

EXPLORATION OF MEDICINAL PHYTO-DIVERSITY AT MAKRAN COAST; A REALM OF OPPORTUNITIES AND CHALLENGES

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Abstract

Pakistan has been endowed with marvelous diversity of potentially therapeutic plants. Makran region is largely comprised of hills along with barren land. Unequivocally, medicinal plants are appreciably utilized by the local communities. These medicinal plants not only used for specific diseases as well as used in combination with other herbal medicinal plants. Due to over exploitation of area, unplanned developmental works and deteriorating law and order situation, wild flora of this district is threatened. This is the foremost report of its nature from this area. This research presents traditional knowledge on medicinal plants usage cum belief as medicine by native population of Gawadar. By adopting standard methods i.e. questionnaire, field visits, interviews etc. data was collected. Statistical tool, F_{IC} and F_L values were calculated to analyze the gathered information for evaluation of knowledge about importance of diverse medicinal plants. Plant species reported in this area are commonly practiced for multifarious purposes e.g. herbal drugs, fodder, wood and essential oils etc. Chief plant habit observed was shrubs. Plants and their parts such as roots, stem, leaves, wood, flowers, bark, seeds, latex and fruits are in common use for various purposes. As per calculated F_{IC} it is evident that category "gastro-intestinal problems" with F_{IC} values 0.897 carried highest degree of agreement by informants. Highest F_L was noted in *Calotropis procera* (87 %) followed by *Indigofera oblongifolia* (78 %).

Key Word: Gawadar, Natural drugs, Plants, Therapeutic efficiency, Traditional knowledge

Introduction

Human interest in vegetation for various purposes has its history starting with inception of human civilization (Shinwari & Gilani 2003; Khan *et al.*, 2015). Evident from their unique combination and properties, products of plant origin are in use with strong belief (Shinwari & Qaiser, 2011; Islam *et al.*, 2016). With reference to the past, even today, humans depend upon green wealth to gain economic and medicinal benefits depending upon requirement, opinion and understanding (Noman *et al.*, 2016; Noman *et al.*, 2017). According to WHO reports, about 25% of modern medicines are of plant origin and research on traditional medicinal herbs led to discovery of 75% of herbal drugs (Anonymous, 2009). Over 21,000 plant species have been recorded for their therapeutic usages across the world. Various higher plants are well known for drug therapy in traditional medicine (Shanmugasundaram *et al.*, 2011; Sarwat *et al.* 2012). Pakistan has been endowed with marvelous diversity of potentially therapeutic plants due to its heterogeneous environments (Shinwari, 2010; Ali *et al.*, 2016). Nearly, 1500 plant species with proper remedial characteristics have been reported in Pakistan (Chaudari, 1961).

Of the total coastline of Pakistan 800 km extends in Baluchistan which lines the dynamic North East Arabian Sea. The Coast of Makran comprises of a strip of mountains elevated up to 5,000 ft. Large part of the coast range is least developed, furnished with beaches and fishing country sides. Uplifted terraces, fluted beds and headlands support the evidences that this coast is tectonic in origin (Anonymous, 2000). The presence of mud

volcanoes situated along the shores further strengthens these evidences. This coastal belt is chiefly bare desert with unique landscape and land forms e.g. sandy beaches, mud flats etc. Then famous as Gadrosia, on the way to Macedonia in 325 BC, army of Alexander the Great crossed through Makran (Noman *et al.*, 2013). Arrian, a Greek historian had mentioned this land, environment and people of the area in his memoirs. He found climate as extremely hot with soil sandy and the land inept for human settlement (IUCN, 2003).

Gawadar district is situated along the Arabian Sea in southern Makran. It is linked to the rest of cities of Pakistan by air and road. The attractive 650 km coastal national highway (N-10) links Gawadar with District Lasbela and Karachi. The local inhabitants of study area are suffering from dearth of health services, primary facilities and education. A major fraction of the population in such deprived areas relies mostly on traditional flora for medication (Qasim *et al.*, 2010).

However, the current worth of a variety of coastal resources i.e. flora and fauna will be diminishing if remain out of control due to ongoing degradation. This is matchless loss to coming generations in terms of decreasing arable land, loss of biodiversity, displacement of local communities, failure to have sufficient livelihoods, smash up of fisheries, pollution and decrease in tourism (Lashari & Khusk, 2007). Phyto-sociological data reflect that thousands of traditional plants are still to be explored in wild (IPGRI, 2002). In spite of untapped potential of study area, many of the plants are marked as ignored and underutilized internationally yet these depict significant utilization at the home level (Hammer *et al.*, 2001; Shedayi *et al.*, 2016). Studies on plants of Pakistan with immense

medicinal value have been conducted in the past by local and foreign researchers. Unluckily, due to the accessibility of recent facilities, the custom of using native plants for many purposes other than food is also vanishing. Keeping in sight the valuable knowledge of folk communities, challenges prevailing in area and opportunities, the present study enlists the wild medicinal phyto-diversity of Gawadar district in Makran Coast. Therefore, we have the hope that present report will appear as silver lining and help to save disappearing/ endangered plants along with knowledge about classical medicinal characteristics of plants especially among the youngsters. On the whole, it is considered that gathered information and knowledge will be applied to expand the utilization of plants in the local pharmacotherapy and in other realms as well along with probable role in the development of new drugs.

Materials and Methods

Study Area: Geographically, Gawadar district is located 25°-01' to 25°- 45' north latitudes and 61°-37' to 65°-15' east longitudes. It is bounded by Kech and Awaran districts in north, Lasbela district in the east, on the southern side by the Arabian Sea and by Iran on the west (Fig. 1). Total area of Gawadar is 12,637 Km² (Table 1). The important rivers and streams of this district are Shadi Kaur, Swar and Dasth river with its tributaries e.g. Nilag and Daddeh. Gawadar has arid hot climate, therefore, it is regarded as “warm summer and mild winter” temperature region. The oceanic influence keeps the temperature low in summer and higher in winter (Noman *et al.*, 2013). This temperature uniformity is a unique property of the coastal area of Balochistan. In Gawadar District, soil is of two types: alluvial and lithosols cum rigosols. The Dasht river valley in the west of the district and the valley of Kulanch in the north have alluvial soil. The mountainous part of the Gawadar is lined with lithosols and rigosols. The main rocks involved in the formation of area include limestone, shale and sandstone (Anonymous, 2000).

Table 1: Area and population of District Gawadar

Admin	Unit Area (mi ²)	Total Population
Tehsil Gawadar	1937.84	109,748
Tehsil Psni	2941.32	75,750
District Gawadar	4879.13	185,498

Local population: The majority population of the area is Muslim. In addition to Minority Zikri sect, there is limited population of Ismailis and Christians settled in Gawadar, Pasni and Ormara. The people are generally liberal in their religious beliefs and practices. A large population from Gawadar district is settled abroad *i.e.* UAE, Oman, Iran. The literacy rate of Gawadar district is 25.5 %. Balochi is spoken with a different dialect from that spoken in interior Baluchistan. There are two main classes in the district, Baloch and Darzadas often regarded as Ghulams. Balochs predominate the area and further divided into various clans and clans. Majority of the Balochs have their lands and property. Ghulams had African origin and worked as servants with the landlords or fuedals in their houses or lands. With the passage of time this concept gradually faded and Ghulams now got their status and recognition. But these social class limits have lost some of their weightage once Baloch Nationalist movements have taken their roots in Makran. Being patriarchal society predominantly, decision power lies with men and the decisions are usually followed by the women. For Women, with limited say in the decision process, still there is a long walk to ensure gender parity in the area. The socio-economic situation of the inhabitants of this coastal district is contemptible. Low income levels are exacerbated by raised level of joblessness caused by the impoverishment of fisheries sector. Women are mainly in employment of fish processing business whether unskilled or semi-skilled receiving inadequate income. The study also report that only 32% of women were unemployed and more than 65% earned a monthly income.

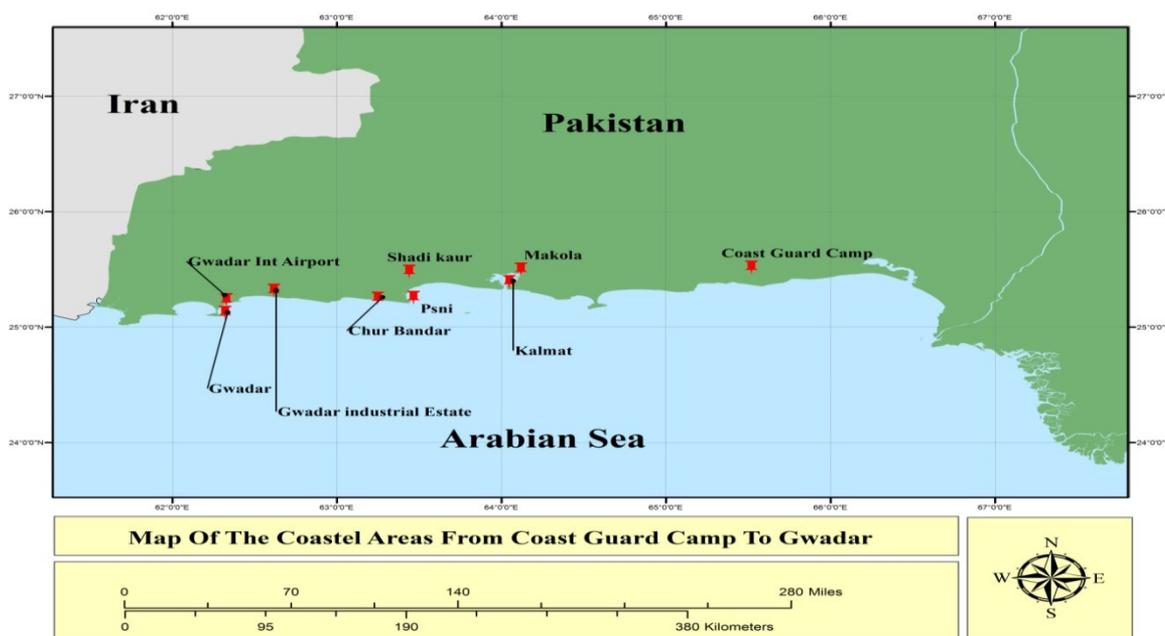


Fig 1: Map of the study area

Field survey and collection of data: The present investigation focused on finding out and documentation of original knowledge and practices for the use of medicinal plants by Gawadari people along with determining the challenges and opportunities in study area. This district was selected for the study as the region is still ignored as far as plant resources are concerned and enormous potential is destructing due to a number factors e.g., Housing schemes, port operations, law and order situation.

Plants were collected in the wild form with the help of locals. However, local medical practitioners (Hakeems) were somehow consulted for confirmation of the plants and their medicinal properties. Data were recorded in different trips on different times. Plant Specimens were collected following standard method of Martin (1995). According to the guidelines described by Chan *et al.*, (2012). Plants were properly identified and information regarding traditional medicinal use of plants was collected. In addition, local materia medica was taken into consultation for confirmation of classical medicinal uses.

A sum of 200 local informants was interviewed in order to get information along with their personal information i.e. name, gender, education etc. Interviews were conducted in Urdu and Balochi languages. In case of person who did not understand Urdu, the script was translated by interpreter to reduce ambiguity, uncertainty and ensure gathered knowledge integrity. By following the method of Malla *et al.*, (2015), Semi- structure questionnaire comprising local names, plant part used, disease, manufacture and mode of application was investigated through interviews, discussion and field observations. Stress was given to obtain first hand information from the participants regarding vernacular name of plant, medicinal use and mode of application etc. and their experience in using plants for treating different ailments. Moreover, care was taken to record data in comprehensive and reproducible way.

Plant collection, identification and preservation: Voucher specimen and ethno-medicinal info were compiled from the field trips. To facilitate knowledge dissemination and highlight valuable information among scientific as well as general quarters of society, attention was given to record the local names of plants, parts used, mode of application and traditional medicinal uses (Chan *et al.*, 2012). Photographs were taken to confirm the identification (Fig. 2).

The specimens were identified with the help of flora of Pakistan (Nasir & Ali, 1980-1989; Ali & Nasir, 1990-1991; Ali & Qaiser, 1995-2015; Qureshi, 2004). Local names and medicinal uses were documented carefully. Categorically, the herbarium was maintained and voucher specimens were deposited in Department of Botany, Government College University Faisalabad. Latest revision of "The Plant List" was accessed to check the correspondence of plant botanical names (www.theplantlist.org).

Statistical analysis

Data gathered about the plants were arranged in an excel sheet. The data were managed in the form of tables

mentioning botanical names, local name, location, family, parts used and medicinal uses for each specimen (Table 4 and 5). By keeping in view recommendations of Verpoorte (2012), data collected was integrated and analyzed by appropriate methods.

Informants consensus factor (F_{IC})

Informant consensus factor was calculated by using formula (Singh *et al.*, 2012; Bhat *et al.*, 2013),

$$F_{IC} = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

N_{ur}: the number of use report in a particular illness category by informants

N_t: the number of taxa or species used to cure that particular disease

1: highest level of informant consensus.

Fidelity level (FL)

By using the following formula the fidelity level (FL) was calculated (Alexiades, 1996),

$$FL (\%) = (N_p / N) \times 100$$

N_p: The number of people who suggested the use of a plant in the particular disease.

N: The total number of persons who described the same plant for any disease.

Results and Discussion

The coastal region in Pakistan is regarded as marvelous depository of green wealth. Plant species reported in this area are commonly practiced for multifarious purposes e.g. herbal drugs, fodder, wood and essential oils etc. Present investigation was planned and executed to document untapped potential of wild flora with therapeutic characteristics of Makran coast in general and Gawadar district in particular. Information collected revealed that majority of informants had the opinion that most of the plants have been used for the treatment of gastro-intestinal problems (Fig. 3). Noteworthy is the information that many plants have been used to treat multiple disorders.

Forty plant species were identified which fall into twenty five families (Table 5,6). Chief plant habit observed was shrubs (Table 4). Many of the plants possessed xerophytic characters exhibiting their capacity for withstanding long spans of climatic extremes. Halophytes had also been noted. We have recorded various plant communities in the study area. Our result is in agreement with that of Ahmad (1987) who has categorized vegetation of this area into different distinct communities. Collected data reveals that majority of the plant species fall in Chenopodiaceae family. This is in conformity with earlier workers who have supported that many of the plant species in Makran coast belong to this family (Goodman & Ghafoor, 1992). In addition, coastal parts of adjoining Lasbella district have nearly same appearance of Chenopodiaceae in its flora (Qasim *et al.*, 2010; Noman *et al.*, 2013).



Fig. 2: Biodiversity and some of the reported wild plants of district Gawadar

Table 2: Age and gender distribution of informants from District Gawadar

Age group	Gender		No. of persons	Percentage
	Male	Female		
20-29	17	00	17	8.5
30-39	21	10	31	15.5
40-49	55	27	82	42.0
50-59	33	17	50	25.0
60-69	15	5	20	10.0
Total		59	200	-

Table 3: Education level of interviewed informants from Gawadar District

Education level	Number of individuals	Percentage
Illiterate	68	34.0
Primary	39	19.5
Middle	52	26.0
Secondary	31	15.5
University	10	5.0
Total	200	

Demographic feature: A total of 200 informants (149 males and 51 females) aged between 20 to 69 years were interviewed in which 70.5% were males and 29.5% were females. The average age of informants was 49 years old (Table 2). Illiteracy rate was 34% and at primary, middle and secondary levels were 19.5, 26 and 15.5% respectively (Table 3).

Phyto-diversity, utilization and its application: The present research has unveiled the multipurpose use of 40 plant species belonging to 25 families in use to cure human diseases. The initial information on ethno-botanical plants were arranged systematically by species name along with ethno-medicinal uses (Table 4). We recorded normal practice of collecting medicinal plants in wild forms for use.

Results unveil the fact that most of the reported plants are used for medicinal purpose by population of this district. Our results get favor from work of different workers who have already reported the resembling usages of plants, especially as medicine in Gawadar and adjoining areas (Goodman & Ghafoor, 1992; Leporatti & Lattanzi, 1994). A review of literature shows that many of the plant species recorded in Gawadar district have also been observed in other parts of Makran coast and southern part of province. For example, *Nannorrhops ritchienana*, *Indigofera oblongifolia*, *Commiphora wightii* etc. have been reported here in this district and in area of Hingol National park and Awaran District (Qureshi, 2012). It is noteworthy that the area had poor cultivation facilities of valuable medicinal plants and potential is facing threat in form of over exploitation. This situation, in long run, can pave the way to depletion of autotrophic resources along with extermination for natural habitat of the plants and other life forms. There was cypher storage, conservation or preservation practice observed.

Plants parts used: This study provides sufficient evidence about the traditional medicinal practices of using native flora of the study area. The explored knowledge of inhabitants of district has tremendous ethno-botanical as well as ethno-medicinal importance. Plants and their parts such as roots, stem, leaves, wood, flowers, bark, seeds, latex and fruits are in common use for various purposes (Shinwari, 2010). It has also been observed that despite complete plant, various parts of plant are used to treat different diseases and even natives have a preference in using that particular plant part in time of problem. Leaves and root are more frequently used in comparison to the rest of plant parts (Gidaya *et al.*, 2009; Noman *et al.*, 2013). Present result also highlights the use of leaves by most of the indigenous people for medicinal function. This collected data is similar to the report of Keter and Metiso (2012). Plant uses mentioned in Fig. 2, Table 5 as well as stated in results involves different routes of administration (Shinwari, 2010).

Informant consensus factor: Proportion of medicinal plants mentioned (Fig. 3, Table 4,5) shows confidence and believe of commons over the plants as majority of the treated ailments are general and frequent like stomach and liver disorders, rheumatism, sting bite treatment and fever or flu. This result is supported by the work of Noman *et al.*, (2013) who have described approximately same trust of all and sundry in a part of Makran coastal belt *i.e.* Tehsil Ormara. According to Malla and Chhetri (2012) and Malla *et al.*, (2015) reliability of evidence collected by ethno-medicinal investigations can be tested by informant consensus factor. Plants of medicinal value used against various disease when categorized into 8 classes and F_{IC} values were calculated (Fig. 3), it is evident that category “gastro-intestinal problems” with F_{IC} values 0.849 carried highest degree of agreement followed by F_{IC} values for “snake/scorpion bite” having F_{IC} values 0.846 and “wound healing” with F_{IC} 0.714 respectively. The least consensus (0.55) was found in category of plants with anti-rheumatic/joint pain relieving properties.

Different researchers have described such F_{IC} values as reliable tool in ethno-botanical studies (Megersa *et al.*, 2013, Song *et al.* 2013). Our results are in line with those researchers and depict present agreements in opinion among different informants in Gawadar. This informant consensus factor in fact, represent the trust as native people on those plants and provide evidence that curing various human diseases with diverse use of plants is still practiced. Our findings also get favor from previous reports by Noman *et al.* (2013) and Qasim *et al.* (2010). These enable us to say whether modern medicine system or the Greek way of treatment, we cannot refute the worth of medicinal potential of diverse plant species. But alarming is a situation in the case of young people. Their participation in data collection and their knowledge sharing represent lack of knowledge and interest. Many youngsters even showed complete ignorance about the use of plants (parts) for medicinal purpose. Their intension in using indigenous plants for treatment of different ailments is reducing day by day and passing of knowledge down the generation is at stake.

Number of Plants Used for Ailment (%age)

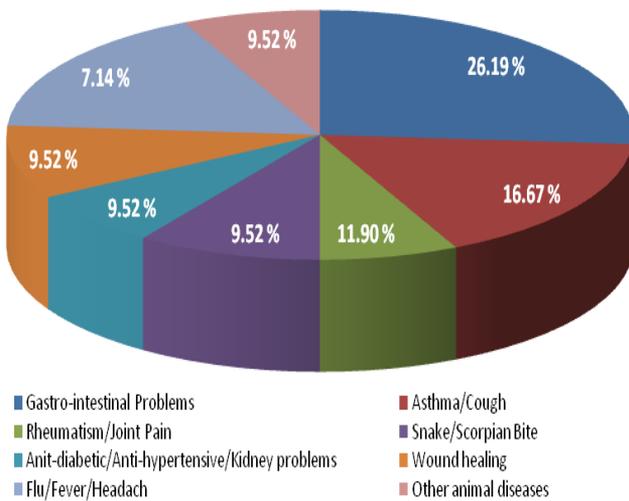


Fig. 3: Number of plant species in use for medicinal purpose in District Gawadar of Makran.

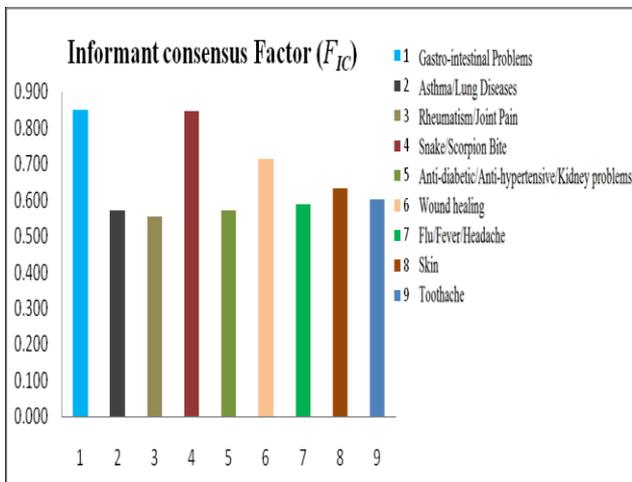


Fig 4: Informant Consensus Factor presenting significance of local flora for inhabitants in treatment of different disease in study area.

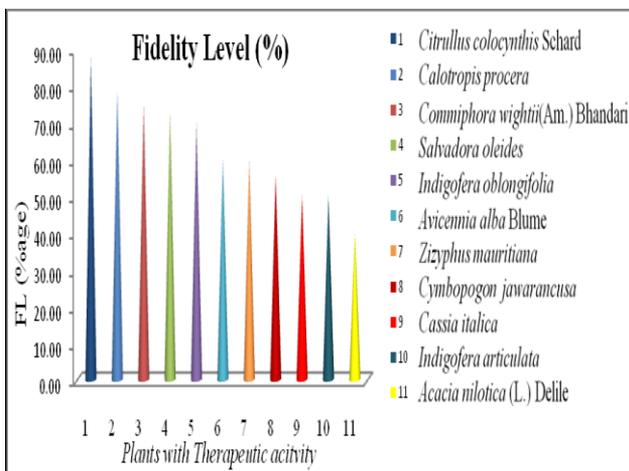


Fig 5: Fidelity Level depicting diverse flora with therapeutic activity in District Gawadar of Makran Coast.

Fidelity level: We are in realm where up to 80% of population cannot find the money for appropriate healthcare and depends upon wild plants because of their association, belief, simple use and effectiveness (Anonymous, 2009; Malla *et al.*, 2015). In addition to F_{IC} , F_L values calculated to assess most significant plant species in each disease class (Fig. 4). Care was taken in calculating F_L of medicinal plants when at least four or more informants supported the use of a given plant against an ailment.

Highest F_L was noted in *Citrullus colocynthis* (87.5%) followed by *Calotropis procera* (78.57%) and *Commiphora wightii* stood third with F_L (75%). Chenopodiaceae was leading plant family.

Challenges and opportunities: During the last ten years, Govt. of Pakistan has targeted this area with cooperation of Peoples Republic of China. A plan has been implemented for developmental operations for city and Gawadar port. A very misfortune, realized with passage of time, is neglecting the biodiversity. Although port operations and developmental activities in the area have provided country valuable financial support but has disturbed environment badly. Increments in population along with influx of people from different parts of country for business and job have burdened already limited opportunities. It has been described by workers that any of the anthropogenic activity that exerts pressure on planet in terms of effecting biological diversity or biological survival is considered as threat to survival (Scherst & Brooks, 2002). The study area faces numerous challenges despite the opportunities.

A great blow to land can be seen in form of numerous Housing Schemes. Many of such schemes have emerged without planning and resulted in speeding up of soil erosion. On the other hand construction of houses and roads right along the beach i.e. Singhar Housing society and Naval base has restricted the access of humans and animals herds to this part of city. Such conversion of land into housing areas is in fact fragmentation of Habitat. It is very clear that such fragmentation can cause decreased population and range size for various species in area. Some or many species will not be able to disperse throughout a fragmented habitat particularly when intervened land scape comprises of barriers like roads and boulevards. Water erosion due to sea currents is at its peak and no one is ready to pay heed to this alarming situation. It has already been accepted that no. of species in an area are related to size of that area. Nearly 1/2 Reduction in size of area may cause extinction of 1/6th species (Pimm & Brooks, 1999). Though wild plants are adaptable to natural environment of this area but still they need to be look after. Agencies like Gawadar Port Authority and Gawadar Development Authority are not interested at all to plan and carry out saving efforts for biodiversity. Shipping through this area is also threatening marine life forms and habitats. This heavy sea traffic is leaving negative impressions through rubbish produced, damages during anchorage, shipping accidents and oil spills etc. These are reckoned as acute environmental disasters that appear lethal (Scherst & Brooks, 2002). Generally, coastal environments are considered as a component of fragile but dynamic ecosystem. The subtraction of vegetation may have deleterious effects on whole ecosystem or upon its different members. Officials of wetlands project are to some extent working but we can find only one information board installed on road a little before industrial estate. In 1999, projects like mangrove conservation, turtle conservation

were launched. But in the present decade deteriorating state of affairs along this coast is result of negligence. Meyers et al. (2000) has identified 25 hotspots in the world that need to be dealt on top priority basis. No efforts are being conducted to educate local people to save biodiversity. Still in this century, we are far away from defining any marine reserves or marine protected areas of country. Though effort has been made in Jiwani by planting mangrove tree seedlings but this is little one. Without concrete efforts and effectively managed marine protected areas, future of such biodiversity rich areas cannot be declared certain. Drilling for oil and gas reserves e.g in Pasni may pose serious threats to existing marine species and habitats. Pollutants like untreated sewage,

plastics and chemicals from city are eventually making their way to sea (Scherest and Brooks, 2002). Much of items like plastic bottles etc can be seen on beaches and are causing problems not only for marine animals but for the whole food chain till the end user. Coral bleaching along with changed species distribution is evident in different parts of Makran coast. Day by day worsening law and order situation is an impediment for researchers and workers from other areas to come here and work. In addition due to illiteracy and language problem, communication gap is increasing. In addition to absence of local experts, folk communities are not ready to accept any person, who else he is, for listening and following in order to save biodiversity.

Table 4: Distribution and habit of plant species at Makran Coast, District Gawadar

Name of Species	Habit	MD	FD	OR	FW	TM	DI	AN	FO	OT
<i>Acacia nilotica</i> (L.) Delile		■				■				■
<i>Acacia senegal</i> (L.) Willd.			■							
<i>Aerva javanica</i> (Burm. F.) Juss. ex Schult.										■
<i>Anethum graveolans</i> L.		■					■			
<i>Atriplex griffithii</i> var. <i>stocksii</i> (Boiss.) Boiss.		■	■							
<i>Avicennia alba</i> Blume		■	■							
<i>Calotropis procera</i> (Aiton) Dryand.		■					■			
<i>Capparis decidua</i> (Forssk.) Edgew.									■	
<i>Capparis spinosa</i> L.								■		
<i>Caralluma tuberculata</i> N. E. Brown		■					■			
<i>Cassia italica</i> (Mill.) Lam. ex F. W. Andr.							■			
<i>Ceriops tagal</i> (Perr.) C.B. Rob.		■				■	■			
<i>Citrullus colocynthis</i> Schard.		■								
<i>Commiphora wightii</i> (Arn.) Bhandari		■					■			
<i>Cornulaca monacantha</i> Delile		■					■		■	
<i>Cymbopogon jawarancusa</i> (Jones) Schult.		■								
<i>Ferula asafoetida</i> H. Karst							■			
<i>Gentiana olivierii</i> Griseb			■				■		■	
<i>Haloxylon stocksii</i> (Boiss.) Benth. & Hook		■								■
<i>Haplophyllum tuberculatum</i> (Forssk.) F. W. Ander.							■			
<i>Heliotropium subulatum</i> (Hochst. ex DC.) Hochst. ex Martelli			■							
<i>Indigofera articulata</i> Gouan		■								
<i>Indigofera oblongifolia</i> Forssk.							■	■		
<i>Inula grantioides</i> Boiss		■					■			
<i>Launaea nudicaulis</i> (L.) Hook. F									■	
<i>Lawsonia inermis</i> L.		■					■			■
<i>Otostegia persica</i> (Burm. F.) Boiss							■			■
<i>Panicum turgidum</i> Forssk.			■							
<i>Parkinsonia aculeata</i> L.		■					■			
<i>Peganum harmala</i> L.										
<i>Reseda aucheri</i> Boiss										
<i>Rhizophora mucronata</i> Lam.						■	■			■
<i>Salvadora oleoides</i> Decne.		■	■							
<i>Sericostoma pauciflorum</i> Stocks ex Wight			■							
<i>Solanum incanum</i> L.		■					■			
<i>Suaeda fruticosa</i> Forssk. ex J.F.Gmel.										■
<i>Tamarix indica</i> Willd						■		■	■	
<i>Trigonella anguina</i> Delile								■	■	
<i>Zizyphus mauritiana</i> Lam.		■								
<i>Zizyphus nummularia</i> (Burm. f.) Wight & Am.							■			

 Tree,  Shrub,  Herb,  Grass

Table 5: Presentation of plant parts used along with their distribution across the district

Name of Species	Common Name	Location	WP	ST	RT	L	FL	FR	SE	HW	B	RE
<i>Acacia nilotica</i> (L.) Delile	Khaghird	Dorghatti, Psni										
<i>Acacia senegal</i> (L.) Willd.	Babur	Psni, Sighar housing society										
<i>Aerva javanica</i> (Burm. F.) Juss. ex Schult.	Kapook,	Nailent, Naya abad										
<i>Anethum graveolans</i> L.	Soya	Kalimat gorab										
<i>Atriplex griffithii</i> var. <i>stocksii</i> (Boiss.) Boiss.	Deli	Sur Bander, Marine drive										
<i>Avicennia alba</i> Blume	Api-api puthi	Sur Bander, Chur Bander										
<i>Calotropis procera</i> (Aiton) Dryand.	Kharegh	Gawadar city, Psni										
<i>Capparis decidua</i> (Forssk.) Edgew.	Kdlr	Shadi Kaur										
<i>Capparis spinosa</i> L.	Bhoooh	Shadi Kaur, Makola, Psni										
<i>Caralluma tuberculata</i> N. E. Brown	Marmootak	Industrial Estate										
<i>Cassia italica</i> (Mill.) Lam. ex F. W. Andr.	Mairo maz	Pishukan, Shambay Ismail										
<i>Ceriops tagal</i> (Perr.) C.B. Rob.	Gandokh	Jiwani, Gawadar, Psni										
<i>Citrullus colocynthis</i> Schard.	Gucch	Makola, Psni										
<i>Commiphora wightii</i> (Am.) Bhandari	Sadaf, Gugur	Sur Bander, Turbat More										
<i>Cornulaca monacantha</i> Delile	Gundak	Singhar housing, Eastern bay										
<i>Cymbopogon jawarancusa</i> (Jones) Schult.	Nadag	Singhar housing, Eastern bay										
<i>Ferula asafoetida</i> H. Karst	Hing	Turbat road, Psni										
<i>Gentiana olivierii</i> Griseb	Bangero	Airport road, Shadi Kaur										
<i>Haloxylon stocksii</i> (Boiss.) Benth. & Hook	Khaar,Bundi	Sur Bander										
<i>Haplophyllum tuberculatum</i> (Forssk.) F. W. Ander.	Gandrem	Chur Bander, Barambah										
<i>Heliotropium subulatum</i> (Hochst. ex DC.) Hochst. ex Martelli	Kanjaro	Eastern bay										
<i>Indigofera articulata</i> Gouan	Aqno	Psni, Barambah										
<i>Indigofera oblongifolia</i> Forssk.	Shimmil	Gawadar city, Psni										
<i>Sphiona grantioides</i> (Boiss.) Anderb.	Naro	Nailent, Shinkari dar										
<i>Launaea nudicaulis</i> (L.) Hook. F	Alku	Coast guard camp										
<i>Lawsonia inermis</i> L.	Hina	Governor house										
<i>Otostegia persica</i> (Burm.) Boiss.	Gurder	Pishukan avenue										
<i>Panicum turgidum</i> Forssk.	Not confirmed	Pishukan avenue, Airport road										
<i>Parkinsonia aculeata</i> L.	Bdboor	Pasni, Industrial estate										
<i>Peganum harmala</i> L.	Aspand	Airport road, Gawadar city										
<i>Reseda aucheri</i> Boiss.	Not confirmed	Psni										
<i>Rhizophora mucronata</i> Lam.	Not confirmed	Jiwani, Gawadar, Psni										
<i>Salvadora oleoides</i> Decne.	Jar, Peroon	Shadi Kaur, Bismillah										
<i>Sericostoma pauciflorum</i> Stocks ex Wight	Bheeng	Makola, Psni										
<i>Solanum incanum</i> L.	Batag	Chur Bander										
<i>Suaeda fruticosa</i> Forssk. ex J.F.Gmel.	Lani	Main coastal highway										
<i>Tamarix indica</i> Willd.	Lao ,Gaz	Psni										
<i>Trigonella anguina</i> Delile	Shmish	Makola, Nailent										
<i>Zizyphus mauritiana</i> Lam.	Ber	Psni, Gawadar city										
<i>Zizyphus nummularia</i> (Burm. f.) Wight & Am.	Khnur	Psni, Gawadar city										

WP: Whole Plant; ST:Stem; RT:Root; L:Leaf; FL:Flower; FR:Fruit; SE:Seed; HW:Heart Wood; B:Bark; RE:Resin

Table 6: Potential Bio-Active ingredient and Traditional medicinal Uses of diverse medicinal plants reported in Makran Coast.

Family Name	Plant Name	Potential Bio-Active Ingredient	Traditional Medicinal use
Apiaceae	<i>Ferula asfoetida</i> H. Karst	Ferullic Acid, Luteolin, Diallyl di sulfide, Umbelliferone (Mahendra and Bisht, 2012)	This is used as a digestive aid. People think it helpful in curing bronchitis, asthma and whooping cough.
	<i>Anethum graveolans</i> L.	Carvone, Limonene, α -phellandrene including pinene, Diterpene, Dihydrocarvone, Cineole, Myrcene, Paramyrcene, Dillapiole, Isomyristicin, Myristicin, Myristin, Apiol and Dillapiol, Flavonoids (Al-Snafi, 2014; Yazdanparast and Bahramikia, 2008)	Used as laxative by locals and to relieve gastric trouble. The powdered seeds are taken orally. High dose may cause diarrhea.
Asclepiadaceae	<i>Calotropis procera</i> (Aiton) Uscharin, Calotoxin, Latex Dryand.	Pentacyclictriterpenes, Cardenolides, Phytosterols, β -Amyrin benzoate, Proceraanol (Dewan <i>et al.</i> , 2000; Sharma <i>et al.</i> , 2012)	This plant is famous among natives of study area as it is in use to get relief in case of nasal congestion, headache, and rheumatic pains. Finely ground root powder is inhaled for clearing nasal blockage. Root powder is placed on heated and the fumes are inhaled to cure headache.
Asteraceae	<i>Caralluma tuberculata</i> N. E. Brown	Steroids, Terpenoids, Tannins, β -cyanin (Rauf <i>et al.</i> , 2013), Flavone glycosides (Rizwani <i>et al.</i> , 1990), Saponins, Alkaloids, Tannins (Ahmad <i>et al.</i> , 2014)	In Gawadar and vicinity, It is used in treatment of fever. Plant is ground and powder is taken with water.
	<i>Inula grantioides</i> Boiss.	Lactones, Phytosteroids (Ecdysones), Phenolics, Glycosides (Urbanska <i>et al.</i> , 2014)	People of the study area consider this plant helpful in healing lacerations and festering wounds. Crushed leaf paste is applied to wounds along with bandage.
Avicenniaceae	<i>Avicennia alba</i> Blume	Anticancer compounds, Alkaloids, Flavonoids, Triterpenoids, Naphthoquinones (Karamia <i>et al.</i> , 2012)	People use its bark in skin disorders. Poultice made of its unripe seeds is applied over ulcers, sores etc. Its resin is commonly believed to have anti-venome properties against snake bite.
Boraginaceae	<i>Heliotropium subulatum</i> (Hochst. ex DC.) Martelli	Pyrrrolizidine alkaloids, Naphthoquinones, Flavonoids, Terpenoids, Saponins, Alkaloids, Tannins (Sharma <i>et al.</i> , 2009)	People of gawadar keep root infusion overnight and that is used as purgative and stomach pain reliever. Its paste is applied over snake scorpion bite.
Capparidaceae	<i>Sericostoma Stocks ex Wight</i>	Caffeic acid, β -sitosterol (Jain <i>et al.</i> , 2012), Triterpenoids (Fernane, Hopane), Fridelin, β -Amyrin (Jain <i>et al.</i> , 2014)	Traditionally this is used by the natives of study area as remedy for stomach acidity and dehydration.
	<i>Capparis decidua</i> Edgew.	Terpenes, alpha-pinen, Thymol, Myrcen, Cymen, Terpinen, Campher, isocarveol, Kaempferol glycosides, Paraffin, Heptacosane-14-one, spinasterol, Triacetylalkohol (Upadhyay, 2013)	This plant is generally associated with Intestinal troubles i.e. blood in the stools. Alpha- Wood powder, mixed with clarified butter is taken orally.
	<i>Capparis spinosa</i> L.	P-hydroxy benzoic acid, α -D-fructofuranosides methyl, Uraclil, Stachydrine (Feng <i>et al.</i> , 2011), Cadabicine, Glucosides (Khanfar <i>et al.</i> , 2003), Indole acetonitrile, Glucosides (Calis <i>et al.</i> , 2002)	Dried fruits of this plant are taken by people as they think this cure blood pressure. Paste made of root bark is considered effective against skin rashes, dry skin, arthritic pains and swollen joints.
Caesalpinaceae	<i>Cassia italica</i> (Mill.) F. W. Andr.	Benzimidazole, Nifedipine, Propionic acid (Abdul-Enein <i>et al.</i> , 2014), Squalene, Ricinoleic acid, Undecanoic acid, Hexadecanoic acid, Phytol (Sermakkani & Thangapandian, 2012)	This plant is famous as a coolant. The aerial plant parts are ground to and applied on forehead and the heels to draw out fever and internal body heat.

Table 6: (Cont'd)

Family Name	Plant Name	Potential Bio-Active Ingredient	Traditional Medicinal use
Chenopodiaceae	<i>Cornulaca monacantha</i> Delile	Triterpenoids/saponins, Saponins of oleanolic acid: Hederagenin and 30-methyl phytolaccagenate (Kamel <i>et al.</i> , 2000), Flavonoids: Luteolin-7-O-rhamnoside, made is given to jaundice patients. Its leaf tea is also famous for correcting Luteolin-7-O-glucoside, Gallotannins: Monacanthin (Kandil and Grace, 2001) digestion.	This plant is believed to be a tonic for liver. Its parts are boiled and the decoction made is given to jaundice patients. Its leaf tea is also famous for correcting digestion.
	<i>Aerva javanica</i> (Burm. F.) Juss. exSchult.	Hentriacontanane, Nonacosane, Heptacosan, Pentacosane, Triacosane, Hexacosane (Samejo <i>et al.</i> , 2012 & 2013), Chrysoeriol, rhamnogalactoside (Chawla <i>et al.</i> , 2012).	Its paste is applied over acnes and skin rashes.
	<i>Atriplex griffithii</i> var. <i>stocksii</i> Boiss.	Alkaloids, Phenolic compounds, Flavonoids, Cardiac glycosides (Mansuri <i>et al.</i> , 2014)	
	<i>Haloxylon stocksii</i> (Boiss.) Benth. & Hook	Ursolic acid, Triacantanol, Octadecanoic acid, Octacosonic acid, Triacantanolic acid, β -Sitosterol, Sitosterol 3-O-b-D-glucopyranoside (Ahmed <i>et al.</i> , 2004)	This is used as coolant agent. Poultice is made from ash to be applied upon boils.
	<i>Suaeda fruticosa</i> ex J.F. Gmel.	Forssk. Alkaloids, Flavonoids, Saponins, Phenolic compounds, Terpenoids, Cardiac glycosides (Munir <i>et al.</i> , 2014)	This plant is famous among indigenous population for curing constipation among infants and ringworm problem. The fresh leaves paste, is mixed with milk and fed to the infant. For ringworm treatment, fresh leaf juice is applied to the infected thrice a day.
	<i>Citrullus colocynthis</i> Schard.	Flavone glucosides: Isosaponarin, Isovitexin, Isoorientin 3'-O-methyl ether, Cucurbitacinynglucosides (Delazar <i>et al.</i> , 2006), Colocynthin, Colocynthinin, Cucurbitane, Flavonoid, Glycoside, Quercetin, Flavone-3-glucoside viziso-vitexin, Iso-orientine (Pravin <i>et al.</i> , 2013), Saponins, Terpenoids, Alkaloids (Uma & Sekar, 2014), Phenolics, Riboflavin (Asyaz <i>et al.</i> , 2010).	Locals are convinced of wide variety of medicinal purposes of this plant as a laxative, reliever of peptic pain and sexual stimulant for men, to cure sore gums, to dry up pimples, as a vermifuge, to prevent hair fall, to relieve rheumatic pains, to cure leucorrhoea and piles To break constipation, dried seeds are taken orally.
	<i>Commiphora wightii</i> (Am.) Bhandari	Guggulsterone (E and Z), β hydroxyprogesterone, Strols (Guggulsterols I, II, III IV & V), Mukulol, β -Sitosterol, Manusumbionic acid, Octanordamarane (<i>et al.</i> , 2012), Myrcene, Dimyrcene, Nonadecan, Octadecan (Kulloli and Kumar, 2013)	People used this plant to treat infected skin and pimples. A paste is made of the woody portion and resin. This poultice is applied over the affected skin. This ruptures the infection and subsequent drying.
Cucurbitaceae	<i>Indigofera oblongifolia</i> Forssk.	Indigin, Alkylated xanthin, Indigoferic acid, Beta-sitosterol, 3-Hydroxybenzoic acid (Sharif <i>et al.</i> , 2005), antibacterial effect, cytotoxicity (Teyeb <i>et al.</i> , 2012)	The leaves are used to treat rashes and stomach pain.
Fabaceae	<i>Indigofera articulata</i> Gouan	Indicaine, Nitro compounds (Ghazanfar, 1994)	Twigs are boiled and used in throat pain.
	<i>Gentiana olivieri</i> Criseb	Xanthonoids, Xanthonoids, Terpenoids, Flavonoids, Alkaloids, Iridoid, Iridoid Glycosides (Brahmachari <i>et al.</i> , 2004)	This plant is trusted in treatment of liver and spleen diseases might be related to hepatitis. Stems and flowers are boiled in water. This decoction is filtered and taken orally. Normally two doses are administered in a day.
	<i>Orostegia persica</i> (Burm. F.) Boiss.	Alpha-pinene, Phenolics: Morin, Quercetin, Kaempferol, Isovitexin, Cinnamic acid, Caffeic acid, p-hydroxy benzoic acid, β -sitosterol, β -sitosteryl acetate, Terpenoids: β -Amyrin, Campesterol, Stigmaesterol (Sadeghi <i>et al.</i> , 2014)	Local uses in treatment of dehydration, fever, and arthritic pain have been reported. For all these ailments the mixed stems and leaves are soaked in water and infusion is drunk.
Gentianaceae	<i>Lawsonia inermis</i> L.	Quinones, Phenylpropanoids, Flavonoids, Terpenoids, Phenolics, Eugenol, Hexadecanoic acid, Phytol, α -terpineol, etherphenylvinyl (Kidnamariam <i>et al.</i> , 2013)	Commonly this plant is considered as the best coolant in humans and as a tonic for digestive tract disorders.
Lamiaceae	<i>Acacia nilotica</i> (L.) Delile	Terpenes (Diterpenes, Phytosterol, Triterpenogenins and Saponins), tannins, Flavonoids, Condensed tannins, m-digallic acid, Gallic acid, Protocatechuic, Ellagic acids, Leucocyanidin, Apigenin, Catechin, Threonine, Kameferol (Malviya <i>et al.</i> , 2011)	Locals prefer to use branches of plant as tooth brush. Powdered root is used in stomach pain. Leaves are being used to treat dysentery.
Lythraceae	<i>Acacia senegal</i> (L.) Willd.	Rhamnose, Arabinose, Glucuronic acid (Mariana <i>et al.</i> , 2012)	Gum is considered very beneficial in treating intestinal mucosa inflammation. Gum of this plant is thought to be very active against catarrh, colds, coughs.

Table 6: (Cont'd)

Family Name	Plant Name	Potential Bio-Active Ingredient	Traditional Medicinal use
Mimosaceae	<i>Rhizophora mucronata</i> Lam.		Fisher community use poultice of leaves to get relief from fish stings. Some people believe it beneficial against diabetes.
Myrsinaceae	<i>Trigonella anguina</i> Delile	Plamitic acid, Phytol, alpha-limolenic acid (Shanti and Gowri, 2008)	Local population use the aerial parts for cooking as a vegetable.
	<i>Parkinsoni aculeata</i> L.	Glycosides, Parkinsonin-A and B, Parkinin, flavone C-glycoside (Luteolin), Orientin, iso-orientin, Vitexin, Iso-vitexin, Lucentin-II, Vicenin-II, Diosmetin, Ground root, stem, leaves and flowers, are swallowed with water twice a day.	Traditionally the plant is famous for relieving pain in the joints, limbs and heels.
Papilionaceae	<i>Cymbopogon javarancusa</i> (Jones) Schult.	Apigenin, Luteolin, Kaempferol, Chrysoeriol (Hundekari <i>et al.</i> , 2012)	Ground root, stem, leaves and flowers, are swallowed with water twice a day.
	<i>Panicum turgidum</i> Forssk.	Piperitone, Geranial, Citral, B-Pinene, Citronellol, Terpinene, Sesquiterpene, Agarospirol, Phellandrene (Prasad <i>et al.</i> , 2014)	It has been remarked that this herb is used to treat fever. A quantity of the plant is collected into a cushion; the patient then lies on it and immediately experience heavy sweat that dissipates the heat. The aerial part is chopped and used as a tea additive.
Poaceae	<i>Reseda aucheri</i> Boiss	Alkanoid glycosides, Steroidal saponins (Zaki <i>et al.</i> , 2015)	Locals of the area use this plant in toothache and treating wounds. Its leaf paste is applied over sore gums and teeth.
	<i>Zizyphus nummularia</i> (Burrm. f.) Wight & Am.	Flavonoids, Glucosides (Noori, 2012)	Natives use leaves of this plant in snake and insect bite. They believe this plant as toxicity remover.
Resedaceae	<i>Zizyphus mauritiana</i> Lam.	Cyclopeptides, Flavonoides, Saponins, Triterpenoides, Ziziphin N, O, P & Q, dodeca acetylprodephinidin B3, nummularogenin, zizynummin, lapachol (Kumar <i>et al.</i> , 2011)	This is used to get relieve from diarrhea. The fruits are ground into paste. This dodeca acetylprodephinidin B3, nummularogenin, zizynummin, lapachol (Kumar <i>et al.</i> , 2011)
	<i>Cerriops tagal</i> (Perr.) C.B. Rob.	Betulinic acid, Betulinic acid, Betulin, Beta-sitosterol, n-hexacosanylferulate (Zhang <i>et al.</i> , 2005), Ent-8(14)-pumarene-15R,16-eczema, Stigmasterol (Chen <i>et al.</i> , 2008)	Seeds in ground form are taken with butter to control nausea and vomiting. A sitosterol, Daucosterol, Daucosterol-6'-octadecanoate, Docosanoic acid, Stearic acid, Palmitoleic acid (Guo <i>et al.</i> , 2014), Jujuboside, Cyclopeptide alkaloids this plant is used on ulcers and cuts.
Rhamnaceae	<i>Haplophyllum tuberculatum</i> (Forssk.) F. W. Ander.	Tagalinsin A, ent-Salpa-dolabr-4, Squalene, Betulinic acid, Betulin, Beta-sitosterol, n-hexacosanylferulate (Zhang <i>et al.</i> , 2005), Ent-8(14)-pumarene-15R,16-eczema, Stigmasterol (Chen <i>et al.</i> , 2008)	Locals of the area made juice from stem bark of this plant that is beneficial in diabetes.
	<i>Salvadora oleoides</i> Decne.	Tricyclene, a-thujene, a and b-pinene, Camphene, Sabinene, Myrcene, Carene, Phellandrene, Terpinene, Limonene, Eucalyptol, Linalool, Cis-p-menth-2-en-1-ol, Trans-p-Menth-2-ene-1-ol, Borneol, Estragole, Myrtenal, Piperitone, Eucarvone, β -Sesquiphellandrene, Lauric acid, Spathulenol (Al-Rehaily <i>et al.</i> , 2013; El-Naggar <i>et al.</i> , 2014)	This plant is in use of native population as cough suppressant. Stem and seed are powdered and boiled in water, and the decoction is made. This procedure can be used for adults. The treatment for children involves frying the partially dried ground parts in oil, then rubbing the ointment on the heads of children.
Rutaceae	<i>Solanum incanum</i> L.	Sterols (beta-sitosterol), Glucosides, Flavonoids (quercetin, rutin), Dihydroisocoumarin, Terpenoids (methoxy-4-vinylphenol, cis-3-hexenyl benzoate), Salvadorin, Salvadourin, Octadecanoylheptanoate, Octacosane, Nonacosane, Heptacosane, Squalene (Arora <i>et al.</i> , 2013; Garg <i>et al.</i> , 2013)	The branches of this plant are famously used as tooth brush and believed to have antiseptic properties. Its dried ground fruits and seeds are taken orally to treat urinary tract infections.
	<i>Tamarix indica</i> Willd	Flavonoids, Chlorogenic acid, Adenosine, benzyl-O- β -D-xylopyranosyl(1 \rightarrow 2)- β -D-glucopyranoside, Phenylalkanoic acids (Lin <i>et al.</i> , 2013), Saponin, Steroids, Triterpenes, Phytosterols, Glycosides (Abebe <i>et al.</i> , 2014)	This helps in healing of infected fingers, nails and toes. Whole fruits are heated in water, then cut and the infected digit is placed in pulp. Or the warm pulp is applied directly over the wound. Normally single application is adequate.
Solanaceae	<i>Peganum harmala</i> L.	Tannin, Tamarixin, Troupin, 4-Methycoumarin, 3,3-di-O-methyllellagic acid (Naz <i>et al.</i> , 2013; Rahman <i>et al.</i> , 2011)	According to gawadri people, plant is endowed with properties of healing skin wounds and traumatic injuries. Bulk of shoots and leaves are put in water and boiled. The decoction is further boiled until it becomes Semi solid. The ointment is applied directly to open and festering sores.
	<i>Zizyphus nummularia</i>	Flavonoid glycosides, β -carboline alkaloids (Harmaline, Harmalol, Harmol, Harmine and Tetrahydroharmine) (Affifi & Kasabri, 2013; Loutfiaet <i>et al.</i> , 2013).	This is used in relieving fever, stomachache, and gas.seeds are ground into powder and then swallowed with water to relieve digestive tract pain associated with indigestion. The fumes of burning seeds are inhaled by the patient to lessen fever.
Tamaricaceae	<i>Zizyphus nummularia</i>		
Zygophyllaceae	<i>Zizyphus nummularia</i>		

Conclusion

The present study reflects that the local population depends on various plants to fulfill their needs and to cure different ailments. Varied plant parts are used for different medicinal purpose and consumption. To a major extent, the understanding and use of the medicinal flora rely upon on traditional thoughts and theories. So, need is thorough biochemical and pharmacological investigation of the plants for correct identification of bioactive compounds. This can further aid in administering novel drugs. This will be a pronounced input for pharmaceutical and herbal sector in and out of Pakistan. Our observations explored that human infringement like haphazard urbanization, habitat loss, no conservation of medicinal plants are the main causes of shrinking of exceedingly persuasive therapeutic plants. An apt conservation strategy is need of hour to protect the medicinal plant diversity. To conserve the plants in their original habitats, it is imperative to launch medicinal estates and marine reserves for ex-situ conservation with involvement of local communities. In-situ conservation practices are also recommended as these can surely help to save diminishing plants. Systematic screening of recorded medicinal flora through chemical and pharmacological ways for potential bioactive compounds should be done accordingly. Investigational authentication of the therapies may appear helpful in development of new drugs that can be used to treat formidable diseases like cancer, hepatitis and HIV.

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