

**Ethnography of major wild food plants uses and their
consumption in the Thar Desert of Sindh, Pakistan**



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Abstract

Wild Food Plants (WFPs) are non-cultivated plants, being used as food in food insecure countries including underdeveloped and developing countries. They occupy a key position among economically and medicinally important plants throughout the world. Pakistan, especially deserts as a natural habitat, has a rich diversity of WFPs. The desert's indigenous inhabitants have a wealth of traditional knowledge about the use and consumption of important WFPs. A comprehensive study was conducted in the Thar Desert of Sindh province, Pakistan, for socio-economically beneficial documentation of traditional ethnobotanical knowledge on the nutritional uses of WFPs and the comparison of their consumption among the different cultural groups (i.e., Muslims and Hindus) in the study area. During the ethnobotanical survey, 60 inhabitants of the Thar Desert were interviewed and a total of 25 WFP species belonging to 15 families were reported to be used as natural food, having nutritional and therapeutic values. Mostly WFPs are used as dry fruit due to their natural taste. The fruits have dietary ingredients and don't need to cook. The fruits are usually eaten raw or used to prepare other types of food. Other parts of wild plants like leaves, stems, flowers, cereals, and roots are used as a vegetable and for pickling. The most cited WFP families were Fabaceae (04 species) followed by Cucurbitaceae (4 species) while most of the species belong to herb life forms (species). Among reported plant species, *Commiphora wightii*, *Blepharis scindica*, *Abrus precatorius*, and *Acacia Senegal*, had the highest importance among informants and are considered precious WFPs that are rarely available in different habitats in Pakistan. In life forms, most of the plant species were herbs (60%) while the least reported were shrubs (16%). The most frequently cited plant part used were fruits (11 records) followed by seeds (10 records) and leaves (09 records) while the least used part was the bark. Among the 25 reported WFPs, 19 are used in Muslims and Hindus equally, 3 were reported unique in consumption in Muslims, and 4 were reported unique in Hindus. Most of the plants are consumed as raw and cooked as vegetables. This study was also involved in the collection of some nutritionally important local wild plant species. Results of the study may contribute to the preservation of local knowledge about WFPs and the development of the management and sustainable use of the wild plants of the Thar Desert.

Summary

The importance of wild food Plants (WFPs) cannot be denied as they were a source of food during famine and food scarcity days. They are being used from the day of man on the earth. Non-cultivated or semi-cultivated, natural and native plant species are considered in the category of wild plants. WFPs are a natural source of food and many other nutritional products in food insecure areas throughout the world. WFPs are considered as food buffers in seasons and off-seasons and inhabitants of that area are rich in indigenous knowledge of their importance. In many parts of the Thar Desert, WFPs are consumed as common household food and contribute significantly to the food security of the local population. The desert's indigenous inhabitants have a wealth of traditional knowledge about the use and consumption of WFPs. The study aimed to document the traditional knowledge about wild plants and their importance as a traditionally balanced food and therapeutic source. For these purposes, a comparative study on the WFPs was conducted in the Thar Desert in the province of Sindh, Pakistan to document traditional knowledge about nutritionally important wild food sources and their consumption comparison among major different ethnic groups in the study area.

The research was based on an ethnobotanical investigation of traditional knowledge about the consumption of WFPs. Ethnobotanical methods were used to interview 60 Thar residents in total. During the survey, 25 wild plant species belonging to 15 families were reported with their nutritional values and mode of consumption. Some wild plant species were also gathered and submitted to Herbarium as reference specimens. Herbs were the most common living forms, mostly belonging to Fabaceae, Amaranthaceae, and Cucurbitaceae families. Among the reported species, 19 were commonly used in Muslims and Hindus. *Commiphora wightii*, *Caralluma edulis*, *Cucumis melo var.* and *Pennisetum polystachion* are being used among Hindus; while *Podexis psittularis*, *Zizyphus mauritian* and *Caralluma adscendens* are being utilized only in Muslims of the Thar Desert. In life forms, most of the plant species (60%) while least reported were shrubs (16%). The most frequently cited plant part used were fruits (11 records) followed by seeds (10 records) and leaves (09 records) while the least used part was the bark. The most dominant mode of utilization was eaten raw and cooked as vegetables. During this research study, novel nutritional uses of some species were reported as there are only medicinal uses reported and no literature exists on the consumption of these species as a portion

of food. *Citrullus colocynthis* belonging to the family Cucurbitaceae was reported to use this species as food. Fruit, Seed, Root and Leaves are being utilized as Raw Snacks. The findings of the present study reveal that plants in the study area are major sources of food for residents. The scope of this project is limited to the first report on an ethnobotanical exploration of wild plants being used as food in Sindh's Thar Desert.

Chapter 1

Introduction

Plants that do not grow in a controlled environment are referred to as "wild plants". It primarily consists of native species that grow in their natural territory but are occasionally managed, just like discovered species that have grown naturally (Rexhepi et al., 2013). Aside from that, many other species are regarded as "wild" and labelled as such, either for marketing reasons (a positive term) and also as a negative effect (a negative term). For instance, cultivated, wild, or semi-wild trees include *Juglans regia* L., *Prunus avium* L., *Mespilus germanica* L., *Sambucus nigra* L., and others, depending on the area and circumstances, and sometimes formerly cultivated and then relinquished. *Allium schoenoprasum* L. in modern Estonia; *Origanum vulgare* L. in Spain and *Scolymus hispanicus* L. in southern Italy are examples of wild types of plants that were brought to the garden from the wild and cultivated actively for culinary purposes, either because of the anticipated greater yield, instant accessibility, or limited availability in the area. Many of the herbs being used for making tea are also extensively cultured, but many people still refer to them as wild plants. However, a few species that become native-born and are collected from meadows but are still unsupervised by people, such as *Armoracia rusticana* and *Calendula officinalis* L. in Estonia, are still deemed cultured. When asked about wild plants, people also inform the ethnobotanist about worth eating uses of species that are chiefly cultivated for non-edible and other food purposes. *Bidens aurea*, *Chenopodium ambrosioides* L., *Carum carvi* L., while in Scandinavia, *Aegopodium podagraria* L., and *Myrrhis odorata* L. are popularly considered "wild" (Svanberg, 2012).

Wild food plants (WFPs) have been used since the dawn of civilization. They provide a full or partial complement for a wide range of items, including food, allopathic medications, fuel, forage, lumber, fertilisers, chemicals, and many more significant goods used on a daily basis. Carotenoids, polyphenols, and other natural nutrients like carbohydrates, proteins, sugars, fibre, and other macro- and microelements are all potential sources of these foods (Martins). Fruits, leaves, flowers, and seeds of untamed trees and bushes are examples of wild edibles.

Especially in food-insecure areas like deserts and dry lands or where the majority of cultivated food plants are normally inaccessible due to off-seasons, both rural and urban inhabitants regularly use WFPs as a source of natural food. Over 50% of the world's ice-free area is covered by a diversity of vegetation, including multiuse forests and desert rangelands (Foley et al., 2011). Between 30,000 and 70,000 plant species are thought to be utilised as traditional foods and remedies globally (Verpoorte, 2012).

WFPs have served as a buffer food during times of starvation and food scarcity and have helped save countless lives. Major famines were brought on by underutilised WFPs and their wild counterparts in Bangladesh (1974–75), India (1965–66), and Africa (1973–and 1984–85). (Bell, 1995; FAO, 1999). Millions of people lack access to enough food to meet their daily needs all across the world (Charles et al., 2010). Nearly two billion people are thought to suffer from micronutrient deficiencies. As a result, economic growth has drastically slowed down (Fao, 2012). Nutritional security becomes brittle when dietary options are constrained to a restricted number of domesticated animals and cultivated crops. Deserts and wooded environments generate a large number of underutilised and nutritionally valuable wild foods, such as fruits and vegetables. As a result, in recent years much attention has been paid to the direct and indirect advantages of wild fruits and vegetables in terms of livelihoods and food security. This has enhanced international efforts to fight unrecognised hunger and maintain nutritional standards during emergencies.

In present times, the utilization of wild foods is particularly more frequent and widespread among rural communities of local inhabitants than in urban populations. Among the WFPs, mostly are wild fruit all around the world, which are known for their edible and dietary value. Most fruits have a sweet taste and generally do not need cooking like most vegetables and cereals. Thus, the fresh or dried forms of wild fruit are extensively eaten in many regions and are also used in making commercial food products. Other parts of WFPs like roots, leaves, unripened fruit, and soft stems are cooked as vegetables also (Aziz et al., 2017a).

Several wild fruits are used as key ingredients in traditional breweries. The chemical composition and mineral content of some wild fruits have been documented to have a high nutritional value in literature (Mayers & Vermeulen, 2002). Wild fruits comprise antioxidants like ascorbic acid, carotenoids, vitamin E, and phenolic compounds such as flavonoid groups,

flavones, flavanones, and anthocyanins which counteract oxidizing substances produced as a consequence of human metabolic activities. Antioxidants have anticancer and cardio-protective capabilities (Lako et al., 2007). During the last decade, several wild fruits, vegetables, herbs, grains, sprouts, and seeds have been studied for novel antioxidant properties (Gioia et al., 2020); (Hmid et al., 2017). Some natural antioxidants (such as rosemary and sage) are currently commercially available as supplements. Many wild fruits include phytochemicals that are useful in medicine; for example, the wild Medlar (*Mespilus germanica* L.) fruit can be used to dissolve kidney and bladder stones and function as a diuretic (Gruz et al., 2011). Local healers or hakims employ the fruits of *Capparis decidua* to treat ailments such as toothache, malaria, cough, and asthma (Zia-Ul-Haq et al., 2011).

Indigenous knowledge of locals about WFPs played a major role. The importance of cultural associations between wild plant diversity and humans cannot be neglected as each culture generates unique knowledge of its surroundings, which is constantly reshaped as a result of ongoing socio-ecological changes. Few studies have been published that explore cultural associations, traditional and indigenous knowledge and local food uses, and man-wild plant interactions in many parts of the world. For a long time, the ritual, therapeutic, and symbolic usage of some key plant species have been deeply ingrained across ethnic local societies. There is also insufficient research on the consumption of WFPs among different ethnic and religious groups of indigenous communities (Mahapatra et al., 2012).

Numerous research have looked at the use and collection of WFPs as well as their nutritional content in various Asian, European, and African nations during the past ten years. Spain, France, Italy, Cyprus, Greece, Turkey, and other Mediterranean nations (Stefanaki & van Anandel, 2021). They support the economies of the indigenous communities in these nations and are a crucial part of peoples' diets. Southern Italian farmers use traditional plants that have undergone extensive research and are crucial to the region's economy (Nebel et al., 2006). Wild fruits, vegetables, nuts, and legumes, including those from Finland, Japan, Greece, Yugoslavia, Holland, Italy, and America, make up 40% of Cretans' daily calorie intake (Caprara, 2018). In India's Central Himalayan mountain area, wild edible fruit-based juices, squash, jams, and jellies have significant commercial potential (Dhyani et al., 2010).

An ethnobotanical study was conducted to identify the WFPs area in Gorbeialdea (Biscay, Iberian Peninsula), as well as to assess the cultural significance of various species and food categories. Between 2008 and 2010, 103 informants were questioned regarding the traditional use of wild plants for nourishment in the field. 49 species were found to be edible, and 45% of them were being collected for their fruits. Other northern Iberian Peninsula regions also include the most significant wild species (*Prunus spinosa*, *Rubus ulmifolius*, *Castanea sativa*, *Fragaria vesca*, *Rumex acetosa*, *Vaccinium myrtillus*, and *Arbutus unedo*). Three specific uses of the wild species as a source of natural food include the leaves of *Fagus sylvatica*, the seeds of *Pinus radiata*, and the shoots of *Pteridium aquilinum*. The sources claim that up until a few decades ago, eating the fruits of *Quercus robur* and *Quercus ilex* was common (Menendez-Baceta et al., 2012).

In the Austrian Grosses Walsertal Biosphere Reserve, another investigation was conducted. Using standardised questionnaires, 433 individuals from varied socioeconomic and geographic backgrounds discussed their knowledge of wild plants. The data were analysed using descriptive statistics and generalised linear models. The majority of survey respondents were aware of the uses for wild plants. Women, older respondents, and home gardeners reported using wild plants more frequently than males, younger informants, and non-house gardeners. More farmers than non-farmers reported using wild plants, and the value of wild plants as food and medicine is greatly influenced by location. Understanding the intracultural knowledge disparity in the Grosses Walsertal was made easier by the distribution of occupation within homes and the general sociocultural environment. The study of intracultural variation in local knowledge revealed cultural characteristics and placed emphasis on the local knowledge's incorporation into culture (Schunko et al., 2012).

In order to determine people's consumption and interest in mushrooms nowadays, a poll was issued in Sweden in October and November 2017. 100 questionnaires in all were returned. The qualitative analysis included data from open-ended interviews, textual sources, participant and non-participant observations, including information about mushroom foraging behaviours shared on social media sites. Diachronic analysis was carried out with the use of historical materials, including earlier research and ethnographic data sets, to comprehend the changes across time. Sweden has evolved from a mycophobic to a mycophilic society over the last 100 to

140 years, with a significant interest in the usage of wild mushrooms. Mushrooming has become widely accepted in the early twenty-first century, particularly among the middle class but also with Swedes in general. The so-called hipster generation—those who were born in the 1990s—collects mushrooms because they want to grow their own food. The public's interest in mushrooms as a wild food source and Swedish society both have seen major change in recent decades. For many metropolitan Swedes, mushrooming has emerged as a popular pastime among urban dwellers at the beginning of the twenty-first century.

With over half of the population experiencing food insecurity, Pakistan is one of the countries with the lowest rankings on the Food Security Risk Index (NNS, 2011). The employment of WFPs is a crucial component of the methods people employ to deal with challenging circumstances including war, crop failure, insect attack, and drought. Pakistan also has a significant floral variety due to the diverse range of climatic and edaphic environments despite its food deficit. There are many biodiversity hotspots in the area. Pakistani flora comprises approximately 8000 higher plant species, of which about 600 species are nutritionally important (Rashid et al., 2018). In the country's tropical, subtropical, temperate, and alpine woods, a wide range of wild food plants, including underutilized fruits, flourish. Northern Pakistan (upper Punjab and Khyber Pakhtunkhwa), Azad Jammu and Kashmir, and the Punjab and Sindh deserts are home to the majority of domesticated and WFP diversity. Over 90 different species of unusual and wild plants have been found to have excellent potential as food sources. More than 37.5 million individuals in the country lack access to a healthy food despite having access to thus many resources. The main causes of malnutrition are poverty and a lack of knowledge about other food sources (Kabir & Afzal, 2016).

Moreover, there are many WFPs in forests, deserts as well as agricultural land that is less familiar, and under subjugated, and their economic prospects are yet to be investigated. Various deserts have unique diversity of wild plants that have rich ethnobotanical, cultural, and ritual values among the local population as well as at regional and global levels. Meanwhile, deserts are one of the most mysterious places on the globe that always attract adventurers, explorers, and tourists for recreational purposes is a cause of the transfer of plant-related knowledge from desert communities all over the world (Magsar et al., 2018). In deserts, the reliance of local people on WFPs for herbal medicine and food is profound and has a very old history of traditional

ecological knowledge. In Pakistan, deserts including the Cholistan in Punjab and the Thar Desert in Sindh attract many tourists during the monsoon and have a rich diversity of ethnobotanically important nutritional plants.

The value of using wild plants as a source of additional food and as a means of survival during times of famine and drought has long gone unappreciated. Research on the socioeconomic, cultural, traditional, and nutritional aspects of wild food plants is still not given enough attention in Pakistan, despite the fact that traditional knowledge of the medicinal applications of wild plants has been fairly thoroughly documented in some parts of the world (Hosseini et al., 2019). Recent comparative studies in Pakistan have focused on the cross-cultural aspect of WFP collecting and consumption while highlighting the significance of various linguistic and religious groups (Aziz et al., 2021); (Soukand Renata, 2016). Due to practises that mostly involve local experimentation and specialised local competence, modern society nevertheless relies on wild plants to support itself (Yaseen et al., 2019). In the age of industrialization and globalisation, this traditional knowledge is in danger of vanishing (Aziz et al., 2021; Soukand Renata, 2016), and if efforts are not taken to chronicle the local knowledge, it might be lost to future generations. In the Thar Desert, not enough research has been done on the traditional uses of plants for food and medicine. To preserve locals' traditional knowledge of the nutritional advantages of regional WFP variants, which is a result of their various ethnic backgrounds, research is needed (Zenderland et al., 2019).

The ancient wisdom of multiracial groups will help to promote the social and economic applications of wild plants, improve human health worldwide, and address the issue of food security. This study was conducted to find out more about the benefits and applications of numerous edible wild species that are consumed by the residents of the Thar Desert in the Pakistani province of Sindh as vegetables and fruit. The Thar Desert is a desert region with undulating sand hills in the Indian subcontinent. It is split between the Rajasthan state in northern India and the Punjab and Sindh provinces in eastern Pakistan. The terms thal or t'hul, which describe a wide sandy plain, are possibly the origin of the word Thar. Plant-based remedies have been used in the Thar Desert since the beginning of the Christian era, presumably during the Mohanjo Daro and Harappan civilizations. Plant species that generate medicines, essential oils, and other useful products have been employed extensively since the

dawn of numerous civilizations. The Dravidians and the Aryans, two of these civilizations, were masters in herbal medicine. Similar to how numerous civilizations supported their arid rural people using locally sourced foods and plant remedies (Salvi & Katewa, 2016). However, studies of desert cultural civilizations' ethnobotanical practises have received comparatively little attention. The Thar Desert's vegetation is mostly herbaceous or stunted scrub, with a few scatted trees that can withstand drought, especially to the east. Arabic gum acacia and euphorbia are found growing on the hills. *Prosopis cineraria*, often known as the Khajri tree, is widely distributed in the lowlands (Kumar et al., 2018). The natural vegetation in the arid land is sparse and primarily composed of permanent and cyclical species. Most of these are perennials and stunted, prickly, or thorny shrubs that appear in open cluster forms periodically. Common desert plants are scatted throughout the stretches of open grassland (Meghwar et al., 2017). *Acacia nilotica*, *Prosopis cineraria*, *Tamarix aphylla*, *Lycium barbarum*, *Salvadora oleoides*, *Zizyphus numularia*, *Capparis deciduas*, *Acacia jacquemontii*, *Calligonum polygonoides*, and *Leptadenia phytotechnica* are among the perennial species found in the Thar Desert (Arora et al. 2010); (Britannica, 2019).

Objectives of the study

The purpose of this study is to document the traditional knowledge about the use of wild food plants produced in the Thar Desert of Sindh. The study aims;

- To document traditional ethnobotanical knowledge on the nutritional uses of WFPs and to compare among the different cultural groups (i.e., Muslims and Hindus) in the study area.

Chapter 2

Literature Review

Traditional knowledge among indigenous people precedes contemporary civilization. This is mentioned in a number of disciplines, including ethnoecology, ethnobotany, ethnobiology, ethnoentomology, and ethnozoology. Ethnoecology is defined as "the science of how man sees the link between humans, plants, animals, and physical components of an area," in contrast to ethnobotany, which studies human-plant interactions (Toledo, 1992). 2010 (Martin). American botanist Harshberger first used the term "ethnobotany" in 1896 to describe the study of plants used by ancient and indigenous peoples. Since then, it has come to be understood as the study of the traditional knowledge of indigenous populations of contiguous plant variety as well as how people of a given culture and region use indigenous plants. Botany, or the study of plants, is the foundation of ethnobotany.

Different kinds of plants can be found in different places of the world. Plants are used by many communities around the world based on their unique beliefs, knowledge, and previous experiences. Their knowledge of plant utilization is largely unknown to the rest of the world or science. It must investigate the hidden locations and use their plants and understanding of these plants to do so (Cunningham, 2014). Ethnobotany is used to conduct this investigation. Ethnobotanists study how plants are used for a variety of purposes, including food, housing, clothing, medication, and religious rituals (Awan et al., 2011).

2.1 Introduction to Ethnobotany

Ethnobotany is now widely recognized as more than just the study of plants helpful to humans; it is also concerned with the limitations and behavioural repercussions of humans on their plant environment. Nutraceuticals, or the use of plants for health and food, open up new avenues for medical and nutritious plant research. A variety of international and national efforts have been conducted to learn about these goals.

Currently, ethnobotany is focusing on the relationship between humans and plants, which includes the use, awareness, and ecology, rather than on the use of plants by persons. By emphasizing the link between humans and plants, modern definitions of ethnobotany (Balick, 1996); (Cotton, 1996); (Turner, 1995) reflect agreement to include more than just use. There is

disagreement on whether the discipline should emphasize all people or traditional and aboriginal people. Cotton (1996) and Balick and Cox (1996) do not deliver a convincing case for ethnobotany being restricted to traditional and/or aboriginal inhabitants. Ethnobotany is the study of the direct cultural relationship between humans and plants. Humans have acquired attitudes, beliefs, and skills in using plants and their actions have a direct effect on the natural flora with which they interact. Plants impose limitations on humans as well.

Early ethnobotanical research and much of it still is today, was primarily descriptive, focusing on compiling lots of plants used for numerous purposes and local names of plants. Such research has proven to be of limited utility in terms of conservation and rural progress. Plants have been used as traditional food and medicine by numerous human civilizations throughout history, and essential knowledge has always been passed down through generations among rural communities (Leaflets, 2010). It is thought to be highly conserved among native peoples at the local, regional, and global levels, particularly in deserts where populations are well accustomed to ancient traditions and cultures (Heinrich & Gibbons, 2010). Many ethnobotanical kinds of research from all around the world have been published.

2.2 Ethnobotanical Studies of Wild Food Plants (WFPs) in the World

Around 30.000 to 70.000 plant species have been documented to be utilized as food and medicines around the world, and a lot of them show significant promise as innovative products (Verpoorte, 2012). In Europe, wild food consumption has much importance due to its low calorie and characteristic flavour. Europeans feel pleasure in gathering wild food and consider it a traditional recreating practice. Manuel-Pardo-de-Santayana et al. (2007) compared traditional knowledge about the consumption of WFPs in six rural regions, campoo, sanabria, Piona, Pico's de Europa, Spain and Portugal. They collected 97 species through semi-structured interview and their relative importance was documented (Pardo-de-Santayana et al., 2007). Schulp et al. (2014) conducted a study on the importance of WFPs, demand, benefits and their special distribution in the terrestrial wild food plant groups of the European Union. They reported that 38 game species, 27 mushrooms and 81 vascular wild plants as consumed throughout Europe (Schulp et al., 2014).

Soukand et al. (2015) conducted a survey of major anthropological literature, historic resources, and a few ad hoc ethno - botanical field studies in seven Eastern European countries (Albania, Belarus, Bulgaria, Estonia, Hungary, Kosovo, and Poland). They discovered 116 plant species belonging to 37 groups that had been abandoned in fermented food or therapeutic food

preparations. The goal of that research was to report conventional plant-based foods and liquors that are still in use or were used in the recent past in the aforementioned Eastern European countries, so that further microbial contamination, nutritious, and medicinal research works could be established to evaluate their rational use (Söukand et al., 2015).

It has been discovered via extensive ethnobotanical research that wild plants are extensively used throughout the Mediterranean region. Recent years have seen a rise in interest in ethnobotanical research conducted in Italy as scientists investigate the traditional uses of plants and their derivatives. Others concentrate on wild edible plants, while some research employ ethnobotany to infer the usage of wild plants as food. Guarrera et al. (2015) conducted 45 semi-structured interviews with farmers, herders, and fishermen in the Italian region of Tolfa Cerite-Manziate to investigate local knowledge of wild plants (Latium, district of Rome). In this section, a basic diachronic comparison between the current study and a prior one conducted in several of the study area's villages is made to highlight probable losses of traditional knowledge of native flora. They compiled a list of 102 plant species from 48 different families, along with their intended usage (other than for food) (Guarrera et al. 2015). Additionally, they discovered a number of herbs from the Fabaceae family, which are fed to cows for their galactagogue effects, and other herbal remedies that are mostly utilised in veterinary medicine, such as *Calendula arvensis*.

Zarba (2019) conducted the study in a region rich in biodiversity and agricultural landscapes (wild plants strip), as well as the birthplace of many civilizations, that is, Sicily. The sample consisted of 134 consumers, 95 of whom came from the Inland Sicilian Hills, i.e. the local contexts of Caltanissetta, Enna, and, to a lesser extent, Catania (provinces of Italy), and 39 from the Hyblaean Plateau (including the provinces of Syracuse and Ragusa). The findings of a sample of all 134 respondents, as well as discussions with local purveyors, demonstrate that interest in wild leafy 'vegetables' for human consumption is ubiquitous, to the point where they are now included among new dietary habits (Zarbà et al., 2019).

Yeşil et al (2019) conducted an ethnobotanical study in Yeşilli district (Mardin, Turkey) to chronicle aboriginal people's traditional knowledge about wild food plants. The information was gathered by interviewing 62 people and then evaluated to assess the cultural value of wild consumable plants and the informants' awareness of them. In their research, they discovered 74 wild edible taxa from 31 families and 57 genera. *Ficus carica subsp. carica*, *Glycyrrhiza glabra*,

Sinapis alba, *Gundelia tournefortii*, *Onopordum carduchorum*, *Malva neglecta*, *Mentha longifolia*, *Juglans regia*, and *Urtica dioica* were the most culturally important taxa, with *Ficus carica* subsp. *carica*, *Glycyrrhiza glabra*, *Sinapi*. The study highlighted the region's cultural richness, and additional research is needed because it is believed that this diversity will benefit the economy. The historic usage of wild plants as food sources will be passed down to future generations as a result of research like this (Yeşil et al., 2019).

There is a significant amount of work related to the consumption of wild edible plants in the new world, North America and South America. Native Americans consume a wide range of wild plants as food. A most comprehensive review of the easily accessible WFPs was produced by Kuhnlein and Turner (2020). They documented 550 different wild species, including fungi, algae, lichen, ferns, and angiosperms, that provide a variety of wild food. Wild food consumption practice has equal importance in Africa also (Kuhnlein & Turner, 2020). Bharucha and pretty (2010) cited that 1500 wild food species are being consumed in the south and central Africa (Bharucha & Pretty, 2010). Maroyi (2014) reported that 24 species belong to 11 families of pteridophytes in Sub-Saharan Africa (Maroyi, 2014).

Within the different regions of Asia, research work in the last two decades provided significant and interesting information about the consumption of wild edible plants. Chen et al. (2014) cited in their review that there are about 1000 to 2000 wild edible plant species existing in Japan, an island country in East Asia (Chen et al., 2014). A significant study on the consumption of WFPs was conducted in China due to food crises. In China, people of mountain areas still use WFPs and stored them for winter season. Zhang et al. (2014) mentioned 350 wetland plant edible species in their review of regional literature (Zhang et al., 2014).

(Shikov et al., 2017) identified 70 wild plant species that have been consumed by local Russian communities, in the Asian part, as food. They compile information on plants that have been used in food for a longer time and that have been published in Russia and other countries. Fermented foods and beverages have an essential role in the global foodscape, food realm, and domestic healthcare policies.

Rafiqul et al., (2019) reported a study exploring WFPs in 14 villages of Brishal, Bangladesh. He documented 43 WFPs belonging to 23 families and 33 genera, along with their English, local and scientific names, fruiting seasons and their medicinal and nutritional uses (Islam et al., 2019). Another documentation of 242 species, belonging to 58 families, was

documented by Mostafa and shaikh (2019). Among the reported species, 50 species were herbs, 49 were shrubs, and 150 were trees (Pasha & Uddin, 2019). In Nepal, Lal B Thapa et al., (2014) reported some WFPs being consumed in indigenous Raji tribes. They documented 67 WFPs belonging to 38 families. They reported the uses of these species in detail with all the nutritional benefits and modes of consumption (Thapa et al., 2014).

Harpreet et al., (2018) prepared an inventory of WFP used in the district Udhampur India and documented 95 edible plant species belong to 48 families. 46 species are being consumed as vegetables and 36 as fruits. Among the reported species, 36 species are also being used as wild phytomedicines in this area. An exploratory analysis was done by Avik et al., (2020) in India. They reported 1403 species across India, belonging to 184 families. Mostly leaves and shoots of the species are consumed in the form of vegetables, pickles or raw (722 species), followed by the consumption in the form of fruits such as raw, juices, dried fruits, and jams (652 species) (Bhatia et al., 2018).

2.3 Ethnobotanical Studies in Pakistan

In literature, various indices including vegetation, geomorphic, climatic, and aridity have been developed to identify and locate the world's major deserts. According to Thomas, (1997) deserts can be classified based on Aridity Index (AI). The aridity index is developed from data on precipitation and temperature recorded over decades at various metrological stations (Parsons & Abrahams, 2009). All over the world, deserts are found in Africa, Asia, South-North America, Australia, and Antarctica. Some of the major deserts are the Sahara, Arabian Desert, Gobi Desert, the Libyan Desert, The Nimb, Kalhari, Taklamakan, Tarim, Great Basin Desert, Mojave Desert, Sonoran Desert, Chihuahuan, and deserts of Australia and Asia.

Due to its different rangelands, ecology, and ecosystems, Pakistan has a vast cultural and botanical diversity. The floral variety regions of Pakistan nearly encompass an area of 803,940 km² and range from high ranges such as the Himalayas, the Karakorum, and Hindukush in the north to plains and deserts in the south, all the way to sea level (Qureshi & Bhatti, 2008). Ethnobotanical studies have been carried out extensively in Pakistan's northern mountainous areas and Punjab plains, while the country's deserts are being investigated.

Sher et al. (2011) collected Ethnobotanical information for 216 species of 89 families of dicots, monocots, and pteridophytes collectively from Chagharzai Valley, District Buner, Pakistan that are being used as traditional medicine and economic food products (Sher et

al., 2011). Parvaiz M. (2014) did a study in Mangowal, District Gujrat, Punjab, Pakistan, to collect aboriginal traditional knowledge about plants and their uses. About 40 local plant species from 22 families were studied, and they were found to be used by native people to treat a variety of maladies and problems including asthma, ulcers, gonorrhoea, piles, stomach ache, and skin diseases (Parvaiz, 2014). Umair et al (2017) compiled a wealth of information on the traditional applications of plants by the people of Hafizabad, Punjab, Pakistan. They gathered ethnobotanical data by interrogating 166 local respondents and 35 outdated health practitioners from Hafizabad district's various locales. There were 85 species identified, divided into 71 genera and 34 families, as well as uses. The plant species *Solanum surattense*, *Withania somnifera*, *Cyperus rotundus*, *Solanum nigrum*, and *Melia azedarach* were the more often consumed ones and had the maximum consumption worth. Gastrointestinal and urinary problems were treated with *Withania somnifera* and *Ranunculus sceleratus*, respectively. According to a comparison analysis, 79 per cent of the described species' usage was documented for the first time (Umair et al., 2017).

Shuaib et al. (2019) spent four seasons in District Dir, Tehsil Timergara, Khyber Pakhtunkhwa, Pakistan, documenting 59 plant species of 39 genera and 28 families used for various therapeutic applications (Shuaib et al., 2019). While 46 plant species were shown to be effective in medicine, just 13 plant species were identified to have ethnobotanical uses, with the majority of species (11) being applied for chest ailments, primarily coughing, as diuretics (4 species), and in respiratory problems (5 species). They believe that documenting knowledge is critical to preserving this valuable old information before it is lost forever due to global technology and environmental developments.

An ethnobotanical trip was carried out to describe the traditional ethnobotanical applications of wild flora in the Dawarian and Ratti Gali (DRG) villages of District Neelam, Azad Jammu, and Kashmir (AJK) Pakistan (Ajaib et al., 2021). District Neelam features a diverse plant community and is home to several indigenous species. The current study discovered by (Mattalia et al., 2020) plants that were previously unknown in the study area (DRG) in AJK's District Neelam. Usman et al. (2021) investigated 58 plant species in total, belonging to 28 taxonomic groups, in southern Punjab, Pakistan, based on information from 200 local experts. For each species, the vernacular name, voucher number, plant components used

and were recorded. Poaceae remained the most common family among the recorded species, followed by Solanaceae and Asteraceae (Usman et al., 2021).

Iqbal et al. (2021) used questionnaires and interviews during field excursions to collect ethnobotanical data from Bhalolpur, Upstream Chenab, River Tavi and River Manawarwala Tavi. There were 119 plant species identified, divided into 54 groups, with 87 dicots, 12 monocots, 11 aquatics, 5 ferns, and 4 bryophytes. 78% of the reported species are used as human sustenance, such as vegetables and fruits (Iqbal et al., 2021).

Aziz et al. (2017) investigated ethnobotanical plants in the Bajaur Agency in Pakistan's Federally Administered Tribal Area (Aziz et al., 2017). Following the interviews, the described plants were gathered and then pressed onto herbarium vouchers for reference. In the research area, a total of 79 plant species were used to cure various illnesses. There were 28 plant species from a highland settlement in the country that had never been named previously. Both *Viola indica* and *W. Becker*, which have certain medical applications in the research realm but are somewhat private, were made public for the first time. Aziz et al. carried out another investigation in the same area emphasising the use of traditional knowledge in veterinary treatment (2018). In order to share ethnoveterinary knowledge with other communities, their research sought to gather it from remote locations. Using ethnoveterinary methods, 73 distinct therapeutic plants have been identified. *Visnaga daucoides* Gaertn., *Foeniculum vulgare* Mill., *Solanum virginianum* L., *Withania somnifera* (L.) Dunal, *Glycyrrhiza glabra* L., and *Curcuma longa* L. were the most commonly utilised plants with the greatest usage reports (URs) (M. A. Aziz et al., 2018).

Regarding the significance of WFPS among various linguistic and religious groups, Aziz et al. (2020) provided more information. They examine three minority populations' traditional wild food plant (WFP) foraging practises in the Kalasha and Lotkoh valleys of Chitral, NW Pakistan (Muslim Ismaili Yidgha, Muslim Sunni Kamkatavari speakers, and Muslim Kalasha). Three mycological taxa and fifty-five locally available wild food plants were discovered during a field survey. Yidgha speakers reported consuming the most WFPs, either as cooked vegetables or as snacks. Yidgha and Kalasha speakers provided the majority of use reports and also mentioned a few WFPs that were specifically used by them. Conclusions of the investigation revealed that lesser tribes had remarkably adapted to the main Kho/Chitrali civilisation (M. A. Aziz et al., 2020). Kharan and Chagi deserts in Pakistan's Baluchistan province are covered in

sand and hills. Dunes, little flora, worn rocks, high salinity, and small natural water dams make up the majority of Pakistan's deserts. Out of Pakistan's 7000 identified plant species, 400 to 600 are located in the country's deserts, which have a unique plant biodiversity (Yaseen et al., 2019).

2.4 Ethnobotanical Studies in the Thar Desert

Various deserts have unique diversity of plants that have rich ethnobotanical, cultural, and ritual values among the local population as well as at regional and global levels. Many studies have been published on the vegetation of various regions of Pakistan, but only a few have focused on ethnobotanical documentation of plants regularly used by diverse groups in deserts. Singh et al. (2012) published ethnobotany research in Spiti, a cold desert in the western Himalayas (Singh et al., 2012). Cold desert, Ladakh was explored by (Rinchen & Pant, 2014). Indian cold desert was studied by Verma & Tewari (2016) regarding traditional practices of wild plants (Verma & Tewari, 2016). The Thar Desert in India has been studied by (Yaseen et al., 2015). Meanwhile, deserts are one of the most mysterious places on the globe that always attract adventurers, explorers, and tourists for recreational purposes is a cause of the transfer of plant-related knowledge from desert communities all over the world (Magsar et al., 2018). In Pakistan, deserts including the Thar Desert in Sindh attract several tourists in the monsoon and have a rich diversity of ethnobotanically important plants.

Ethnobotanical studies are essential for assessing the cultural connections between human and plant groups, especially for rural desert populations that rely on primary healthcare. Local people's reliance on customary herbal therapy is firmly ingrained and has a long history in deserts like Pakistan's Thar Desert. Plant-based remedies have been used in the Thar Desert since the beginning of the Christian era, presumably during the Mohanjo Daro and Harappan civilizations. Plant species that generate medicines, essential oils, and other useful products have been employed extensively since the dawn of numerous civilizations. The Dravidians and Aryans were herbal remedies masters among these civilizations. Similarly, numerous civilizations were reliant on plant treatments in arid rural populations (Katewa, 2008). However, ethnobotanical investigations among desert cultural societies have received very little attention.

We identified only a few references to nutritious and therapeutic plants from Pakistan's deserts, notably those in Sindh, based on a study of past studies. Traditional treatments made from botanicals are still more prevalent in Sindh's desert areas than homoeopathy and biomedical

medicine. Only a few data come from the Nara desert, and most studies on Pakistan's deserts have concentrated on the Cholistan and Thal deserts. But compared to other deserts, the Thar Desert and the areas around it, such as Achro and Thar, have gotten less attention. The Thar Desert's strategic junction with the arid, Palearctic landscapes of South-West Asia and the Sahara and the monsoonal, oriental biomes of South and East Asia makes it possible to study cross-cultural trends in and nourishing wild plants (Blinkhorn, 2012).

Due to sudden climatic changes, long-term drought brought on by insufficient rainfall, famines, and natural disasters, the Thar Desert, which is rich in wild food plants, has a tight relationship to indigenous knowledge that is swiftly disappearing. As a result, Pakistan's deserts, particularly those in Sindh, run the risk of losing their indigenous knowledge of herbal therapy. Locals in Sindh's deserts forage for native wild cuisine made from untamed plants and animals to eat naturally and affordably. They use wild plants in various herbal treatments to cure a variety of problems due to the absence of health services, which fosters the occurrence of illnesses and less hygienic conditions. The natives place a high value on traditional medicine, whose knowledge is transmitted from one generation to the next orally and without written records. The Thar Desert, Nara, and Achhro Thar in Sindh are home to a diverse population of ethnically diverse people. Bhagora, Bheel, Kohli, Meena, Garasia, and Damor are ethnic groups with a long history of cultural connections to plants. The Thar Desert is home to a wide variety of plants, particularly in the Nangerparkar region. These plants include angiosperms and non-vascular basal species. To the best of our knowledge and after a careful study of the literature, there is not enough data on hand regarding the indigenous knowledge of WFPs in Pakistan's Sindh province's Thar Desert, with an emphasis on the usage of ethnobotanical records at the local, regional, and global levels. The floristic richness of plants in Sindh's deserts has to be studied and recorded urgently in order to highlight the value of species on a local to a global scale. The verification of the usage of medicinal herbs from the desert should receive special attention.

Chapter 3

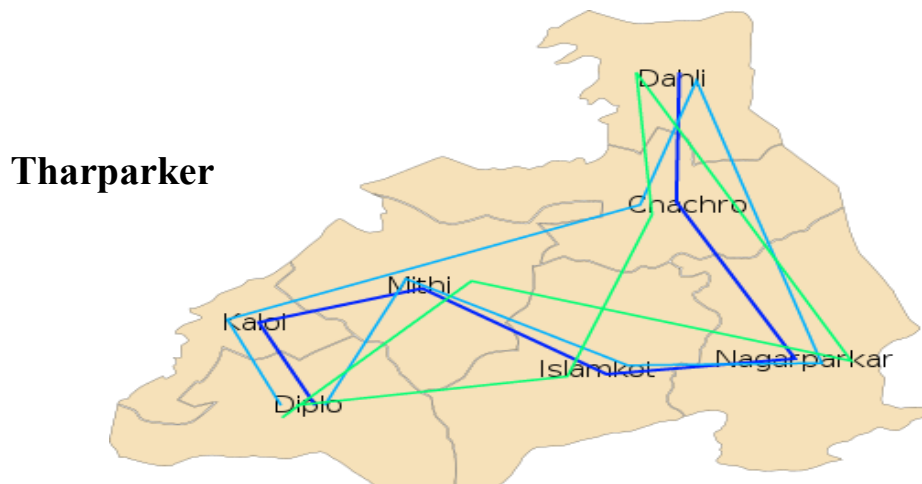
Material and Methods

3.1. Study Area and Communities

The Thar Desert, as well as its extenders Nara and Achro are found in Sindh's deserts, which are located in Pakistan's southern region and the western corner of South Asia. In the east, it shares borders with India's Thar Desert (Great Indian Desert), and in the west, it bonds with the Kirthar range. It continues north into the Cholistan desert, east into the Rajasthan desert, and south into the Arabian Sea, where it combines with the Rann of Kutch. It is ranked 18th overall among deserts and 9th among subtropical deserts. It has the highest population density of any desert on the planet, with 83 people per square kilometre. It has a population of nearly 1.2 million people, according to estimates. It covers an area of about 30, 000 km², with the rest of the Thar Desert being in India. The geography of the area includes dunes, hill outcrops, and alluvial flood flats. Its aridity is similar to that of the Kalahari Desert, with most areas receiving almost exceeding 100 mm of annual rainfall. It is, nevertheless, distinguished by a variety of dry terrain, including slopes in Nangerparkar, valleys and the Indus delta, and the salt land of Rann Kachh in the south, in contrast to Kalhari.


We covered many villages doing the survey, and had a chance to see and live their culture first hand. We spent days there living with them and understanding their problems.


Total Area we covered is around 100 Kilometers.

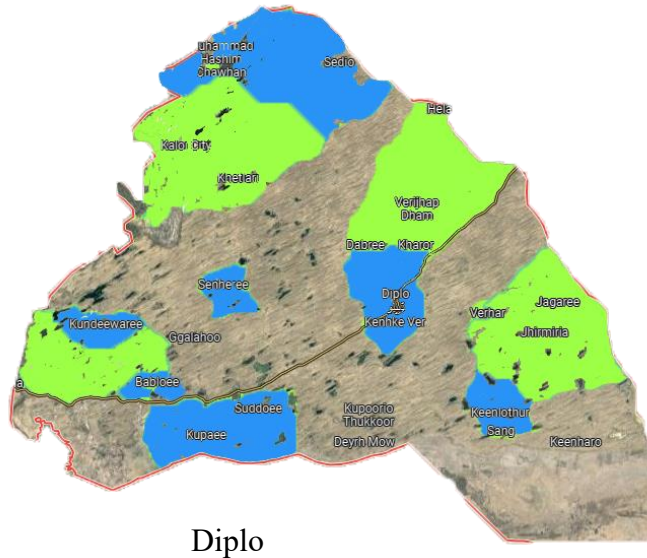


Here are some villages we visited & took survey from, in Diplo and Dahlia, Tharparker.

- Kundeewaree
- Babloee
- Senheree
- Kehtlari
- Muhammad Hashim Chawhan
- Sedio
- Keenlothur Sang
- Kupae


 Survey Taken


 Areas Visited

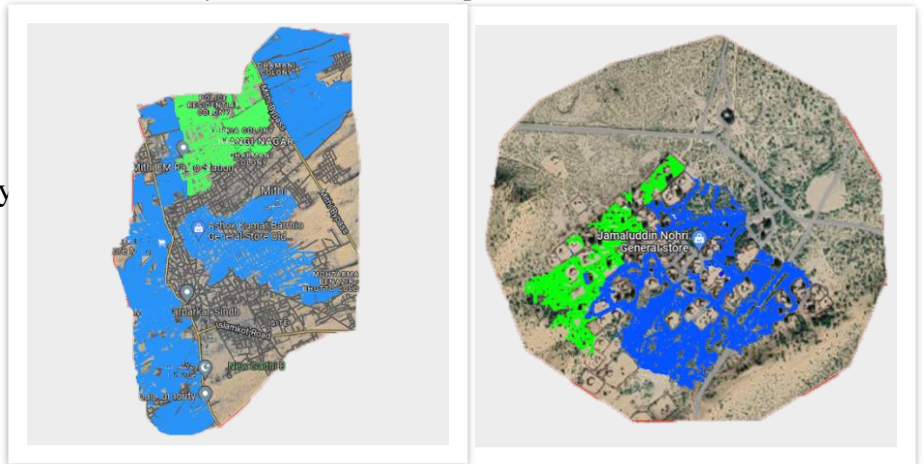


Here are some villages we visited & took survey from, in Mithi, Tharparker.

- Turkia Colony
- Site
- Dhamani Colony
- Police residential colony
- Mithi

 Survey Taken

 Areas Visited



Mithi

Dehlia

High temperatures, less annual rainfall, and a high rate of evaporation are some of the climatic features. The annual range of temperature varies from 20 to 51 degrees Celsius

depending on the season. Temperatures may reach their highest point in May and July, with the lowest point in January. The yearly rainfall ranges from 88 to 135 millimetres, with the greatest months for moon soon rain being July and August. In December, January, and February, however, low-intensity winter rainfall is probable. The normal moon soon is 127.5 mm in records, but due to abrupt climatic changes, it reached a maximum of 443.9 mm in 2011 (Cheema et al., 2012). Water scarcity is common in most areas, limiting agriculture, while groundwater can be found at depths of 50 to 300 feet, with salt concentrations varying. Ponds, dugouts, and tanks filled during moon soon rainfall are the most convenient and readily available source of water (Qureshi & Bhatti, 2005). Droughts, disasters, and uneven rainfalls have severely harmed plant biodiversity in Sindh's deserts over the last half-century as a result of global warming and rapid climatic change.

The Bhagora, Bheel, Kohli, Meena, Garasia, Damor, and Garasia ethnic groups all have a deep traditional connection to herbs. The Thar Desert, particularly the Nangerparkar region, includes a wide range of plants, from lower non-vascular to Angiosperms.

Percentage of Hindu's



3.2. Vegetation of the Thar Desert

Sindh's desert biodiversity is closely linked to the diversity of its habitats (Ch & Khan, 2006). Except for Nangerparkar, most of the regions have sparse vegetation. Drought-resistant perennial herbs and prickly bushes predominate in most areas. *Acacia jaquemonti*, *Commiphora whightii*, *Centenchi tubulosa*, *Euphorbia caducifolia*, *Moringa concanensis*, *Pedaliium murex*, *Senna occidentalis*, *Tecomella undulata* and others are among the most important plant species. The vegetation at Nangerparkar is abundant owing to the landscape and numerous mainsprings and waterfalls. It appears lavish green during the rainy season. Except for a few species like *Tecomella undulata*, *Prosopis cineraria*, and *Acacia Senegal* which develop swiftly throughout the moon and finish their life cycle until winter, tree populations are limited in general. There are niches for native Thar flora and animals in every desert habitat and landform. Economically significant plant species are now in danger or danger of extinction (e.g. *Commiphora wightii* and *Tecomella undulata*). Other indigenous species require certain climatic conditions to thrive and must reproduce and be conserved (Ch & Khan, 2006).

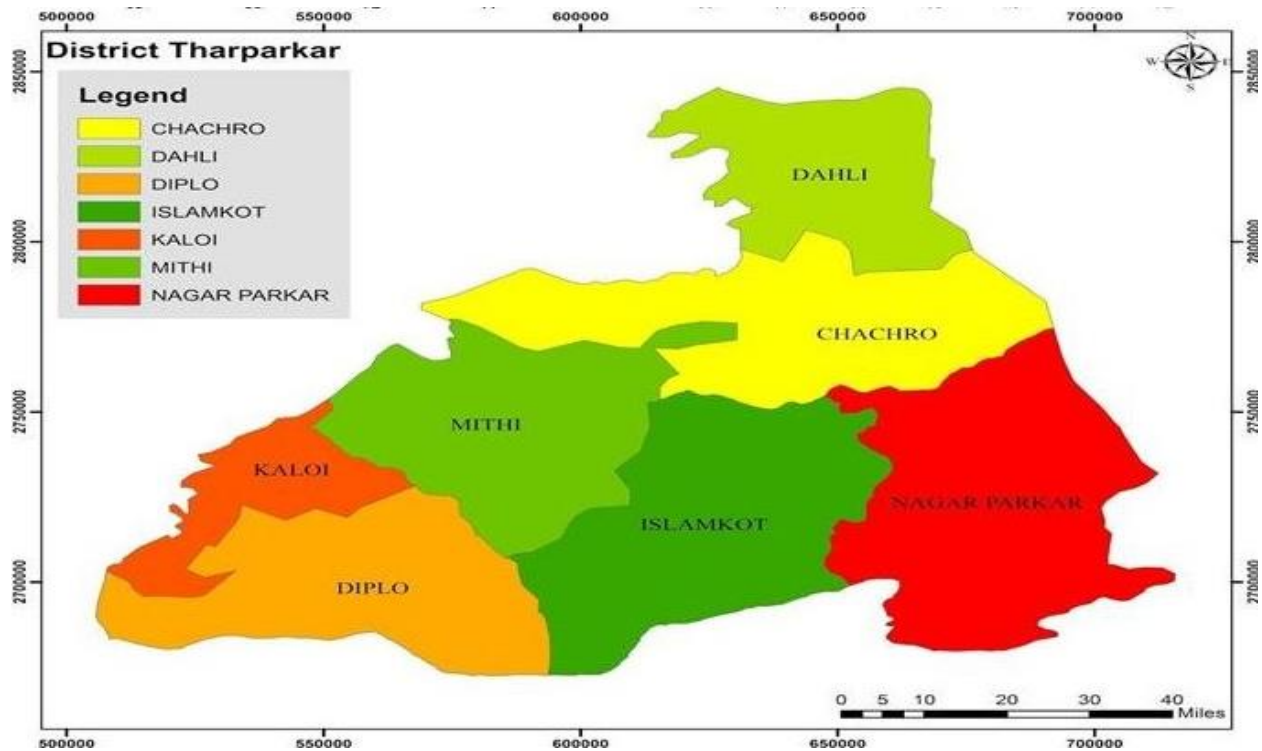


Figure 1: Map of the Study Area (the Thar Desert, Sindh, Pakistan)

The Thar, Achro, and Nara deserts in Sindh are home to sizable populations of people and livestock. Local migrants make up most of the populace, which is distributed based on requirements and precipitation patterns. Although Sindhi is the most common language, several tribes have different mother tongues. The only means of livelihood for the inhabitants of the study area is livestock rearing, which is practised by the Thari people of Sindh's desert regions. The main livelihoods of its citizens are farming or agriculture, which fails due to a lack of water and crop irrigation, or farming, which causes the land clearing of territory. The area frequently experiences drought despite the lack of other things to do. They rely on these occupations as there is a severe dearth of education in the area.

Cultural links to WFPs have a long history in desert cultures, possibly dating back to the start of civilization. Mohan Jo Daro, Harappa, Aryans, and Dravidians are examples of early civilizations (Albuquerque et al., 2017). Prehistoric homo communities were tightly linked to plants used as nutrition and medication, and indigenous treatments were commonly used in the deserts of this subcontinent throughout this time (Ramawat et al., 2009). Locals have inherited traditional wisdom from their grandparents due to their close ties to nature. The rural community has a wealth of knowledge regarding therapeutic characteristics, herbal recipes, and uses, and many features are unidentified external to these communities. Native plants are considered a cultural and important element of these indigenous populations, and knowledge of such plants is always passed down the generations via oral folklore.

Furthermore, nomads who are directly tied to wild flora represent the many indigenous communities of Sindh's deserts. For the majority of nomads, livestock is among their primary income sources, and their status is based on the size of their herd. Nomads use plants for a number of purposes, including fodder, nutrition, shelters, traditional medication, and more.

Sindh's deserts have a rich cultural heritage that has been passed down through the generations and provides a thrilling experience for tourists and visitors. Dhatki, Gujrati, and Sindhi are the most commonly spoken languages, while Urdu is a rarely spoken language. With few exceptions, the joint family system is mostly found in Sindh culture, as it is in other parts of the country. Among family systems, teenage marriage, polygamy, and daughters' weddings against their consent are the most prevalent. Certain lineages and castes are chosen over others, and the teenage wedding is seen as a religious need. Mostly, all three generations live together,

including grandparents, parents, and children, in a joint family system. Males are assigned tasks such as ploughing, weaving, caring for animals, and building houses at the family level, while females are assigned tasks such as cooking, washing, carrying water from lakes and water wells, and assisting males in the field. Sindh's deserts are home to a diverse range of cultures. Rajasthani, Sindhi, and Gujrati are the most popular. Thari is one of the most popular, impressive, and unusual types of music. Expert Thari singers, also known as faqirs, are invited to perform at many carnivals and traditional programs. Mitco, Rasooro, Dandan, and Chakar Rand are the most popular folk dances. Hindus and Muslims are both directly intertwined in each custom, regardless of religious belief. In almost every region of Sindh's deserts, Hindus and Muslims are the two ethnicities. Although Hindus account for 62 per cent of the population and Muslims for 38 per cent, their coexistence demonstrates strong cultural ties that transcend religious differences. Relationships between cultures are seen at cultural festivities. The four most significant cultural events are Maha Shivaratri, Diwali (or Deepawali), Holi and Krishna Janmashtami.

3.3. Ethnobotanical Field Study

The current research was conducted from August to December of 2021. The survey's main goal was to document local knowledge of WFPs' uses among two religious groups. Snowball techniques were used to recruit thirty informants from each of the studied groups to participate in semi-structured interviews. Local people in the study area, which was the Thar Desert in Sindh, Pakistan, were involved. Before beginning field surveys, the university's ethical committee was consulted, and the local administration was notified. During field surveys, intellectual property rights were properly conveyed to residents and study participants. The goals and objectives were discussed in detail before each respondent was interviewed, and each person's contribution was appreciated at each level. The study contributors were chosen based on their long-term relationship with nature. Informants were chosen from a group of middle-aged and elderly residents (ages 52 to 74), including farmers and shepherds, who were thought to be the area's potential knowledge holders. The research respondents were chosen based on their long-term relationship with nature. It's worth noting that we weren't permitted to interview female civic members because of their Pardah ("Veil") practice. (Aziz et al., 2021)

Oral informed assent was obtained before beginning an interview, and the International Society of Ethnobiology's Code of Ethics (Mattalia et al., 2020) was followed. With the assistance of translators, semi-structured interviews were conducted in the two local languages Sindhi and Datki. The information gathered, according to Kujawska and Luczak (Kujawska & Łuczaj, 2015), concentrated on wild plant collecting and consumption patterns such as prepared vegetables, raw snacks etc. The ingestion of edible wild food plants, as well as the utilization of wild plants in everyday eating habits or food fermentation, were researched in depth (Ahmad & Pieroni, 2016). Sindhi and Datki, two native languages, were used to record the names of the taxa that were collected. Each of the free listed plants recorded throughout the survey was given a local name and a local culinary purpose. Qualitative ethnographic data was also gathered through open-ended questions and participant observation.

Information is collected through informed consent semi-structured interviews, focused group discussion, and village walk with key informants in which all the questions were asked from the 60 residents of the Thar Desert to attain the research objectives of this field study. The implication of each species is documented based on the use of reports given by participants in each study area. The ethnobotanical inventory includes the plant's local name, the parts utilized, the technique of preparation, the mode of application, and the disease treated. Plant identification is primarily based on native names with the support of experienced local informers (Majeed et al., 2021).

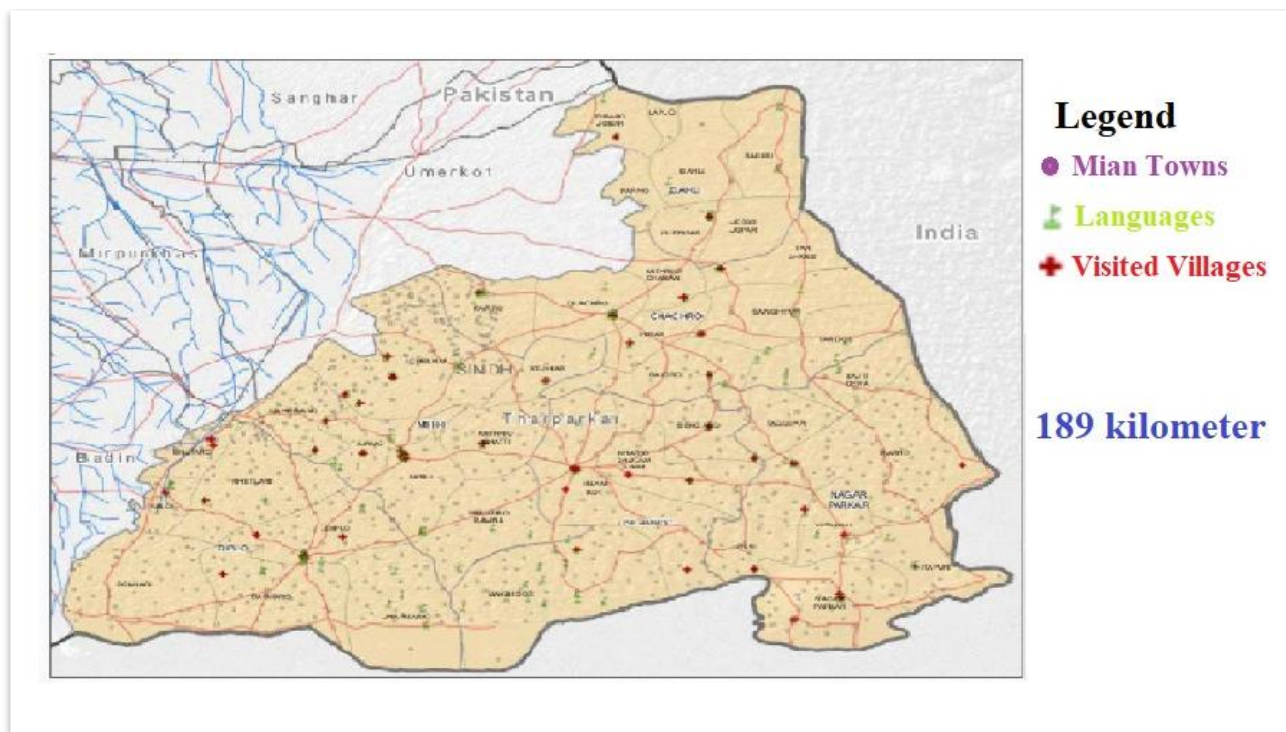


Figure 2: Map of the study area showing main towns, languages and visited villages

3.4. Data analysis

Venn diagram was created using free software to compare ethnobotanical species and their applications between the two community groups (<http://bioinformatics.psb.ugent.be/webtools/Venn/>, viewed on 22 March 2022). A complete literature survey on the ethnobotany of Pakistan's WFPs was also undertaken for national data comparison. Cross-cultural analysis and comparison among the major ethnic groups of the Thar Desert were performed and explained with the help of the Venn diagram.

Chapter 4

Results and Discussion

Results

4.1 Information about the Informants of the Thar Desert

In total, 60 local people were interviewed during the study (Table 1). 30 per cent of those interviewed were above the age of 60, while only 5 per cent were under the age of 40. Older informants shared the most diversity and information, while younger informants contributed the least. The lower contribution is owing to the youthful generation's loss of interest during the last century.

In the mother tongue, 60% of informants were Dhatki/Maharwari speaking while 35% were Sindhi speakers and 5% were Urdu speaking which was not indigenous to the old culture in the study area. Dhatki-speaking informants had the most ethnobotanical knowledge of the reported plant species, while Urdu speakers had the least. All Dhatki people claimed to have lived in the Thar Desert since birth. According to Bolson et al, indigenous communities have a wide range of knowledge about local plant uses. The population's inability to communicate effectively with one another and as a result of their lack of cultural flexibility may be the cause of the lack of awareness among Urdu speakers. The detailed demographic information for informants is compiled in the table 1.

Another important thing to discuss here is that a total of 60 interviews were conducted regarding the 25 plant species in the local regions. Out of 60 interviews, only 25 interviews have been presented here because of the limitation of space. The 25 interviews were selected such that one most significant and detailed response of the respondents was chosen for each of the plant species under the study. Therefore, the interview transcript of the questions for the 25 plant species is given under the table 2 in the form of one question per plant species.

Table 1: Information of Study participants in Thar Desert

Variable	Categories	Participants	Percentage
Age	30 to 40 years	3	5%
	40 to 50 years	9	15%
	50 to 60 years	30	50%
	Above 60 years	18	30%
	Total	60	
Mother Language	Dhatki/ Maharwaari	36	60%
	Sindhi	21	35%
	Urdu	3	5%

Table 2: Interview transcript for 25 plant species under study

No.	Interviewer	Respondent
01	Good morning sir. Could you please tell me about an herb named as Pippa or Pipun?	The Thar Desert's pippa or pipun, a well-known and delectable wild vegetable, is a drought-tolerant plant that may be found in the dry, scorching Tharparkar arid zone during the rainy or monsoon season. It always develops beneath bushes and shrubs with numerous branches, with each bunch having more than 25 branches. The typical height of plant branches ranges from 20 to 30 centimeters, depending on the amount of soil moisture and rainfall. The Tharparkar dry region of Sindh, Pakistan, is home to the significant vegetable herb/plant known as pinpa, pippan, or pippa. Green branches, which are quite appetizing, were traditionally utilized as a vegetable by the local indigenous Thari people.
02	Hello sir. Please tell me	It has ethnobotanical uses in Pakistan's Thar

	what do you know about Babor?	Desert indigenous people. The leaves and seeds of the plant contained, respectively, babor crude protein, fat, fibre, ash, and fats. People in the area have strong religious convictions; they refer to this plant as the "shrub of the ghosts" and think that it has magical properties that are useful in necromancy. Greek doctors who practiced in this region in the past utilized it to treat common illnesses.
03	Hello sir. I want to know about a local herb called as Dandathor or Chong. Do you have any idea about what it is and what are its uses?	It looks strange initially but when people start liking it when they hear its benefits. In Pakistan's outlying areas, such as Khushab, Mianwali, Sialkot, Gujrat, and some areas of Narowal, it can be found. In Punjabi and Urdu, it is known as Dandathor and Chong, respectively. It can be eaten uncooked, prepared, or preserved as pickles. Due to its ability to satiate both hunger and thirst, it is also used to decrease the appetite. It also improves endurance and cleanses the blood when ingested as a green vegetable.
04	Good afternoon sir. Tumba or Tumma is quite a famous plant especially in the desert area of Pakistan. Could you please describe the plant for me?	It can be found primarily in the Thar and Cholistan deserts, which are located on Pakistan's desert side. Although it produces small, hard fruits with bitter pulp, the vine resembles the one used to cultivate traditional watermelon. It goes by a variety of names, including tumba, tumma, and Abu Jahl's melon. This is used in numerous ways by the natives. For instance, it helps treat colds and coughs and offers relief from snake and scorpion bites. Despite being well-known throughout the nation

		for its extremely bitter taste, it is also quite effective in treating stomach and intestinal issues. Blood cleansing is another application for it.
05	Good afternoon sir. Please describe some details about a local plant named as Chibbar. Do you know about its benefits?	The plant has numerous branches, and the up to seven lobes on the stem are covered with scabrous hairs. Chibbar is a locally popular fruit that is ellipsoid and oval-globose. It also features stripes that are variegated and dark green. When ripe, the pulp is a pale yellow colour and bitter. Traditional healers (Hakeems) and herbalists frequently employ various sections of chibbar to treat various illnesses. The green fruit is supposed to treat stomach aches and biliousness since it is bitter and just a little sour.
06	Dear sir. Watermelon is an important fruit of Pakistan especially Punjab. What do you know about this plant?	A huge, spherical to oval, edible, wet, fleshy fruit known as a watermelon is produced by an annual, prostrate, vining vegetable of the same name. Fruits from watermelons that are fully or nearly putridly ripe can be consumed as a febrifuge. Kidney stones and dropsy can both be treated using the fruit of this plant. Fruit peel is advised in cases of alcohol poisoning and diabetes. A good source of lycopene, glucose, vitamin C, fibre, and -carotene can be found in watermelon's aqueous extract. Watermelons are often grown for consumption of their fresh, delicious fruit flesh and need a long, warm growing season.
07	Good morning sir. Please describe some important	An annual legume with the scientific name <i>Cyamopsis tetragonoloba</i> , the guar or cluster

	<p>details and benefits of Guar.</p>	<p>bean is the source of guar gum. It goes by the names gavar, gawar, or guvar bean as well. Since <i>Cyamopsis tetragonoloba</i> has never been discovered in the wild, its origin is unclear. Although guar has several uses for both human and animal nutrition, the gelling substance found in its seeds (guar gum) is by far the most significant application. The upright-growing <i>Cyamopsis tetragonoloba</i> can grow as tall as 2-3 m at its tallest. It has a single main stem that may have fine or basal branching along the stem. Guar taproots may penetrate shallow soil layers to acquire moisture.</p>
08	<p>Hello sir. In most of the sandy areas of Pakistan, Datura is a name quite often heard. Can you please describe some of the details of the plant?</p>	<p>Datura is also referred to by the popular names thorn apple, jimsonweed, and datura itself. Due to its effects on the mind and body, which are frequently seen as being incredibly uncomfortable and leading to a possibly lethal state of profound and prolonged disorientation or delirium (anticholinergic syndrome), it is unlikely to ever become a significant substance of abuse. The plant is used in Eastern medicine, particularly in Ayurvedic medicine, to cure a variety of human illnesses, including toothaches, ulcers, inflammation, rheumatism and gout, sciatica, bruising, and swellings.</p>
09	<p>Good morning respected sir. Please tell me what you know about a plant locally named as Lular. What is its importance and what</p>	<p>An annual plant, it blooms between August and September. False amaranth's young leaves and branches are cooked in curries, or the entire plant is boiled and spiced. Although practically all of its parts are employed in traditional medical</p>

	benefits does it have?	systems, the most significant portions that are used medicinally are the leaves, roots, and shoots. In cases of intestinal problems, crushed plant material is used as a mild astringent. Seeds and flowers are used to cure urinary discharges.
10	Good morning sir. Please do describe some details about Khip, also called as kheemp or kheep. What important details do you know about the plant?	In Hindi, Urdu, and Punjabi, it is referred as khimp and as khip. Due to its exceptional drought resistance, khip has been a key component of desert reforestation initiatives. The herb khimp is one of the pioneer species in sand dune fixing because it is a powerful soil binder. Khip has long been used to treat a number of illnesses. This species has a range of bioactive components that have therapeutic effects.
11	Dear sir. Karela is one of the important summers crop in Pakistan. Are you able to describe some details and importance about karela?	For its fleshy fruit, which is cylindrical in shape, orange to red in colour, thorny on the outside, and in certain species bursts when mature, usually with elastic force, into irregular valves, karela is grown in cultivation. A plant known for millennia for its medicinal effects and nutritional qualities is karela, often known as bitter melon. This plant is utilized in folk medicine all over the world for the treatment of several pathologies, mostly diabetes, but also cancer and other inflammation-related disorders due to the presence of numerous bioactive chemicals, some of which have powerful biological effects.
12	Good morning sir. What can you tell me about a local herb called as Bhurt? What is the importance of	Bhurt is a robust annual grass that can reach heights of over 1 m and produces a lot of seeds. It is a naturally occurring invader of disturbed ground, commonly found in fallow land, notably

	<p>this plant?</p>	<p>the periphery of Pakistan's numerous deserts. In the form of fodder and forage, it is fed to animals as food. Because of its dense growth, it is occasionally utilised to create a barrier, a border, or a support across buildings or fields. It also possesses some conventional therapeutic qualities.</p>
13	<p>Hello sir. Bajra is considered as one of our most important crops especially in the southern side of the country. What information can you give about this plant?</p>	<p>In Pakistan, bajra is mostly utilised as animal fodder. Bajra is a grain that is predominantly used in Pakistani and Indian desert populations as a source of sustenance. In most cases, the seeds are ground into a flour or cooked as a cereal grain. Bajra, like certain other grains, has been connected to important health advantages just by virtue of being a whole grain food. Eating whole grains like bajra on a regular basis may help fend off several chronic diseases like diabetes, heart disease, and some malignancies. However, consuming bajra may also have other, more focused health advantages.</p>
14	<p>Dear sir. Ghaf, also called as keekar, kandi, or khejri in some areas, is an important tree of the desert areas of the country. What are the benefits of the tree that you can share?</p>	<p>One of Pakistan's desert's most recognizable trees is the keekar. Due to its minimal water needs and excellent resistance to water scarcity, it can be found all throughout the desert. It also goes by the name "miswak tree" due to its highly regarded dental qualities. The ancients utilised the tree's twigs to strengthen and clean their teeth. In an animal model, it was discovered that an extract from the plant's unripe fruit pods may repair testicular injury brought on artificially. This tree's leaves can treat oral ulcers. Ulcers can</p>

		be treated by chewing its leaves for a short while and letting the juice of the leaves enter your mouth. The swelling significantly decreases.
15	Hello sir. We all have seen khumbi in desert areas where there is prevalence of some moisture. What is this plant, and what is its importance?	Large numbers could show up following heavy rains. In Pakistan's deserts and semi-deserts, it thrives. Many desert tribes use it for body painting and to darken the white hair in the whiskers of elderly men. There are rumors that it's also used as a fly swatter. Additionally, it is applied to the skin to heal wounds and cure skin conditions. In addition to all of this, this fungus may be eaten raw or cooked and is used as food.
16	Hello sir. Do you know about a plant locally named as khabar or jaar? What is the importance of this plant?	It is an evergreen, bushy tree that is primarily found in the southern regions of Pakistan and India. The root and stem are traditionally used as toothbrushes in Pakistan and India and contain a variety of antibacterial properties. For local use as a source of materials and medicine, the tree is cut down in the wild. In addition to being planted to take use of its thick shade, it is occasionally grown as a shelterbelt and to safeguard the soil. The fruit of this plant is consumed either raw or dried. The seed oil is used topically to relieve rheumatic aches; it also serves as a foundation for ointments and is used to make suppositories.
17	Good afternoon sir. We all know that moong or moongi is one of our most important pulse crops. What do you know about	A native vegetable legume, moongi is one of Southeast Asia's most significant pulse crops. Moong has a position in agricultural cycles involving rice, wheat, and other crops due to its minimal input requirements, quick growth, high

	the importance of this plant?	value crop, and restorative properties. The leguminous mungbean plant fixes nitrogen, enhancing soil fertility, and requires significantly less watering than other field crops. The use of moong in cereal cropping systems can raise agricultural sustainability, boost farm revenue, and improve soil productivity while using less irrigation water. All around the world, it is primarily consumed in various prepared forms as food.
18	Good afternoon sir. Almost all the people living in the deserts of Pakistan know about ber or beri. What can you tell about the benefits and importance of this tree?	Ber is a tiny spreading tree that grows 5 to 8 meters tall and has drooping branches. This tree is primarily found in desert regions and on the southern sides of the nation. The ber can therefore withstand severe temperatures and water shortages for longer periods of time. As a result, it is primarily consumed as fruit by desert people. The fruit is also utilised to create a number of other medicines. Ber is also used as a sedative, to avoid stress ulcers and liver problems, to increase muscular strength and weight, and to improve weight.
19	Hello sir. Can you describe the plant grown alongside your village called as chenothi or ratti? What is its importance, and how is it beneficial for us?	The plant is most famous for its seeds, which are used in percussion instruments and as beads. However, owing to the presence of abrin, the seeds are poisonous and cannot be consumed. One seed, thoroughly chewed, can be lethal to both adults and kids. Ratti seeds are highly prized for their vibrant coloring in traditional jewelry. Because seeds are toxic, it is also used to prevent animal hides from decomposing.

		However, the leaves are also used to make a tea that is believed to treat fevers, coughs, and colds.
20	Hello sir. There is a tree similar to keekar largely grown in the sandy areas. It is called as Koonbhat. Can you describe any important aspects of this tree?	Along with keekar, it is a tiny, prickly tree that grows primarily in desert, sandy, or dry regions of the nation. This tree resembles keekar in terms of appearance. This tree is also known as an Arabic gum tree, a goond (gum) tree, and a kikkaar. It can survive extended periods of heat and drought. The tree has significant economic value because of the gum Arabic it produces, which is used as a cosmetic, a food additive, and in crafts. A solitary tree will produce 200 to 300 grams of gum when it is cut into the bark and the gum is then drained. This tree produces 80% of the gum Arabic used in the world.
21	Good morning sir. Please describe what is ubat kandari, and what importance does it have in our lives?	This is a significant yet underappreciated plant in our area. One of the many species of medicinal plants with a noteworthy therapeutic potential is ubat kandari. It helps youngsters with colic, dropsy, boils, and piles. It is also employed to treat coughs. Additionally, it has a wide range of applications in the many traditional health care systems, including the treatment of fever, wound healing, tooth pain, arthritis, gynecological problems, urinary problems, insect and snake bites, abdominal tumors, stomach pain, and a number of other illnesses. Although the entire plant is frequently utilised, various plant components, including the stem, root, leaf, and seeds, are used individually to cure various ailments. In addition to its medical benefits, this

		plant's juice is a powerful component of a mixture used to make wall plaster, particularly in Hindu culture.
22	Good morning sir. There is a plant much similar to onion, called as jangli basar or jangli piyaz. Do you know any importance of this plant?	Field weed jangli basar is widespread, especially in wheat and chickpea areas. In Pakistan, it is also referred to as "jangli piyaz" or wild onion. This is due to the plant's apparent onion-like appearance. Paint, varnish, and soap can all be made using oil extracts from jangli basar. These oils also possess a number of therapeutic and pharmacological benefits; for instance, their high linoleic acid concentration makes them effective in preventing arteriosclerosis. When used externally on ulcers, the seeds have diuretic and antibacterial properties. The oil cake from jangli basar has been used as cow feed and as manure. The tuberous root system was consumed by people in the past and is occasionally consumed now as food. It can also be used to make adhesives.
23	Good morning sir. Neem or Nim is one of the most prevalent trees all over the southern part of the country. Do you know the importance of this tree?	It is a tree that can withstand drought and heat and has a cooling effect. Because of this, it is primarily grown in the country's hot and dry regions, where it may provide shade and cold during the hot summer months. The tree can grow to a height of 15 to 20 meters. Neem oil is produced from the plant's fruits and seeds. Neem leaves are dried and placed in cabinets to stop insects from devouring clothes, as well as in tins where grains of rice or wheat are stored, because the tree's leaves offer insect-repelling abilities.

		<p>Neem twigs are also used to treat gum disease and make kikkar in addition to other uses. Neem tree products have been utilised in traditional medicine for many years. As a cost-effective and environmentally friendly solution, neem oil has been demonstrated to prevent termite assault. Neem is a crucial component of non-pesticide management (NPM), which offers a healthy substitute for synthetic pesticides. Neem seeds are crushed into a powder, which is then soaked in water overnight and applied to crops as a spray. Additionally, it helps to keep the fertility of the soil. The nitrification process is inhibited by adding neem extract to fertilizers. Rabbits and ruminants occasionally consume neem leaves as forage.</p>
24	<p>Good morning sir. Can you describe any important aspect of the plant locally known as utangan? What importance does it have?</p>	<p>The hakeems are largely familiar with this herb thanks to its unique medicinal qualities. The Hakeems use the plant to treat a wide range of acute and chronic illnesses, inflammatory problems, bone problems, and parasite difficulties. While the plant's powder is applied topically to treat burns and vaginal infections, the plant's roots are used to treat dysmenorrhea and urine discharge. Utangan is employed as a regional forage and pasture species in addition to ethno medical applications. Tonics are made by boiling seeds in milk. Cattle are also administered it to boost milk output.</p>
25	<p>Good afternoon sir. There is a plant locally called as</p>	<p>The Googlan or gugal plant can grow as tall as 4 meters and resembles a tiny tree or shrub. Gugal,</p>

	<p>googlan or gugal. What is its importance? Can you describe the benefits of the plant?</p>	<p>guggul, or gugul, a fragrant resin made by the plant, is utilised in incense and Vedic or Unani medicine. The plant is primarily found in southern Pakistan and India. Numerous reptiles find the plant's scent repulsive. Due of this ability, dried gugal plants are burned and their smoke is utilised to deter reptiles, particularly snakes, from the dwelling.</p>
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4.2 Diversity of Wild Food Plant and their life forms in the Thar Desert

During the ethnobotanical survey for this study, 25 plants from 15 families (Figure 2) that are significant in ethnobotany were reported. Taxonomic names, regional names, components used, methods of usage, folk conventional applications, and the body system treated are all covered in depth in Table 3. Among reported plant species, *Commiphora wightii*, *Blepharis scindica*, *Abrus precatorius*, *Acacia Senegal* had the utmost significance among informers and are regarded as priceless plant species that are infrequently found in Pakistan's various settings. Meanwhile, *C. wightii* is a highly threatened endemic species in the study area as well as all over Pakistan and Indo-Pak region. It is well-known species recorded in various systems throughout India and Pakistan (Jain & Nadgauda, 2013). *Acacia Senegal*, *Citrullus colocynthis*, and *Datura innoxia* were the most frequently reported species. Easily available plant species and very the highest phytotherapeutic preparations always have the highest frequency of citation.

The most represented families were the Fabaceae (04 species) and Cucurbitaceae (04 species), while the least represented family was abridged in figure 2. Unquestionably, the study area's immense diversity and richness account for the greatest use reports of Cucurbitaceae and Fabaceae species. Many previously published studies report the same reasons. However, Asteraceae, Lamiaceae, and Rosaceae are frequently described in most studies in Pakistan and around the world owing to their dispersion nature in study areas. The increased usage of Amaranthaceae plants may be related to the area's arid-desert habitats and xerophytic conditions.

As shown in figure 3, the mainstream plant species (60 per cent) was herbs, while shrubs (16 per cent) were the least common. There was, however, no statistically considerable variation in the number of trees and shrubs. There are numerous reported causes for the recurrent use of herbs in outdated medication in the published literature. Herbal recipes can be easily made from herbs. Herbs can be found growing in abundance along roadsides, wastelands, household gardens, farmland, and in the outdoors. Herbs, to the best of our knowledge, are most widely employed in traditional cuisine and medicine due to societal beliefs regarding preparation patterns and extraction procedures.

4.3 Wild Food Plants' parts used and their mode of utilization

The most frequently cited plant part was fruits (11 reports), followed by seeds (10 reports), with the whole plant being the least used (Figure 4). The fact that fruits are a more commonly used plant part is supported by the majority of the ethnobotanical literature reviewed. Fruits are preferred over other plant parts in various traditional healthcare systems. When compared to other parts, leaves contain the most active phytochemicals. As a result, leaves may offer better therapeutic potential for a variety of disorders. In this study, several informants reported that the leaves are the most important portion and are often used in regional populations; nevertheless, the complete plant is more commonly used for herbaceous species. Because they take less work to obtain than other elements like roots, leaves are widely employed. A leaf is also involved in the formation of a basic metabolite, which acts as the beginning site for the formation of the other bioactive molecules.

Furthermore, from a conservation viewpoint, findings show that leaves are less damaging than other parts that might as a result of the plant's loss. Locals always use readily available plant parts. Other research undertaken throughout the world has reached similar outcomes.

In this study, various modes of utilization were recorded. Vegetables and raw snacks were the most commonly reported modes of use, while powder, paste, and juice were the least frequently reported. It is also identified as juice as the most common mode of utilization. The powder can serve as a starting point for all types of herbal preparations.

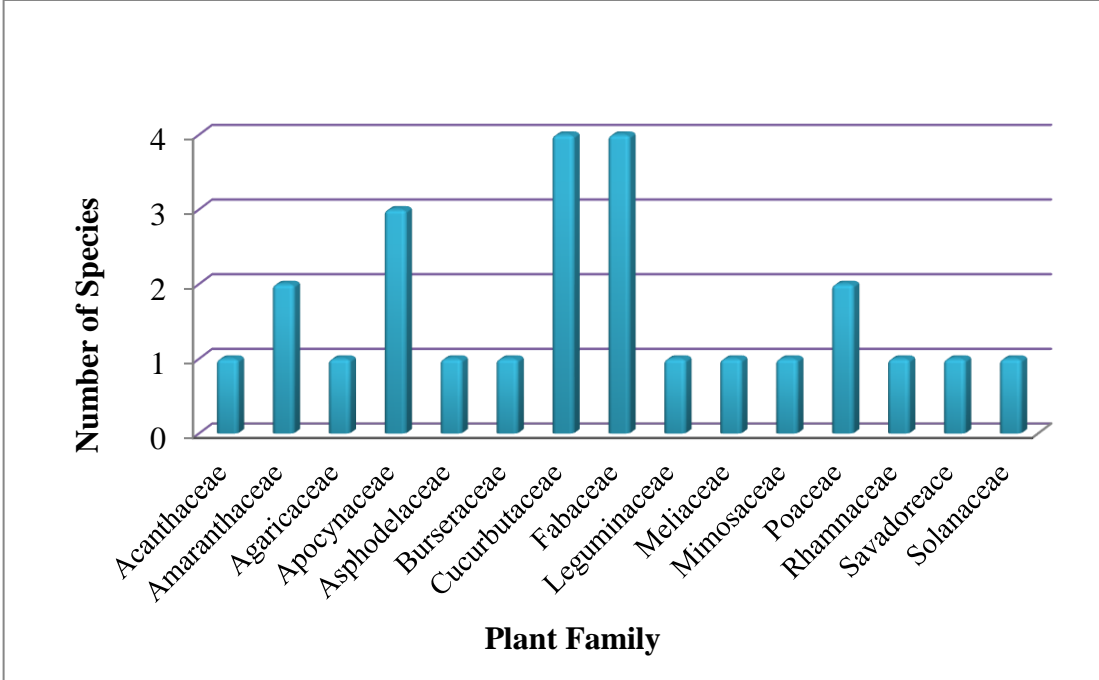


Figure 3: Diversity of plant families reported in the Thar Desert

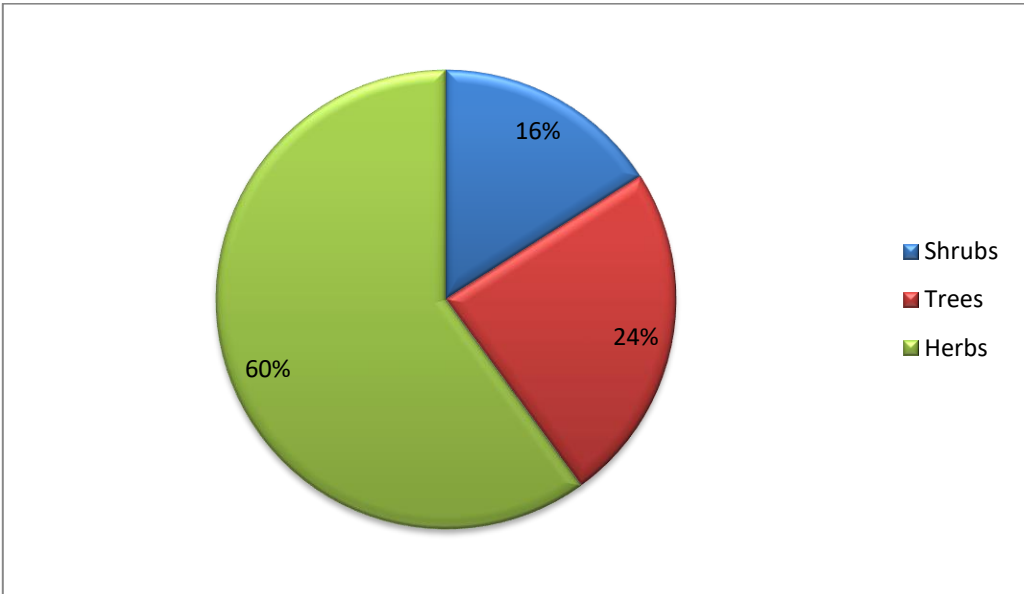


Figure 4: Life forms of reported plant species in the Thar Desert

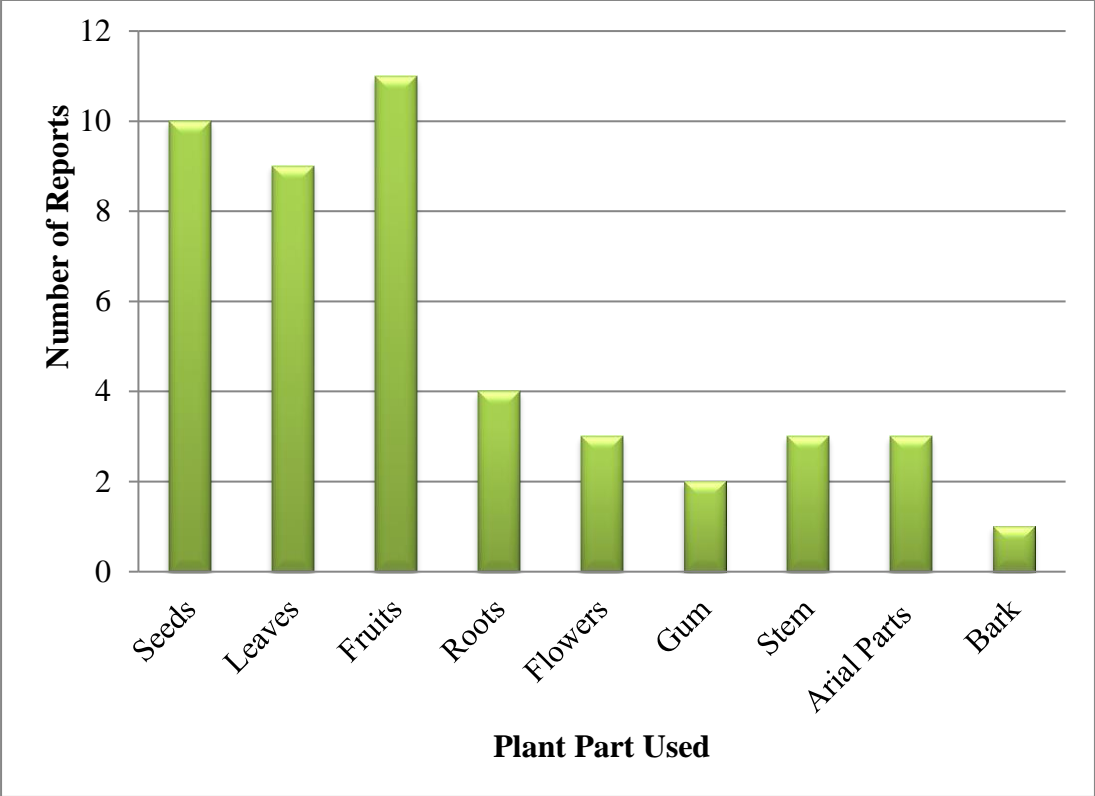


Figure 5: Plant parts used and number of reports in the Thar Desert

Table 3: Traditional uses of Wild Food Plants (WFPs) among the different communities of the Thar Desert, Sindh, Pakistan

Botanical Name; Family	Recorded Local Name	Parts Used	Recorded Local Food Uses	Muslims	Hindus	Traditional Food Uses Previously Reported in Pakistan
<i>Acacia jacquemontii</i> Mimosaceae	Babor/ Baonli	Aerial parts	Provides fodder and fuelwood	++	++	(Rasool et al., 2017b)
<i>Caralluma edulis</i> ; Apocynaceae	Pippen/ Pipun	Buches	Cooked as vegetable dish	+	++	(Dutt et al., 2012)
<i>Caralluma adscendens</i> ; Apocynaceae	Caralluma	Fruits	cooked and eaten with salt	++	++	(Naveen et al., 2016)
<i>Citrullus colocynthis</i> ; Cucurbitaceae	Trooh	Fruit, Seed, Root, Leaves	Raw Snacks	+	+	(Bahloul et al., 2016)
<i>Cucumis melo var. agrestis</i> Cucurbitaceae	Chibhar/ Wild melon	Fruit and flowers	Seasonal fruit and vegetable	++	++	(Ullah et al., 2015)
<i>Citerullus lanatus</i> Cucurbitaceae	Unripe water melon	Fruits	Vegetable	++	++	(Raziq et al., 2012)
<i>Cyamopsis tetragonobola</i>	Guar (cluster Bean)/Gawar/	Beans, Leaves,	Cooked as vegetable, Paste	++	++	No

Fabaceae	Gavar/ Gowaar	Seeds, Fruit				
<i>Datura stramonium</i> ; Solanaceae	Dhatura/ thorn apple/ devils trupet	Seeds and fruit	Seeds are eaten and its fruit juice is for dandruff and hair fall.	+	+	(Z. Abbas et al., 2019)
<i>Digera muricata</i> (L.) Amaranthaceae	Lular/ False amaranth	Aerial parts	Cooked as vegetable dish	++	++	NO
<i>Leptadenia pyrotechnica</i> ; Apocynaceae	Kheemp/ Broom bush	Flowers, leaves	Flowers buds are pickled. Leaves are used as salad.	++	++	(Idrees et al., 2016)
<i>Momordica charantia</i> ; Cucurbitaceae	Karela/ Karelo	Fruits	Vegetable	+	++	(Raghavan Anilakumar, 2015)
<i>Pennisetum polystachion</i> ; Poaceae	Bhurt/ Mission grass	Flowers and seeds	Used as fodder	-	+	(Shehzadi et al., 2021)
<i>Pennisetum glaucum</i> ; Poaceae	Millet/ Bajara	Seeds	Used for flour to make breads	++	++	No
<i>Prosopis cineraria</i> ; Fabaceae	Kandi/ Khejri/ Miswak tree	Leaves	Vegetable for humans	++	++	No

<i>Podexis psittularis;</i> Agaricaceae	Khumbhi/Mashroom	Stalk and cap	Cooked as vegetable	++	+	
<i>Salvadora oleoides;</i> Savadoreace	Peelu/Khabar/Jaar/ Methi Jaar	Fruits or Berries	Berries are cooked as a vegetable	++	++	
<i>Vigna radiate;</i> Leguminaceae	Moong/ Green gram/ Mung/ Maash	Seeds	Vegetable	++	++	
<i>Zizyphus mauritian;</i> Rhamnaceae	Ber/ Bair/ Borari	Fruits or Berries	Raw snacks nutrient fruits	++	++	(Abbasi et al., 2013)

-: not reported; +: quoted less than 50% informants; ++: quoted by more than 50% of informants

Table 4: Meditational uses of Wild Food Plants (WFPs) among the different communities of the Thar Desert, Sindh, Pakistan

Botanical Name; Family; Botanical Voucher Specimen Code	Recorded Local Name	Parts Used	Recorded Local Food Uses	Muslims	Hindus	Traditional Food Uses Previously Reported in Pakistan
<i>Abrus precatorius</i> L Fabaceae	Chenothi/Ratti	Seeds, Fruit, Leaves	Powder, Paste	++	++	(Sawant et al., 2017)
<i>Acacia Senegal</i> (L.) Fabaceae	Koonbhat	Bark, Gum, Seed, Leaves	Juice, Powder	++	++	(Kaddam et al., 2020)

<i>Achyranthes aspera</i> L.; Amaranthaceae	Ubat Kandari	Leaves, Stem, Root	Ash, Juice Decoction, Poultice, Paste	++	++	(Khan & Shaukat, 2006)
<i>Asphodelus tenuifolius</i> ; Asphodelaceae	Jangli Basar	Root, Leaves	Powder, Paste	++	++	(Younis et al., 2018)
<i>Azadirachta indica</i> ; Meliaceae	Nim, Neem	Seeds, Leaves, Fruit, Root	Oil, Juice, Infusion, Decoction, Powder	++	+	(Elmarzugi & Eid, 2017)
<i>Blepharis scindica</i> ; Acanthaceae	Utangan	Seeds, Root	Powder, Juice	++	+	(Dirar et al., 2021)
<i>Commiphora wightii</i> ; Bursaceae	Googlan	Seeds, Gum	Powder, Decoction, Juice, Smoke	+	++	(Akhtar et al., 2013)

-: not reported; +: quoted less than 50% informants; ++: quoted by more than 50% of informants

4.4 Cross-Cultural Comparison

A comparative analysis of the consumption of the reported species revealed that three-quarters of the WFPs were quoted commonly among both the ethnic groups (Muslims and Hindus) of the Thar Desert, showed in the Venn diagram. Among the 25, 19 WFPs were reported by Muslim and Hindu informants. This similarity showed that there is considerable homogeneity in consumption of WFPs among the ethnic groups as they have been sharing similar socio-ecological cultures and environments for several generations.

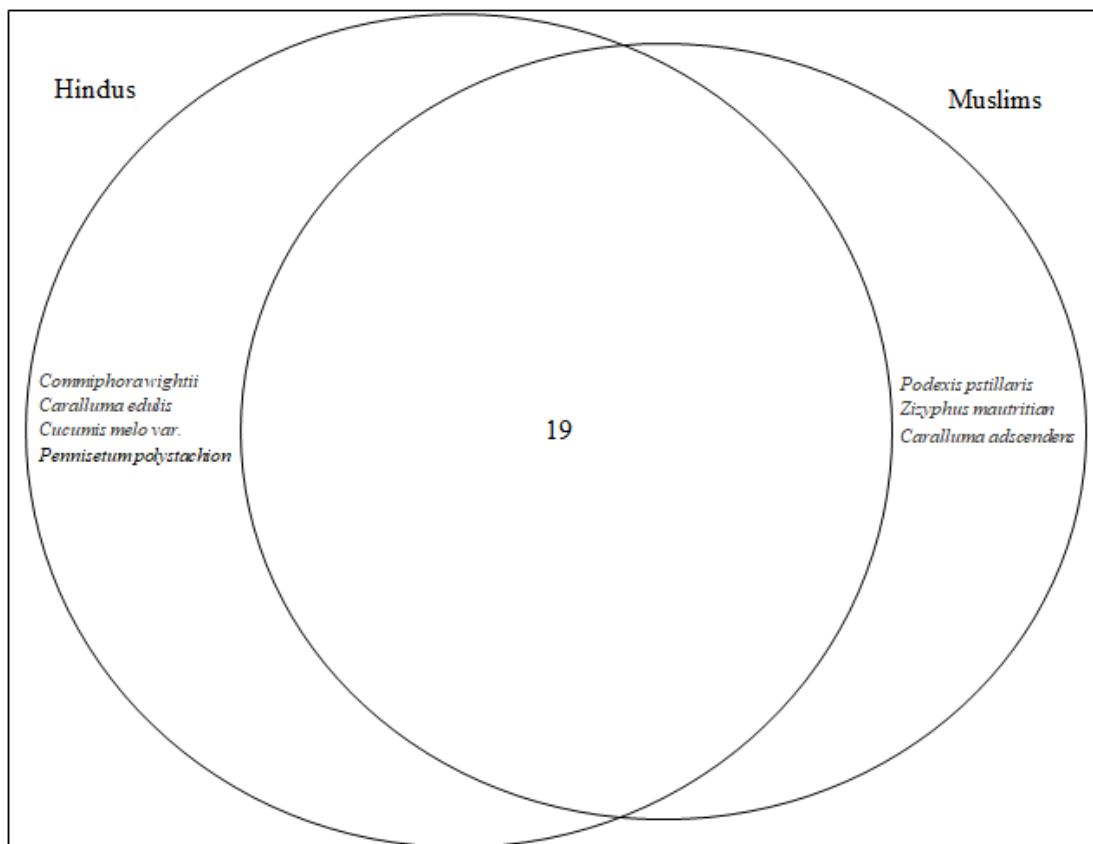


Figure 6: Venn Diagram showing the overlapping among studied groups

Due to religious effects and some special lifestyles, some cross cultures in the consumption of food were also exhibited in this study. *Commiphora wightii*, *Caralluma edulis*, *Cucumis melo* var. and *Pennisetum polystachion* are being used among Hindus; while *Podexis psyllaris*, *Zizyphus mauritiana* and *Caralluma adscendens* are being utilized only in Muslims of the Thar Desert.



A



B



C



D



E



F



G



H



I



J



K



L

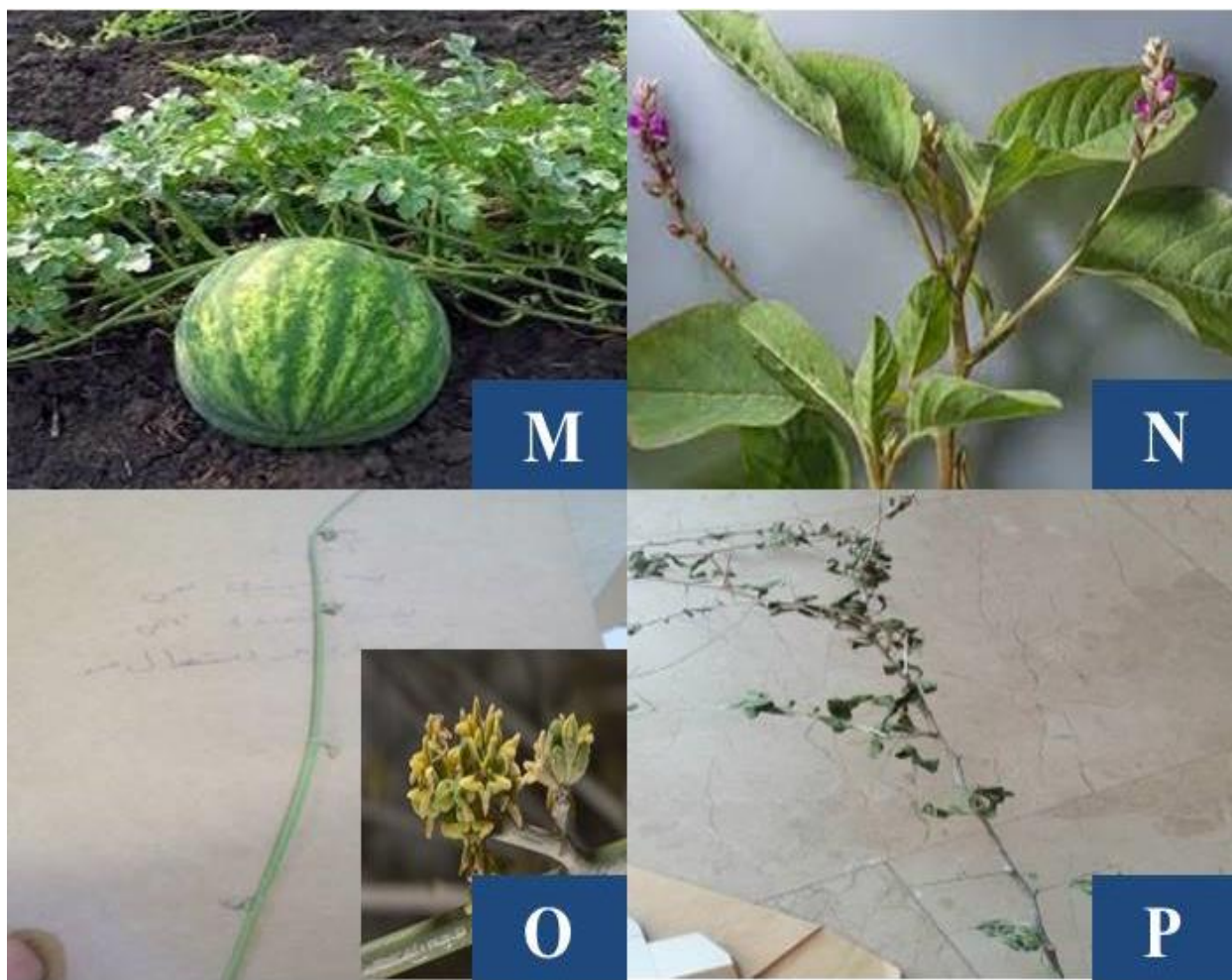


Figure 7: Some examples of wild food plants of Thar, Sindh Pakistan: **(A and B)** *Vigna radiate*; **(C and D)** *Salvadora oleiodes*; **(E)** *Podexis pstillaris*; **(F)** *Caralluma edulis*; **(G)** *Citrullus lanatus*; **(H)** *Citerullus lanatus*; **(I)** *Momordica charantia*; **(J)** *Cyamopsis tetragonobola*; **(K)** *Pennisetum glauccum*; **(L)** *Datura stramonium*; **(M)** *Citrullus colocynthis*; **(N)** *Digera muricata* (L.); **(O)** *Leptadenia pyrotechnica*; **(P)** *Zizyphus mauritria*

Discussion

Nowadays, the majority of human food is derived from a very small number of crops and fruit plants; nonetheless, the usage of natural plants is still significant in many regions across the globe (Cavender, 2006); (Pieroni et al., 2007)). No one can deny the fact that the nutritional content of traditional food resources is uncovered to be more than several known types of nurtured food providing floras (Orech et al., 2007). Wild fruits are often suited for use as a great source of nutrients and supplement for diet (Nahar et al., 1990). They provide essential nutrients for human health, including minerals, ascorbic acid, and antioxidant phenols such chlorogenic acid and its polymers. They also serve as a significant source of fibres, vitamins, and nutrients including carbs, oils, proteins, and minerals like ascorbic acid (Aberoumand & Deokule, 2009). The use of organic food and natural or wild plants as a vegetable is considered safe and beneficial for human health. The wide variability of traditional local meals for the rural population in emerging countries already makes use of the fruits, seeds, and leaves of a variety of wild plants (Humphry et al., 1993). Dry fruits such as apricots, raisins, and dates are rich sources of calcium and iron. These minerals are necessary for the development and maintenance of strong bones and healthy blood, respectively (Pederson, 2009). Vegetables are the unprocessed, fresh, and edible parts of plants; as a result, wild food plants are essential for maintaining good health as well as preventing a variety of ailments.

Acacia Senegal (L.) belonging to family Fabaceae commonly known as Koonbhat was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Bark, Gum, Seed and Leaves) are consumed. Newly born leaves (foliage) are delicious for wild and domestic ruminants as used as their forage. The gum obtained from the species is also used as a food additive and for commercial purposes. Dried seeds are also used by humans as food. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by more than 50% of informants as food and fodder. Bhushette & Annapure (2017) also reported it as a high gum-producing acacia. Its gum is consisted of arabinose, rhamnose and galactose and has great importance as a food additive. (Bhushette et al., 2017)

Acacia jacquemontii belongs to family Mimosaceae. The species was identified in the Thar Desert with the common names Babor/Baonli. After interviewing the residents of the Thar

Desert, it is found that its aerial parts are used as food for cattle and wild grassing animals. Its fruit is utilized for human food when cooked with other vegetables. Rasool et al., (2017) reported that the stems and leaves of the species are odourless and tasteless but impart significant flavour and taste when cooked or used in food preparation. Especially gum excreted from the plant when it is wounded is considered a health tonic and used in food preparation especially for patients in case of injuries or women after giving birth (Rasool et al., 2017a). It is also found from the study that this species is being equally used in both Muslims and Hindus ethnic groups informed by more than 50% of informants. Some traditional uses have also been reported as the species is a valuable source of firewood and roots as a source of rope.

Caralluma edulis belonging to family Apocynaceae is commonly known as Phippen/Pipun was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Fruits) are consumed in the form of Cooked as a vegetable dish. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by less than 50% informants of Muslims and more than 50% informants of Hindus group. Parihar, (2016) conducted a study on the *Caralluma edulis* species, where its edible, therapeutic and threatened aspect was discussed. (Parihar, 2016)

Citrullus colocynthis belonging to the family Cucurbitaceae commonly known as Trooh was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Fruit, Seed, Root and Leaves) are consumed in the form of raw snacks. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by less than 50% of informants. Bhasin et al., (2020) have devised a research study on the nutritional and medicinal importance of *Citrullus colocynthis* where they concluded that consumption of this plant is common in rural populations but further investigations are required to improve the utilization of this superfood. (Bhasin et al.,2020)

Cucumis melo var. agrestis belonging to the family Cucurbitaceae is commonly known as Chibhar/Wild melon was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Fruit and flowers) are consumed in the form of Seasonal fruit and vegetable. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by more than 50% informants of Muslims and less than 50% informants of Hindus group. Silva et al., (2020) studied this species where they

discussed the potential food ingredients like minerals, proteins and bioactive compounds of *Cucumis melo*. (Silva et al., 2020)

Citerullus lanatus belonging to the family Cucurbitaceae is commonly known as Unripe watermelon was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Fruit) are consumed in the form of vegetables. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by less than 50% of informants. Nakoana et al., (2021) conducted a study on *Citerullus lanatus* where its nutritional, phytochemical and natural therapeutic values were discussed. (Nkoana et al., 2021)

Datura stramonium belonging to family Solanaceae is commonly known as Dhatura/thorn apple/devils trumpet was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Seeds and fruit) are consumed as Seeds are eaten and its fruit juice is for dandruff and hair fall. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by less than 50% of informants. Sayyed et al (2015) have devised a study to review the phytochemistry and pharmacological and traditional uses of *Datura stramonium* species. (Sayyed et al., 2014)

Leptadenia pyrotechnica belonging to family Apocynaceae is commonly known as Kheemp/Broom bush was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Flowers and leaves) are consumed as Flowers buds are pickled. Leaves are used as salad. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by more than 50% of informants. Verma et al., (2014) conducted a study on the phytochemistry, pharmacology and traditional uses of *Leptadenia pyrotechnica*. (Verma et al., 2014)

Momordica charantia belonging to the family Cucurbitaceae is commonly known as Karela/Karelo was identified from the Thar Desert and after interviewing the residents of the Thar Desert it is found that its parts (Fruits) are consumed as vegetables. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by less than 50% informants of Muslims and more than 50% informants of Hindus group. Palamthodi et al.,

(2014) has performed a study on the Nutraceuticals value of gourd family vegetables including *Momordica charantia*. (Palamthodi et al., 2014)

Podexis psittillaris species also found in the Thar desert during the collection of species. This species belongs to the Agaricaceae family. It is commonly known as Khumbhi/Mashroom. After interviewing the Thar residents we come to know that its Stalk and Cap are consumed as cooked vegetables. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by more than 50% informants of Muslims and less than 50% informants of Hindus group. Abdullah et al., (2016) have devised a study on the wild edible mushrooms where they also described the *Podexis psittillaris* species as edible. (Abdalla et al., 2016)

Salvadora oleiodes belongs to the Savadoreace family. Its common names are Khabar, Jaar/Methi Jaar. It is found that its Fruits or Berries are consumed as cooked vegetables. It is also found that this species is being equally used in both Muslims and Hindus ethnic groups informed by more than 50% of informants. Singhi et al., (2017) have surveyed desert plants used by desert residents for medicinal/nutritive supplementation. It has been established that plants/plant parts are used for specific purposes. In which *Salvadora oleiodes* species was also included. (Singhi et al., 2010)

Vigna radiate belongs to the family Leguminosae. It is commonly known as Moong/Green gram/Mung/Maash. Its seeds are consumed as vegetables. It is found that this species is equally consumed by both Muslims and Hindus ethnic groups as informed by more than 50% of informants. Kahraman et al., (2014) described the use of *Vigna radiate* as food; their title for the study was especially on the *Vigna radiate* as human food. (Kahraman et al., 2014)

The study aimed to document traditional and indigenous knowledge of the use and consumption of WFPs for the nutritional purpose among different ethnic groups in the Thar Desert of Sindh, Pakistan. During this research study, novel nutritional uses of some species were reported as there are only medicinal uses reported and no literature exists on the consumption of these species as food. *Citrullus colocynthis* belonging to the family Cucurbitaceae was reported to use this species as food. Fruit, Seed, Root and Leaves are being

utilized as Raw Snacks. According to Abdullah et al. (2014), a variety of conventional medical conditions can benefit from using this plant, including diabetes, leprosy, viral disease, sore throat, breathing problems, pneumonia, anaemia, joint pain, cancer, toothaches, wounds, metritis, and digestive disorders like dyspepsia, bowel problems, giardiasis, norovirus, colic pain, and diverse bacterial infectious diseases. Hussain et al., (2013) has reported its phenolic profile and antioxidant activity.

A total of 25 plant species belonging to 15 plant families are reported from 60 study participants using semi-structured, open-ended, and group interviews. The most cited families were Fabaceae (04 species) and Cucurbitaceae (4 species) while most of the species belong to herb life forms (15 species). Among reported plant species, *Commiphora wightii*, *Blepharis scindica* and *Moringa concanensis* *Abrus precatorius*, *Acacia Senegal* had the highest value amongst respondents and was regarded as valuable plant species that was uncommonly found in Pakistan's various ecosystems. The majority of plant species in life forms were herbs (60 per cent), while shrubs were the least frequently observed (16 per cent). Fruits were the most commonly mentioned plant component (11 records) proceeded by seeds (10 records) and leaves (09 records) while the least used part was the bark. The most dominant mode of utilization was eaten raw and cooked as vegetables. The findings of the present study reveal that plants of the study area are main sources of food for residents.

In terms of food categories, over 52 per cent of the WFPs reported are consumed raw as snacks, while more than two-thirds are prepared as veggies. Raw snack consumption arose mostly as a result of local communities co-evolving. Our results are consistent with earlier ethnobotanical research that found snacks to be the most common food type (Abdul Aziz et al., 2020). The wild vegetables that were most frequently cited were “*Allium* spp., *Amaranthus viridis*, *Lepidium draba*, *Portulaca quadrifida*, *Polygonatum verticillatum*, *Rumex dentatus*, and *Urtica dioica*,” and in Pakistani culinary ethnobotanical literature, these wild vegetables are commonly mentioned (Abbas et al., 2020). The bulk of the known wild vegetables seem to be weed species, and these weeds are common in many food ethnobotanies, possibly because to their wide natural range (Lyimo et al., 2003). According to the researchers, industrialized areas present a major region for the collection of WFPs (Menendez et al., 2012).

Ahmad et al., (2019) revealed in a study that different ethnic groupings in Pakistan's North West Frontier Province frequently used weeds as wild veggies (Ahmad et al., 2019). The majority of the WFPs described are herbs, and their aerial parts, which were the most widely used plant parts, were ingested during the early stages of life. WFPs, according to researchers, maybe a better solution for dealing with food shortages and reaching long-term nutritious targets (Mertz et al., 2001). The relevance of fruit in dietary ethnobotany is well known among various cultures, and it is the second most significant plant component (approximately 30%). According to popular belief, the unique or appealing taste of the fruit influences whether or not natives choose to consume it (Söukand & Kalle, 2016). Young community members primarily collect fruits, which are then immediately consumed. Male and female participants in the collection and ingestion of WFPs are found in Sindh's the Thar Desert.

Chapter 5

Conclusion and Future Recommendations

5.1 Conclusion

WFPs are being utilized by human beings from the time of their birth for nutritional, cultural, and economic purposes. The present study focused on the documentation of traditional uses of WFP species reported from the Thar Deserts of Sindh-Pakistan. The study highlighted the most promising species based on ethnobotanical analyses and described the ethnobotanical importance of WFPs in the region and the preservation of related traditional knowledge. The local inhabitants of the Thar Desert have indigenous knowledge about the local wild food plants (WFPs) and their consumption. The sole aim of the study was to document the ethnobotanical traditional knowledge about the nutritional value of WFPs and their consumption among different ethnic groups in the Thar Desert of Sindh. In this study, 60 Thar inhabitants were interviewed, and 32 WFPs were reported from various communities of the Thar Deserts of Sindh, and their nutritional uses were documented and analyzed qualitatively (Manually). Most of the reported species were herbs (60%) while the remaining was trees, shrubs, and climbers, and their leaves, seeds, underground parts, and aerials parts are being utilized as vegetables, fruits, juices, etc. They have high importance in natural food for the inhabitants as well as medicine. Furthermore, this research refreshed and updated traditional knowledge about the consumption of WFPs. Some of them have been reported in previous studies but are no longer practiced today. Documentation about the consumption of WFPs in the desert provided significant ethnobotanical and medicinal knowledge. The most important WFP species reported in this study are *Abrus precatorius L.*, *Acacia Senegal L.*, *Acacia jacquemontii*, *Aerva javanica*, *Achyranthes aspera L.*, *Allium spp.*, *Allium jacquemontii Kunth*, *Amaranthus viridis L.*, *Asphodelus tenuifolius*, *Azadirachta indica*; and *Blepharis scindica*, These plant species were used as nutritional species in both the major ethnic groups i.e. Hindus and Muslims. The mode of consumption of these species is paste, powder, vegetable, dry fruit, salad, oil, ashes, snakes, and juices.

The results indicated that the Thar Desert of Sindh has a rich diversity of Fabaceae and Amaranthaceous species commonly used for food and drugs. Data regarding ethnobotanical uses

indicate that a high degree of plant knowledge still exists among ethnic and indigenous communities of the desert. Moreover, the importance of traditional medicines and indigenous knowledge may contribute to the documentation and conservation of traditional knowledge, and sustainable use of flora of the deserts.

Among the reported species, 19 were commonly used among Muslims and Hindus. *Commiphora wightii*, *Caralluma edulis*, *Cucumis melo var.* and *Pennisetum polystachion* are being used among Hindus; while *Podexis psittularis*, *Zizyphus mauritian* and *Caralluma adscendens* are being utilized only in Muslims of the Thar Desert. In life forms, most of the plant species (60%) while least reported were climbers (16%). The most frequently cited plant part used were fruits (11 records) followed by seeds (10 records) and leaves (09 records) while the least used part was the bark. The most dominant mode of utilization was eaten raw and cooked as vegetables. *Citrullus colocynthis* belonging to the family Cucurbitaceae was reported to use this species as food. The findings of the present study reveal that plants in the study area are major sources of food for residents. The scope of this project is limited to the first report on an ethnobotanical exploration of wild plants being used as food in Sindh's the Thar Desert.

The findings of this study provide a solid foundation for further phytonutritional and pharmacological research, which could be useful in the development of sustainable food and drug system, respectively. Furthermore, species with only a few documented traditional uses may be investigated further to preserve traditional knowledge.

5.2 Future Recommendations

Ethnobotanical studies in deserts require special attention when it comes to documenting traditional uses. Because knowledge obtained from local people in Sindh's deserts is considered a chain of all activities, including drug development, it must be preserved. Some key recommendations that may be implemented in the future are listed below.

- ❖ Effective usage of WEF species and management of natural resources
- ❖ Detailed information should be focused on species that have no records in the published ethnobotanical, pharmacological, or phytochemical literature and may also be easily selected for future studies using meta-analysis

- ❖ New trends in the field of ethnobotany should be introduced by highlighting the important uses of plant species in a single study and by comparing large datasets of ethnobotany that lead to pharmaceutical drug development.
- ❖ Ethnobotanical databases should be developed from where one may select species of interest for aimed study.
- ❖ For more detailed studies, the selection of plant species based on the most authenticated ethnopharmacological uses should be adapted for good results within the limited time and cost of studies.
- ❖ The contribution of local people should be highlighted and appreciated for the conservation and sustainable use of plant diversity in the deserts of Sindh and the Intellectual property rights of locals should be implemented for their activities in the community.
- ❖ Local people should be involved in the conservation of species and the preservation of traditional knowledge associated with species.
- ❖ Priority species having risks of survival should be selected for conservation strategies.
- ❖ Cultivation and dissemination approaches should be adopted in respect of WFPs preservation

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