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Full Length Research Paper

Herbal gardens of India: A statistical analysis report

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A knowledge system of the herbal garden in India was developed and these herbal gardens' information was statistically classified for efficient data processing, sharing and retrieving of information, which could act as a decision tool to the farmers, researchers, decision makers and policy makers in the field of medicinal plant species.

Key words: Knowledge system, herbal garden, medicinal plant, decision tool.

INTRODUCTION

The enormous benefits of various medicinal plants to resist and recover from illness of not only human beings, but also animals were intuitively recognized centuries ago by the primitive people. The common saying is that each and every plant, observed by the study to at least have some medicinal value to man, is perhaps not much exaggerated. Since time immemorial, man has searched for plants that would relieve pain and get rid of ailments. The curative properties of plants are thought to have come to the knowledge of the ancient people through extensive searching of plants and examination of their uses.

India is one of the 12 mega biodiversity centres having over 45,000 plant species. Its diversity is unmatched due to the presence of 16 different agro climatic zones, 10 vegetative zones and 15 biotic provinces. The country has 15,000 to 18,000 flowering plants, 23,000 fungi, 2500 algae, 1600 lichens, 1800 bryophytes and 30 million micro-organisms. India also has an equivalent of 3/4 of its land exclusive economic zone in the ocean that is harbouring a large variety of flora and fauna. However, many of them showed therapeutic properties. About 1500 plants with medicinal uses are mentioned in ancient texts and around 800 plants have been used in traditional medicine (Anonymous, 1998).

There is a large number of information available on the different types of herbal gardens in India. However, as most of them are not networked or linked, therefore, it is very tedious and time taking to retrieve such type of information. Currently, there is no knowledge driven system available for classifying these herbal gardens to decision makers and the research community for sharing and retrieving the information. Hence, the objective of this study was to develop knowledge system on herbal gardens in India and classify the information for easy and efficient data process.

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MATERIALS AND METHODS

Location of study

The study was conducted at the Agricultural Research Information Systems Cell (ARIS cell) and Computer Cell of Directorate of Medicinal and Aromatic Plants Research (DMAPR), Boriavi, Anand, Gujarat, India.

Data collection

The different herbal gardens available in India were identified. The information on different medicinal plant gardens existing in India were collected, maintained and compiled through the help of different state forest departments. The collected information, thus compiled, was utilized for the database development and data analysis in this study.

Classification of collected data

Geographical classification

The data received were classified according to the location of the

city, state and district. Information on the organizations which maintain these gardens was also collected. Besides, the area (in hectares) of the gardens was also taken into account.

Classification of plants

The organizations, who were interested in sending the information about the different plants collections, were identified. The plants are classified in two ways:

Classification of the plants based on habit: The habit of the plant gives the general appearance of the plant, including size, shape, growth form and orientation (Grime, 2001). The collected herbal plant information, such as herb, shrub, tree and climber, was classified.

Classification of plants in accordance to the binomial system of nomenclature: Following classification according to the habit, the binomial name, the family, other synonyms of the plant and vernacular names were used to classify the plants. Other vital information, like number of plants available in each species and the amount of planting material available was used.

Database platform

A database management system (DBMS) that is built upon the Structured Query Language (SQL) was used in this study. The SELECT statement for the selection and CREATE VIEW for the virtual relations were used with the idea of creating and using the different tables and their existing relations.

Design of the knowledge system

The knowledge system was developed using Tomcat6 (Moodie and Mittal, 2007) as an application server, Struts' 2.0 (Donald et al., 2008) as an application framework, Java Script (Flanagan, 2006) as a front-end and MySQL 6.0 (DuBois, 2007; Dyer, 2005) as a back-end.

Statistical analysis using SPSS

SPSS (Statistical Package for the Social Sciences) is a computer program used for statistical analysis. Statistical analysis operations are related in the sense that these operations make use of the user-driven techniques, and so iterative analysis can prove to be most beneficial.
The descriptive statistical analysis was carried out to determine the following:

1. The number of gardens in every state.
2. The percentage of plant species belonging to every habit.
3. The number of different habits of plant according to the family.

RESULTS AND DISCUSSION

Database development and design of the knowledge system

The developed database was uploaded online and the Knowledge system was hosted at www.herbalgarden-india.org. This system, at present, indicates the presence of a total of seventy-one (71) herbal gardens from all over the country that are registered as members in this network.

Features of the knowledge system

The homepage helps in organizing links or information for the user when the web page starts. It provides list of herbal gardens in India along with the plant species like trees, shrubs, herbs and climbers, etc., grown in those gardens. The home page interface consists of 3 main modules namely 'Gardens', 'Species' and 'Search' (Figure 1).

Gardens module

The garden module lists the different registered member herbal gardens and the number of species available at the respective garden within parenthesis.

When each of the herbal gardens is accessed, it gives details (such as, the name, address, location and area of the herbal garden) of the person to be contacted in the herbal garden and information about the different types of species.

Species module

This module is designed to search the availability of a desired medicinal species available in different herbal gardens. The 'Species' module consists of plants listed under the tree, shrub, herb and climber sub categories. Each species gives the details of the plant species, such as type of species, botanical name, common name, synonyms, family name and local names, and the table having details, such as name of the herbal garden, number of plants maintained, quality parameters identified and quantity of planting material/seed production at various herbal gardens.

Search module

The 'Search' module consists of various search options such as 'City wise', 'State wise', 'Species wise', 'Scientific name wise', 'Common name wise', 'Local name wise', 'Family wise' and 'Advance search'.

The knowledge system created gave centralized information on all available herbal gardens in India through web based networking. The maintained database has compiled the information, which may be used by both the general public and other agricultural and herbal scientists.

Figure 1. Home page of the knowledge system.

Statistical analysis

The statistical analysis, in regard to various classifications, were carried out using SPSS software.

Classification of gardens

The total number of gardens incorporated in the database development is illustrated in Table 1. It is noted that all the herbal gardens, from all the states in the country, have not been included in the database. Most of the gardens occur in Northern India. This can be attributed to the fact that the northern part of India harbours a great diversity of medicinal plants than southern India because of the majestic Himalayan range. So far, about 8000 species of angiosperms, 44 species of gymnosperms and 600 species of pteridophytes have been reported in the Indian Himalaya. Out of these, 1748 species are medicinal plants (Samant et al., 1998).

Classification of species

A total of 1024 species are available from 71 different herbal gardens (Table 2), from which majority of the species present in the garden are herbs. It has been reported that there is a total of 7500 cultivated medicinal species in India (Srivastava et al., 1996), of which only 1024 species have been included here.

Classification of habit according to family

A total number of 4024 plants, classified by its different habits, are available according to their family (Table 3), from which 42% of the families are present in the tree habit, 28% are present in the herb habit, 19% are present

Table 1. State wise number of gardens as registered in herbal garden network.

State Name	Number of garden
Assam	2
Chandigarh	1
Gujarat	14
Haryana	1
Himachal Pradesh	7
Karnataka	1
Kerala	5
Madhya Pradesh	3
Maharashtra	4
Meghalaya	5
Orissa	14
Punjab	2
Rajasthan	1
Tamil Nadu	6
Uttarakhand	1
Uttaranchal	1
Uttarpradesh	3
Total number of gardens	71

Table 2. Total number of species listed in the database.

	Type	Frequency	Percent	Valid percent	Cumulative percent
	Climber	94	9.2	9.2	9.2
	Herb	466	45.5	45.5	54.7
Valid	Shrub	206	20.1	20.1	74.8
	Tree	258	25.2	25.2	100.0
	Total	1024	100.0	100.0	

Table 3. Total number of plants classified by habit according to family.

Name of the family	Type				Total
	Climber	Herb	Shrub	Tree	
Acanthaceae	0	36	41	0	77
Acantheceae	0	17	0	0	17
Agavaceae	0	6	0	0	6
Aizoaceae	0	4	0	0	4
Alangiaceae	0	0	0	21	21
Alliaceae	0	7	0	0	7
Amaranthaceae	0	28	0	0	28
Amaryllidaceae	0	10	0	0	10
Anacardiaceae	0	0	0	34	34
Ancardiaceae	0	0	0	15	15
Annoanceae	0	0	0	13	13
Annonaceae	1	0	0	11	12
Apiaceae	0	20	0	0	20

Table 3 Cont.

Apocynaceae	0	47	74	58	179
Araceae	0	25	0	0	25
Arecaceae	0	1	0	15	16
Aristolochiaceae	17	0	0	2	19
Asclepiadaceae	62	3	45	0	110
Asphodiliaceae	0	1	0	0	1
Asteraceae	9	112	1	0	122
Barringtoniaceae	0	0	0	3	3
Basellaceae	5	0	0	0	5
Berberidaceae	0	3	3	0	6
Betulaceae	0	0	0	1	1
Bignoniaceae	2	0	6	49	57
Bixaceae	0	0	0	19	19
Bombacaceae	0	0	0	26	26
Boraginaceae	0	6	0	6	12
Brassicaceae	0	3	0	0	3
Bromeliaceae	0	2	0	0	2
Burseraceae	0	0	20	17	37
Buseraceae	0	0	2	0	2
Cactaceae	0	0	4	0	4
Caesalpiniaceae	0	0	19	0	19
Cannabinaceae	0	2	0	0	2
Capparaceae	0	0	0	3	3
Capparidaceae	1	0	4	10	15
Caricaceae	0	0	0	6	6
Casuarinaceae	0	0	0	4	4
Celastraceae	16	0	0	3	19
Chenopodiaceae	3	2	0	0	5
Cleomaceae	0	2	0	0	2
Clusiaceae	0	0	0	19	19
Cochlospermaceae	0	0	0	2	2
Colchicaceae, Liliaceae	19	0	0	0	19
Combretaceae	3	0	1	128	132
Commelinaceae	0	2	0	0	2
Convolvulaceae	15	32	0	0	47
Costaceae	0	17	2	0	19
Crassulaceae	0	4	0	0	4
Cruciferae	0	1	0	0	1
Cucurbitaceae	21	2	0	0	23
Cyperaceae	0	12	0	0	12
Dilleniaceae	0	0	0	5	5
Dioscoreaceae	0	13	0	0	13
Dipterocarpaceae	0	0	0	5	5
Ebenaceae	0	0	0	7	7
Elaeagnaceae	0	0	1	0	1
Elaeocarpaceae	0	0	0	5	5
Elaeocarpeceae	0	0	0	8	8
Ericaceae	0	0	1	0	1
Euphorbiaceae	0	41	108	66	215
Fabaceae	1	0	0	0	1

Table 3.

Fabaceae Papilionoideae	0	0	2	0	2
Fabaceae Caesalpinioideae	0	0	0	21	21
Fabaceae Papilionoideae	0	0	2	0	2
Fabaceae-Caesalpinioideae	2	19	20	115	156
Fabaceae-Mimosoideae	0	23	1	116	140
Fabaceae-Papilianaceae	10	0	0	0	10
Fabaceae-Papilionioideae	26	7	13	84	130
Fabaceae-Papilionoidea	0	13	6	0	19
Fabaceae-Papilionoideae	39	15	10	38	102
Flacourtiaceae	0	0	7	6	13
Gentianaceae	0	6	0	0	6
Ginkgoaceae	0	0	0	2	2
Goodeniaceae	0	0	3	0	3
Hippocrateaceae	0	0	1	2	3
Hydrocotylaceae	0	21	0	0	21
Hypoxidaceae	0	14	0	0	14
Iridaceae	0	4	0	0	4
Labiatae	0	2	0	0	2
Labiateae	0	0	2	0	2
Lamiaceae	0	99	22	0	121
Lamianaceae	0	1	0	0	1
Laminaceae	0	2	0	0	2
Lauraceae	0	0	0	33	33
Lecythidaceae	0	0	0	2	2
Leguminosae	0	7	0	0	7
Liliaceae	44	50	1	0	95
Liliaceae, Anthericaceae	0	5	0	0	5
Lobeliaceae	0	1	0	0	1
Loganiaceae	0	0	0	12	12
Loranthaceae	0	1	0	0	1
Lythraceae	0	0	30	26	56
Magnoliaceae	0	0	0	23	23
Malpighiaceae	0	0	2	0	2
Malvaceae	0	27	75	12	114
Marantaceae	0	4	0	0	4
Marsileaceae	0	2	0	0	2
Melastomaceae	0	0	0	3	3
Melastomataceae	0	0	0	2	2
Meliaceae	0	0	0	64	64
Menispermaceae	50	0	0	1	51
Mimosaceae	0	1	0	0	1
MImosaceae	4	0	0	0	4
Moraceae	0	0	0	100	100
Moringaceae	0	0	0	2	2
Musaceae	0	2	0	3	5
Myrcinaceae	0	0	10	0	10
Myricaceae	0	0	0	1	1
Myrsinaceae	0	0	0	2	2

Table 3

Myrsticaceae	0	0	0	8	8
Myrtaceae	0	0	8	40	48
Nyctaginaceae	0	20	0	0	20
Nyctanthaceae	0	0	0	24	24
Oleaceae	0	3	19	13	35
Ophioglossaceae	0	1	0	0	1
Orchidaceae	0	2	0	0	2
Oxalidacae	0	5	0	0	5
Oxalidaceae	0	7	0	1	8
Pandanaceae	0	0	6	0	6
Papaveraceae	0	6	0	0	6
Papilionaceae	3	0	0	0	3
Pedaliaceae	0	12	0	0	12
Periplocaceae	0	2	5	0	7
Phytolacaceae	0	1	0	0	1
Pinaceae	0	0	0	1	1
Piperaceae	42	0	1	0	43
Plantaginaceae	0	3	0	0	3
Plumbaginaceae	0	0	40	0	40
Poaceae	0	44	1	14	59
Polygonaceae	0	1	0	0	1
Portulacaceae	0	1	0	0	1
Ranunculaceae	0	7	1	0	8
Rhamnaceae	4	0	7	11	22
Rosaceae	0	0	1	1	2
Rubiaceae	12	0	37	13	62
Rutaceae	1	6	28	74	109
Salvadoraceae	0	0	2	0	2
Santalaceae	0	0	0	27	27
Sapindaceae	8	0	0	16	24
Sapotaceae	0	0	0	44	44
Saxifragaceae	0	1	0	0	1
Scitaminaceae	0	3	0	0	3
Scrophulariaceae	0	28	0	0	28
Simarubaceae	0	0	0	15	15
Smilacaceae	2	0	0	0	2
Solanaceae	0	77	20	0	97
Sterculiaceae	0	0	10	34	44
Symplocaceae	0	0	0	1	1
Taxaceae	0	0	0	7	7
Thymelaeaceae	0	0	0	4	4
Tiliaceae	0	2	0	6	8
Ulmaceae	0	0	0	15	15
Urticaceae	0	1	0	0	1
Valerianaceae	0	3	0	0	3
Verbanaceae	0	0	5	0	5
Verbenaceae	0	4	27	75	106
Violaceae	0	3	0	0	3
Vitaceae	21	0	3	0	24
Zingiberaceae	0	109	0	0	109

Table 3

Zygophyllaceae	0	7	0	0	7
Total	443	1146	760	1675	4024

in the shrub habit and 11% are present in the climber habit of plants.

Therefore, the statistical analysis of the database system, developed on herbal gardens, showed that the herbal garden has potentials to become an important source of cultivated medicinal species all over the country. The benefit of this data analysis in herbal garden database is that there is a considerable ease in the access of required information with regard to the different search modules developed in the knowledge system.

Conclusions

Despite the advent of allopathic medicine, there has been an increase in the demand for medicinal plants. This instant increase in the demand for plant based drugs has led to the concerns about medicinal plant conservation for which there is an increasing need to maintain a database of the different herbal gardens in India, so that *ex situ* conservation of many medicinal species can be encouraged. The classification of the database, created also, provides a source of the different cultivated species of medicinal plants in India, so the species which are not available can be identified, acquired and cultivated.

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