and development agencies, as well as non-government organisations have encouraged the marketing and sale of NTFPs as a way of boosting income for poor people in the tropics and encouraging forest conservation. NTFPs are used and managed in complex socio-economic and ecological environments (CIFOR, 2014). In traditional forest communities, many NTFPs may be used for subsistence while others are the main or only source of income (Sills, 2011). Some NTFPs have significant cultural value, as incense or ritual item, while others have important medicinal value and contribute to the community's health and well-being. However as areas of wild forests are disappearing, human population growing, and market changing, the sustainable production of many NTFPs is no longer assured. Widespread over-exploitation resulted in resource destruction at many places, affecting the local biodiversity and leaving the people without an important source of income (CIFOR, 2014).

### ***2.2. Ethnobotanical studies***

#### **2.2.1. The importance of regional/local markets for non-timber forest products**

Ethnobotanical studies and market surveys undertaken in many parts of the world have highlighted importance of non-timber forest products on the local markets (Quiroz et al., 2014; Adam et al., 2013; Sanz-Biset et al., 2009; De-la-Cruz et al., 2007; Kvist et al., 2006). As it was mentioned local markets for non-timber forest products perform variety of functions, from assisting households to secure food supply and accumulating financial capital. There is a variety of case studies from around the world on the contribution of

NTFPs to local livelihoods (Steele et al., 2015; Adam et al., 2013; Saha and Sundriyal 2012; Adam and Petzsch, 2010; Shackleton et al., 2007a). The precise values and percentages from different regions and studies are frequently not directly comparable because of the different NTFPs included and the varying methods that were used (Angelsen et al., 2014; Shackleton et al., 2011). Based on the research of Adam et al. (2013), Vuola (2013), Marshall et al. (2006) and Arnold (2002) advantages and disadvantages of local markets are summarized in the table reproduced below. They suggest that local markets are more stable than the international ones, mainly because of the cultural value of many products that ensures stable demand. They also state that local markets are well accessible for the traders, often informal, less technological and capital investment is needed (Table 1).

**Table 1.** Advantages and disadvantages of local markets (based on the research of Adam et al. (2013), Vuola (2013), Marshall et al. (2006) and Arnold (2002)).

Advantages of local markets	Disadvantages of local markets
<b>Existence value:</b> Local markets exist, and may be relatively large, while export markets often have to be developed.	<b>Limited growth:</b> Local markets may show limited potential for growth or grow more slowly than export markets, but this does not apply to all products.
<b>Stable:</b> Local markets are relatively stable and guaranteed while export markets are often fickle, uncertain and demonstrate „boom and bust” characteristics.	<b>Saturation:</b> Local markets can quickly become saturated, limited opportunities for new entrants, impacting on incomes and constraining expansion of individual business.
<b>Self-reliance:</b> Participants in local markets are often independent, whereas various dependencies are created for export markets increasing the risk of benefits capture away from local beneficiaries and collapse if any of the actors withdraw.	<b>Neglected and invisible:</b> Local markets and producers have poor external visibility and are often neglected by policy makers and development planners receiving little support.
<b>Low technological requirements:</b> Low-cost appropriate technology is often adequate for local markets, whereas sophisticated export markets may require a very different level of processing, quality control and grading.	<b>Low research investments:</b> Local markets and products lack research and development (e.g. extending shelf life, resource ecology and management) relative to emerging internationally marketed products.
<b>Fewer regulations:</b> Local markets are relatively unregulated with less bureaucracy as compared to the complex regulations for exported products.	<b>Lack of support:</b> Producers often lack the technology, credit, contacts or skills to develop their businesses and have little access to external support.
<b>Lower risk of appropriation:</b> Because of the lower value of goods sold in local markets there is less risk of takeover by elites or displacement by large-scale cultivated sources.	<b>Deficit of information and sales options:</b> Rural areas may have scant access to market intelligence and may be beholden to historical trade patterns.
<b>Low barriers to entry:</b> Local markets have low barriers to entry compared to export markets allowing poor, unskilled and marginalised community members to engage in the trade.	<b>Less opportunity for diversification:</b> Local markets may show less potential for product diversification to reduce risk in the long-term (due to technology constrains for example), whereas this is often a feature that is developed for export markets.
<b>Low investment:</b> Minimal interventions and capital investments is required to support local trade and enhance livelihood benefits.	<b>Marginalisation:</b> Informal traders may face problems establishing themselves in the market place and frequently encounter harassment. The conditions under which they operate are often poor.

**Table 1. (Continued)**

Advantages of local markets	Disadvantages of local markets
<b>Cultural value:</b> The cultural value of many locally traded products provides market stability and can be used to expand markets amongst urban communities with strong rural roots. Many of the products having value in local markets may be have limited potential in export markets.	<b>Time consuming supply chain:</b> Producers supplying local markets may be constrained by performing all or most functions along the trade chain. At the same time, however, such horizontal integration could be seen has having positive benefits including more control, realisation of more benefits, less dependency, etc.
<b>Economies of scale:</b> The economies of scale of local markets can be appropriate in remote areas where some products are more effectively supplied locally.	<b>Geographically dispersed:</b> Producers supplying local markets are often dispersed over large areas making it difficult to target interventions and build collaboration.
<b>Control and flexibility:</b> In local markets, participants may have greater control, setting their own prices, selling where and to whom they wish, and determining their own work pace to fit in with other household activities.	<b>Low purchasing power:</b> Consumers located near local markets are often poor and have limited buying power keeping prices low. Products in specialised export markets can often fetch high prices.
<b>Local knowledge of markets:</b> Local producers and traders understand the needs of local markets, the quality standards and expectations. Export markets tend to be socially and geographically foreign.	<b>Lack of consumers for new goods:</b> There may be few buyers in local markets for producers who are creative and produce high quality, unusual goods.
<b>Accessible:</b> Local markets are accessible and close to producers/traders reducing transaction costs relative to export markets.	<b>Isolated:</b> Local markets are often located in marginalised areas characterised by poorly developed transport and communication infrastructure.

### 2.2.2. Forest degradation and over-exploitation

In the scientific literature we have evidence that management through exploitation of non-timber forest products may prevent deforestation of natural forest (Nepstad, 1992; Panayotou and Ashton, 1992). An accepted attitude includes NTFPs as a part of sustainable, diversified forest management as an alternative to prevalent industrial timber production (Belcher, 2003). However sustainability of forest management through NTFPs harvest is strongly dependent on the intensity with which the products are collected. Difficulty of achieving sustainability in NTFPs production is increasing with the intensity and frequency at which products are harvested and with the extent to which they are sold (Belcher & Schreckenberg, 2007).

Forest degradation and decreasing availability of non-timber forest products are widely noted concerns in the NTFP literature (Steele et al., 2015; Jusu and Sanchez, 2014; Bussmann and Sharon, 2009; Ticklin, 2004). In addition, many forests in developing countries are essential open-access for NTFPs harvest, which can lead to over-collection and conflict when the product is scarce (Vuola, 2013). Marshall et al. (2006), suggest that the local people should be responsible for the sustainable management. According to Belcher and Belcher and Schreckenberg (2007), NTFPs are normally harvested from the wild and collectors very often do not have clear land tenure to the forest. Monteiro et al.



(2010) reviews studies of local markets with medicinal plants and mentions the local dependence on the traditional medicines as they are normally cheaper. However, local people appear not to understand that these species might become extinct.

According to the previously mentioned studies we have assumed that some of the wild plants commercialized on the “Bellavista” market might be in the threat of exploitation caused by overharvesting of the species. On the bases of our data and field observation, we are highlighting species which should be taken in consideration for further protection.

### **2.2.3. Previous ethnobotanical inventories in studied area**

Despite a rich tradition of folk wild plant usage and its general importance for local people in Peruvian Amazon, only certain ethnobotanical studies (mainly focused on medicinal use), were published (Polesna et al., 2011; Sanz-Biset et al., 2009; De-la-Cruz et al., 2007; Kloucek et al., 2007; Kvist et al., 2006; Duke, 1994). Several studies have confirmed our assumption from “Bellavista” market of Pucallpa city, Ucayali Region, that most of the plant material sold on the local markets in the Peruvian Amazon consists of plants collected in the wild (Bussmann and Sharon, 2009; Sanz-Biset et al., 2009; Duivenvoorden et al., 2000). However, there is still lack of studies from the Ucayali Region, documenting diversity of non-timber forest products commercialized on the local markets and impact of their harvest from the wild.

### **3. Objectives**

Considering the lack of research on wild plants commercialized on the local markets in the area of Ucayali region, an aim of this study is to document diversity of wild plants, mostly represented by NTFPs, on the “Bellavista” market of Pucallpa city, administrative centre of Coronel Portillo Province of Ucayali Region, Peru.

In addition, description of the study area, summary of previous ethnobotanical studies and discussion of environmental impacts of wild plant collecting are included as background information for this work.

Therefore the specific objectives are:

- Inventory of wild plant species sold on the market in Pucallpa
- Provide ethnobotanical and taxonomic information on all species sold
- To document general geographical setting related to wild plants commercialized on Pucallpa market
- Discuss potential impact of commercialization on wild plant species occurrence

## **4. Materials and Methods**

### ***4.1. Ethnobotanical data collection***

The data were collected from July to September 2014 on the informal market “Bellavista” of Pucallpa city, administrative centre of Coronel Portillo Province, Ucayali Region, Peru (Figure 3). Research data have been obtained through direct interviews with the vendors, based on the semi-structured questionnaires. The interviews were recorded immediately at the place on the field notebook. Subsequently data were transcribed into the spreadsheet.

Semi-structured questionnaires (Appendix 1) were prepared according to the standard ethnobotanical procedures adapted from Martin (2004) and slightly modified for purposes of our research. Since all of the interviewees speak Spanish language, the interviews were conducted in Spanish.

Seven stalls selling wild plants have been studied (Appendix 3). All stalls on the “Bellavista” market selling non-timber forest products from the wild plants were investigated. Respondents were firstly asked about the personal details, frequency of selling and ownership of the stall. Subsequent information was dedicated to plant species and products sold. The information was collected from 7 vendors (4 women, 3 men). Respondents estimated age ranged from 32 to 65 years. Six of the stalls selling wild plants on the “Bellavista” market were permanent; one was temporary, selling only seedlings. All the stalls were owned by the vendors. Each respondent replied that is harvesting the plants by himself and sell them on the market daily.

All information on plants/products sold on the market are based on responses of the vendors or on the observations made by author. Information asked on the wild plants/products consists of common name, plant life form, plant part sold, main use and mode of preparation. Moreover an increase in the demand was studied and amount of plant material was estimated for all wild plant species present on the market. Respondents were also asked how and where the plants brought to market are harvested, in order to point out the gathering areas and harvesting technique. Several gathering areas were visited to verify where some of the species sold on the market are collected and how are they harvested. In addition, map of gathering areas was developed using GoogleEarth 2015 (Appendix 2) and harvesting technique was recorded (Table 3).

All species were documented by herbarium reference collection (MIX001-MIX068). Plant materials and photographs were obtained by author. Voucher specimens of studied plants were prepared according to the standard procedure (Bridson and Forman, 1999), deposited at La Facultad de Ciencias Forestales y Ambientales de la Universidad Nacional de Ucayali and authenticated in cooperation with Herbario Regional de Ucayali, Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA), Universidad Nacional Mayor de San Marcos; Universidad Nacional de Ucayali (UNU) and Universidad Nacional Intercultural de la Amazonia (UNIA). Species names were verified on the Tropicos - botanical information system of the Missouri Botanical Garden (Tropicos, 2010).



**Figure 3.** Location of “Bellavista” market within Pucallpa city.

## 4.2. Data analyses

Ethnobotanical data were analyzed and summarized using Microsoft excel and statistics to determine proportions of different variables such as plant families present on the market, plant life form, form of the product, plant part sold, mode of preparation or main use.

To evaluate increasing market demand for wild plants Relative Frequency of Citation index (RFCs) was calculated for all species sold on the stalls. In order to point out the wild species that might be in threat of overexploitation due to the increasing market demand. The index was obtained by dividing the number of informants, who replied positively on the question: How much is the plant/product sold now compared to in past five years (FCs), by the number of informants participating in the survey ( $N$ ), using the following formula (Tardio and Pardo-de-Santayana 2008):

$$(1) \text{ RFC}_s = \frac{\text{FC}_s}{N}$$

Number of informant responses was reported to indicate how significant increase in harvest of particular species is present currently compared to the past five years.

Based on discussions with vendors and field observations sustainability of plant harvest was indicated for all species and evaluated according to Jusu and Sanchez (2014). Harvesting techniques were divided into three categories (Table 3): 0 - the species is always sustainably harvested; 1 - the species is mostly sustainably harvested depending upon collector, and 2 - the species is unsustainably harvested. Jusu and Sanchez (2014), considered harvest sustainable when small percentage of individuals or only leaves are collected from the wild; when seeds are collected from the ground and when fruits are pickled from the tree without its felling. Certain of the observed species are classified as mostly sustainably harvested. These plants are harvested by majority of respondents in sustainable manner; however some of them collect the whole plant, wider parts of bark from one plant, or fell the tree during the harvest. Harvest is considered to be unsustainable when roots or 80 percent of the total reproductive output of the plant is collected. In our results also trees where ring debarking was applied, are classified as unsustainably harvested.

In addition total amounts of plant materials on the market were estimated for sale units of plants (bundle of herbs, fruits, seeds, bark and root). The estimated amounts are summed up for particular species and listed in the Table 4, together with number of stalls,

at which the plants were present. The method of amounts estimation was adapted from an earlier market survey in Benin (Quiroz et al., 2014), Ghana (Van Andel et al., 2012) and from the guidelines for ethnobotanical market inventories designed by Cunningham (2001). We estimate their amount by using the average weight for a sale unit, bundle of herbs (105.4 g), bundle of leaves (90.8 g), piece of bark (45.2 g), root (152.8 g), seeds (9 g) and fruits (21 g). On one stall only seedlings of wild plants were sold, for those species and for species present in the form of resin or latex amounts are not estimated.

Categories of ethnobotanical data (plant life form, plant parts sold, main use) were set up on the basis of Economic Botany Data Collection Standards (Cook, 1995). Mode of preparation was divided into the five categories based on the division proposed by Macía et al., (2005). Moreover, maps of Peru, the market location and position of collection sites were developed using GoogleEarth 2015 (Appendix 2) and ArcMap 10.2.2 (Figures 1, 3).

## 5. Results

Ethnobotanical data on sixty-eight wild plant species represented on the “Bellavista” market by one hundred thirty eight non-timber forest products were collected. We are devoting the first chapter of the results to plant species and second one to non-timber forest products. Third chapter of results is dedicated to the amounts of plants sold on “Bellavista” and sustainability of their harvest. Following chapter provides brief taxonomical description of all studied species.

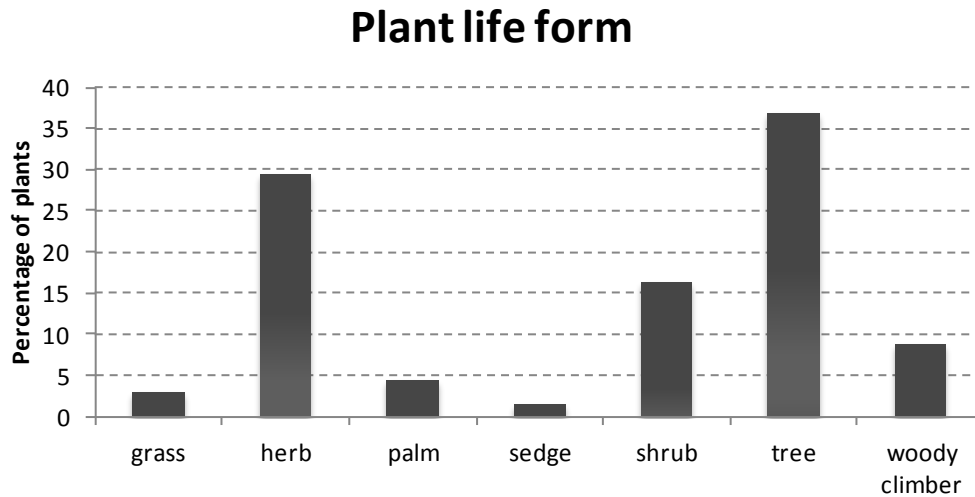
### 5.1. Ethnobotanical data on wild plants

Sixty-eight wild plant species belonging to thirty-eight families were documented being sold on the market in Pucallpa (Table 3). For each species, the information on botanical and common names, life form, plant part sold, uses and mode of preparation are provided. The most represented families listed in the Table 2 are Fabaceae (8 species), Euphorbiaceae (6), Araceae (4), followed by Arecaceae, Asteraceae and Moraceae (three species each).

**Table 2.** The number of species according to botanical families.

Plant family	Number of species	Plant family	Number of species
Fabaceae	8	Celastraceae	1
Euphorbiaceae	6	Clusiaceae	1
Araceae	4	Cyperaceae	1
Arecaceae	3	Equisetaceae	1
Asteraceae	3	Erythroxylaceae	1
Moraceae	3	Iridaceae	1
Amaranthaceae	2	Lecythidaceae	1
Annonaceae	2	Malpighiaceae	1
Apocynaceae	2	Malvaceae	1
Bignoniaceae	2	Maranthaceae	1
Boraginaceae	2	Menispermaceae	1
Lamiaceae	2	Phyllanthaceae	1
Phytolaccaceae	2	Plantaginaceae	1
Piperaceae	2	Rhamnaceae	1
Poaceae	2	Rubiaceae	1
Acanthaceae	1	Sapotaceae	1
Anacardiaceae	1	Solanaceae	1
Aristolochiaceae	1	Urticaceae	1
Bixaceae	1	Winteraceae	1

The proportion of different plant life forms is shown in the Figure 4. The most common plant life form was tree (37%), followed by herb (29%), shrub (16%), woody climber (9%), palm (4%), grass (3%) and sedge (2%). According to our results, proportion of woody plant species (palm, tree, shrub and woody climber) are most abundant and represent 66% of all studied species on the market.



**Figure 4.** Life forms of wild plants commercialized on the “Bellavista” market of Pucallpa city, Ucayali Region as a percentage of the total number of wild plants (n=68).



**Table 3.** Wild plants/non-timber forest products sold on the “Bellavista” market of Pucallpa city, Ucayali Region.

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Alchornea castaneifolia</i> (Humb. & Bonpl. ex Willd.) A. Juss. (MIX 055)	<i>Euphorbiaceae</i>	Iporuro	tree	bark	dried plant material	medicines	decoction	2	0
<i>Alternanthera brasiliensis</i> Voss (MIX 020)	<i>Amaranthaceae</i>	Lancetilla	herb	aerial part	fresh	medicines	infusion	3	0
				aerial part	fresh	food	fresh		
				aerial part	fresh	medicines	infusion		
<i>Ambrosia peruviana</i> Willd. (MIX 006)	<i>Asteraceae</i>	Marco sacha	herb	leave	powder	food additives	dried plant material	3	0
				leave	fresh	medicines	infusion		
				leave	dried plant material	food additives	dried plant material		
<i>Annona</i> sp. (MIX 068)	<i>Annonaceae</i>	Anona	tree	seedling	fresh	environmental uses		2	0
<i>Aristolochia asperifolia</i> Ule (MIX 027)	<i>Aristolochiaceae</i>	Huanchahui sacha	woody climber	bark	dried plant material	medicines	decoction	2	1
<i>Ayapana triplinervis</i> (Vahl) R.M. King & H. Rob. (MIX 007)	<i>Asteraceae</i>	Caguena	shrub	leave	fresh	medicines	infusion	0	0
<i>Bactris gasipaes</i> Kunth (MIX 044)	<i>Areaceae</i>	Pijuayo	palm	seedling	fresh	environmental uses		1	0
<i>Banisteriopsis caapi</i> (Spruce ex Griseb.) C.V. Morton (MIX 051)	<i>Malpighinaceae</i>	Ayahuasca	woody climber	bark	dried plant material	social uses	decoction	4	1
<i>Bixa orellana</i> L. (MIX 041)	<i>Bixaceae</i>	Achiote	shrub	leave	fresh	medicines	infusion	4	0

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Bixa orellana</i> L. (MIX 041)	<i>Bixaceae</i>	Achiote	shrub	seed	powder	social uses	dried plant material	4	0
<i>Brosimum acutifolium</i> Huber (MIX 031)	<i>Moraceae</i>	Tamamuri	tree	bark	dried plant material	medicines	decoction	5	1
				bark	tincture	medicines	tincture		
				infructescence	fresh	food	fresh		
<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Sweet (MIX 032)	<i>Solanaceae</i>	Toe	shrub	exudate	latex	medicines	fresh	2	0
				infructescence	fresh	medicines	infusion		
				infructescence	fresh	social uses	decoction		
<i>Caesalpinia spinosa</i> (Molina) Kuntze (MIX 011)	<i>Fabaceae</i>	Tara	shrub	seed	dried plant material	medicines	dried plant material	1	0
<i>Cajanus cajan</i> (L.) Huth (MIX 029)	<i>Fabaceae</i>	Puspo poroto	shrub	leave	fresh	medicines	infusion	4	0
				leave	fresh	food	fresh		
				leave	fresh	animal food	fresh		
<i>Cissampelos pareira</i> L. (MIX 018)	<i>Menispermaceae</i>	Abuta	tree	bark	dried plant material	medicines	decoction	5	1
				bark	tincture	medicines	tincture		
<i>Clusia rosea</i> Jacq. (MIX 045)	<i>Clusiaceae</i>	Renaquilla	tree	bark	dried plant material	medicines	bath	4	0
<i>Copaifera paupera</i> (Herzog) Dwyer (MIX 050)	<i>Fabaceae</i>	Copaiba	tree	exudate	latex	medicines	fresh	2	1
				infructescence	fresh	food	fresh		

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Cordia alliodora</i> Cham. (MIX 057)	<i>Boraginaceae</i>	Ajos kiro	tree	leave	fresh	medicines	decoction	1	0
				infructescence	fresh	food	fresh		
<i>Couroupita guianensis</i> Aubl. (MIX 026)	<i>Lecythidaceae</i>	Ayahuma	tree	infructescence	fresh	medicines	infusion	4	1
				infructescence	fresh	medicines	fresh		
<i>Croton lechleri</i> Müll. Arg. (MIX 030)	<i>Euphorbiaceae</i>	Sangre de grado	tree	exudate	latex	medicines	fresh	4	0
<i>Desmodium axillare</i> (Kuntze) Urb. (MIX 028)	<i>Fabaceae</i>	Amor seco	herb	aerial part	fresh	medicines	infusion	0	1
				aerial part	fresh	medicines	fresh		
<i>Dieffenbachia</i> sp. (MIX 033)	<i>Araceae</i>	Patiquina	herb	aerial part	fresh	medicines	infusion	4	0
				aerial part seedling	fresh fresh	social uses environmental uses	fresh		
<i>Dracontium loretense</i> K. Krause (MIX 014)	<i>Araceae</i>	Sacha jergon	herb	root	dried plant material	medicines	decoction	3	2
				root	powder	medicines	dried plant material		
<i>Drimys winteri</i> J.R. Forst. & G. Forst. (MIX 052)	<i>Winteraceae</i>	Canelo	tree	bark	dried plant material	medicines	decoction	4	1
				bark	dried plant material	food additives	dried plant material		
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants (MIX 036)	<i>Amaranthaceae</i>	Paico	herb	aerial part	fresh	medicines	infusion	5	0

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants (MIX 036)	<i>Amaranthaceae</i>	Paico	herb	aerial part	fresh	food	fresh	5	0
				aerial part	fresh	medicines	fresh		
				aerial part	dried plant material	food additives	dried plant material		
<i>Eleutherine bulbosa</i> (Mill.) Urb. (MIX 039)	<i>Iridaceae</i>	Yahuar piripiri	herb	root	fresh	medicines	fresh	3	2
				aerial part	fresh	social uses	bath		
<i>Eleutherine bulbosa</i> (Mill.) Urb. (MIX 039)	<i>Iridaceae</i>	Yahuar piripiri	herb	root	dried plant material	medicines	decoction	3	2
<i>Equisetum giganteum</i> L. (MIX 016)	<i>Equisetaceae</i>	Cola de caballo	herb	aerial part	dried plant material	medicines	infusion	2	0
<i>Erythroxylum coca</i> Lam. (MIX 013)	<i>Erythroxylaceae</i>	Coca	shrub	leave	fresh	medicines	fresh	1	0
				leave	fresh	medicines	infusion		
<i>Ficus insipida</i> Willd. (MIX 065)	<i>Moraceae</i>	Oje	tree	exudate	latex	social uses	fresh	2	0
<i>Fittonia verschaffeltii</i> G. Nicholson (MIX 037)	<i>Acanthaceae</i>	Motelillo	herb	inflorescence	fresh	social uses	fresh	1	0
				aerial part	fresh	medicines	infusion		
<i>Gnaphalium</i> sp. (MIX 054)	<i>Asteraceae</i>	Lengua de perro	herb	inflorescence	fresh	medicines	infusion	3	0
				inflorescence	fresh	medicines	decoction		
				inflorescence	fresh	social uses	bath		
<i>Gynerium sagittatum</i> (Aubl.) P. Beauv. (MIX 040)	<i>Poaceae</i>	Caña brava	grass	leave	fresh	medicines	infusion	2	0

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> (n)	Harvesting <sup>c</sup>
<i>Heliotropium</i> sp. (MIX 046)	<i>Boraginaceae</i>	Alacran	herb	aerial part	fresh	medicines	infusion	1	0
<i>Heteropsis flexuosa</i> Kunth (MIX 015)	<i>Araceae</i>	Tamishi	woody climber	infructescence	fresh	medicines	fresh	3	2
				root	fibre	materials	fresh		
<i>Himatanthus sucuuba</i> (Spruce ex Müll. Arg.) Woodson (MIX 008)	<i>Apocynaceae</i>	Bellaco caspi	tree	aerial part	fresh	medicines	infusion	1	1
				aerial part	fresh	food	fresh		
<i>Hura crepitans</i> L. (MIX 042)	<i>Euphorbiaceae</i>	Catahua	tree	bark	tincture	medicines	tincture	3	1
				exudate	latex	medicines	fresh		
<i>Imperata brasiliensis</i> Trin. (MIX 038)	<i>Poaceae</i>	Cashausha	grass	exudate	latex	medicines	fresh	1	0
				exudate	latex	medicines	infusion		
<i>Inga edulis</i> Mart. (MIX 053)	<i>Fabaceae</i>	Guaba	tree	leave	dried plant material	medicines	decoction	4	1
				leave	fresh	medicines	infusion		
<i>Jatropha curcas</i> L. (MIX 060)	<i>Euphorbiaceae</i>	Piñon blanco	shrub	infructescence	fresh	animal food	fresh	4	0
				infructescence seedling	fresh	environmental uses	infusion		

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Jatropha curcas</i> L. (MIX 060)	<i>Euphorbiaceae</i>	Piñon blanco	shrub	aerial part	fresh	medicines	fresh	4	0
<i>Jatropha gossipifolia</i> L. (MIX 061)	<i>Euphorbiaceae</i>	Piñon colorado	shrub	aerial part	fresh	medicines	infusion	3	0
<i>Lonchocarpus</i> sp. (MIX 047)	<i>Fabaceae</i>	Barbasco	tree	root	dried plant material	medicines	decoction	5	2
				root	tincture	medicines	tincture		
				bark	dried plant material	medicines	decoction		
				root	dried plant material	medicines	bath		
<i>Mandevilla scabra</i> (Hoffmanns. ex Roem. & Schult.) K. Schum. (MIX 058)	<i>Apocynaceae</i>	Clavo huasca	woody climber	bark	dried plant material	medicines	bath	4	2
<i>Mansoa alliacea</i> (Lam.) A.H. Gentry (MIX 064)	<i>Bignoniaceae</i>	Ajosacha	woody climber	leave	fresh	medicines	infusion	3	1
				leave	fresh	medicines	decoction		
<i>Mansoa alliacea</i> (Lam.) A.H. Gentry (MIX 064)	<i>Bignoniaceae</i>	Ajosacha	woody climber	bark	tincture	medicines	tincture	3	1
<i>Maquira coriacea</i> (H. Karst.) C.C. Berg (MIX 049)	<i>Moraceae</i>	Capinuri	tree	bark	dried plant material	medicines	decoction	1	0
				exudate	latex	medicines	fresh		
<i>Maranta arundinacea</i> L. (MIX 062)	<i>Marantaceae</i>	Shimipampana	herb	root	dried plant material	medicines	dried plant material	4	2
				root	dried plant material	medicines	decoction		

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Maranta arundinacea</i> L. (MIX 062)	<i>Marantaceae</i>	Shimipampana	herb	root	fresh	food	fresh	4	2
				root	fresh	medicines	fresh		
<i>Mauritia flexuosa</i> L. f. (MIX 004)	<i>Areceaceae</i>	Aguaje	palm	infructescence	fresh	food	fresh	7	2
				leaves	fibre	materials	fresh		
<i>Maytenus macrocarpa</i> (R. & P.) Briq. (MIX 059)	<i>Celastraceae</i>	Chuchuhuasi	tree	bark	dried plant material	medicines	dried plant material	4	1
<i>Minthostachys mollis</i> (Kunth) Griseb. (MIX 066)	<i>Lamiaceae</i>	Muña	herb	aerial part	fresh	medicines	infusion	3	1
<i>Ocimum</i> sp. (MIX 003)	<i>Lamiaceae</i>	Albahaca	herb	leave	fresh	medicines	infusion	5	1
				leave	fresh	food additives	fresh		
				leave	fresh	food	fresh	5	1
				leave	fresh	medicines	fresh		
<i>Oenocarpus batau</i> Mart. (MIX 017)	<i>Areceaceae</i>	Ungurahui	palm	seedling	fresh	environmental uses		1	0
<i>Ormosia</i> sp. (MIX 025)	<i>Fabaceae</i>	Huayruro	tree	seed	dried plant material	social uses	dried plant material	4	0
<i>Petiveria alliacea</i> L. (MIX 019)	<i>Phytolaccaceae</i>	Mocura	herb	aerial part	fresh	medicines	infusion	4	0
<i>Phyllanthus niruri</i> L. (MIX 067)	<i>Phyllanthaceae</i>	Chanca piedra	herb	aerial part	fresh	medicines	infusion	3	0
				aerial part	fresh	food	fresh		

**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> ( <i>n</i> )	Harvesting <sup>c</sup>
<i>Phyllanthus niruri</i> L. (MIX 067)	<i>Phyllanthaceae</i>	Chanca piedra	herb	aerial part	fresh	medicines	bath	3	0
<i>Phyllanthus urinaria</i> L. (MIX 063)	<i>Phyllanthaceae</i>	Chanca piedra blanca	herb	aerial part	fresh	food	fresh	3	0
<i>Piper aduncum</i> L. (MIX 035)	<i>Piperaceae</i>	Matico	shrub	aerial part	fresh	medicines	infusion	5	0
				leave	fresh	medicines	poultice		
				seed	fresh	food	fresh		
				seed	oil	food additives	fresh		
<i>Pistia stratiotes</i> L. (MIX 021)	<i>Araceae</i>	Huama	herb	aerial part	fresh	medicines	infusion	4	0
				seed	dried plant material	medicines	dried plant material		
				seed	oil	food additives	fresh		
<i>Plantago major</i> L. (MIX 009)	<i>Plantaginaceae</i>	Llanten	herb	aerial part	fresh	medicines	infusion	4	1
<i>Plukenetia volubilis</i> L. (MIX 001)	<i>Euphorbiaceae</i>	Sacha inchi	shrub	seed	powder	medicines	dried plant material	4	1
				seed	oil	food additives	fresh		
				aerial part	dried plant material	medicines	decoction		
<i>Pothomorphe peltata</i> (L.) Miq. (MIX 043)	<i>Piperaceae</i>	Santa maria	herb	leave	fresh	medicines	poultice	0	2
<i>Pouteria caimito</i> (Ruiz & Pav.) Radlk. (MIX 048)	<i>Sapotaceae</i>	Caimito	tree	seedling	fresh	environmental uses		1	0



**Table 3.** (Continued)

Botanical name, voucher specimen	Family	Common name	Plant life form	Plant part sold	Form of product	Main use	Preparation <sup>a</sup>	Citations <sup>b</sup> (n)	Harvesting <sup>c</sup>
<i>Pterocarpus ulei</i> Harms (MIX 024)	<i>Fabaceae</i>	Maribuena	tree	bark	tincture	medicines	tincture	0	0
<i>Quararibea cordata</i> (Bonpl.) Vischer (MIX 056)	<i>Malvaceae</i>	Sapote	tree	seedling	fresh	environmental uses		1	1
<i>Scleria</i> sp. (MIX 005)	<i>Cyperaceae</i>	Cortadera	sedge	aerial part	dried plant material	medicines	decoction	1	0
<i>Spondias mombin</i> L. (MIX 012)	<i>Anacardiaceae</i>	Ubos	tree	bark	dried plant material	medicines	decoction	6	1
				infructescence	fresh	food	fresh		
				infructescence	fresh	medicines	fresh		
<i>Tabebuia serratifolia</i> G. Nicholson (MIX 002)	<i>Bignoniaceae</i>	Tahuarí	tree	bark	dried plant material	medicines	decoction	2	1
<i>Uncaria tomentosa</i> (Willd.) DC. (MIX 023)	<i>Rubiaceae</i>	Uña de gato	woody climber	bark	dried plant material	medicines	decoction	7	2
<i>Unonopsis spectabilis</i> Diels (MIX 034)	<i>Annonaceae</i>	Icoja	tree	bark	dried plant material	medicines	dried plant material	3	1
<i>Urera laciniata</i> Wedd. (MIX 022)	<i>Urticaceae</i>	Ishanga	shrub	aerial part	fresh	medicines	fresh	0	0
<i>Ziziphus cinnamomum</i> Triana & Planch. (MIX 010)	<i>Rhamnaceae</i>	Achuni sanango	tree	root	dried plant material	medicines	decoction	1	1
				bark	dried plant material	medicines	decoction		

<sup>a</sup>Preparation of the product, recommended by the vendor

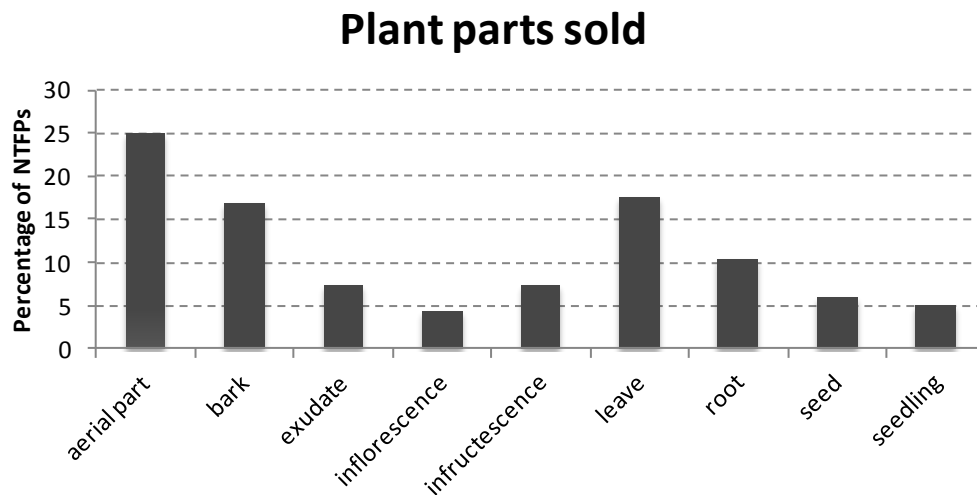
<sup>b</sup>Frequency of citation: An increase in the market demand for particular wild plants was recorded as a number of responses of vendors (out of 7), who answered positively on the question: How much is the plant sold now compared to the past five years (Appendix 2)?

<sup>c</sup>Harvesting technique: 0 = sustainably harvested; 1 = mostly sustainably harvested; 2 = unsustainably harvested

## 5.2. Ethnobotanical data on non-timber forest products

### 5.2.1. Plant parts sold

In the Figure 5 proportion of different plant parts sold is shown. Primarily, aerial part (26%) is sold; whole above ground part is simply cut and sold for further remedy preparation. Other plant parts were represented by leaves (18%), bark (16%), roots (10%), including tubers; exudates (7%), including resin and latex; infructescences (7%), seeds (6%), seedlings (5%) and inflorescences (5%). Category of seedlings comprises of *Annona* sp., *Bactris gasipeas*, *Diefenbachia* sp., *Inga edulis*, *Oenocarpus batau*, *Pouteria caimito* and *Quararibea cordata*.



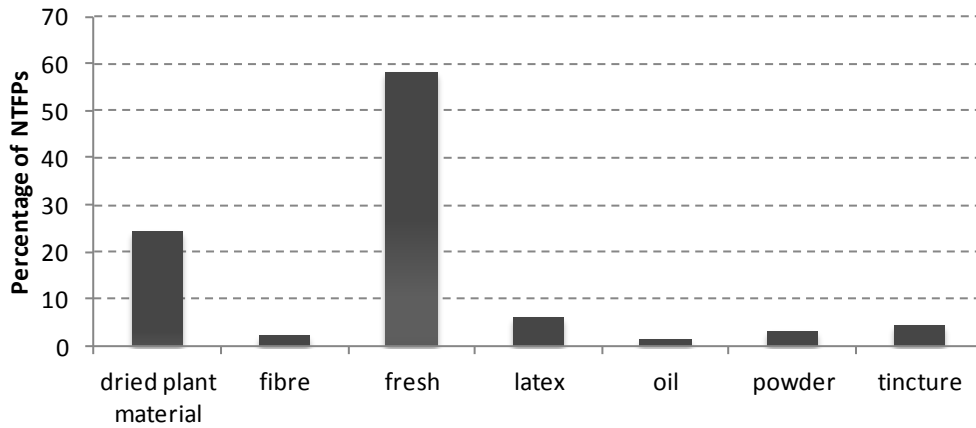
**Figure 5.** Plant parts sold on the “Bellavista” market of Pucallpa city, Ucayali Region as a percentage of the total number of products (n=138).

### 5.2.2. Form of the product

In the Figure 6 proportion of different form at which the products were present on the market is shown. According to our results, most frequently products are offered as a fresh plant material (58%) or sold dried (23%). From documented products 6% were latexes of different trees (e.g. *Brosimum acutifolium*, *Copaifera paupera*, *Croton lechleri* or *Hura crepitans*). Products soaked in alcohol (tincture) represent 5% of all recorded non-timber forest products. The fibres (2%) from *Heteropsis flexuosa*, *Mauritia flexuosa* and from *Imperata brasiliensis* were present on the market for handicrafts making. The leaves of *Ambrosia peruviana*, root of *Dracontium loretense*, seeds of *Bixa orellana* and

*Plukenetia volubilis* were observed to be sold in the form of powder (3%). On the studied stalls oil (1%) from the seeds of *Piper aduncum* and *Plukenetia volubilis* was present.

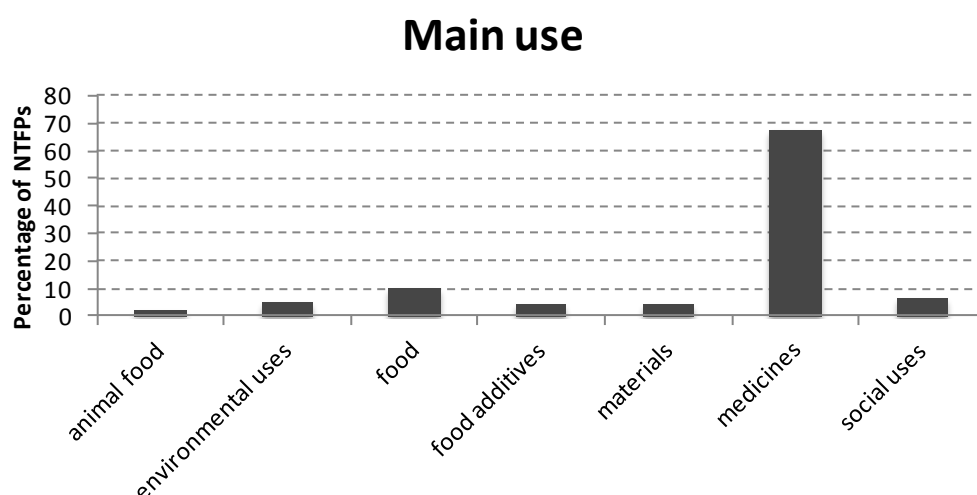
### Form of the product



**Figure 6.** Form in which NTFPs are sold on the “Bellavista” market of Pucallpa city, Ucayali Region as a percentage of the total number of products (n=138).

#### 5.2.3. Use categories

According to Figure 7, presenting categorization of uses reported by informants, majority of NTFPs on the market serve as medicine (68%) or for direct consumption as a food (10%). Category of social uses constitutes of 7% and includes plants, which are not definable as food or medicines, for instance hallucinogens and psychoactive drugs or plants with ritual or religious significance such as *Banisteriopsis caapi*, *Brugmansia suaveolans*, *Dieffenbachia* sp, *Gnaphalium* sp. or *Ormosia* sp. In the case of this study category of environmental purposes (5%) is stated for seedlings sold on one of the stalls. Vendor who was selling them answered that plants were harvested in the wild and should be planted for further cultivation for different purposes. Other non-timber forest products were used as materials (4%). In this category plants used for handicrafts (eg. *Heteropsis flexuosa*, *Imperata brasiliensis*, *Mauritia flexuosa*) are included. Other 4% of studied products are utilized as food additives, represented by ingredients which are used in food preparation (eg. *Ambrosia peruviana*, *Dysphania ambrosioides*, *Ocimum* sp.) NTFPs used as forage or fodder are categorized as animal food and represent 2% of studied products.

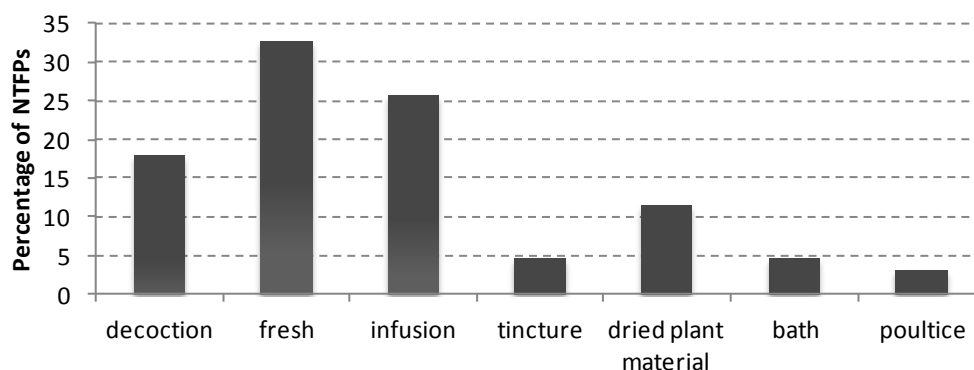


**Figure 7.** Main use of NTFPs sold on the “Bellavista” market of Pucallpa city, Ucayali Region as a percentage of the total number of products (n=138).

#### 5.2.4. Preparation of remedies

Standard ways of remedies preparation, recommended by the vendors are shown in the Figure 8. According to our results, most frequently plant material is consumed fresh (32%), prepared as infusion “like tea” (25%) or decoction (plant material boiled in water, 16%). Dry plant material, stated for 12% of studied non-timber forest products should be grinding and used as a condiment, or in the case of seeds of *Bixa orellana* and *Ormosia* sp. used for ornamental purposes. From 5% of the studied products vapor baths should be prepared or plants are added to bath for healing purposes. Fresh or mashed up fresh leaves should be applied directly to the skin as poultices (3%) usually on rashes as pain-relieving remedy. Barks of *Brosimum acutifolium*, *Cissampelos pareira*, *Himatanthus sukuuba*, *Mansoa alliacea*, *Pterocarpus ulei* and roots of *Lonchocarpus* sp. were recommended to be prepared as tinctures (products macerated in alcoholic spirit).

## Preparation of products according to vendors

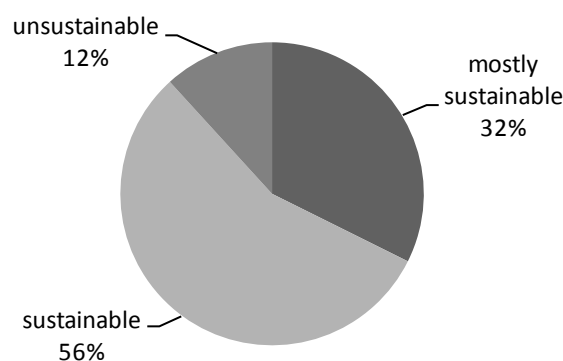


**Figure 8.** Mode of preparation of NTFPs according to vendors recommendation, as a percentage of the total number of products (n=138).

### 5.2.5. Collection sites, amounts of plants and sustainability of harvest

Majority of wild plants traded on the “Bellavista” market are collected from the semi-ever green, seasonal forest, or old fallows. Remaining plants are sourced either in young fallows or floodplains around Pucallpa city (Appendix 2). With regard to harvesting, 56% of plant species sold on the market is harvested sustainably, 32% of examined species might or might not be harvested sustainably depending upon the collector and 12% of studied plants is harvested unsustainably (Figure 9). In our case eight out of sixty-eight plants are considered to be harvested unsustainably, meaning roots or 80 percent of the total reproductive output was collected. For *Dracontium lorentense*, *Eleutherine bulbosa* and *Marantha arundinacea* whole root is excavated from the soil. In the case of *Heteropsis flexuosa*, *Mandevilla scabra*, *Mauritia flexuosa*, and *Uncaria tomentosa* plant is felled during the harvest. Some collectors practise ring debarking in the case of Barbasco tree (*Lonchocarpus* sp.), which can negatively affect the tree survival and therefore we consider it in our study as unsustainably harvested species.

## Harvesting technique



**Figure 9.** Species harvesting technique as a percentage of the total number of species (n=68), traded on the “Bellavista” market of Pucallpa city, Ucayali Region.

Relative Frequency of Citation index (RFCs) was calculated for all studied plant species. For 27 out of 68 plant species more than 50% of respondents replied that the demand in recent years was significantly increased (Table 3). For *Mauritia flexuosa* and *Uncaria tomentosa* citation frequency was 100%, which mean all respondents answered demand of these species is higher compared to the past five years. For *Spondias mombin* citation frequency was 85.7%. Other plants were cited with lower frequencies as shown in the Table 4.

Estimated amounts of plant materials are listed in the Table 4. According to our results *Mauritia flexuosa* (496.5 kg), *Spondias mombin* (19.2 kg) and *Uncaria tomentosa* (9.3 kg) were represented by the highest amounts on the market. Species with lowest amounts were: *Urera laciniata* (0.6 kg), *Caesalpinia spinosa* (0.6 kg), *Clusia rosea* (0.6 kg), *Scleria* sp. (0.6 kg) and *Himatanthus sukuuba* (0.5 kg).

On the bases of an increase in the market demand, sustainability of harvest, and amounts of plant material present on the market we are highlighting three wild plant species which are under the collection pressure (*Mauritia flexuosa* (RFCs = 100%, unsustainably harvested); *Spondias mombin* (RFCs = 85.7%, mostly sustainably harvested depending on collector); *Uncaria tomentosa* (RFCs = 100%, unsustainably harvested)), for further conservation and protection. Highlighted species all have the highest citation rate, mostly unsustainable way of harvesting and were present on the market in the high amounts (Table 4).

**Table 4.** Wild plants sold on the “Bellavista” market of Pucallpa city, Ucayali Region.

Botanical name	RFCs (%) <sup>a</sup>	Harvesting <sup>b</sup>	Total amount (kg) <sup>c</sup>	No. of stalls <sup>d</sup>
<i>Alchornea castaneifolia</i> (Humb. & Bonpl. ex Willd.) A. Juss.	28.6	0	1.6	2
<i>Alternanthera brasiliensis</i> Voss	42.9	0	8.0	4
<i>Ambrosia peruviana</i> Willd.	42.9	0	4.4	3
<i>Annona</i> sp.	28.6	0	na	1
<i>Aristolochia asperifolia</i> Ule	28.6	1	2.2	1
<i>Ayapana triplinervis</i> (Vahl) R.M. King & H. Rob.	0	0	0.8	2
<i>Bactris gasipaes</i> Kunth	14.3	0		1
<i>Banisteriopsis caapi</i> (Spruce ex Griseb.) C.V. Morton	57.1	1	0.8	2
<i>Bixa orellana</i> L.	57.1	0	3.1	2
<i>Brosimum acutifolium</i> Huber	71.4	1	9.0	5
<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Sweet	28.6	0	1.7	3
<i>Caesalpinia spinosa</i> (Molina) Kuntze	14.3	0	0.6	2
<i>Cajanus cajan</i> (L.) Huth	57.1	0	6.3	4
<i>Cissampelos pareira</i> L.	71.4	1	4.0	3
<i>Clusia rosea</i> Jacq.	57.1	0	0.6	1
<i>Copaifera paupera</i> (Herzog) Dwyer	28.6	1	Na	2
<i>Cordia alliodora</i> Cham.	14.3	0	2.5	2
<i>Couroupita guianensis</i> Aubl.	57.1	1	6.0	2
<i>Croton lechleri</i> Müll. Arg.	57.1	0	na	4
<i>Desmodium axillare</i> (Kuntze) Urb.	0	1	2.3	2
<i>Dieffenbachia</i> sp.	57.1	0	6.7	4
<i>Dracontium loretense</i> K. Krause	42.9	2	2.1	2
<i>Drimys winteri</i> J.R. Forst. & G. Forst.	57.1	1	6.8	3
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	71.4	0	8.1	5
<i>Eleutherine bulbosa</i> (Mill.) Urb.	42.9	2	2.8	2
<i>Equisetum giganteum</i> L.	28.6	0	0.8	2
<i>Erythroxylum coca</i> Lam.	14.3	0	0.7	1
<i>Ficus insipida</i> Willd.	28.6	0	Na	2
<i>Fittonia verschaffeltii</i> G. Nicholson	14.3	0	0.7	1
<i>Gnaphalium</i> sp.	42.9	0	2.7	3
<i>Gynerium sagittatum</i> (Aubl.) P. Beauv.	28.6	0	1.8	2
<i>Heliotropium</i> sp.	14.3	0	8.3	5
<i>Heteropsis flexuosa</i> Kunth	42.9	2	4.5	3
<i>Himatanthus sucuuba</i> (Spruce ex Müll. Arg.) Woodson	14.3	1	0.5	1
<i>Hura crepitans</i> L.	42.9	1	Na	2
<i>Imperata brasiliensis</i> Trin.	14.3	0	0.9	1
<i>Ficus insipida</i> Willd.	28.6	0	Na	2
<i>Fittonia verschaffeltii</i> G. Nicholson	14.3	0	0.7	1
<i>Gnaphalium</i> sp.	42.9	0	2.7	3
<i>Gynerium sagittatum</i> (Aubl.) P. Beauv.	28.6	0	1.8	2
<i>Heliotropium</i> sp.	14.3	0	8.3	5
<i>Heteropsis flexuosa</i> Kunth	42.9	2	4.5	3
<i>Himatanthus sucuuba</i> (Spruce ex Müll. Arg.) Woodson	14.3	1	0.5	1
<i>Hura crepitans</i> L.	42.9	1	Na	2

**Table 4.** (Continued)

Botanical name	RFCs <sup>a</sup>	Harvesting <sup>b</sup>	Total amount (kg) <sup>c</sup>	No. of stalls <sup>d</sup>
<i>Imperata brasiliensis</i> Trin.	14.3	0	0.9	1
<i>Inga edulis</i> Mart.	57.1	1	3.5	3
<i>Jatropha curcas</i> L.	57.1	0	2.8	3
<i>Jatropha gossipifolia</i> L.	42.9	0	2.5	3
<i>Lonchocarpus</i> sp.	71.4	2	4.9	3
<i>Mandevilla scabra</i> (Hoffmanns. ex Roem. & Schult.) K. Schum.	57.1	2	1.7	3
<i>Mansoa alliacea</i> (Lam.) A.H. Gentry	42.9	1	2.9	2
<i>Maquira coriacea</i> (H. Karst.) C.C. Berg	14.3	0	Na	2
<i>Maranta arundinacea</i> L.	57.1	2	7.3	4
<i>Mauritia flexuosa</i> L. f.	100	2	496.5	3
<i>Maytenus macrocarpa</i> (R. & P.) Briq.	57.1	1	0.9	1
<i>Minthostachys mollis</i> (Kunth) Griseb.	42.9	1	1.9	2
<i>Ocimum</i> sp.	71.4	1	4.8	6
<i>Oenocarpus bataua</i> Mart.	14.3	0	Na	1
<i>Ormosia</i> sp.	57.1	0	1.4	4
<i>Petiveria alliacea</i> L.	57.1	0	3.4	4
<i>Phyllanthus niruri</i> L.	42.9	0	2.5	3
<i>Phyllanthus urinaria</i> L.	42.9	0	1.9	3
<i>Piper aduncum</i> L.	71.4	0	2.8	3
<i>Pistia stratiotes</i> L.	57.1	0	1.7	2
<i>Plantago major</i> L.	57.1	1	2.9	4
<i>Plukenetia volubilis</i> L.	57.1	1	2.8	3
<i>Pothomorphe peltata</i> (L.) Miq.	0	0	1.1	2
<i>Pouteria caimito</i> (Ruiz & Pav.) Radlk.	14.3	0	Na	1
<i>Pterocarpus ulei</i> Harms	0	0	Na	1
<i>Quararibea cordata</i> (Bonpl.) Vischer	14.3	1	Na	1
<i>Scleria</i> sp.	14.3	0	0.6	1
<i>Spondias mombin</i> L.	85.7	1	19.2	5
<i>Tabebuia serratifolia</i> G. Nicholson	28.6	1	1.7	2
<i>Uncaria tomentosa</i> (Willd.) DC.	100	2	9.3	4
<i>Unonopsis spectabilis</i> Diels	42.9	1	1.9	2
<i>Urera laciniata</i> Wedd.	0	0	0.6	1
<i>Ziziphus cinnamomum</i> Triana & Planch.	14.3	1	7.1	3

<sup>a</sup>Relative Frequency of Citation index (RFCs). The index was obtained by dividing the number of informants, who replied positively on the question: How much is the plant sold now compared to in past five years, by the number of informants participating in the survey ( $N=7$ ).

<sup>b</sup>Harvesting technique: 0 = sustainably harvested; 1 = mostly sustainably harvested; 2 = unsustainably harvested

<sup>c</sup>Total amount: estimated total amount of plant material on the market, na= data not available – these plants were present on the market in the form of seedlings, resin or latex and amounts were not estimated.

<sup>d</sup>No. of stalls: Number of stalls, at which the plant was present (out of 7)



### ***5.3. Wild plants sold on the “Bellavista” market in detail***

This chapter lists wild plants sold on the “Bellavista” market of Pucallpa city, Ucayali Region. For all species scientific name, common name, family and brief taxonomical description is provided.

#### ***Alchornea castaneifolia (Humb. & Bonpl. ex Willd.) A. Juss.***

**Family:** Euphorbiaceae

**Common name:** Iporuro

**Description:** A shrubby tree with an open crown, which can grow 8 to 10 metres tall. The leaves are alternate with simple leaf blade; junction with petiole is usually with two to four glands. The inflorescences are terminal and/or axillary, branched or unbranched. The bracts are small, usually with two basal glands. The flowers are sometimes sessile. The fruit is a smooth or muriculate capsule. The seeds are globose, usually tuberculate (FNA, 2008).

#### ***Alternanthera brasiliensis Voss***

**Family:** Amaranthaceae

**Common name:** Lancetilla

**Description:** An erect, herbaceous plant that can grow up to 3 m tall but is usually smaller than 1 m. The leaves are usually red, ovate to lanceolate, oppositely arranged, up to 7 cm long and up to 5 cm broad. The inflorescence is spiky or rounded, occurring in the leaf axils or at the ends of branches. The flowers are greenish-white peduncle up to 2 cm long and up to 10 cm long. The fruit is a utricle containing one seed (FNA, 2008).

#### ***Ambrosia peruviana Willd.***

**Family:** Asteraceae

**Common name:** Marco sacha

**Description:** An erect perennial herb, 40 to 200 cm high, frequently with a woody base. The twigs are more or less circular, pubescent with long fine hairs. The leaves are alternating, bipinnate, 4 to 8 cm long with hairy upper and lower surfaces. The inflorescences are unisexual. The subglobose achene is about 2 mm long (Roth and Lindorf, 2002).

#### ***Annona sp.***

**Family:** Annonaceae

**Common name:** Anona

**Description:** Anona refers to an evergreen tree that grows about 5 to 6 m tall. The bark is thin, mostly broadly and shallowly fissured. The leaves are fleshy, oblong to oval 8 to 16 cm long and 3 to 7 cm broad. The flowers are yellow and appear opposite to the leaves on the woody peduncles, 2 to 5 mm long. The fruits create fleshy syncarps, one per flower, usually ovoid to nearly globose, up to 30 cm long. The seed is usually one per pistil, ovoid to ellipsoid, beanlike (FNA, 2008).

***Aristolochia asperifolia* Ule**

**Family:** Aristolochiaceae

**Common name:** Huancahui sacha

**Description:** A perennial woody vine that can reach the height of 20 m. The leaves are entire or lobed, usually with dilated petiole, but often with an undeveloped axillary stipule-like leaf (pseudostipule). The inflorescence is solitary, axillary or in short fascicled racemes. The seeds are compressed, usually winged all around (FNA, 2008).

***Ayapana triplinervis* (Vahl) R.M. King & H. Rob.**

**Family:** Asteraceae

**Common name:** Caguena

**Description:** An ornamental erect perennial herb growing 20 to 30 cm in the height. The leaves are aromatic, purple, 5 to 8 cm long, smooth, opposite and lanceolate. The many flowering heads are each 6 to 13 mm long and bear about twenty pink flowers, which are 6 to 7 mm long. The fruit is a narrowly oblong achene approximately 2 mm long (Taylor, 1996).

***Banisteriopsis caapi* (Spruce ex Griseb.) C.V. Morton**

**Family:** Malpighiaceae

**Common name:** Ayahuasca

**Description:** A woody vine with many branches, growing up to 12 m in the height. The leaves are round and green, 8 to 18 cm long and 5 to 8 cm broad. The flowers are between 12 to 14 mm in size and have five white or pink petals. The fruits are winged achenes. The seeds are black to brown, 12 mm long and 9 mm broad (Ott, 1996).

***Bixa orellana* L.**

**Family:** Bixaceae

**Common name:** Achiote

**Description:** A shrub or small tree, growing up to 7 m in the height. The stem is small and contains latex of yellow-reddish colour. The alternating simple leaves are broad-ovate, 10 to 23 cm long, stipules are small. The flowers are of rose or white colour and are arranged in terminal panicles. The fruit is ovoid to globose, up to 5 cm long and enveloped with prostrate flexible spines or bristles. The fruit is a capsule which opens with two valves. The seeds reach 4.5 to 5.3 mm in length and are surrounded by an orange-red aril (Roth and Lindorf, 2002).

***Brosimum acutifolium* Huber**

**Family:** Moraceae

**Common name:** Tamamuri

**Description:** A large evergreen tree with milky sap, reaching 15 to 25 m. The terminal buds are surrounded by bud scales. The leaves are alternate, 8.5 to 14.5 cm long and 3.5 to 5 cm broad. The leaf blade is oblong, leathery, margins entire, never lobed; venation pinnate. The inflorescences form globose heads. The fruit is a globose syncarp with achenes embedded in enlarged, pulpy pericarp (Majía and Rengifo, 2000).

***Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet**

**Family:** Solanaceae

**Common name:** Toe

**Description:** A semi-woody shrub or small tree, growing 3 to 5 m tall. The leaves are oval, to 25 cm long and 15 cm broad, asymmetrical at the base. The flowers are fragrant, about 24 to 32 cm long and shaped like trumpets. The calyx is tubular, lobed at apex. Corolla is white to yellow-orange, tubular and wide in the apex. The fruit is a spiny capsule 4 to 10 cm long and 2 to 6 cm broad containing many hard seeds (Majía and Rengifo, 2000).

***Caesalpinia spinosa* (Molina) Kuntze**

**Family:** Fabaceae

**Common name:** Tara

**Description:** A thorny shrub to 5 m in height with reflexed prickles along its spreading spinose. The branches have grey bark and are densely covered by leaves. The leaves are bipinnate, oblong-elliptic, often 10 mm long with about 8 pairs of firm, oblong-elliptic glabrous leaflets. The flowers are reddish-yellow, in narrow racemes. The fruit is a red pod, 10 cm long and 2.5 cm broad with 4 to 7 seeds. The seeds are large, round and black when matured (Duke, 1981).

***Cajanus cajan* (L.) Huth**

**Family:** Fabaceae

**Common name:** Puspo poroto

**Description:** A shrub about 1 to 3 m tall. The leaves are trifoliate, alternate, set in a spiral around the stem. The leaflets are oblong and lanceolate, 2 to 10 cm long and 2 to 4 cm broad. The flowers are yellow and the pods contain 3 to 6 seeds. Seeds are gray, sometimes with brown spots, subspherical, 5 mm in diameter (FNA, 2008).

***Cissampelos pareira* L.**

**Family:** Menispermaceae

**Common name:** Abuta

**Description:** A slender tomentose climber. The leaves are peltate, 2.5 to 12 cm long, 2.5 to 11.5 cm broad, triangularly broad-ovate, or orbicular, tomentose on both sides. The flowers are minute, bisexual. The male flowers are in pedunculate branched cymes, clustered in the axil of a small leaf. The female flowers are clustered in the axils of orbicular, on 5 to 10 cm long racemes. A drupe is 4 to 6 mm long, 3 to 4 mm broad, subglobose, compressed, hairy-pubescent, red when fresh, black when dry. The seeds are horseshoe-shaped (FNA, 2008).

***Clusia rosea* Jacq.**

**Family:** Clusiaceae

**Common name:** Renaquilla

**Description:** A tree containing yellow latex, usually 6 to 15 m high. The leaves are simple, opposed with a short petiole. The blade is obovate, 8 to 19 cm long and 6 to 16 cm broad. The inflorescences are axillary and terminal, 3 to 5 cm long. The globular fruit is a septicidal capsule, greenish or almost white, 5 to 8 cm in diameter and with 6 to 9 locules. The seeds have an aril (Roth and Lindorf, 2002).

***Copaifera paupera* (Herzog) Dwyer**

**Family:** Fabaceae

**Common name:** Copaiba

**Description:** A tree 20 to 30 m tall. The trunk is erect with rounded canopy. The bark is grey-greenish with small lenticels. The branches are glabrous. The leaves are alternate, compose, coriaceous. The inflorescence is terminal panicle with small, white, bisexual flowers. The fruits are small dehiscent pods with 1 to 4 seeds covered with an orange aril (Brack, 1999).

***Cordia alliodora* Cham.**

**Family:** Boraginaceae

**Common name:** Ajos kiro

**Description:** A large tree that can grow to over 40 m in the height. The bark is smooth, yellowish and garlic smelly. The leaves are simple, oblong or lanceolate to elliptic, up to 5 cm broad and 18 cm long. The inflorescences are loosely branched racemes with small white flowers. The fruit is a cylindrical drupe, enveloped by the persistent corolla and calyx tube (Smith, 1991).

***Couropita guianensis* Aubl**

**Family:** Lecythidaceae

**Common name:** Ayahuma

**Description:** A tall tree growing up to 40 m high. The leaves are oblong, obovate, elliptic or broadly lanceolate 10 to 16 cm long, 4 to 6 cm broad. It has large rose-coloured to yellowish flowers which arise in racemes from the stem and older branches (cauliflory). The fruits (cannon balls) are nearly globular, reddish-brown, hard outside, pulpy inside reaching an enormous size of 15 to 20 cm in diameter or more and are quite heavy (Roth and Lindorf, 2002).

***Croton lechleri* Müll. Arg.**

**Family:** Euphorbiaceae

**Common name:** Sangre de grado

**Description:** A large tree of 18 to 30 m height. The outer bark is light brown and cracked. The inner bark is light pink, homogenous and smooth, when cut exuding rich and translucent red sap. The leaves are large, pubescent, simple, alternate and spirally arranged. The inflorescences are in terminal spike with small unisexual flowers. The fruit is globose capsule, with three monocarps bivalves (Reynel et al., 2003).

***Desmodium axillare* (Kuntze) Urb.**

**Family:** Fabaceae

**Common name:** Amor seco

**Description:** A weedy, perennial herb that grows to 50 cm tall. The leaves are pinnately three-foliolate. The flowers are usually smaller, in racemes or panicles, axillary or terminal. The calyx is campanulate, four or five-lobed, upper two lobes connate for all or most of length, lower lobes are free. The corolla is white, green-white, pink, purple, or violet. The fruit is a compressed beanlike pod, usually indehiscent (Taylor, 1996).

***Dieffenbachia* sp.**

**Family:** Araceae

**Common name:** Patiquina

**Description:** Patiquina refers to a perennial herb up to 2.5m tall. The leaves are large, simple or alternate containing white spots and flecks. The flowers are small, white-greenish, arranged in the cylindrical spadix. The fruit is a berry (FNA, 2008).

***Dracontium lorentense* K. Krause**

**Family:** Araceae

**Common name:** Sacha jergon

**Description:** An herbaceous plant 2 to 4 m tall. A single giant leaf is pinnately deeply divided and borne on a long thick stem from an underground tuber. The inflorescence, emerges from the ground near the base of the petiole and reaches the height of 1 to 2 m, the spadix is enclosed by a large acuminate maroon spathe (Gentry, 1993).

***Drimys winteri* J.R. Forst. & G. Forst.**

**Family:** Winteraceae

**Common name:** Canelo

**Description:** A slender tree, growing up to 20 m in the height. The leaves are lanceolate, glossy green above, whitish below up to 20 cm long. The flowers are white with a yellow center and comprise a great number of petals and stamens. The fruit is a bluish berry (Fern, 2014).

***Dysphania ambrosioides* (L.) Mosyakin & Clemants**

**Family:** Amaranthaceae

**Common name:** Paico

**Description:** An herb about 50-80 cm tall, with strong odor. Stem is erect, branched; branches are usually slender, pubescent and articulated villous, sometimes subglabrous. The leaf blade is oblong-lanceolate to lanceolate with scattered glands, slightly hairy around veins. The flowers are borne in upper leaf axils, usually 3 to 5 per glomerule, bisexual and female. The utricle is enclosed by perianth. The seeds are horizontal or oblique, black or dark red, glabrous, 0.7 mm in diameter (FNA, 2008).

***Eleutherine bulbosa* (Mill.) Urb.**

**Family:** Iridaceae

**Common name:** Yahuar piripiri

**Description:** An herbaceous, perennial flowering plant with a red bulbous rootstock, producing a clump of grass-like leaves 15 to 75 cm tall. The flowers are small, white, and stellate. Usually a sexually sterile plant, it often does not form a seed (Majía and Rengifo, 2000).

***Equisetum giganteum* L.**

**Family:** Equisetaceae

**Common name:** Cola de caballo

**Description:** One of the largest horsetails. The stems are erect, growing 2 to 5 m tall and are 1 to 2 cm in diameter. The stems are jointed, grooved, hollow except at the joints and bear numerous whorls of very slender branches. There are no leaves, the joints terminate in toothed sheathes. It bears a terminal cone-like catkin, consisting of numerous closely-packed peltae, bearing the sporanges (Vasquez, 1997).

***Erythroxylum coca* Lam.**

**Family:** Erythroxylaceae

**Common name:** Coca

**Description:** A shrub that grows 2 to 3 m in the height. The branches are straight. The leaves, which have a green tint, are thin, opaque, oval, and taper at the extremities. The flowers are small, and disposed in little clusters on short stalks; the corolla is composed of five yellowish-white petals, the anthers are heart-shaped, and the pistil consists of three carpels united to form a three-chambered ovary. The flowers mature into red berries. Seed has a thin testa (FNA, 2008).

***Ficus insipida* Willd.**

**Family:** Moraceae

**Common name:** Oje

**Description:** A tree growing up to 40 m in the height, with tall buttresses. The bark contains white latex. The leaves are bright, narrow to ellipse-shaped, shiny green with yellow veins and long petiolate, 13 to 23 cm long and 5.5 to 10 cm broad. The fruits are yellow-green, 4 to 6 cm in diameter (Majía and Rengifo, 2000).

***Fittonia verschaffeltii* G. Nicholson**

**Family:** Acanthaceae

**Common name:** Motelillo

**Description:** A perennial herb reaching up to 60 cm. The stem is covered in hair. The leaves are opposite, olive green with colorful veins, oval to elliptic 2-4 cm long. The flowers are insignificant redish to white spikes (Perry, 2001).

***Gnaphalium* sp.**

**Family:** Asteraceae

**Common name:** Lengua de perro

**Description:** Lengua de perro refers to a perennial herb growing 15-60 cm high. The stem is silvery green, erect, solitary or more often several strongly decumbent flowering branches arise from the base. The leaves are narrow, oblong to spatulate, apex is rounded to obtuse, base is truncate and wooly on both sides, 1 to 5 cm long. The flowers heads are 3 to 4 mm long, arranged in clusters of 3 to 10. The achene is oblong to elliptic, 0.5 mm long, minutely glandular (FNA, 2008).

***Gynerium sagittatum* (Aubl.) P. Beauv.**

**Family:** Poaceae

**Common name:** Caña brava

**Description:** A tall, rhizomatous, perennial grass that grows up to 6 m. The culms are erect, reed-like. The leaves are cauline, distichous, blades ranges from 40 to 200 cm long and are 20 to 80 mm broad and are clustered towards the top of the stout. The inflorescence is an ovate panicle, 100 to 150 cm long (Kroon and Kalliola, 1995).

***Heliotropium* sp.**

**Family:** Boraginaceae

**Common name:** Alacran

**Description:** Alacran refers to an annual or perennial herb that grows 15 to 80 cm high. The leaves are alternate or opposite. The blade is elliptic ovate to lanceolate, with acuminate or obtuse tip 1.5 to 9 cm long and 0.7 to 4 cm broad. The terminal

inflorescences are in scorpioid cymes. The flowers appear solitary or in pairs. The fruits are laterally compressed, rugose, and densely covered with small vesicles, producing two mericarps, each with two seeds (Roth and Lindorf, 2002).

***Heteropsis flexuosa* Kunth**

**Family:** Araceae

**Common name:** Tamishi

**Description:** A hemi-epiphytic liana climbing up to 15 to 20 m on a tree trunk. The roots are dimorphic, classified either as anchor roots or feeder roots. The leaves are distinctive, distichous with strong marginal collecting veins. The flowering shoots usually have short internodes and buds on the first few internodes of the apical region. The fruits are berries with two to four seeds (Gentry, 1993).

***Himatanthus sukuuba* (Spruce ex Müll. Arg.) Woodson**

**Family:** Apocynaceae

**Common name:** Bellaco caspi

**Description:** A tree that grows up to 20 m in the height. The leaves are lanceolate to elliptic, alternate 11 to 37 cm long and 3 to 11 cm broad. The inflorescences are in panicles, terminals, to pseudoaxillares up to 20 cm with each division protected by a white bract. The flowers have small calyx, white corolla is about 2 cm long. The fruits are two leathery, glabrous follicles of ellipsoid shape. Seeds are winged and appear in great number (Majía and Rengifo, 2000).

***Hura crepitans* L.**

**Family:** Euphorbiaceae

**Common name:** Catahua

**Description:** An evergreen tree reaching 10 to 40 m in height. The stem and branches are spiny. The leaves are more or less orbicular or broadly ovate, 5 to 10 cm long. The unisexual flowers are apetalous. The capsules which are 3 to 4 cm long and 6 to 8 cm broad are profoundly surcate, indicating the position of the numerous cocci inside. Their shape is depressed-globose. They contain about 11 oneseeded cocci. The capsule opens in an explosive manner through a throwing mechanism, when the fruit dries out (Roth and Lindorf, 2002).

***Imperata brasiliensis* Trin.**

**Family:** Poaceae

**Common name:** Cashausha

**Description:** A perennial rhizomatous grass with solid, erect stems and silky inflorescences. It grows from 0.6 to 3 m tall. The leaves are mostly basal, about 2 cm broad near the base of the plant and narrow to a sharp point at the top, the margins are finely toothed. The main vein has a lighter colour than the rest of the leaf and tends to be nearer to one side of the leaf. The upper surface is hairy near the base of the plant while the underside is usually hairless. The inflorescence is 7-20 cm, terminal panicle; the fruit is a caryopsis (FNA, 2008).

***Inga edulis* Mart.**

**Family:** Fabaceae

**Common name:** Guaba

**Description:** A small tree that grows 3 to 8 m high. The outer bark is smooth and greyish-brown. The leaves are compound, alternate and paripinnate with winged brown rachis and deciduous stipules. The inflorescence is on axillary spikes or terminal spikes up to 7 cm long. The fruit is dark green-brown cylindrical indehiscent pod, with multiple longitudinal grooves, 40 to 120 cm long. The number of seeds is 10 to 20 per fruit, they are oblong, black to black-violet and covered by a white aril that seems like sweet cotton (Flores, 1990).

***Jatropha curcas* L.**

**Family:** Euphorbiaceae

**Common name:** Piñon blanco

**Description:** A deciduous shrub which is 1 to 5 m tall. The stem is cylindrical, glabrous, with lenticels and has white latex in the bark. The leaves are simple, alternating, with a petiole, about as long as the blade. The blade is coriaceous, glabrous, of ovate shape, 5 to 10 cm long and 3 to 9 cm broad. The small unisexual flowers are united in cymose inflorescences. The globular fruit is a capsule, 2.5 to 4 cm in diameter with two or three cocci. The black seeds are 1 to 2 cm long, reniform (Roth and Lindorf, 2002).

***Jatropha gossipifolia* L.**

**Family:** Euphorbiaceae

**Common name:** Piñon colorado

**Description:** A Shrub, reaching the height of 1 to 2 m. The membranaceous leaves are 6 to 10 cm long and 7 to 15 cm broad. The petiole reaches a length of 6 to 8 cm. The flowers are unisexual and occur in paniculiform cymes. The bracts are 8-10 mm long, linear-oblong and have glandules. The capsule measures approximately 1 cm in diameter (Roth and Lindorf, 2002).

***Lonchocarpus* sp.**

**Family:** Fabaceae

**Common name:** Barbasco

**Description:** Barbasco refers to a small tree. The root is an important source of rotenone, widely used as an organic insecticide. The leaves are alternate, pinnate. The stipules are absent for most species. The flowers are purple-white, arranged in axillary racemes. The fruits are thin, papery until thick and woody. Contain 1 to 12 seeds (Fern, 2014).

***Mandevilla scabra* (Hoffmanns. ex Roem. & Schult.) K. Schum.**

**Family:** Apocynaceae

**Common name:** Clavo huasca

**Description:** A large, woody vine, which grows up to 80 m in length and contains latex. Leaves are opposite; stipules interpetiolar, reduced to many linear segments. Racemes is axillary, few flowered. Flowers are large. Calyx is deeply divided, with many basal glands inside. The fruits are elongated, bean-like. The seeds are narrowly oblong and comose (FNA, 2008).



***Mansoa alliacea* (Lam.) A.H. Gentry**

**Family:** Bignoniaceae

**Common name:** Ajosacha

**Description:** An evergreen shrubby vine, 2 to 3 m tall. It produces opposite leaves, divided into two ovate leaflets, up to 20 cm long of bright green color. Long and deep lavender flowers with white throat are fading to pale lavender color as they mature. When the plant is crushed, it has specific garlic-like odor (Majía and Rengifo, 2000).

***Maquira coriacea* (H. Karst.) C.C. Berg**

**Family:** Moraceae

**Common name:** Capinuri

**Description:** A large-buttressed tree reaching 45 m in height. It has a smooth-barked cylindrical and conspicuously self-pruning trunk. The latex is cream colored and occurs in the wood, bark and leaves. The leaves are distichous; stipules free, not fully amplexicaul. It has masculine flowers (4 to 10 mm in diameter) in bunches of 1 to 6, while the female flowers occur singly or in pairs. The fruits are ellipsoid or subglobose, around 1 cm in diameter (Gentry, 1993).

***Maranta arundinacea* L.**

**Family:** Marantaceae

**Common name:** Shimipampana

**Description:** Perennial herb growing about 30 to 130 cm tall. It has fleshy, cylindrical rhizomes rich in starch. The leaves are ovate to oblong, 4 to 35 cm long and 3 to 11 cm broad. The stem is erect, often apically branched and has creamy white flowers at the end. Flowers are mostly self-pollinating (FNA, 2008).

***Mauritia flexuosa* L. f.**

**Family:** Arecaceae

**Common name:** Aguaje

**Description:** Tall dioecious palm with a branchless stem, about 15 to 20 m (30 m) high. The leaf is about 80 to 120 cm long; the petiole (with prickles) reaches 2 to 3 m. The 2 to 3 m long spadix is pendant and has about thirty branches. The fruit is globular with a depression at the apex and measures about 4 to 6 cm in diameter. The pericarp is scaly on its outside and is red when it is riped (Roth and Lindorf, 2002).

***Maytenus macrocarpa* (R. & P.) Briq.**

**Family:** Celastraceae

**Common name:** Chuchuhuasi

**Description:** A tree that grows to 30 m high. The leaves are leathery, fleshy, 10 to 30 cm long. The flowers are small and have white to greenish color. The bark is smooth, reddish-brown, extremely heavy and tough (Taylor, 1996).

***Minthostachys mollis* (Kunth) Griseb.**

**Family:** Lamiaceae

**Common name:** Muña

**Description:** Perennial aromatic semi-shrub that reaches 30 to 200 cm in height. It has many small dense, erect and parallel branches starting at the base of the stem. The leaves are small, ovate, serrated and placed opposite to each other. The white tubular flowers are united in short racemes. Its aroma is similar to that of mint (Ojeda et al., 2004).

***Ocimum* sp.**

**Family:** Lamiaceae

**Common name:** Albahaca

**Description:** Is a genus of aromatic annual and perennial herbs and shrubs in the family *Lamiaceae* with about 100-150 species worldwide. The leaves are petiolate and dentate, often opposite and silky. The flowers are usually small, white and arranged in a terminal spike. The nutlets are ovoid or subglobose, smooth or glandular, with a white basal areola (FNA, 2008).

***Oenocarpus batau* Mart.**

**Family:** Arecaceae

**Common name:** Ungurahui

**Description:** A palm tree reaching the height of 20 m. The stem is solitary, erect and smooth. The leaves are erect, 1 to 1.5 m long, more or less pendulous, forming a funnel shaped crown. The inflorescence has numerous pendulous branches to 1.2 m long, born on a very short axis. The fruits are elongate, 2.5 to 4 cm long, purple when ripened, pointed at apex (Galeano, 1992).

***Ormosia* sp.**

**Family:** Fabaceae

**Common name:** Huayruro

**Description:** Huayruro refers to an evergreen tree reaching the height of 25 to 35 m, with a large, moderately dense, rounded crown. The leaves are compound, usually whorled or clustered in a group on the twigs, 7 to 21 cm long and 3.5 to 8 cm broad. The flowers are pink, clustered in panicles. The pods are about 5 to 9 cm long and 2 cm broad, containing hard, shiny seeds, which are bright red or half red and half black (Gentry, 1993).

***Petiveria alliacea* L.**

**Family:** Phytolaccaceae

**Common name:** Mocura

**Description:** An herb that reaches up to 150 cm in the height. The leaves are simple, alternating. Blades are small-elliptic, 6-18 cm long, with an acuminate tip, entire margins and an attenuate base. The flowers are in axillary or terminal spikes, which are 10 to 40 cm long. The fruit is elongated 80 to 100 mm long, and provided with four hooks that are bending downwards (Roth and Lindorf, 2002).

***Phyllanthus niruri* L.**

**Family:** Phyllanthaceae

**Common name:** Chanca piedra

**Description:** A small, erect, annual herb which grows 50 to 70 cm in height. The leaves are small, arranged in two rows resembling compound leaves. The bark is smooth and light green. The flowers are pale green and often flushed with red. The fruits are tiny, smooth capsules containing seeds (Gentry, 1993).

***Phyllanthus urinaria* L.**

**Family:** Phyllanthaceae

**Common name:** Chanca piedra blanca

**Description:** A small tropical annual herb growing up to 60 cm in height. The stem is red and erect. The leaves are small, alternate, disposed in the two ranges. The flowers are

greenish white, minute and appear at axiles of the leaves. The fruits are small, green-red, round and smooth and are found along the underside of the stem (Gentry, 1993).

***Piper aduncum* L.**

**Family:** Piperaceae

**Common name:** Matico

**Description:** A shrub growing 6 to 7 m in the height. The leaves are alternate, distichous, lanceolate, 12 to 20 cm long. The inflorescence is a leaf-opposed, white to pale yellow curved spike that contain many minute flowers. The fruit is one-seeded drupe. The seeds are brown to black with a reticulate surface (Majía and Rengifo, 2000).

***Pistia stratiotes* L.**

**Family:** Araceae

**Common name:** Huama

**Description:** A floating, stemless, stoloniferous herb. The leaves are simple, without a stem, thick, 2 to 20 cm in length, forming a rosette. The flowers are dioecious, small, white to pale green, hidden in the middle of the plant amongst the leaves. The fruits are small green berries. The roots are hanging beneath the rosette of leaves and can be up to 50 cm long (Attionu, 1976).

***Plantago major* L.**

**Family:** Plantaginaceae

**Common name:** Llantén

**Description:** A perennial herb which grows 10 to 30 cm tall. The leaves are of oval-shape spirally arranged in rosettes, 5 to 20 cm long and 4 to 9 cm broad. The flowers are small, greenish-brown with purple stamens, produced in dense spikes, 5 to 15 cm long on the top of the stem. The seeds are minute, angulate, dull black, 1 to 1.7 mm long and 0.8 mm broad (FNA, 2008).

***Plukenetia volubilis* L.**

**Family:** Euphorbiaceae

**Common name:** Sacha inchi

**Description:** A thick-stemmed liana reaching 2 m in height. The leaves are alternate, heart shaped, serrated, 10 to 12 cm long and 8 to 10 cm broad. Above the blade is very characteristic pair of large narrow glands. The inflorescence is a tenuous raceme or racemose panicle. The fruits are capsules of 3 to 5 cm in diameter and usually consist of four to five lobes. The seeds are oval, dark-brown, 1.5 to 2 cm in diameter and weight 45 to 100 grams (Gentry, 1993).

***Pothomorphe peltata* (L.) Miq.**

**Family:** Piperaceae

**Common name:** Santa maria

**Description:** An erect shrub 2 m high with a succulent stem. The leaves are alternate with petioles up to 21 cm long. The inflorescence is axillary, holding long apical umbels with a set of spikes. The flowers are creamy-white, up to 12 cm long. The fruit is a fleshy drupe of brownish color containing one seed (Majía and Rengifo, 2000).

***Pouteria caimito* (Ruiz & Pav.) Radlk.**

**Family:** Sapotaceae

**Common name:** Caimito

**Description:** A tree with a pyramidal or rounded crown which grows up to 35 m. The bark contains gummy latex of white or reddish color. The leaves are alternate and highly variable, from ovate-oblong, obovate to elliptic, 10 to 20 cm long and 3.5 to 6.5 cm broad. The flowers occur separately or in clusters of two to five. They appear on the leaf axils on long, thin shoots. The fruit shapes vary from round to oval. When ripe, it has smooth bright yellow skin and contains one to four ovate seeds (Morton, 2013).

***Pterocarpus ulei* Harms**

**Family:** Fabaceae

**Common name:** Maribuena

**Description:** Large, deciduous tree growing 30 to 40 m tall, with large and high buttresses. Leaves are 12 to 22 cm long, alternate, imparipinnate, with 5 to 13 leaflets. The inflorescence is a simple raceme growing on the terminal or axillary panicles, containing numerous flowers. The flowers are yellow, 6 to 13 cm long. The fruits are indehiscent pods, broadly hardened and winged around margin, usually with one, oblong seed (FNA, 2008).

***Quararibea cordata* (Bonpl.) Vischer**

**Family:** Malvaceae

**Common name:** Sapote

**Description:** A large, semi-deciduous tree growing up to 40 m, sometimes buttressed with gummy yellow latex. Leaves are alternate, long-petioled, clustered in rosettes near the ends of the branches, normally 15 to 30 cm long and nearly as wide. The flowers are short-stalked, yellowish-white, about 2.5 cm wide, borne in masses along the lesser branches and on the trunk. The fruit is rounded, ovoid or elliptical. The rind of the fruits is thick, leathery, greenish-brown. The flesh is soft, orange-yellow, sweet and of agreeable flavor and surrounds two to five seeds (Morton, 2013).

***Scleria* sp.**

**Family:** Cyperaceae

**Common name:** Cortadera

**Description:** *Scleria* is a genus of flowering plants in the sedge family. The plants of this genus are mostly perennial, sometimes annual. Some have rhizomes. They produce solitary stems or clumps of many. They are a few centimeters tall to well over one meter. They have few leaves or many. The inflorescence is variable, terminal, paniculate, usually stout and elongated, sometimes reduced into a discontinuous spike bearing one to many spikelets. Nutlets are brick red, white, or yellowish purple, spherical or ovoid, often obtusely 3-sided, smooth or variously sculptured, mostly shiny, glabrous or hairy (FNA, 2008).

***Spondias mombin* L.**

**Family:** Anacardiaceae

**Common name:** Ubos

**Description:** A large deciduous tree, about 6 to 25 m high, with a straight stem. The bark is smooth and has vertical fissures. The leaves are alternate, imparipinnate and 10 to 50 cm long. The inflorescences are in the form of pyramidal terminal panicles, about 30 to 40 cm

long. The white flowers are fragrant. The yellow drupaceous fruit is ovoid to oblong and 2 to 4 cm long. The mesocarp is fleshy and edible. The seeds are large and up to 3 cm long (Roth and Lindorf, 2002).

***Tabebuia serratifolia* G. Nicholson**

**Family:** Bignoniaceae

**Common name:** Tahuarí

**Description:** A tree that grows up to 30 m in height and has large buttresses at the base. The leaves are bright-green, palmately compound, composed of 3 to 5 leaflets. The yellow tube-shaped flowers are borne in clusters at the end of branches. The fruit is a long, narrow capsule that is divided into two parts each of which contains many winged seeds (Majía and Rengifo, 2000).

***Uncaria tomentosa* D.C.**

**Family:** Rubiaceae

**Common name:** Uña de gato

**Description:** A woody vine with hook-like thorns, which can grow up to 30 m tall. The leaves are of herbaceous consistency, elliptic, 5 to 9 cm in length, and grow in opposite whorls of two. The flowers are united in dense solitary heads which develop axillary or terminally. The infructescence develops numerous fusiform brown capsules, 18 to 24 mm long and 5 to 7 mm in diameter (Roth and Lindorf, 2002).

***Unonopsis floribunda* Diels**

**Family:** Annonaceae

**Common name:** Icoja

**Description:** A tree growing up to 20 m in the height. The stem has fissured bark with reddish sap. Branches are glabrous. Leaves are elliptic-obovate, 12 to 25 cm long and 4 to 8 cm broad. The apex of the leaf is acuminate at the base cuneate to obtuse, glabrous on both sides. The flowers are creamy; perianth has tiny sepals united at the base. The fruits are black and fleshy, 15 to 20 mm in diameter (Majía and Rengifo, 2000).

***Urera laciniata* Wedd.**

**Family:** Urticaceae

**Common name:** Ishanga

**Description:** A deciduous shrub reaching 5 m in the height, covered in spines and stinging hairs. The thin, toothed leaves are up to 25 cm long and 12.5 cm broad. The blades are borne on long petioles. The inflorescence is a pink or purple cluster of flowers (Gentry, 1993).

***Ziziphus cinnamomum* (Mart.) Sandwith**

**Family:** Menispermaceae

**Common name:** Achuni sanango

**Description:** A tree growing up to 30 m in height. The leaves are alternate, petiolate, distinctly triplinerved or rarely pinnately veined. The flowers are yellow-green, small, and bisexual, clustered in axillary cymes. The fruit is a globose or oblong drupe, with fleshy and soft mesocarp. Each fruit contain a single seed. The seeds are ellipsoid, smooth, without endosperm, 3.2 cm long and 1.5 cm wide (FNA, 2008).

## 6. Discussion

### *6.1. Wild plants sold in the form of non-timber forest products*

In our study we documented 138 non-timber forest products represented on the market by 68 wild plant species. Our results show that the most represented family was Fabaceae. The fact that Fabaceae belong to the species-richest families is frequently cited in previous ethnobotanical market studies (e.g. Kidane et al., 2014; Van Andel et al., 2012; Albuquerque et al., 2009; Sanz-Biset et al., 2009).

Woody species represent 66% of all studied species present on market. Previous studies carried out in Peruvian Amazon have shown woody species are most abundant plant life forms sold on the local markets Sanz-Biset et al., (2009) and Bussmann et al., (2007). Result also corresponds to study conducted in Ghana by Van Andel et al., (2012).

Figure 4 illustrates the percentage of plant parts commercialized on the market. Most frequently aerial parts (25%), leaves (18%) and barks (16%) were sold. Our result is in correspondence with the results from other local markets in the Amazon basin, where plants are most commonly sold in the form of leaves or as an entire plant (Bussmann, 2013; Monteiro et al., 2010; De-la-Cruz et al., 2007; Macía et al., 2005). However it is interesting to mention the studies from the East and South Africa, where bark and roots seem to dominate local markets for NTFPs, accounting for approximately 50% of the plant products sold (McMillen, 2008; Williams, 2007). This fact could be explained by local climate conditions: in the humid conditions of Ucayali Region, leaves are abundant throughout the whole year, while in dryer regions, such as East and South Africa, people rely more on the roots, seeds and bark (Van Andel, 2012).

Non timber forest products from the “Bellavista” market are most commonly used as a medicine (68%). This result (Figure 5) coincides with many studies worldwide (Kidane et al., 2014; Van Andel et al., 2012; Luziatelli et al., 2010; Bussmann et al., 2006), as nearly 80% of the people in developing countries use traditional medicine, mainly medicinal plants, to cure ailments (McMillen, 2008; Macía et al., 2005). Figure 6 presents mode of preparation of plant species. According to our results, most frequently plant material is consumed fresh (36%), prepared as infusion “like tea” (28%), or boiled in the water (19%). These results corroborate the conclusions of Polesna et al., 2011; De-la-Cruz et al., 2007; Hammond et al., 1998) conducted in the Peruvian Amazon.

## **6.2. Market demand and sustainability of plants harvest**

Despite the long history of NTFPs harvesting (Moegenburg, 2002), attention of conservation scientists has focused relatively recently on the NTFPs management as a potential tool of forest conservation. In the scientific literature of the 1990s we have evidence that management through exploitation of NTFPs may prevent deforestation of natural forest. An idea of linking NTFPs harvest as an alternative to deforestation has become a widely accepted conservation paradigm (Shackleton et al., 2007b; Nepstad, 1992; Panayotou and Ashton, 1992). Other increasingly accepted attitude includes NTFPs as a part of sustainable, diversified forest management to offset the costs of reduced-impact logging (Campos et al., 2001).

On contrary, effects of NTFPs harvesting have important consequences on the ecosystems in which they grow. If harvesting is uncontrolled, extraction may cause forest degradation and in the extreme situation even species extinction (Browder, 1992). Forest degradation and decreasing availability of non-timber forest products are widely noted concerns in the most recent literature focused on NTFPs (Steele et al., 2015; Jusu and Sanchez, 2014; Bussmann and Sharon, 2009). Detrimental impact arises because NTFPs (e.g. species life form, harvested parts) widely vary in the way they are harvested and sold. Sustainability is more difficult to achieve when harvested plant parts (e.g. roots; seeds; bark or whole individuals) are critical for long-term survival of the species. Difficulty of achieving sustainability in NTFPs production is increasing with the intensity and frequency at which products are harvested and with the extent to which they are sold (Belcher & Schreckenberg, 2007).

The removal of wood, roots, or whole plants generally leads to the death of an individual, as does the cutting of bark when ring debarking takes place (Cunningham, 1993). The harvest of leaves, fruits, or seeds is considered to be less destructive (Gaoue and Ticktin, 2007). From total number of species (n=68) eight we have identified (12%) to be harvested from the wild unsustainably, meaning ring debarking was applied, roots or 80 percent of the total reproductive output of the plant is collected (Figure 2). Among them were *Dracontium lorentense*, *Eleutherine bulbosa*, *Heteropsis flexuosa*, *Lonchocarpus* sp., *Mandevilla scabra*, *Marantha arundinacea*, *Mauritia flexuosa*, and *Uncaria tomentosa*.

Out of these eight species we are highlighting three species which might be under the threat of over-exploitation in Ucayali Region: *Mauritia flexuosa*, *Spondias mombin* and *Uncaria tomentosa*. These species were present on the market stalls in the highest amounts

and also for those species market demand in the last five years was increased most significantly. *Uncaria tomentosa* is mostly traded as a bark and harvesting normally involves debarking of the whole plant. Trade of *Uncaria tomentosa* involves such a large volume that, in fact, collectors of this primary forest liana started complaining about a lack of resource years ago (Bussmann and Sharon, 2009).

Another species *Mauritia flexuosa* is one of the most commonly found palms in the Amazon, and forest dwellers currently invest substantial effort in gathering fruits from these palms to generate income (Coomes et al., 2004). Until recently, in many Amazonian locations the fruit-bearing female palms in the wild are cut down, as the mature palm tree are typically more than 20 meters in the height and make the fruit difficult to harvest (Holm et al., 2008). The male palms of this dioecious species do not bear fruits and therefore are left standing. Only female palm cutting leads to nonviable populations of the species (Manzi and Coomes, 2009). The same way of harvesting was indicated also in our results and unsustainable way of harvest was noted also in the study of Gilmore et al., (2013) conducted in the Maijuna communities of the Peruvian Amazon. Gilmore mentions that the relationship that the Maijuna have with *Mauritia flexuosa* has changed considerably over the years as *Mauritia* fruit (appendix 3) went from a subsistence item collected opportunistically from the ground to a market good destructively harvested beginning in the early 1990s. According to Manzi and Coomes, (2009) and Delgado et al., (2007) it is a prime candidate for sustainable management of non-timber forest products in Amazonia.

For *Spondias mombin* there have not been found direct studies concerning the impacts on wild plant populations, connected with its commercialization on the local markets. However, several studies of non-timber forest products emphasize *Spondias mombin* to be an important NTFP worldwide (Herrero-Jáuregui et al., 2013; Ayoka et al., 2008). Within our results we are highlighting significant increase in the market demand for this species in the last five years. Good consumer acceptance of the fruits of *Spondias mombin* which are favoured because of their high nutritional value and taste, which ranges from sweet to sour-sweet, was also mentioned in the study of Maldonado-Astudillo et al., (2014).



## 7. Conclusion

This study documents ethnobotanical data on 68 wild plants sold on the “Bellavista” market in Pucallpa city. Wild plants are mostly represented by non-timber forest products. Within this study 138 NTFPs were investigated. The majority of wild plant was represented by woody plant species collected from the semi-evergreen, seasonal forest or old fallows around Pucallpa city. Among 138 listed non-timber forest products 98 were used by the local people as a medicine and standard way of remedies preparation was infusion.

Most of the wild plant species were harvested in the sustainable manner; however 8 out of 68 studied species are threatened by the way of their collecting. We have found that under the threat of over-exploitation are *Mauritia flexuosa*, *Spondias mombin* and *Uncaria tomentosa*. For these species an increase in demand in the last five years was most significant and they were present on the market in the highest volumes of all the studied plants. *Spondias mombin* has not been documented in previous studies concerning the impacts of harvest on the wild plant species. To sustain an increase in the market demand it may be necessary to cultivate some of the most required species. Researchers and forest managers should work with local harvesters to design and evaluate management practices and encouraged them to preserve existing wild plant populations essential for sustainable harvest.

There is no doubt that a further research of the wild plants commercialized on the local markets in developing countries; especially with an overlap to biodiversity conservation would be valuable in general. At present, knowledge on biology, abundance and distribution of many wild plant species, as well as the long-term studies that focus on the ecological impacts of wild plant harvest in the Ucayali Region are lacking and need to be documented. Our study is pointing out the trend of increasing marked demand for wild plant products harvested around the Pucallpa city and aims to serve as a background for further research focused on the sustainable management of plant resources.

## 8. References

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## Appendices

Location of Marketplace: \_\_\_\_\_

Collector: \_\_\_\_\_ Collection Number: \_\_\_\_\_ Date: / /

**INFORMATION ON THE VENDOR:**

Name: \_\_\_\_\_

Type of Vendor: Permanent stall Temporary stall Ambulatory

Gender: male female Estimated age: \_\_\_\_\_

How often do they sell here? \_\_\_\_\_ In other markets? \_\_\_\_\_

**INFORMATION ON THE COLLECTION:**

Local name: \_\_\_\_\_ Lifeform: \_\_\_\_\_

Village: \_\_\_\_\_ Vegetation type: \_\_\_\_\_

Cultivation status: cultivated managed wild

Marketing status: gathered by vendor resold

How is the plant/plant part harvested?

Condition of plants: fresh dried preserved: \_\_\_\_\_

Brought to market: daily weekly on occasion

Estimated quantity: vendor \_\_\_\_\_ whole market \_\_\_\_\_

How much sold now compared to in past five years: more same less

Why? less available less demand by buyers other \_\_\_\_\_

Use: \_\_\_\_\_

Plant part used: \_\_\_\_\_

Preparation: \_\_\_\_\_

Notes: \_\_\_\_\_

**HERBARIUM INFORMATION:**

Botanical family \_\_\_\_\_ Scientific name: \_\_\_\_\_

No. \_\_\_\_\_

Localización de Mercado: \_\_\_\_\_

Collector: \_\_\_\_\_ Collection Number: \_\_\_\_\_ Date: / /

**INFORMACIÓN SOBRE EL VENDEDOR:**

¿Cuál es su nombre?: \_\_\_\_\_

¿Es usted un vendedor: Permanente ocasional o ambulante?

¿Cuál es el nombre de su ciudad o pueblo?/ ¿De dónde viene?: \_\_\_\_\_

Gender: male female Estimated age: \_\_\_\_\_

¿Con qué frecuencia vende aquí? \_\_\_\_\_ ¿Vende en otros lugares? \_\_\_\_\_

**INFORMACIÓN SOBRE LA COLECCIÓN:**

¿Cómo se le llama a esta planta (localmente)?: \_\_\_\_\_ lifeform \_\_\_\_\_

¿De dónde viene el producto?: \_\_\_\_\_

¿En qué tipo de suelo o vegetación crece esta planta? \_\_\_\_\_

¿Es ésta una planta salvaje o cultivada?: cultivated managed wild

¿Usted mismo(a) la cosechó/recolectó o la compró a otra fuente?

¿Cómo se cosecha esta planta/parte de planta?/ Como lo cosechan Usted?

(Marketing status: gathered by vendor/resold)

¿Está fresco, seco o preservado? : \_\_\_\_\_

¿Con qué frecuencia trae este producto al mercado?: diario semanalmente ocasionalmente

Estimated quantity: vendor \_\_\_\_\_ whole market \_\_\_\_\_

¿Cuánto vende de este producto en comparación con los últimos cinco años?: mas igualmente menos

¿Por qué? \_\_\_\_\_

¿Cuál son los usos de esta planta?: \_\_\_\_\_

¿Qué parte de la planta se usa?: \_\_\_\_\_

¿Cómo se prepara?: \_\_\_\_\_

Notas: \_\_\_\_\_

**Appendix 1.** Semi-structured questionnaires adapted from Martin (2004), slightly modified; english and spanish version.





**Appendix 2.** Gathering areas of plants brought to “Bellavista” market, Pucallpa.



**Appendix 3. Stalls offering wild plants on the “Bellavista” market, Pucallpa.**



**Picture 1. Stall with the wild plants on the “Bellavista” market, Pucallpa.**



**Picture 2. Stall with the wild plants on the “Bellavista” market, Pucallpa.**





Picture 3. Stalls with the wild plants on the “Bellavista” market, Pucallpa.



Picture 4. Fruits of *Mauritia flexuosa* sold on the “Bellavista” market, Pucallpa.