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सत्यमेव जयते

BIODIVERSITY OF SALINE AND WATERLOGGED ENVIRONMENTS : DOCUMENTATION, UTILIZATION AND MANAGEMENT

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CONTENTS

Earth's ecosystems. In population stabilization program, improvement in literacy particularly female literacy and health security should get the highest priority. We should envision that every child born in India has a right to food, nutrition and healthy life. For climate stabilization we would have to shift from carbon based energy to hydrogen/solar/plant-based energy. For increasing productivity, degraded lands are to be reclaimed through improved techniques. With the scenario of scarcity of good quality water for agriculture the biosaline agriculture should get priority. Technologies of genetic engineering should be promoted particularly in developing salt-tolerant, drought resistant and water use efficient varieties of arable crops. In the scenario of climate change and sea level rise, we would have to preserve our natural species, which are capable to tolerate water submergence and also those sustain during high temperature. To achieve the goal of meeting the requirements of ever-increasing population, we would have to conserve our biodiversity of all the natural resources including microbiology of soil. Space technology, geographic information system and crop modeling are also important tools for enhancing productivity. Harvesting of information technologies for the environment should get outmost priority.

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the people inhabiting these areas particularly the tribal. Immediate steps need to be taken to protect and conserve the remaining mangrove stands and their biodiversity and wherever is feasible more coastal areas need to be brought under mangrove vegetation.

In recent years the attention is being paid worldwide to accommodate the salt tolerant species of industrial importance for highly saline degraded areas including coastal marshes. Many species are widely cultivated for food, fodder, fuel-wood, timber, fiber, edible and aromatic oil and medicines, thatching material, beverages and cosmetics. As the twenty-first century dawns, we take a fresh look at the trends that have put the global economy on a collision course with the Earth's ecosystems. There lies a possible threat to the human survival due to burgeoning population, atmospheric pollution, changes in climatic conditions around the globe, depletion of aquifers, shrinking croplands per person, collapsing of ecosystems, increasing salinity and waterlogging in irrigated command areas, and disappearing biodiversity due to anthropogenic factors. The illegal felling of trees, expansion of sea water, frequent cyclones and *Tsunami* like disasters in coastal areas, melting of ice on the glaciers, and burning of carbon-based fuel in the automobiles and power plants lead to the irreversible damage to the Earth's ecosystems and threat to the human civilization. To stabilize climate and population, redesigning irrigated agriculture, restoration of degraded lands, management of natural ecosystems and biodiversity, replacing ecology with economics, to evolve mechanism to anticipate environmental surprises, harnessing more efficient information technologies for the environmental studies, and implementation of environment- based educational policies are some of the challenges to be met by the environmentalists in recent future.

To meet these challenges we would have to evolve logical strategies and go far crossing national and inter-national borders through responsible political systems. We would have to evolve mechanism of managing the difficult and complex relationships between the global economy and the

1. INTRODUCTION

Biodiversity is often defined as the variety of all life forms-the different plants, animals and microorganisms; the genes they contain and the ecosystems of which they form a part. It is not a fixed entity, but constantly changing and increased by genetic changes and by evolutionary processes and reduced by extinction and habitat degradation. Without going in details of types of biodiversity viz. species (alpha), habitat (beta), landscape (gamma) and genetic diversity a brief general account of biodiversity of salt lands and waterlogged areas of India has been given in this publication, which includes both inland and coastal (mangrove) habitats. In India about 8.85 million ha land is suffering from degradation due to salinity and alkalinity problems. According to the most recent estimation about 4.295 m ha fall under canal command area, 2.195 m ha outside canal command and 2.363 m ha in coastal areas and about 4.75 m ha area is considered waterlogged (Singh, 2005). These lands occur under different environmental conditions and have different morphological, physical, chemical and biological properties. Secondary salinization is rapidly increasing in irrigated areas. These saline soils are universally low in fertility and difficult for conventional agricultural use. Sub-surface drainage is the most effective tool to wash out salts in saline soils, but this method is costly and cannot be adopted in the entire area. However, such lands can effectively be utilized for salt-tolerant biological system.

The coastal areas, particularly the mangrove stands are comparatively rich in biodiversity. The complex root system of mangroves not only protects the shore-line but the roots and their branches also trap nutrients in the form of litter and serve as shelter and food for a large number of organisms including many beautiful orchids, ferns, lichens, mosses, jungerminiales, algae, fungi, ciliates, nematodes and amphibians. Several interesting animals such as salt water crocodiles, turtles, water monitor lizards, snakes, wild pigs, monkeys, deer, even tigers (in Sunderbans), several indigenous and migratory birds, mud skippers, mollusks, insects and several crustaceans make the food chain very complex and interesting. The vast diversity of flora in addition to providing food for different faunal species also provides livelihood for the people inhabiting these areas particularly the tribal. But most disturbing factor is that these most strategic ecosystems are being depleted mostly by anthropogenic factors. Many species (including soil micro-flora) might have become extinct even before reported and many have come in danger zone of extinction.

In recent years, however, the attention is being paid worldwide to accommodate the salt tolerant species of industrial importance for highly saline degraded areas including coastal marshes. Some oil yielding species such as *Salicornia bigelovii, Salvadora persica, S. oleoides, Terminalia catappa, Calophyllum inophyllum,* species of *Pandanus* and many other species are given attention for their industrial importance. These can be grown in highly saline areas irrigating with sea water or water of high salinity. *Borassus flabellifer, Calophyllum inophyllum, Pongamia pinnata* and *Nypa fruticans* are other important coastal plants of economic importance. Similarly many inland salt-tolerant species also find industrial application. The petro/diesel-crops like *Jatropha curcas, Pongamia pinnata* and *Euphorbia antisyphilitica* can successfully be grown irrigating with water of high salinity. *Capparis decidua* found in saline arid regions is medicinal and valued for commercial pickle. *Simmondsia chinensis* with seed-oil similar to sperm-whale; aromatic species like *Matricaria chamomilla, Vetiveria zizanioides, Cymbopogon martinii* and *C. flexuosus*; and medicinal Isabgol (*Plantago ovata*), *Adhatoda vasica, Withania somnifera*, senna (*Cassia angustifolia*) and many others can be grown successfully on alkali soil as well as calcareous saline soil irrigating with saline water up to ECiw 10 dS m^{-1}. There are also many other salt-tolerant fruit, forage, oil yielding, medicinal and fuel wood species, which have been tried and found suitable for highly saline situations. The scopes of many of these species of high economic value for saline, sodic and waterlogged habitats along with their documentation, relative distribution, management and utilization have been discussed in this publication. Potential of plantation in carbon sequestration particularly in salt-affected soils has been worked out. Therefore, growing forest and fruit trees, grasses and non-conventional crops of high economic value including medicinal and aromatic plants on salt-affected soils or using saline water for irrigation may play a vital role in economic growth, C sequestration, improving environmental health in general and biodiversity in particular.

that mankind will face in future. These increasing environmental problems call for strengthening of such research areas as ecosystem analysis and modeling, conservation and evolutionary ecology, restoration ecology, ecology of global change, ecological biotechnology and ecological economics. There is tremendous need to look at our education policy. Environmental Sciences should be included in our basic education and along with Information Technologies, these should not only shape our world view, they must also give our generation greater power to build a world which may be healthier, greener and sustainable to live.

EPILOGUE

In India about 8.85 million ha land is suffering from degradation due to salinity and alkalinity problems. These lands occur under different environmental conditions and have different morphological, physical, chemical and biological properties. These soils are universally low in fertility and difficult for conventional agricultural use. However, such lands can effectively be utilized for salt-tolerant biological system applying suitable new techniques.

Mangroves inhabit the inter-tidal estuarine regions, sheltered coastlines, lagoons, and creeks. Their prop and knee roots protect the coastline from erosion and help in dissipating the incoming wave energy and saving disasters as happened in the Orissa cyclone during 1999 and *Tsunami* in December 2004 all along the coast. The maximum damage was due to the deteriorated condition of the mangroves. The complex root system not only protects the shore-line but the roots and their branches also trap nutrients in the form of litter and serve as shelter and food for a large number of organisms including many beautiful orchids, ferns, lichens, mosses, jungerminiales, algae, fungi, ciliates, nematodes and amphibians. Several interesting animals such as salt water crocodiles, turtles, water monitor lizards, snakes, wild pigs, monkeys, deer, even tigers (in Sunderbans), several indigenous and migratory birds, mud skippers, mollusks, insects and several crustaceans make the food chain very complex and interesting. This vast diversity of flora in addition to providing food for different faunal species also provides livelihood for

GIS can be used as a tool in helping environmental and community activists for identifying local sources of pollution, identifying degraded areas including salt-affected and eroded, surveying vegetation and climatic surprises, allowing energy agencies in developing countries to determine the best site, for renewable energy installations such as wind turbines, helping conservation groups craft strategies for natural resources management, and the protection of biological diversity. The information technology has wide-ranging implications for sustainable development as the scientists can have an easier access to environmental data for their research. This is a tool for a healthy planet. The governments and citizens face new challenges and opportunities to use these powerful tools to conserve natural resources and biodiversity, educate people and diminish inequities.

Environment-based education policies

There is an urgent need at Government level to introduce environmental sciences as compulsory subject at school level. We must educate people to live in harmony with the environment. It is urgent to orient University level education and research in environmental sciences for leadership in society. It may generate a mental whirlwind against spiraling use of environmental resources as philosophy of conservation. We would have to take a holistic view of society and the environment together. The nature is to be conserved in its entirety while using the resources wisely. The economics cannot be generated forever until we don't learn the sustainable use of resources. The impact of economic growth is thus not developmental but incremental misery. It is obvious, therefore, that before it is too late we have to take turn-about and change our behavior in harmony with the environment. Society and environment both are multidimensional and it is possible to establish ecological linkages for harmonious run of the ecosystem. We cannot treat society and environment separately.

We have a responsibility to harness the Information Technologies to build a healthier, greener and more equitable future. There are several environmental problems (particularly loss of biodiversity, degradation of ecosystems, environmental pollution & contamination, and global change),

2. SALT-AFFECTED & WATERLOGGED AREAS AND SALINE WATERS

All soils contain a certain quantity of water-soluble salts, which are indeed essential for healthy growth of plants. If the quantity of soluble salts in a soil exceeds a certain threshold value (which in turn depends on the geochemical and environmental conditions, physico-chemical properties of soil, and chemical composition of salts causing salinity), the growth of the most plants is adversely affected. Such soils are designated as *salt-affected*. These soils occur under different environmental conditions and have different morphological, physico-chemical, and biological properties, but one common feature is the dominating influence of electrolytes on the soil-forming processes. Historically the salt-affected soils have been referred to soils where growth of the most of the crops gets adversely affected either by the presence of excess soluble salts, sodium on the exchange complex or both. Thus attempts have been made to classify the soils on the basis of total soluble salts measured in terms of electrical conductivity of the soil's saturation paste extract (ECe) or various dilutions (soil: water 1:2), exchangeable sodium percentage (ESP) or sodium adsorption ratio (SAR) and pH of the saturation paste (pHs) or other dilutions. US Salinity Laboratory Staff in 1954 originally proposed the three categories of salt-affected soils on the basis of these parameters i.e. saline, saline-alkali and alkali soils. The definitions in respect of these three categories were later on slightly modified (Soil Sci. Soc. Amer., 1987). It was described that owing to excess salts (ECe > 4 dS m^{-1}) and absence of significant amount of sodium (ESP < 15), saline soils are generally flocculated and as a consequence their conductivity is equal to or even greater than their non-saline counterparts. A saline-alkali soil (ECe > 4 dS m^{-1}; ESP > 15) was described similar to that of saline soils as long as sufficient salts are present where as upon leaching, these soils become alkaline (pH > 8.5) leading to dispersion and their permeability reduces to levels those affect crop growth. The term "alkali" was discarded later on to be replaced with 'sodic" and these soils contain sufficient exchangeable sodium (ESP > 15) to affect physical behaviour of soils and interfere with growth of the most of the crops.

The Indian classification of salt affected soil is also based on above criteria but in place of three categories of salt affected soils – saline, sodic and saline-sodic, these soils were classified into two groups based on the nature of plant responses to the presence of salts and the management practices desired for their reclamation. It has been argued that usually recognized two categories of salt-affected soils 'saline' and 'saline-sodic' are no different from each other and that both should be categorized as 'saline' because in these soils plant growth is not adversely affected due to effect of excess exchangeable sodium or soil physical properties or lack of calcium. Soils containing sodium carbonate are necessarily "sodic" in nature. However, the term "alkali' has been invariably used for "sodic" in Indian literature to represent soils which have both excess of exchangeable sodium and have salts capable of alkali hydrolysis e.g. carbonate and bicarbonates of sodium or both. The alkali soils in narrower context are the soils having (i) both high pHs (> 8.2) and sodicity (ESP > 15) and containing soluble carbonates and bicarbonates of sodium such that $Na/Cl+SO_4 > 1$.

Ground water surveys indicate that poor quality waters being utilised in different states are 32 to 84% of the total ground water development. Many more areas with good quality aquifers are endangered with contamination as a consequence of excessive withdrawls of ground water. The saline waters have ECiw 4 or >4 dS m^{-1}, SAR usually < or > 10 mmol l^{-1} but RSC always < 2.5 meq l^{-1}; while alkali waters have ECiw < 4 dS m^{-1} but RSC always 2.5-4.0 meq l^{-1} in marginal alkali waters and >4 meq l^{-1}in highly alkali waters. Indiscriminate use of poor quality waters in the absence of proper soil-water-crop management practices poses great risks to soil health and environment. But in dry regions the use of poor quality waters for irrigation is inevitable, hence the selection of salt-tolerant crops is very important.

3.0 NATURAL VEGETATION OF SALTY LANDS

Saline habitats are usually characterized by sparse vegetation and highly saline soils are often barren "scalds". Based on their genetic potential to counter the defect of root-zone salinity, the plants differ in their capacity to adapt to saline habitats. The capacity to lower the osmotic potential of

reverse holds true for USA, Japan, France, Germany and UK. This disparity obviously results in the flow of biodiversity wealth, from developing to developed countries. There is a need for formulation of policy in gene-rich but deficient in technology countries to avoid what may result in gene-imperialism. Deforestation, population explosion, over hunting, habitat destruction, climate change, resource exploitation and activities related to expanding agricultural and industrial development are the major causative factors for loss of biodiversity. The introduction of alien species can be equally a major cause of extinction of native species and the global effect of increased rates of species introduction is overwhelmingly a net loss of global species diversity. If we take remedial steps to control the above factors and a strict legal vigilance for protection of wild life and rare species, the biodiversity will definitely will be restored.

Harnessing information technology for the environment and biodiversity

Today globalization has become a common buzzword. In ecological perspectives it refers to the collective impact that these diverse processes have on the health of the planet's natural systems. Though the global network in expanding very fast, the international environmental governance is still in its infancy, with the treaties and institutions that governments turn to for global management mostly too weak to put a meaningful dent in the problems. Nations are granting significant and growing powers to economic institutions such as WTO and IMF, but environmental issues remain mostly an after thought in these bodies. It is good sign that growth in the satellite remote sensing, GSI and computer software technologies that obtain, store and analyze information about Earth is quite fast and swelling by roughly 20% each year. The information technology should be used examining pollution and other environmental hazards, identifying areas rich in particular resources, land use planning, soil and water use studies, wild life habitats, model changes to the environment, and environmental surprises such as *tsunami* so that decision makers and planners can manage the environmental crisis more effectively. The information should be shared for human welfare rather than simply mining the money by the wealthiest people.

Formulation of Biodiversity Conservation Policies

The leading cause of plant and animal species loss is habitat destruction and habitat alternations from rising temperatures or pollution. As more and more species disappear, local ecosystems begin to collapse and at some point, we may face wholesale ecosystem collapse. India is a signatory to the International Conventions like Ransar, World Heritage, Convention of Biological Diversity (CBD), and Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES). India being a mega-diversity country can contribute a lot to save the flora and fauna all over the Earth significantly influencing both developed and developing countries by taking meaningful and leak proof steps to conserve wild life and biodiversity of our forests, wetlands, both fresh and saltwater marshes, and coastal sea waters. We would have to protect what ever is left in the form of tropical and temperate forests, wetlands, mangroves, coral reefs and beach forests. Effects would have to be made bringing all kinds of degraded lands under vegetation cover. Wherever is possible, the approach of agroforestry concept should be encouraged even on arable lands. The threatened and endemic species should be multiplied through conventional and bio-technical (tissue culture) means. We find that each tree in tropical forests, particularly in Andaman & Nicobar Islands is clothed with numerous forms of plants such as orchids, ferns, mosses, jungerminiales, lichens and fungi. Many of them may be new to science and are yet to be collected. Immediate steps should be taken to develop nurseries cultivating these plants before the trees of a particular area are harvested. Further in the scenario of rise in sea level those plant species, which tolerate water stagnation and sub-mergence for larger period must be protected and multiplied. The species of tall rice varieties may play a vital role in times to come. The scientists would have to take care of all the types of biodiversity viz. ecosystem diversity, species diversity and genetic diversity adopting the holistic approach.

Khoshoo (2000) established a global relationship between biodiversity and biotechnology. Countries such as Brazil, China, Ethiopia, India, Indonesia, Malaysia and Mexico are biodiversity rich, but poor in bio-technology whilst

cell sap, salt exclusion, salt secretion, and succulence are common but differentially expressed attributes of salt land vegetation. Thus, the plants which are able to grow on saline habitats, possess special adaptive procedures and collectively are called halophytes. Based on the adaptability, the halophytes can be classified (Sen *et al*., 1982) into the following three categories:

*True (obligate) halophytes***:** Plants mainly attaining optimal growth on saline soil (above 0.5% NaCl level) e.g. *Suaeda fruticosa, Cressa cretica, Aeluropus lagopoides, Salsola baryosma, Haloxylon recurvum* and *Zygophyllum simplex*.

Facultative halophytes: Those plants which can grow and achieve optimal growth on saline soil (at 0.5 % NaCl level) like true halophytes, as well as on non-saline soils e.g. *Trianthema triquetra, Tamarix dioica, Salvadora persica, Launaea nudicaulis, Eragrostic pilosa* and many others.

Glycophytes or transitional halophytes: Plants of non-saline habitats, which always grow and achieve optimal growth at non-saline niches of the salt basin. H*aloxylon salicornicum, Sporobolus helvolus, S. marginatus, etc.* are some examples.

Aronson (1989) set the criterion of salinity with ECe/ECiw (soil/irrigation water) 7-8 dS m^{-1} for a species to be designated as salt-tolerant, when plants were found growing well on this salinity without any significant yield reduction. Thus, halophytes are not a single taxonomic group, but are represented by several thousand species of forbs, grasses, shrubs and trees. These represent a wide range of species in which salt-tolerance has already evolved. In the light of management of suitable crops for saline agriculture, the criterion followed by Aronson (1989) for inclusion in the list of halophytes appears to be quite relevant. Those plants which grow well in natural saline habitats with electrical conductivity of soil (ECe) 8 or > 8 dS m^{-1}, can be designated as halophytes. This also includes those, which tolerate the saline irrigation of ECiw 8 dS m^{-1} or more. For management purposes this criteria appears to be relevant and has been followed for present documentation.

A survey conducted (by present authors, reported in this publication) traversing inland and coastal saline areas in India has indicated the occurrence of 1140 vascular plant species distributed under 541 genera and 131 families. The maximum number of salt-tolerant species showing no yield reduction up to ECe/ECiw 8 dS m^{-1} have been found in family Poaceae (131 species) followed by Papilionaceae (67 species), Asteraceae (55), Mimosaceae (53), Cyperaceae (52), and Chenopodiaceae with 48 species (Table 1). In this list many species of *Acacia, Eucalyptus, Atriplex, Prosopis*, and *Casuarina* are exotic to India, and represent 34, 25, 13, 11 and 10 species, respectively. Many of these species are surviving well in salt-stressed localities. All the members of Chenopodiaceae, Salvadoraceae, Tamaricaceae and mangrove families fresh water mixing, tidal range and muddy substratum are the basic requirements on which mangal formation depends. The nature of zonation

Table 1: Number of different taxa found in salt affected soils.

S. No.	Family	No. of Genera	No. of Species	No. of Species having economic uses
1	Acanthaceae	6	11	10
2	Acrostichaceae	1	2	2
3	Agavaceae	2	4	4
4	Aizoaceae	9	15	11
5	Alismataceae	3	3	2
6	Amaranthaceae	7	12	10
7	Amaryllidaceae	1	7	3
8	Anacardiaceae	4	4	4
9	Apiaceae	4	4	4
10	Apocynaceae	10	14	14
11	Aponogetonaceae	1	2	1
12	Araceae	4	5	5
13	Arecaceae	13	23	23
14	Asclepiadaceae	13	21	21

and conservation bench terraces) we must also follow run-off harvesting, storage and recycling of water on watershed basis. This will help in better utilization of rainfall, controlling of erosion and providing some essential and life-saving irrigation to the crops during the dry spells. Some seepage and evaporation losses are evident which can be minimized. The supplemental irrigations through such water-resource-development can increase the yield many fold. Bunga and Sukho Majri in Haryana, Rel Majri in Punjab, Dehra Dun in (Uttranchal), Bellary in Karnataka, Vasad in Gujarat and Solapur in Maharashtra are some examples where some small micro-sheds have been developed for runoff harvesting, storage and recycling purposes for growing food crops. The scientific development of watersheds will automatically promote biodiversity.

On account of severe limitations of slope, erosion, shallowness, wetness, flooding, stoniness and climate, many lands are not fit for cultivation of crops. However, these can be successfully utilized for pasture development and tree plantation. Establishment of vegetation can be facilitated by mechanical measures and closure to biotic interference. Grasses prove to be most effective cover for conservation of soil and moisture on upper soil surface, whereas shrubs and trees intercept rainfall. Gullies and ravines are stabilized and reclaimed mechanically by contour and peripheral bunds, gully plugging, and creating cover of grasses at top and along slopes and growing shrubs in deep gullies or ravines. Agroforestry is the most integrated and sustainable approach for watershed management. In coastal areas, many coconut plantations are non-productive due to overgrazing. These can be protected from grazing and judiciously utilized for optimum production of forages, fuel-wood, spices and products of high economic value. Home gardens, plantation-based multi-storied cropping systems, coconut-based silvi-pastoral system, farming in partially felled forests, alley cropping on slopping lands, and fish & prawn culture having coconut on bunds of ponds, plantations along beaches, and aquaculture keeping mangroves intact are some of the interesting systems which may be adopted in coastal areas and islands regions. Cattle and poultry may be easily blended in these systems, which may further add to the income of the household. This approach will help in promoting the cause of biodiversity.

Restoration ecology and management of natural resources

Degradation of natural resources has been a global problem. Conversion of forest- land into arable land or for other development activities such as urbanization and industrialization, intensive agriculture, over-exploitation, overgrazing, pollution of various kinds, mining and other anthropogenic activities have resulted in degradation of both the land and water resources. Besides, ignorance of proper soil conservation practices and crop rotation, non-judicious use of fertilizers and pesticides, faulty irrigation and water management, discharge of industrial effluents and criminal disposal of sewage/sludge are also responsible for soil and water resource degradation to a considerable extent. Water erosion is the most serious degradation factor in India resulting in loss of topsoil in 130.5 million ha and terrain deformation in 16.4 million ha. Based on data for the year 2004-05, there was annual consumption of 81900 tons pesticides in India, which also adds to soil and water pollution. Eco-restoration of land and water resources is a key component of a broader subject of sustainable development. The goal of restoration of these natural resources may be obtained when ecological processes are linked up with social and economic processes. The problem of natural resource degradation can only be tackled efficiently when the totality of the soil-water-plant-animal-man interactions in the systems synergies through appropriate policies of the government.

The sustainable improvement of farming system is possible by halting further degradation of natural resource base and maintaining soil health through alternative agricultural practices such as adoption of efficient soil and water conservation measures, crop rotation, diversification of crops, reduction of tillage, integrated nutrient management involving bio-fertilizers as key constituents of fertilizers, integrated pest management, and efficient crop/tree/livestock based systems. We would have to apply the indigenous and evolved techniques of *in-situ* water conservation, rainwater storage and harvesting and judicious use of water including saline water through scientific means. Besides following the traditional contour farming, *in-situ* mulching and green manuring, tillage, cover management (strip cropping, mixed cropping and intercropping) and adopting mechanical measures for erosion control (such as contour bunding, graded bunding drainage terraces

S. No.	Family	No. of Genera	No. of Species	No. of Species having economic uses
15	Asteraceae	33	55	32
16	Avicenniaceae	1	3	3
17	Azollaceae	1	1	1
18	Balanitaceae	1	1	1
19	Barringtoniaceae	1	2	2
20	Basellaceae	1	1	1
21	Bignoniaceae	1	1	1
22	Blechnaceae	1	1	1
23	Boraginaceae	7	13	8
24	Brassicaceae	12	15	14
25	Cactaceae	1	4	4
26	Caesalpiniaceae	8	16	16
27	Capparidaceae	3	9	5
28	Caryophyllaceae	3	3	3
29	Casuarinaceae	1	10	10
30	Celastraceae	2	3	3
31	Ceratophyllaceae	1	1	1
32	Chenopodiaceae	10	48	48
33	Cleomaceae	1	4	4
34	Clusiaceae	1	1	1
35	Combretaceae	3	7	7
36	Commelinaceae	2	3	3
37	Convolvulaceae	7	15	10
38	Crassulaceae	1	1	1

S. No.	Family	No. of Genera	No. of Species	No. of Species having economic uses
39	Cucurbitaceae	8	10	8
40	Cycadaceae	1	1	1
41	Cymodoceaceae	3	4	-
42	Cyperaceae	9	52	26
43	Ebenaceae	1	3	3
44	Ehretiaceae	1	5	5
45	Elatinaceae	2	5	-
46	Ephedraceae	1	2	2
47	Euphorbiaceae	22	40	31
48	Flacourtiaceae	2	2	2
49	Flagellariaceae	1	1	1
50	Frankeniaceae	1	1	1
51	Fumariaceae	1	1	1
52	Gentianaceae	4	6	3
53	Geraniaceae	1	1	1
54	Goodeniaceae	1	1	1
55	Gyrocarpaceae	1	1	1
56	Hernandiaceae	1	1	1
57	Hippocrateaceae	1	1	1
58	Hydrocharitaceae	8	10	6
59	Hydrophyllaceae	1	1	1
60	Juncaceae	1	8	8
61	Lamiaceae	3	11	11
62	Lauraceae	1	1	1

wells show declining groundwater levels. Over-pumping in the western coastal states has also caused salt water to invade freshwater aquifers. Rapidly growing cities and industries will be looking towards irrigated agriculture as the big pool of available water to meet their demands. By now agriculture's principal challenge has been raising land productivity i.e. getting more crops out of each ha of land. But now the challenge will shift to the boosting of water productivity i.e. getting more benefit from every liter of water devoted to crop production. We would have to save water loss due to evaporation and seepage in canals. There can be a long and growing list of measures that can increase agricultural water productivity which may include technical, managerial and institutional options, but more scientific inputs would have to be given in evolving agronomic options such as selecting crop varieties with high yields per liter of transpired water, intercropping to maximize use of soil moisture, better matching crops to climate conditions and the quality of water available, sequencing crops to maximize output under conditions of soil and water salinity, selecting drought-tolerant crops where water is scare or unreliable, and above all breeding water-efficient crop varieties. Much attention would have to be given on diversification of crops in irrigated areas. We would have also to adopt new and economic methods of irrigation such as drip or sprinkle irrigation particularly in dry regions. The use of bad quality water for irrigation is inevitable; therefore, research efforts should be diverted towards *biosaline agriculture*. There is need to survey, conserve, and multiply new crops for saline habitats. In the scenario of sea-level rise we would have to take special measures to conserve the genes of those plants, which can survive on higher temperatures and prolonged standing of water and can thrive well under submerged condition of saline water. We would have to give reshape to our research for evolving techniques for rainwater harvesting and recharging our ground waters.

related issues such as reversing the deforestation of Earth, stabilizing water tables and protecting biodiversity. If we cannot stabilize climate and population, there is not any single ecosystem on Earth that we can save. To stabilize climate we would have to shift from a fossil fuel- or carbon-based energy economy to alternative source of energy such as solar/hydrogen/ plant -based energy (State of the World, 2000). One way of dramatically boosting the growth in wind/solar power would be to reduce income taxes and offset them with a carbon tax on fossil fuels, one that would more nearly reflect the full costs associated with air pollution, acid rain and climate disruption. Such a move would raise investment not only in wind power, but also in solar cells and energy efficiency. It could push wind power growth far above the current rates, greatly accelerating the shift to a solar/hydrogen energy economy. Government should give some subsidy for use of solar and wind-based energy. It is good signal that encouragement is being given for producing bio-diesel from plants such as *Jatropha curcas* and *Pongamia pinnata*. More plants need to be screened and cheap techniques need to be developed for oil extraction from potential sources such as *Euphorbia antisyphilitica*, which can produce huge biomass (up to 130 tons ha^{-1} fresh biomass from 2 years old plantation) with minimum application of inputs in highly degraded soils. That's how environment based economy may play a vital role in stabilizing the climate.

Redesigning irrigated agriculture

Most of our irrigation bases are less than 50 years old, yet threats to the continued productivity have surfaced. One out of 5 ha of irrigated land is damaged by salt. In many areas problem of waterlogging has become a regular feature. More and more rivers are running dry for many months in a year leaving agriculture vulnerable to the reallocation of water to burgeoning cities and industries. Of all the vulnerabilities characterizing irrigated agriculture today, none looms larger than the depletion of underground aquifers due to over-pumping. Nine Indian states are now running major water deficits, which is the aggregate total just over 100 billion cubic meters a year (Postel, 2000). In Haryana and Punjab, water tables are dropping 50-70 cm per year while in Gujarat majority of the

S. No.	Family	No. of Genera	No. of Species	No. of Species having economic uses
63	Lemnaceae	3	7	4
64	Lentibulariaceae	1	10	10
65	Liliaceae	5	14	14
66	Loranthaceae	4	7	7
67	Lythraceae	4	9	5
68	Malvaceae	11	25	16
69	Marsiliaceae	1	2	2
70	Melastomataceae	2	3	1
71	Meliaceae	4	6	6
72	Menispermaceae	2	3	3
73	Mimosaceae	11	53	53
74	Moraceae	1	4	4
75	Myristicaceae	1	1	1
76	Myrisinaceae	3	4	3
77	Myrtaceae	6	35	35
78	Najadaceae	1	5	-
79	Naucleaceae	1	1	1
80	Nyctaginaceae	3	5	5
81	Nymphaeaceae	2	4	4
82	Olacaceae	1	1	1
83	Onagraceae	1	5	5
84	Orchidaceae	10	14	14
85	Oxalidaceae	1	4	1
86	Pandanaceae	2	10	10

S. No.	Family	No. of Genera	No. of Species	No. of Species having economic uses
87	Papaveraceae	1	1	1
88	Papilionaceae	34	74	67
89	Periplocaceae	2	2	2
90	Plantaginaceae	1	5	5
91	Plumbaginaceae	2	2	2
92	Poaceae	59	131	131
93	Polygalaceae	1	3	1
94	Polygonaceae	4	14	14
95	Polypodiaceae	4	4	4
96	Pontederiaceae	2	2	2
97	Portulacaceae	2	5	5
98	Potamogetonaceae	1	8	8
99	Primulaceae	2	2	2
100	Pteridaceae	1	2	2
101	Punicaceae	1	1	1
102	Ranunculaceae	1	3	3
103	Resedaceae	2	3	1
104	Rhamnaceae	2	3	3
105	Rhizophoraceae	5	12	12
106	Rosaceae	1	1	1
107	Rubiaceae	11	16	16
108	Ruppiaceae	1	1	1
109	Rutaceae	7	7	6
110	Salicaceae	1	1	1
111	Salvadoraceae	2	3	3

5. STRATEGIES TO MEET FUTURE BIODIVERSITY CHALLENGES

To stabilize population and climate, redesigning irrigated agriculture, restoration of ecology by judicious management of degraded natural ecosystems, biodiversity conservation, replacement of ecology with economics, shifting of carbon-based to hydrogen based energy economy, harnessing information technology for the environmental and biodiversity studies and formulation & implementation of environment-based education policy may be some of the strategies to meet the future environmental and biodiversity challenges. This can be achieved through a responsible political system. Some of these aspects are discussed in brief.

Stabilizing population

One of the keys to stabilize population is change in reproductive behavior, which can be done by creating awareness among people (particularly poor and uneducated rural population, particularly women) and to make them understand the consequences of not shifting quickly to smaller families. Responsible governments can provide the concerned family planning information to people and through national carrying capacity assessments i.e. how many people the cropland, water, grassland and forest resources of the country can sustain. We must educate people that in next two decades how much drinking water will be required for increased population and there will be hardly any good quality water left for irrigation of crops and food production. At present no one knows what form of disaster it will be in times to come, whether it would be water shortages (water wars), food shortages, diseases, internal ethnic or external political conflicts. It is a global problem and would have to be tackled globally by sensible political initiatives. The government should also come-out with a set population policy which must be followed strictly without gaining political mileage.

Stabilizing climate

Stabilizing climate is overriding challenge, which is being faced by our global civilization. The success on this front will depend on mainly other

Tomar *et al*. (1998) showed that when established with saline water, the forest tree species such as *P. juliflora, Casuarina glauca, C. equisetifolia, C. obesa, A. nilotica, A. tortilis, Eucalyptus tereticornis* and *Leucaeua leucocephala* could produce 49, 48, 14, 19, 33, 20, 14 and 15 t C ha^{-1} biomass, respectively on waterlogged saline soil showing the potentiality of C sequestration for highly degraded saline waterlogged areas. Further, trees such as *Tamarix articulata*, *Acacia nilotica, P. juliflora* and *E. tereticornis* and many others could be raised successful giving irrigation with saline water initially for 3 years. After 7 years of planting the C biomass harvested from these was 35.9, 11.7, 10.1 and 7.4 t C ha^{-1}, respectively and the soil organic carbon content was more than 3.5g kg^{-1} (Tomar *et al*., 2003b).

Thus, afforestation and agroforestry in degraded lands have potential to optimize biomass productivity and store the fixed carbon for long time in wood. Increase in biomass production through different innovations has implication for the fixation of CO_2 from the atmosphere. The tropical soils are largely carbon depleted and have a high potential for acting as a sink for additional carbon as is evident from the above discussion. The present stock of carbon in Indian soils is estimated to 63.19 Pg (Velayutham *et al*., 2000), which is just 4.2% of the world. The C carrying capacity of Indian soils is estimated to 85.04 Pg (Dagar and Swarup,2003), therefore, there is a scope of additional C sequestration of 21.85 Pg. Gupta and Rao (1994) advocated that grasses and trees when planted on the degraded lands have a potential of sequestering 1.9 Pg in 7 years as against emission of 2.27 Pg during the same period thus may help in slowing down the warming. The estimation proposed by them is towards conservative side. Analyzing the productive potential critically and including soil microbial carbon this figure may be much higher. Thus, optimization of biomass production through multi-species stands in agroforestry or sole forestry on degraded lands should be the priority for sustaining the system and continuously improving the environment. Wherever there is a scarcity of good quality water for establishment of tree plantation or silvi-pastoral system or growing medicinal plants underground saline water can successfully be used for irrigation.

S. No.	Family	No. of Genera	No. of Species	No. of Species having economic uses
112	Sapindaceae	5	5	3
113	Sapotaceae	3	3	3
114	Scrophulariaceae	8	14	9
115	Simondsiaceae	1	1	1
116	Solanaceae	7	13	12
117	Sonneratiaceae	1	4	4
118	Sparganiaceae	1	1	1
119	Sterculiaceae	4	6	6
120	Surianaceae	1	1	1
121	Tamaricaceae	1	6	6
122	Tiliaceae	4	9	9
123	Trapaceae	1	1	1
124	Typhaceae	1	2	2
125	Verbenaceae	5	10	10
126	Violaceae	1	1	1
127	Vitaceae	2	3	3
128	Vittariaceae	1	1	1
129	Zannichelliaceae	1	1	-
130	Zingiberaceae	1	1	1
131	Zygophyllaceae	4	5	5
Total	**131**	**541**	**1140**	**988**

Mangroves and their Associates (Coastal Vegetation)

Mangroves are woody plants restricted in their distribution to the tropics and subtropics (approximately between 32°N and 38°S) and encountered along the seacoasts in backwater creeks and river estuaries between approximately mid-tide to the extreme high water mark. Air temperature, ocean currents, protection, shallow shores, salt water and of species depends on tidal movements, soil type, salt contents of soil and water, and light. The greatest diversity of mangal occurs in the humid tropics with an annual rainfall of more than 200 cm, the average temperature of the coldest month about 20°C, and where the seasonal temperature range does not exceed 5°C. These conditions are more prominent on the eastern borders of the continents. The restricted distribution is mainly due to the sensitivity of mangroves to frost and cold temperatures. Saenger *et al*. (1983) listed 60 exclusive and 23 non-exclusive mangrove species found in the world. Out of these, 13 mangrove species are reported distributed in Western hemisphere and 51 in Eastern hemisphere. Among non-exclusive (associate) mangroves, 8 are reported from Western hemisphere and 18 from Eastern hemisphere. Among associate mangroves *Acrostichum aureum, Hibiscus tiliaceous* and *Thespesia populnea* are widely distributed and found in both the hemispheres. The non-exclusive species vary a lot in different stands. Dagar (2003) has listed 38 species of exclusive mangroves and 188 species of associate mangroves (including climbers, epiphytes and semi-parasites) found in Indian mangrove stands (Tables 2 & 3). As per State of Forest Report (FSI, 2001) mangrove forest area in India is only 4482 km^2, which is 0.14% of total geographical area of the country, of which 2859 km^2 is dense mangrove and 1623 km^2 is open mangrove. On the western coast of the Indian subcontinent one can distinguish three main areas of the mangal: the Kathiawar peninsula, the Bombay- Ratnagiri region and the Kerala coast with 23 species. On the eastern coast there are four main mangrove areas: the Cauvery delta (Tamil Nadu Coast), the Krishna and Godavari delta (Andhra Coast), the Mahanadi delta, and the Ganga and Brahmaputra delta (Sunderbans). The mangal of Andaman and Nicobar Islands is one of the most luxurious with 35 exclusive mangrove and about 100 associate species and abundant biodiversity. The mangrove vegetation, the associate fauna, and microorganisms form a complex but very interesting food web. The detail distribution, zonation pattern, adaptations and other aspects have been dealt elsewhere (Dagar *et al*., 1991, 1993; Dagar, 1995, 2003).

respectively, accounting for 66 to 80% of total carbon content of the vegetation. The total carbon storage in the tree + *Desmostachya* systems ranged from 6.80 to 18.55 t C ha^{-1} across the treatments. Carbon content in total plant biomass was 1.44 t C ha^{-1} and 12.32 t C ha^{-1} in case of *Dalbergia sissoo* + *Sporobolus marginatus* and *Prosopis juliflora* + *S. marginatus*, respectively (Table 7). The amount of total carbon input through net primary production in the trees + *D. bipinnata* systems (t $ha^{-1}yr^{-1}$) was: 2.81 (*A. nilotica* + *D. bipinnata*), 5.37 (*D. sisoo* + *D. bipinnata*) and 6.50 (*P. juliflora* + *D. bipinnata*). Kaur *et al*. (2002a) also observed a significant relationship between microbial biomass carbon and plant biomass carbon (r=0.92) as well as the flux of carbon in net primary productivity (r=0.92). Nitrogen mineralization rates were found greater in silvo-pastoral systems compared to sole grass stand. Soil organic matter was linearly related to microbial biomass carbon, soil N and nitrogen mineralization rates (r=0.95-0.98, p<0.01). The microbial biomass carbon in the soil under sole grasses (*D. bipinnata* and *S. marginatus*) was low as compared to silvi-pastoral systems. Therefore, silvo-pastoral systems were found to be promising for the highly sodic soils for improving the fertility and carbon sequestration.

Table 7. Carbon content (t ha^{-1}) of *Acacia nilotica* (An), *Dalbergia sissoo* (Ds) and *Prosopis juliflora* (Pj) along with *Desmostachya bipinnata* (Db) and *Sporobolus marginatus* (Sm) in silvi-pastoral systems on a sodic soil

Plant component	An + Db	An + Sm	Ds + Db	Ds + Sm	Pj + Db	Pj + Sm
Tree foliage, branches & bole	4.95	-	6.03	0.33	14.80	9.28
Coarse & fine roots	1.48	-	2.06	0.11	3.66	2.80
Grasses	0.37	1.18	1.01	1.00	0.09	0.24

'-' denotes non-survival of *A. nilotica* due to high pH

Bio-amelioration and Carbon Sequestration in Salt-Lands

Restoration of 1×10^9 ha of soil in the tropics has a potential to sequester C at the rate of 1.5 Pg per year (Lal and Kimble, 2000). The available estimates suggest that land use may mitigate additional 1 to 2 Gt C per year between 1995 and 2050. For achieving this full carbon mitigation potential will require that we use all land-use related options for carbon sequestration. Here, agroforstry and silvi-pastoral systems may play an important role particularly in degraded salty lands. These lands are largely carbon-depleted but can be brought back to their native carbon-carrying capacity by reforestation, bringing under agroforestry systems, and judicious use of organic and inorganic fertilizers in scientifically cultivated arable crops. Afforestation and agroforesty have tremendous potential for carbon sequestration not only in aboveground C biomass but also root C biomass in deeper soil depths. From a long-term experiment raising *Prosopis juliflora, Acacia nilotica, Eucolyptus tereticornis, Albizzia lebbeck* and *Terminalia arjuna* on alkali soil with 2.2 g kg^{-1} OC at initial stage in soil, the same reached to 6.2 - 8.5 g kg^{-1} in upper 15 cm, 4.7-5.6 g kg^{-1} in 15-45 cm depth, and 4.8 - 4.4 g kg^{-1} in 45-90 cm depth after 20 years. In one stand of *P. juliflora*, the organic carbon in soil reached from 0.6-1.0 g kg^{-1} to 1.2-2.5 g kg^{-1} in 5 years. At another alkali site (pH 10.4) the soil organic carbon under *P. juliflora, A. nilotica* and *Tamarix articulata* reached from 0.4 g kg^{-1} to 3.0 g kg^{-1} in upper 15 cm layer. After 7 years of growth the respective species could produce 48, 35 and 25 t C ha^{-1} stem biomass (Dagar *et al*., 2001). The excavated root biomass of respective species was 8.0, 4.0 and 3.4 kg C per plant in 1.2 m soil depth. Fruit trees such as *Emblica officinalis, Psidium guajava, Syzygium cuminii, Ziziphus mauritiana, Carissa carandus* and *Tamariudus indica* could produce a total biomass ranging from 2 to 7 kg C per plant. At the same site Kaur *et al*. (2002b) observed that in a silvi-pastoral system the total carbon storage was 1.18 to 18.55 t C ha^{-1} and carbon input in net primary production varied between 0.98 to 6.50 t C $ha^{-1}yr^{-1}$. The extent of storage of carbon in aboveground parts of the tree + *Desmostachya bipinnata* grass system (t ha^{-1}) were: 4.95, 6.03 and 14-80 in *A. nilotica + D. bipinnata*, *Dalbergia sissoo + D. bipinnata*, and *Prosopis juliflora + D. bipinnata*,

Table 2: Distribution of prominent mangrove species along Indian coasts

Species	Family	Life Forms	West Coast						East Coast				A & N
			1	2	3	4	5	6	7	8	9	10	11
Acanthus ebracteatus (*)	Acanthaceae	Sh	-	-	-	-	-	-	-	-	-	-	o
A. ilicifolius (*)	Acanthaceae	Sh	f	f	f	d	d	f	f	f	f	f	d
A. volubilis (*)	Acanthaceae	Sh	-	-	-	-	-	-	o	r	-	o	o
Aegialitis rotundifolia	Plumbaginaceae	Sh	-	-	-	-	-	-	r	o	-	-	+?
Aegiceras corniculatum (*)	Myrsinaceae	T	o	f	o	o	r	-	f	o	o	f	f
Avicennia alba	Avicenniaceae	T	r	d	-	f	r	-	f	d	o	d	f
A. marina (*)	Avicenniaceae	T	d	d	o	d	o	-	o	f	f	f	f
A. officinalis (*)	Avicenniaceae	T	f	d	d	d	d	-	f	f	o	o	f
Bruguiera cylindrica	Rhizophoraceae	T	-	o	r	-	-	-	f	f	o	o	r
B. gymnorrhiza	Rhizophoraceae	T	f	f	f	o	f	f	f	f	f	o	vf
B. parviflora	Rhizophoraceae	T	-	o	o	-	r	r	o	f	-	r	ld
B. sexangula	Rhizophoraceae	T	-	-	-	-	-	-	o	o	r	-	o
Ceriops decandra	Rhizophoraceae	T, Sh	-	r	-	-	o	r	d	f	o	f	r
C. tagal (*)	Rhizophoraceae	T, Sh	o	o	o	f	-	-	f	f	-	o	d
Cynometra iripa (*)	Caesalpiniaceae	T	-	-	-	-	-	-	-	f	-	-	o
C. ramiflora (*)	Caesalpiniaceae	T	-	-	-	f	-	-	o	o	-	-	o
Excoecaria agallocha (*)	Euphorbiaceae	T	r	f	f	f	d	d	d	d	f	d	d
Heritiera fomes (*)	Sterculiaceae	T	-	-	o	-	-	-	o	f	-	-	-
H. kanikensis	Sterculiaceae	T	-	o	-	-	-	o	-	r	-	-	-
H. littoralis (*)	Sterculiaceae	T	-	-	r	r	-	-	r	o	-	-	f
Kandelia candel (*)	Rhizophoraceae	T, Sh	-	o	o	o	-	-	o	r	-	-	+?
Lumnitzera littorea (*)	Combretaceae	T	-	-	-	-	-	-	-	r	-	-	ld
L. racemosa (*)	Combretaceae	T	-	o	-	-	r	o	o	f	f	o	f
Nypa fruticans (*)	Arecaceae	P	-	-	-	-	-	-	o	-	-	-	ld
Phoenix paludosa	Arecaceae	P	-	-	-	-	-	-	d	d	-	o	o
Rhizophora annamalayana	Rhizophoraceae	T	-	-	-	-	-	-	-	-	-	r	-
R. apiculata	Rhizophoraceae	T	f	f	f	f	f	-	f	d	d	d	d
R. lamarckii	Rhizophoraceae	T	-	-	-	-	-	-	-	-	-	-	vr
R. mucronata (*)	Rhizophoraceae	T	d	f	d	d	d	d	d	d	d	d	d
R. stylosa	Rhizophoraceae	T	-	-	-	-	-	-	-	r	o	r	o
Scyphiphora hydrophyllacea(*)	Rubiaceae	T	-	-	-	-	-	-	-	r	o	o	ld
Sonneratia alba	Sonneratiaceae	T	-	f	f	o	-	-	-	o	f	-	o
S. apetala	Sonneratiaceae	T	-	d	-	-	o	-	f	f	d	o	o
S. caseolaris (*)	Sonneratiaceae	T	-	f	f	o	o	-	-	o	o	-	f
S. griffithii	Sonneratiaceae	T	-	r	-	-	-	-	r	f	-	-	+?
Xylocarpus granatum (*)	Meliaceae	T	-	o	-	-	-	-	f	f	r	o	f
X. mekongensis (*)	Meliaceae	T	-	-	-	-	-	-	f	f	-	f	r
X. moluccensis (*)	Meliaceae	T	-	-	-	-	-	-	f	r	r	-	o

Nos. 1-11 indicate coastal areas of State/Union Territories of 1). Gujarat, 2). Maharashtra, 3). Goa, 4). Karnataka, 5). Kerala, 6). Lakshadweep, 7). West Bengal, 8). Orissa, 9). Andhra Pradesh, 10). Tamil Nadu, 11). Andaman & Nicobar Islands.
Distribution letters depict: d = dominant, f = frequent, o = occasional, r = rare, v = very, l = local, +? = presence doubtful and - = absent. d > f > o > r > vr
Lifeform: T=tree, P=palm, Sh=shrub. Asterisk (*) indicates that the species has medicinal value

Table 3. Distribution of prominent mangrove associates along Indian coasts

Species	Family	Life Form/ Habit	West Coast						East Coast				A & N
			1	2	3	4	5	6	7	8	9	10	11
Acrostichum aureum (*)	Acrostichaceae	F, Sh	-	f	-	f	d	f	d	f	-	-	d
A. speciosum (*)	Acrostichaceae	F, Sh	-	-	-	-	-	-	-	-	-	-	r
Aeluropus lagopoides	Poaceae	G	d	d	d	o	-	-	o	d	f	f	r
Aganope thyrsiflora	Papilionaceae	Cl, Sh	-	-	-	-	-	-	-	-	-	-	r
Allophyllus cobbe (*)	Sapindaceae	Sh	-	-	-	-	-	-	-	r	-	-	o
Amoora cucullata (*)	Meliaceae	T	-	-	-	-	-	-	f	o	-	-	f
Archindendron ellipticum (*)	Mimosaceae	T	-	-	-	-	-	-	-	-	-	-	o
Ardisia elliptica, solanacea (*)	Myrsinaceae	Sh, T	-	-	-	-	-	-	r	o	-	-	o
Arthrocnemum indicum (*)	Chenopodiaceae	Ush	d	f	-	-	-	-	o	o	f	f	-
Aryteria littoralis	Sapindaceae	T	-	-	-	-	-	-	-	-	-	-	f
Atriplex stocksii	Chenopodiaceae	Ush	o	r	-	-	-	-	-	-	-	-	-
Azima tetracantha (*)	Salvadoraceae	Sh	-	-	-	-	-	-	r	-	-	o	-
Barringtonia acutangula (*)	Barringtoniaceae	T	o	f	o	o	o	f	f	f	f	f	f
B. racemosa (*)	Barringtoniaceae	T	o	f	o	o	o	f	f	f	f	f	f
Brownlowia tersa (*)	Tiliaceae	Sh	-	-	-	-	r	-	f	f	-	o	f
Caesalpinia crista	Caesalpiniaceae	Sh	-	o	o	f	f	o	f	f	o	o	f
C. nuga	Caesalpiniaceae	Sh	-	o	o	f	f	r	o	f	o	o	f
Calamus spp	Arecaceae	Sh, Cl	-	-	-	-	-	-	o	-	-	-	f
Calophyllum inophyllum (*)	Clusiaceae	T	r	o	-	o	r	o	-	o	o	r	f
Canavalia cathartica, lineata, maritima	Papilionaceae	Tw, Cl	o	r	-	-	-	-	o	o	-	-	f
Carallia brachiata	Rhizophoraceae	T	-	r	r	-	-	-	-	-	-	-	o
Cayratia carnosa (*)	Vitaceae	Tw	-	-	-	-	-	-	f	-	-	-	f
Cassytha filiformis (*)	Lauraceae	Tr	-	-	-	-	-	-	o	-	-	-	f
Cerbera manghas (*)	Apocynaceae	T	r	o	o	o	o	o	r	o	o	o	f
Cissus quadrangularis (*), *repanda*	Vitaceae	Tw	-	-	-	-	-	-	-	-	-	-	f
Clerodendrum inerme (*)	Verbinaceae	Sh	o	f	o	o	d	o	f	f	o	o	f
Clitoria ternatea (*)	Papilionaceae	Tw	f	-	-	-	-	-	o	-	-	-	f
Colubrina asiatica (*)	Rhamnaceae	Sh	-	o	-	-	r	-	-	-	o	o	f
Cordia subcordata (*)	Cordiaceae	T	-	-	-	-	-	-	-	-	-	-	lf
Crinum asiaticum	Amaryllidaceae	Ush	o	o	o	r	o	-	-	o	o	o	-
C. defixum	Amaryllidaceae	Ush	-	-	-	-	-	-	o	r	-	-	r
Cryptocoryne ciliata (*)	Araceae	H	-	-	-	-	-	-	o	r	o	o	o
Cycas rumphii (*)	Cycadaceae	Sh	-	-	-	-	-	-	-	-	-	-	lf
Cymodocea rotundata	Cymodoceaceae	Sea-G	-	-	-	-	-	-	-	-	-	-	f
C. serratula	Cymodoceaceae	Sea-G	f	f	f	f	o	o	-	-	-	-	-
Cyperus exaltatus	Cyperaceae	S	-	-	-	-	-	-	o	f	-	o	o
C. flavidus	Cyperaceae	S	o	-	-	-	-	-	-	-	-	-	f

medicinal and flower yielding salt-loving herbaceous crop of winter season when grown in alkali soil of different pH on an average could yield 1.3 kg m^{-2} total fresh flower biomass (plucked 4-5 times). It also withstands saline irrigation. Among other salt-tolerant medicinal and aromatic plants, which have been tried and found successful irrigating with saline water of 10-12 dS m^{-1} include Aloe (*Aloe barbadensis*), celery (*Apium graveolens*) and *Chrysanthemum indicum*. The last species also produces ornamental flowers. Species marked (*) in Tables 2, 3 and 5 are of medicinal importance.

Other salt-tolerant plants of economic value

Seed of *Salvadora oleoides* and *S. persica* contain 40-50% fat and is good source of lauric acid. Purified fat is used for soap and candle making. Among other products oil from coastal *Terminalia catappa*, perfume from male flowers of *Pandanus spp*.; essential oil from *Mentha arvensis, M. piperia, M. spicata* (entire plants), *Matricaria chamomilla* (flowers), *Vetiveria zizanioides* (roots), *Cymbopogon martini* and *C. flexuosa* (foliage), *Anethum graveolens* (fruit) and species of *Ocimum* (entire plant); beverages from mangrove palm *Nypa fruiticans*; aromatic oil similar to sperm whale from *Simmondsia chinensis*; rubber from *Parthenium argenatum*; pulp and fibre from P*hragmites australis, P. karka, Juncus rigidus, J. acutus, Pandanus tectorius, Typha domingensis, Hibiscus cannabinus, H. tiliaceous, Urochondra setulosa* and many others; bioactive compounds from *Calophyllum inophyllum, Balanites roxburghii, Catharanthus roseus, Salsola baryosma*; and petrol or diesel from seeds of *Pongamia pinnata*, *Jatropha curcas* and entire plant of *Euphorbia antisyphilitica* are worth mentioning. The last species could produce huge biomass when grown on calcareous soil irrigating with saline water. Many salt-tolerant species can also be used as landscape plants, especially in areas where fresh water is not available for irrigation. These may include trees, shrubs, succulents, ground covers and lawn grasses. These observations show that there lie promising avenues of research and development on halophytes leading to biosaline agriculture.

Catharanthus roseus, Cerbera manghas, Citrullus colocynthis, Clerodendrum inerme, Cressa cretica, Cynometra ramiflora, Heritiera fomes, H. littoralis, Jatropha curcas, Kochia indica , Pandanus odoratissimus, Pongamia pinnata, Ricinus communis, Solanum surattense, Tribulus terrestris, Withania somnifera, Xylocarpus granatum and *X. moluccensis*.

Recently in India, the cultivation of medicinal and aromatic plants has gained more importance and the trade in products of these plants is estimated to be over US $ 3000 million per annum. Due to ever-increasing population, we have optimum pressure on arable lands for cultivation of food crops; therefore, utilization of degraded wastelands including salt-affected soils is a viable option for cultivation of medicinal and aromatic plants. Isabgol (*Plantago ovata*), a potential medicinal *rabi*-crop could be cultivated successfully on alkali soil up to pH 9.6 producing 1.08- 1.27 t ha^{-1} grains. It could also be grown successfully on calcareous degraded land in arid regions irrigating with saline water having EC up to 12 dS m^{-1} and produced 1.35 to 1.55 t ha^{-1} grains with three number of saline irrigation (Tomar *et al*., 2005). Dill (*Anethum graveolens)* could be cultivated successfully with saline irrigation producing grain yield of 1.08, 1.22 and 1.28 t ha^{-1}, respectively with 1, 2, and 3 number of irrigations using saline water of ECiw 12 dS m^{-1}. Periwinkle (*Catharanthus roseus*) widely used against cancerous tumors and several other ailments could produce 3-6 kg m^{-2} fresh biomass up to pH 9.4 showing its potential for moderate alkali soil. It could also be grown successfully with saline water up to ECiw 10 dS m^{-1}. *Ricinus communis* also when grown with saline water produced 400 to 900 kg ha^{-1} seeds per year. Seed oils from *Azadirachta indica, Terminalia billirica, Calophyllum inophyllum, Cynometra ramiflora, Pandanus spp., Salvadora persica, S. oleoides, Pongamia pinnata, Ricinus communis, Salicornia bigelovii, Xylocarpus granatum, X. mekongensis, X. moluccensis, Butea monosperma, Balanites roxburghii, Entada phaseoloides, Horsfieldia irya, Eruca sativa* (cultivated herb), *Sisymbrium irio*, and *Lepidium sativum* (cultivated) are of medicinal value and can be explored for commercial purposes. Vertiver (*Vetiveria zizanioides*) showed tremendous promise for the degraded soils yielding 72.6 - 78.7 t ha^{-1} fresh shoot and 1.19-1.73 t ha^{-1} root biomass when irrigated with saline water of ECiw 10 dS m^{-1}. German chamomile (*Matricaria chamomilla*), a

Species	Family	Life Form/ Habit	West Coast						East Coast				A & N
			1	2	3	4	5	6	7	8	9	10	11
C. imbricatus	Cyperaceae	S	-	-	-	-	-	-	o	-	-	-	o
C. malaccensis	Cyperaceae	S	-	-	-	-	-	-	o	-	-	-	o
C. odoratus	Cyperaceae	S	-	-	-	-	-	-	o	-	-	-	o
Dalbergia candenatensis, pinnata (*)	Papilionaceae	Sh, Cl	-	-	-	-	-	-	-	-	-	-	f
D. spinosa	Papilionaceae	Sh	-	-	o	r	-	-	f	o	f	f	o
Derris andamanica, elegans	Papilionaceae	Cl, Sh	-	-	-	-	-	-	-	-	-	-	o
D. heptaphylla,trifoliata (*)	Papilionaceae	Cl, Sh	-	o	o	r	o	o	o	o	f	f	f
D. scandens (*)	Papilionaceae	Cl, Sh	-	-	-	-	-	-	f	f	-	-	-
Dendrolobium umbellatum (*)	Papilionaceae	Sh	-	-	-	-	-	-	f	-	-	-	f
Dendrophthoe falcata (*)	Loranthaceae	Ush,p	o	-	-	-	-	-	o	-	-	-	f
Desmodium triquetrum (*)	Papilionaceae	Ush	-	-	-	-	-	-	-	-	-	-	f
D.sinuate (heptaphylla)	Papilionaceae	Cl, Sh	-	-	-	-	-	-	o	-	-	-	-
Dischidia benghalensis, major, nummularia (*)	Asclepiadaceae	Tw	o	-	-	-	-	-	o	-	-	-	f
Dolichandrone spathacea (*)	Bignoniaceae	T	-	-	-	-	o	-	o	o	-	-	f
Dracaena angustifolia	Liliaceae	Sh	-	-	-	-	-	-	-	-	-	-	o
Drynaria quercifolia	Polypodiaceae	F,E	-	-	-	-	-	-	-	-	-	-	o
Drymoglossum heterophyllum *	Polypodiaceae	F,E	-	-	-	-	-	-	-	-	-	-	o
Entada phaseoloides (*)	Mimosaceae	Cl	-	-	-	-	-	-	-	-	-	-	f
Erythrina variegata (*)	Papilionaceae	T	-	-	-	-	-	-	-	-	-	-	vf
Excoecaria bicolor, indica	Euphorbiaceae	T	-	-	-	-	-	-	o	-	-	-	o
Ficus retusa (*)	Moraceae	T	-	-	-	-	-	-	-	-	-	-	f
Fimbistyllis ferruginea	Cyperaceae	S	o	o	o	o	o	r	o	f	o	o	f
F. littoralis, miliacea	Cyperaceae	S	o	-	-	-	-	-	o	-	-	-	f
Finlaysonia obovata	Asclepiadaceae	Cl	-	-	-	-	-	-	f	f	-	-	f
Flagellaria indica (*)	Flagellariaceae	Cl	-	-	-	-	-	-	o	o	-	-	f
Freycinetia insignis, scandens	Pandanaceae	T-Cl	-	-	-	-	-	-	-	-	-	-	f
Ganophyllum falcatum (*)	Sapindaceae	T	-	-	-	-	-	-	-	-	-	-	f
Gelonium bifarium	Euphorbiaceae	T	-	-	-	-	-	-	-	-	-	-	f
Glochidion calocarpum (*)	Euphorbiaceae	T	-	-	-	-	-	-	-	-	-	-	f
G. littorale (*)	Euphorbiaceae	T	o	o	o	o	-	-	-	-	-	-	r
Glycosmis mauritiana (*)	Rutaceae	Sh	-	-	-	-	o	-	o	-	-	-	f
Guettarda speciosa (*)	Rubiaceae	T	-	-	-	-	-	-	-	-	-	-	f
Halodule uninervis	Cymodoceaceae	Sea-G	-	-	-	-	-	-	-	-	-	-	f
Halophila ovalis, stipulacea	Hydrocharitaceae	HH	-	f	-	-	-	-	-	-	-	-	o
Heliotropium curassavicum (*)	Boraginaceae	H	o	-	-	-	-	-	r	o	f	f	-

Species	Family	Life Form/ Habit	West Coast						East Coast				A & N
			1	2	3	4	5	6	7	8	9	10	11
Helixanathera coccinea	Loranthaceae	Ush,p	-	-	-	-	-	-	r	-	-	-	o
Hernandia peltata (ovigera) (*)	Hernandiaceae	T	-	-	-	-	-	-	-	-	-	-	f
Hibiscus tetraphyllus	Malvaceae	H	-	-	-	-	-	-	o	-	-	-	o
H. tiliaceous (*)	Malvaceae	T	f	f	o	f	o	f	f	f	o	r	vf
H. tortussus	Malvaceae	T	-	-	-	-	-	-	r	-	-	-	-
Holarrhena antidysenterica (*)	Apocynaceae	T	-	-	-	-	-	-	o	-	-	-	-
Horsfieldia irya (*)	Myristicaceae	T	-	-	-	-	-	-	-	-	-	-	o
Hoya parasitica (*)	Asclepiadaceae	H,p	-	-	-	-	-	-	-	-	-	-	f
Hybanthus enneaspermus	Violaceae	H	-	-	-	-	r	-	-	-	o	o	-
Hydnophytum andamanensis (*)	Rubiaceae	Sh, E	-	-	-	-	-	-	-	-	-	-	f
H. formicarum (*)	Rubiaceae	Sh, E	-	-	-	-	-	-	-	-	-	-	f
Hygrophila phlomoides	Acanthaceae	H	-	-	-	-	-	-	o	-	-	-	o
Intsia (Afzelia) bijuga (*)	Caesalpiniaceae	T	-	-	-	-	-	-	o	o	-	-	o
Ipomoea pes-caprae	Convolvulaceae	Tr	o	f	f	f	f	f	f	f	o	f	o
I. tuba	Convolvulaceae	Tr, Cl	-	-	-	-	-	-	o	f	o	-	ld
Ixora brunnescens (*)	Rubiaceae	Sh	-	-	-	-	-	-	-	-	-	-	f
Lagenandra ovata (*)	Araceae	HH	o	o	-	-	-	-	-	-	-	-	-
Launea sarmentosa	Asteraceae	H	-	-	-	-	-	-	o	-	-	-	o
Lepisanthes senegalensis	Sapindaceae	Sh	-	-	-	-	-	-	-	-	-	-	o
Licuala spinosa (*)	Arecaceae	P	-	-	-	-	-	-	-	-	-	-	f
Macaranga peltata (*)	Euphorbiaceae	T	-	-	-	-	-	-	-	-	-	-	f
Macrosolon cochinchinensis/globosus (*)	Loranthaceae	Ush,p	-	-	-	-	-	-	r	-	-	-	o
Manilkara littoralis	Sapotaceae	T	-	-	-	-	-	-	-	o	-	-	f
Melastoma malabathricum (*)	Melastomataceae	Sh	-	-	-	-	-	-	-	-	-	-	f
Merope angulata	Rutaceae	Sh	-	-	-	-	-	-	o	f	-	-	-
Messerschmidia argentea (*)	Boraginaceae	Sh	-	-	-	-	-	-	-	-	-	-	f
Micromelum pubescens (*)	Rutaceae	T	-	-	-	-	-	-	o	-	-	-	o
Morinda bracteata, citrifolia (*)	Rubiaceae	T	-	-	-	-	-	-	o	-	-	-	f
Mucuna gigantea, pruiens (*)	Papilionaceae	Cl, Sh	-	-	-	-	o	-	o	o	-	-	f
Myriostachya wightiana	Poaceae	G	-	d	-	-	-	-	f	d	d	r	r
Ochrosia oppositifolia (*)	Apocynaceae	T	-	-	-	-	-	-	-	-	-	-	f
Ochthocharis bornensis, javanica	Melastomataceae	Sh	-	-	-	-	-	-	-	-	-	-	o

one of the most widely distributed species throughout the mangal stands of the world and tolerates biotic stress. Many species have been planted successfully in coastal regions of Goa and Tamil Nadu. *Casuarina equiselifolia* has been widely planted along beaches of Orissa and many other coastal areas.

For fuel wood production *Prosopis juliflora, Acacia nilotica* and *Tamarix articulata* were found most successful on highly alkali soil (pH 10 or more). These trees produced 51, 70 and 97 t ha^{-1} biomass, respectively in 7 years of growth on these soils. On saline soil *P. juloflora, Acacia fornesiana, Tamarix articulata, T. troupii, Parkinsonia aculeata* and *Pithecellobium dulce* could tolerate salinity up to ECe 25 to 35 dS m^{-1} and *A. nilotica, A. tortilis, Casuarina glauca, C. obesa, C. equisetifolia* and *E. camaldulensis* up to ECe 15-25 dS m^{-1}. *P. juliflora* and *A. nilotica* produced 98 and 67 t ha^{-1} biomass on waterlogged saline soil (Tomar *et al*., 1998). In arid regions when established on calcareous soil with saline water (ECiw 10 dS m^{-1}), after 7 years of planting, the highest biomass was harvested (Tomar *et al*., 2003b) from *Tamarix articulata* (71.9 t ha^{-1}) followed by *Acacia nilotica* (23.4 t ha^{-1}), *P. juliflora* (20.2 t ha^{-1}) and *Eucalyptus tereticornis* (14.8 t ha^{-1}). These species not only produced economic yield but also improved soil conditions in terms of organic matter. Irrigation at the site with furrow method did not cause measurable increase in soil salinity. *Beta vulgaris* and *Nypa fruticans* have been identified as potential source of liquid fuels while species such as *Jatropha curcas, Pongamia pinnata* and *Eupporbia antisyphilitica* are among potential diesel-fuel plants and these can be grown successfully on degraded lands providing saline irrigation. The energy yield (in the form of biogas) from *Leptochloa fusca* has been estimated at 15 x 10^{6} Kcal/ha (Jaradat, 2003).

Medicinal and aromatic plants

There are many reports on the medicinal uses of halophytes (CSIR, 1986; Dagar, 1995, 2003; Dagar *et al*., 1991, 1993). Some common medicinal halophytes found in natural saline habitats including coastal areas include: *Acanthus ilicifolius, A. volubilis, Achyranthes aspera, Adhatoda vasica, Aloe barbadensis, Azadirachta indica, Balanites roxburghii, Barringtonia acutangula, B. racemosa, Calophyllum inophyllum , Calotropis procera, Capparis decidua,* Kallar grass (*Leptochloa fusca*) has gained attention in India and Pakistan as fodder grass for saline and sodic soils. Being nitrogen-fixer it also helps in soil amelioration. Species of *Sporobolus, Brachiaria, Panicum, Dactyloctenium* and *Eragrostis* are tolerant to high salinity. *Aeluropus lagopoides* is a dominant grass in entire Rann of Kutchh and is used for grazing. The grazing lands of sodic soils are poor in forage production under open grazing but when brought under judicious management these can be explored successfully for sustainable forage production. When only protected from grazing one sodic grassland field, which had herbage biomass of 0.25 t ha^{-1} when unprotected, could yield 2.6 t ha^{-1} forage biomass. Effect of long-term fencing showed that the number of palatable species increased significantly and soil amelioration in terms of reduction in pH and increase in organic matter was considerable. In a trial, species such as *Brachiaria mutica*, *Chloris gayana, Cynodon dactylon, Leptochloa fusca, Panicum antidotale* and *P. maximum* could yield 20 to 50 t ha^{-1} forage on highly alkali soil (pH 10.4, ESP = 90) and 10-20 t ha^{-1} at high salinity (ECe 10 dS m^{-1}) of soil (Kumar, 1998). *Dichanthium annulatum* and *L. fusca* could produce 2.24 and 3.21 t ha^{-1} forage, respectively on saline vertisol with salinity in root zone up to 35 dS m^{-1}. *L. fusca* and *Brachiaria mutica* when grown on alkali loam soil, could produce 18.9 and 13.8 t ha^{-1} forage and reduced soil pH from 10.3 to 9.5 and 9.6, respectively and ESP from 75 to 53 and 57, respectively. In many coastal areas (including Rann of Katchh) where mangroves occur sporadically and there is scarcity of fodder, the foliage of many mangroves and associated plants such as species of *Avicennia, Ceriops, Bruguiera, Rhizophora, Kandelia, Sonneratia, Cynomitra, Terminalia, Pongamia, Hibiscus, Salvadora* and many others, are used as forage for cattle, goats and camel.

Fuel wood

Often fuel wood is obtained from salt-tolerant trees and shrubs, which include species of *Prosopis, Acacia, Tamarix, Casuarina, Eucalyptus, Parkinsonia, Capparis, Sesbania* and *Salvadora*. In coastal areas the mangroves and their associates are widely used for fuel wood and timber leading to deforestation of these habitats. Species of *Rhizophora, Bruguiera, Ceriops, Kandelia, Avicennia*, *Sonneratia, Xylocaprus, Heritiera* and *Excoecaria* are excellent fuel wood and also used for making charcoal. *Avicennia marina* is

Species	Family	Life Form/ Habit	West Coast						East Coast				A & N
			1	2	3	4	5	6	7	8	9	10	11
Operculina riedeliana	Convolvulaceae	Tw	-	-	-	-	-	-	-	-	-	-	f
Pandanus andamanensis	Pandanaceae	T	-	-	-	-	-	-	-	-	-	-	o
P. fascicularis (*)	Pandanaceae	T	-	o	o	o	o	f	-	f	f	f	f
P. foetidus	Pandanaceae	Sh	-	-	-	-	-	-	o	-	-	-	-
P. furcatus (*)	Pandanaceae	T	r	o	-	-	-	-	-	f	f	o	-
P. lerum (*)	Pandanaceae	T	-	-	-	-	-	-	-	-	-	-	f
P. tectorius (*)	Pandanaceae	Sh	-	-	-	-	-	-	o	f	-	-	-
Parsonsia laevigata (*)	Apocynaceae	Sh	-	-	-	-	-	-	o	-	-	-	o
Planchonella obovata (*)	Sapotaceae	T	-	-	-	-	-	-	-	-	-	-	f
Pemphis acidula (*)	Lythraceae	Sh	-	-	-	-	-	-	r	-	-	-	o
Pongamia pinnata (*)	Papilionaceae	T	-	o	-	o	r	o	f	f	o	-	f
Porteresia coarctata	Poaceae	G	-	d	d	-	-	-	d	d	f	-	-
Premna corymbosa (*)	Verbinaceae	Sh	-	o	-	o	r	o	f	f	o	-	f
Pseuderanthemum album	Acanthaceae	H	-	-	-	-	-	-	-	-	-	-	o
Pyrossia adnascens (*)	Polypodiaceae	E. F	-	-	-	-	-	-	-	-	-	-	f
Rotala densiflora	Lythraceae	H	o	-	-	-	-	-	-	-	-	-	-
R. rotundifolia (*)	Lythraceae	H	o	-	-	-	-	-	o	-	-	-	-
Ruppia maritima	Ruppiaceae	HH	-	-	-	-	-	-	f	-	-	-	f
Salacia chinensis (*)	Hippocrateaceae	Cl, Sh	-	-	-	-	-	-	r	f	-	-	-
Salicornia brachiata	Chenopodiaceae	Ush	f	f	-	-	-	-	o	f	r	f	-
Salvadora oleoides (*)	Salvadoraceae	T	o	r	r	-	-	-	-	-	-	-	-
S. persica (*)	Salvadoraceae	T	f	o	r	o	-	-	-	f	o	r	-
Sarcolobus carinatus (*)	Asclepiadaceae	Cl	-	-	-	-	-	-	o	f	o	-	o
S.globosus (*)	Asclepiadaceae	Cl	-	-	-	-	-	-	o	-	-	-	-
Scaevola taccada (sericea) (*)	Goodeniaceae	T	-	-	-	-	-	-	-	-	-	-	f
Scirpus littoralis	Cyperaceae	S	f	o	-	-	-	-	o	o	o	f	ld
Scyphiphora hydrophyllacea	Rubiaceae	T	-	-	-	-	-	-	-	-	-	-	ld
Semecarpus heterophyla	Anacardiaceae	T	-	-	-	-	-	-	-	-	-	-	o
Sesuvium portulacastrum	Aizoaceae	Tr	f	o	o	-	r	-	f	f	f	f	-
Sophora tomentosa (*)	Papilionaceae	Ch	-	-	-	-	-	-	-	-	-	-	vf
Spinifex littoreus	Poaceae	G, Tr	f	f	-	f	-	-	o	r	d	d	-
Sporobolus marginatus, virginicus	Poaceae	G	f	o	o	-	-	-	-	-	-	-	-
Stenochlaena palustris (*)	Polypodiaceae	F, Cl	-	-	-	-	o	-	-	f	-	-	lf
Stenotaphrum dimidiatum	Poaceae	F,Cl	-	o	o	-	-	-	-	f	f	f	-
Sterculia rubiginosa (*)	Sterculiaceae	T	-	-	-	-	-	-	-	-	-	-	f
Stictocardia tiliifolia	Convolvulaceae	Cl	-	o	-	-	-	-	f	o	f	r	r
Suaeda fruticosa	Chenopodiaceae	H	f	f	f	-	f	-	f	f	f	f	-
S. maritima	Chenopodiaceae	H	o	f	r	o	o	o	o	f	f	o	-

Species	Family	Life Form/ Habit	West Coast						East Coast				A & N
			1	2	3	4	5	6	7	8	9	10	11
S. monoica	Chenopodiaceae	H	-	r	r	o	-	-	-	f	o	-	-
S. nudiflora	Chenopodiaceae	H	-	-	-	-	-	-	o	-	-	-	-
Suriana maritima	Surianaceae	T	-	-	-	-	-	-	o	-	-	o	o
Syringodium isoetifolium	Cymodoceaceae	Sea-G	-	-	-	-	-	-	-	-	-	-	f
Syzygium claviflorum, samarangensis (*)	Myrtaceae	T	-	-	-	-	-	-	-	-	-	-	f
Tabernaemontana crispa (*)	Apocynaceae	Sh	-	-	-	-	-	-	-	-	-	-	f
Tamarix gallica	Tamaricaceae	Sh	-	f	-	-	-	-	o	r	-	-	-
T. troupii	Tamaricaceae	Sh	o	r	-	-	-	-	o	f	-	-	-
Tarenna asiatica (*)	Rubiaceae	Sh	-	-	-	-	-	-	-	-	-	-	o
Terminalia catappa (*)	Combretaceae	T	f	o	o	-	-	-	o	o	o	o	f
Thalassia hemprichii	Hydrocharitaceae	HH	-	-	-	-	-	-	-	-	-	-	f
Thespesia populnea/ populneoides (*)	Malvaceae	T	o	o	-	-	r	o	f	f	o	o	f
Thuarea involuta	Poaceae	G	-	-	-	o	-	f	-	-	-	o	ld
Timonius jambosella	Rubiaceae	T	-	-	-	-	-	-	-	-	-	-	o
Tournefortia ovata (*)	Boraginaceae	Sh	-	-	-	-	r	-	-	-	-	-	f
Trachys muricata	Poaceae	G	o	o	o	-	-	-	-	-	-	-	-
Triumfetta repens (*)	Tiliaceae	Cr	-	-	-	-	-	-	-	-	-	-	o
Tylophora fasciculate, tenuis (*)	Aslepiadaceae	Cl	-	-	-	-	-	-	o	o	r	o	o
Urochondra setulosa	Poaceae	G	f	r	-	-	-	-	-	-	-	-	-
Vicoa vestita	Asteraceae	H	o	-	-	-	-	-	f	-	-	-	-
Vigna marina	Papilionaceae	Tw	-	-	-	-	-	-	r	-	-	-	f
Vittaria elongata (*)	Vittariaceae	E H	-	-	-	-	-	-	-	-	-	-	o
Vitex negundo (*)	Verbinaceae	Sh	-	-	-	-	-	-	-	-	-	o	o
Wedelia biflora (*)	Asteraceae	H	-	-	-	-	-	-	o	-	-	-	o
Wrightia tomentosa (*)	Apocynaceae	T	-	-	-	-	-	-	-	-	-	-	o
Ximenia americana (*)	Olacaceae	Sh, T	-	-	-	-	-	-	r	-	-	-	f
Zoysia matrella	Poaceae	G	f	o	o	o	o	-	o	-	-	-	o

Distribution in the States/Union Territories of (West Coast): 1) Gujarat, 2). Maharashtra, 3). Goa, 4). Karnataka, 5). Kerala, 6). Lakshadweep; (East Coast): 7). West Bengal, 8). Orissa, 9). Andhra Pradesh, 10). Tamil Nadu; and 11). Andaman & Nicobar Islands.
Distribution letters depict: d = dominant, f = frequent, o = occasional, r = rare, v = very, l = local, +? = presence doubtful and - = absent; d > f > o > r > vr
Lifeform & habit: T=tree, P=palm, Sh=shrub, Ush=undershrub, F=fern, H=herb, G=grass, S= sedge, Cl= climber, HH=hydrophyte, Sea-G= sea grass, P=semi-parasite, E=epiphyte, Tr= trailer, Tw= twiner
Asterisk (*) indicates that the species has medicinal value

tanella, Dichanthium annulatum, Brachiaria mutica, Bothriochloa pertusa and many others are commonly used as fodder from alkali and saline areas (Dagar 2006). Many of these forage species can be cultivated successfully on degraded salt-affected soils or in drought prone areas irrigating with saline water, where other arable crops cannot be grown.

Grazing lands of arid and semi-arid regions are poor in yield. One site in north-western India with average yield of 0.85 t ha^{-1} when protected from grazing could produce 2.4 t ha^{-1} forage and the same site when brought under cultivated grasses and irrigated with saline water (ECiw 12 dS m^{-1}) could produce up to 16.9 t ha^{-1} dry forage (Table 6). Even in the lean period when people are forced to lead nomadic life along with their herds of cattle, sufficient forage (30% of total) was available from these perennial grasses.

Table 6. Gross dry matter yield (Average of 3 years) and water use efficiency of different grasses raised with saline irrigation

Species	Yield (t/ha) at Diw/CPE			Water use efficiency (kg/ha cm)		
	0.2	0.4	0.8	0.2	0.4	0.8
Brachiaria mutica	9.54	12.15	11.72	26.7	12.15	11.72
Cenchrus setigerus	4.64	4.57	4.38	12.9	4.57	4.38
Cynodon dactylon	8.91	9.23	10.20	25.0	9.23	10.20
Panicum antidotale	9.34	11.41	11.77	26.2	11.41	11.70
P. coloratum	6.95	10.29	8.93	19.5	10.29	8.93
P. laevifolium	13.49	16.85	16.88	37.8	16.85	16.88
P. maximum (C)	10.87	13.04	12.72	30.5	13.04	12.72
P. maximum (wild)	14.00	14.72	13.72	39.3	14.72	13.72
P. virgatum	9.95	12.10	11.36	27.9	12.10	11.36
Mean	9.74	11.60	11.30	27.3	11.60	11.30

Diw/CPE = irrigation water/cumulative pan evaporation. Source: Tomar *et al.* (2003a)

(*Gossypium hirsutum*) and safflower (*Carthamus tinctorius*) are also salt-tolerant oil crops. The earlier is also well known for its commercial gloss fiber value. Recently *Salicornia bigelovii* has been evaluated as a source of vegetable oil and the cake as animal feed, is being grown in some areas of Gujarat and Rajasthan. It withstands high salinity both of soil and water.

Forages

Many salt-tolerant plants have been used as forage in arid and semi-arid areas for millennia. The value of certain salt-tolerant shrubs and grasses has been recognized by their incorporation in pasture-improvement programs in many salt-affected regions throughout the world. There have been recent advances in selecting species with high biomass and protein levels in combination with their ability to survive a wide range of environmental conditions, including salinity. Salt-tolerant species suitable for forage production either as native stands or cultivated include grasses such as species of *Leptochloa, Aeluropus, Cynodon, Panicum*, *Paspalum, Sporobolus, Chloris, Brachiaria, Eragrostis*, etc; and the forage shrubs such as species of *Atriplex, Kochia* and *Leucaena.* Many species of *Panicum, Paspalum, Brachiaria, Echinochloa, Eragrostis, Saccharum, Vetiver and Pharagmites* have tolerance to waterlogging and low to moderate salinity.

Other desert halophytes to be considered as valuable genetic resources particularly in India include *Haloxylon persicum, H. aphyllum, H. salicornicum* and *Kochia indica*. Among other trees and bushes grown on salty lands used as forage for cattle, goats and camel include species of *Acacia*, *Ailanthus. Azadirachta*, *Prosopis, Salvadora, Cordia, Balanites*, *Tamarindus, Pithecellobium, Parkinsonia, Anogeissus, Terminalia, Dichrostachys, Flacourtia*, and *Ziziphus*. These are also included as a tree component in silvi-pastoral systems. *Colophospermum mopane* an exotic shrub has also been found suitable for salty soils. Species of *Salicornia, Chenopodium, Kochia, Atriplex*, *Salsola, Suaeda, Trianthema, Portulaca, Tribulus* and *Alhagi* along with several grasses such as *Leptochloa fusca, Aeluropus lagopoides, Cynodon dactylon, Dactyloctenium sindicum, Paspalum vaginatum, Sporobolus airoides, S. marginatus, Chloris gayana, Echinochloa turnerana, E. colonum, Eragrostis*

Mangroves have unique mode of adaptation to saline environment. Their prop and knee-like root systems protect the coastline from erosion. The root systems enable the mangroves to trap sediments and provide the seabed a shallow slope. The roots help the mangroves to absorb the energy of waves and tidal surges, thus acting as a shield for the hinterland. The trees form a barrier against winds and play a vital role during cyclones and *Tsunami* like disasters. These not only protect the shores and provide fuel wood, charcoal, fodder, honey, medicine and food items (for the coastal population), but also create a substratum, which provides shelter to a variety of animals. Several interesting animals inhabit this zone. Das and Dev Roy (1989) reported several animal species such as polychaetes (8), earthworm (2), molluscs (100), crustaceans (59), echinoderms (6), insect-mites (35), amphibians (2), fishes (35), reptiles (7), birds (53) and mammals (8) in association with mangroves of Andaman and Nicobar Islands–a good number of them being endemics. The coastal population depends on these resources for a variety of food, honey, fodder, fuel-wood, medicine and thatching material. The ecosystem also helps in shrimp and fish production. Some tribes of Andaman - Nicobar Islands such as Jarawas, Sentenalies, Onges, Great Andamanese and Shompens are part and parcel of coastal ecosystem and solely depend for their survival on this unique ecosystem. But as a result of over-exploitation the economy, life style and even survival of these tribes has become difficult and these are at the verge of extinction.

Inland Saline Marshes

While studying the vegetation pattern in salt basins of Rajasthan it was observed that there was distinct change in the taxa composition from the periphery towards the center of the salt basin. Some species that dominate at the periphery disappear slowly and gradually in the successive zones towards the center. *Suaeda fruticosa – Aeluropus lagopoides* association was found on highly saline areas like old flood plains of Bikaner district.

Succulents such as *Suaeda fruticosa, Salsola baryosma, Haloxylon salicornicum* and *H. recurvum* contributed to the large part of the ground cover. Other salt-tolerant species which are found very frequently among the saline communities include *Eleusine compressa, Sporobolus marginatus, S. diander, S. tremulus, Lasiurus sindicus, Sphaeranthus indica, Solanum xanthocarpum, Citrullus colocynthis, Heliotropium curassavicum, Zygophyllum simplex, Cressa cretica, Euphorbia granulata, Portulaca oleracea, P. quadrifida, Fagonia cretica, Peganum hermala, Trianthema triquetra, Chloris virgata, Eleusine compressa, Dactyloctenium aegyptium* and *Dichanthium annulatum*. The zonation of salty vegetation is also controlled by the amount of salinity and moisture present in the soil. At Pachpadra salt basin both salinity and water content were low at periphery, high between the center and periphery and moderate at the center. Desert halophytes (*Eleusine compressa- Dactyloctenium sindicum-Cyperus arenarius* association) were found predominant on periphery, halophytes such as *Cressa cretica*, *Suaeda fruticosa* and *Zygophyllum simplex* were in the middle, and a zone of facultative halophytes (*Dichanthium annulatum - Chloris virgata- Dactyloctenium aegyptium association*) was found in the center. Several plant communities in relation to soil were studied at different locations and compiled (Table 4).

producing 15-20 t ha^{-1} fresh forage and rice (var. CSR-10) producing up to 4 t ha^{-1} paddy when grown in sunken beds without applying any amendments (Dagar et al.*, 2001).*

Raw fruits of kair (*Capparis decidua*) are used for pickles and possess medicinal value. It grows naturally on both saline and sodic soils and can be cultivated raising from rootstocks, seeds and also stem cuttings in nursery and then transplanted. It may be irrigated with saline water. Fruits of *Ziziphus nummularia* are consumed when riped, while its leaves are stored as palatable fodder. The use of *Suaeda maritime, Salichornia brachiata and Salsola baryosma* in *papar/sajji* industry in Rajasthan and Gujarat is well known. The young leaves and shoots of *Chenopodium album*, species of *Amaranthus, Portuleca oleracea, Sesuvium portulacastrum* and many others are used as vegetable and salad in many parts of the country. Many of these are even cultivated. The raw pods of Khejri (*Prosopis cineraria*) are consumed as vegetables and leaves are nutricious fodder for livestock in dry regions. The pods of cluster bean (*Cyamopsis tetragonoloba*) are used in vegetables and seeds in glue making and in cosmetic industries. It could yield 1.5 to 1.8 t ha^{-1} seed when irrigated with water of ECiw 10 dS m^{-1}.

Fruits of coastal *Pandanus* are staple food for coastal population of Bay Islands. Palmirah palm (*Borassus flabellifer*) is widely used for toddy, juggery, vinegar, beverage, juice for sugar and radicles and fruits are edible. It is found widely distributed all along Andhra coast. It needs to be genetically improved for wider cultivation. Many other wild species are consumed as food by local people. For example, seeds of *Cycas rumphii*, fruits of mangrove *Avicennia* (flowers are good source of honey), fruit pulp of *Balanites roxburghii*, leaves of *Basella album*, fruits of *Opuntia*, *Diospyros ferrea, Syzygium cuminii, S. samarangense, Rhodamania trinervia*, and *Ximenia americana* are consumed. Flowers of many species are good nector for honeybees.

CSSRI has developed salt-tolerant varieties of mustard (*Brassica juncea*-vars CS 52, CS 54), which can be grown with success for its edible oil using saline water up to ECiw 10 dS m^{-1} in degraded calcareous soils. Cotton

4. UTILIZATION & MANAGEMENT OF SALT-TOLERANT PLANTS

With the scenario of ever-increasing population and the need for increased crop production, the non-productive salt-affected lands have to be used for tree plantation and producing conventional and non-conventional crops of economic value. Many halophytes combine high biomass and high protein or mineral levels with outstanding ability to a wide range of environmental stresses. Aronson (1989) identified more than 1600 salt-tolerant plants of coastal and inland desert environments of the world to have an economic potential. More than thousand plant species having economic importance are found on Indian salt-affected areas. Out of total 1140 species more than 500 species have been reported to have medicinal value. These along with others have been documented in this publication. The utilization and some management aspects of some important salt-tolerant species have been mentioned here in brief.

Food yielding plants: *Many species of seed-bearing salt-tolerant plants are potential source of food grains and edible oil. Food crops such as barley (Hordeum vulgare), wheat (Triticum aestivum-vars. KRL 1-4, KRL 19, KRL 35 developed by CSSRI) and rice (Oryza sativa vars. CSR 10, CSR 23, CSR 27, CSR 30, CSR 36) are well known for their salt tolerance and are being grown by farmers even using saline water for irrigation. Pearl millet (Pennisetum typhoides) grows well on sand dunes and tolerates ECiw of 10-14 dS m^{-1} for irrigation and yields 1.6 and 6.5 t ha^{-1} grains and fodder, respectively. Among other conventional crops, beetroot (Beta vulgaris) and date palm (Phoenix dactilifera) are well known for their food value and can be grown successfully irrigating with saline water. Fruit bearing gooseberry (Emblica officinalis),* karonda *(Carissa carandus),* ber *(Ziziphus mauritiana), and* bael *(Aegle marmelos) withstand drought as well as salinity. These can be cultivated with success irrigating with water up to ECiw 12 dS m^{-1}. These along with guava (Psidium guajava) and* Syzygium cuminii *could also be grown on highly alkali soil (pH up to 9.8) with application of amendments (gypsum) in auger holes. Pomegranate (Punica granatum) is salt-tolerant but does not withstand waterlogging. This when grown on raised bunds in alkali soil (pH 9.8) performed well along with kallar grass (Leptochloa fusca)*

Table 4. Soil characteristics of some prominent plant communities found in salt-affected areas (mostly inland salt marshes)

Plant Communities	Soil depth cm	pH_2	EC_e dS m^{-1}	Org.C %	Na (me l^{-1})	K (me l^{-1})	Ca+Mg (me l^{-1})
Rann of Kutchh, Gujarat							
1. *Aeluropus logopoides*(pure)	0-15	8.4	60.2	0.31	538.0	28.6	30.5
	15-30	8.4	21.9	0.22	164.4	17.3	33.0
	30-90	8.3	13.6	0.16	74.2	7.6	39.4
2. *A.lagopoides, Cressa cretica,*	0-15	8.4	33.5	0.51	294.0	15.2	60.0
Suaeda fruticosa	15-30	8.3	37.5	0.44	334.3	12.2	46.0
	30-90	8.8	43.9	0.30	368.1	11.5	51.5
3. *Cressa cretica,*	0-15	8.8	30.0	0.26	242.0	7.0	45.5
Cyperus sp.	15-30	8.2	38.6	0.24	255.4	9.0	120.0
Sporobolus marginatus	30-90	8.1	34.5	0.18	209.6	7.0	118.0
4. *Prosopis juliflora,Sporobolus*	0-15	8.3	42.5	0.15	178.0	153.8	81.0
marginatus,Crotalaria burhia,	15-30	8.6	30.9	0.12	158.1	115.0	33.5
Aeluropus lagopoides	30-60	8.7	29.6	0.08	167.0	89.8	37.6
	60-90	9.2	29.3	0.05	170.9	76.3	40.5
5. *Salsola baryosma,*	0-15	8.2	31.9	0.26	161.0	10.6	145.0
Suaeda fruticosa,	15-30	8.5	33.5	0.21	164.3	12.1	155.0
Cressa cretica	30-90	8.7	36.2	0.15	193.0	15.3	152.0
6. *Suaeda fruticosa*	0-15	8.7	25.2	0.32	192.0	11.8	43.8
7. *Tamarix troupii,*	0-15	8.3	27.4	0.26	230.0	5.0	37.0
Suaeda fruticosa,	15-30	8.2	24.1	0.10	146.4	10.0	83.5
A.lagopoides	30-90	8.0	19.0	0.06	123.2	13.7	51.4
8. *Phragmites australis,*	0-15	8.2	36.8	0.31	236.4	8.0	69.5
Carex sp., Cyperus sp.	15-30	8.3	28.9	0.26	214.3	7.0	64.0
(lowlying area)	30-90	8.2	27.6	0.29	185.3	7.0	86.0
9. *Suaeda fruticosa,*	0-15	8.2	59.0	0.31	456.5	13.5	58.0
A.lagopoides,	15-30	8.6	53.0	0.22	524.5	15.7	51.0
Urochondra setulosa	30-90	9.0	67.9	0.13	626.1	16.5	33.0

Plant Communities	Soil depth cm	pH_2	EC_e dS m^{-1}	Org.C %	Na	K (me l^{-1})	Ca+Mg
10. *A.lagopoides, Trianthema portulacastrum, Solanum incanum, Sphaeranthus indicus, Spopobolus sp., Urochondria setulosa*	0-15	8.4	14.3	0.24	21.0	8.8	39.4
	15-30	8.7	21.6	0.18	148.4	13.7	48.4
	Near Bhachau, Gujarat						
11. *S.persica, Tamarix troupii, Suaeda fruticosa*	0-15	8.3	28.9	0.45	236.4	7.0	44.5
	15-30	8.2	32.0	0.49	241.8	7.8	65.4
	30-60	8.4	41.4	0.38	281.4	8.2	116.5
	60-90	8.6	49.7	0.27	353.6	11.2	126.7
12. *Salvadora persica, Suaeda fruticosa, S.nudiflora*	0-15	9.0	40.2	0.30	342.4	5.0	53.5
	15-30	8.4	34.8	0.21	274.5	6.0	60.0
	30-60	9.1	46.3	0.17	405.0	6.1	48.0
	60-90	9.0	49.6	0.09	416.7	8.6	57.4
13. *S.persica, Tamarix troupii*	0-15	7.8	117.5	0.98	1049.0	6.0	111.0
	15-30	8.2	91.3	0.82	745.0	7.0	148.5
	30-120	8.6	78.3	0.53	585.0	8.0	187.6
14. *S.fruticosa, Oleochaeta ramosa, Sphaeranthus indicus, Dichanthium annulatum, A.lagopoides*	0-15	9.2	69.1	0.48	598.0	4.0	74.5
	15-30	9.0	55.1	0.29	437.6	7.8	96.6
15. *S.persica, Tamarix troupii, A.lagopoides*	0-15	8.34	89.9	0.64	790.8	28.5	76.0
	15-30	8.59	67.2	0.49	548.6	31.2	87.5
	30-60	8.4	46.6	0.27	315.4	37.4	105.6
16. *P.juliflora, S.persica, S.fruticosa, A.lagopoides* (Near Mahi river)	0-15	8.8	39.4	0.94	210.0	11.1	68.0
	15-30	8.7	35.4	0.73	239.7	12.9	73.5
	30-60	8.6	26.2	0.40	160.0	10.6	88.0
	60-90	8.6	24.6	0.32	138.4	9.7	101.3
	Gadoi, Nasar, 22km from Nosari, Gujarat						
17. *Acacia nilotica, Ipomoea carnea, Desmostachya bipinnata, Typha, Fimbristilis, Bacopa monerii* (alkali quake)	0-15	10.5	55.2	0.12	524.5	4.0	20.0
	15-30	10.6	50.2	0.10	467.4	5.0	26.0
	30-60	10.7	45.1	.08	456.5	4.0	17.0
	60-90	10.5	57.3	.08	548.9	4.0	15.5

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
Wolfia arrhiza, microscopia	Lemnaceae	HH	G	-	Stagnant waters
Woodfordia fruticosa (*)	Lythraceae	Ch	G	17	G, Ra, O
Xanthium strumarium (*)	Asteraceae	Th	G	16	Common wastelands
Xeromphis spinosa (*),	Rubiaceae	N	G	20	R, G, O
X. ulginosa	Rubiaceae	N	G	20	R, Sau, G, O
Zaleya radimita	Aizoaceae	Ch	G	24	P, O
Zannichellia palustris	Zannichelliaceae	HH	Cr	-	H, G, O
Ziziphus mauritiana (*)	Rhamnaceae	M	G	12 (pH9.5)	Cultivated
Z. nummularia (*)	Rhamnaceae	Ch	G	20 (pH 9.7)	Most localities
Zornia gibbosa (*)	Papilionaceae	Th	G	12 (pH 9.4)	Common in H, D, G,O
Zoysia matrella	Poaceae	HCr	H	16-30	Coastal areas S , G, K
Zygophyllum simplex (*)	Zygophyllaceae	Th	FH	40	Most localities

The symbols depict as: G = Glycophytes, FH= Facultative halophytes, H = True halophytes, M=Mesophenerophytes, N=Nano-phanerophytes, Ch=Chamaephytes, He= Hemicryptophytes, Cr=Cryptophytes (Geophytes), Th=Therophytes, Cp =Climbing phanerophytes, E=epiphytes, HH= hydrophytes.

Localities: P=Pachpadra, L=Lunsarkar, Gh= Ghagar belt, S=Sanwarala, T=Thob, Ra=Other localities of Rajasthan, GC=Gujarat Command areas, G=Other localities of Gujarat, M= Mathura and nearby areas, R= Rann of Kutchh, H= Salt affected areas in Haryana (mainly Hisar), D= Delhi, MP=Madhya Pradesh, Sau=Saurashtra, UP=Uttar Pradesh, Pu=Punjab, AP=Andhra Pradesh, TN=Tamil Nadu, Ma=Maharashtra, K=Karnataka, Ke=Kerala, Su=Sunderbans (West Bengal), AN= Andaman & Nicobar Islands, O= Other salt affected minor localities.

Asterisk (*) indicates that the species has medicinal value

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
T .triquetra	Aizoaceae	Th	G	32 (pH10)	Most localities
Tribulus alatus (*)	Zygophyllaceae	Th	G	18	H, O
T. terrestris (*)	Zygophyllaceae	Th	G	20	P, S, T, H, O
Trichodesma amplexicaule (*)	*Boraginaceae*	*Th*	*G*	*15*	*GC, O*
Trichosanthes cucumerina (*)	*Cucurbitaceae*	*Th*	*G*	*14*	*In bushes of R, H, O*
Tridax procumbens	*Asteraceae*	*Th*	*G*	*20*	*Most localities*
Trifolium alexandrium, fragiferum, resupinatum	*Papilionaceae*	*Th*	*G*	*12 (pH 9.4)*	*Cultivated*
Triphasia trifolia (*)	*Rutaceae*	*Ch*	*FH*	*15-25*	*AN, Su, AP, TN, O*
Tylophora fasciculate (*)	*Asclepiadaceae*	*Cp*	*G*	*16*	*Ra, R, G, H, O*
T. indica (*)	*Asclepiadaceae*	*Cp*	*G*	*13*	*GC, G, R, Su, AN, O*
T. tenuis (*)	*Asclepiadaceae*	*Cp*	*G*	*17*	*TN, Or,G,Ke,Su,AN,O*
Typha australis	*Typhaceae*	*Ch*	*FH*	*20*	*GC, Gh*
T. elephantine (*)	Typhaceae	Ch	FH	20	Common throughout
Ulex europaeus	Papilionaceae	Ch	G	-	Cold deserts
Urginea maritima (*)	Liliaceae	Ch	G	12	R, G, S, O
Urochondra setulosa	Poaceae	Ch	FH	47	GC, R
Utricularia (many species)	Lentibulariaceae	HH	-	-	Common in lakes
Vallisnerria spiralis (*)	Hydrocharitaceae	He, HH	G	-	Common in streams
Vernonia anagallis-aquatica	Asteraceae	Th	G	-	H, G, O
V. cineraria (*)	Asteraceae	Th	FH	20	Most localities
Vetiveria zizanioides (*)	Poaceae	Ch	FH	24 (pH9.6)	H, GC, O
Vicoa indica	Asteraceae	Th	G	-	Wastelands
V. vestita	Asteraceae	Th	G	-	Su, O
Viscum articulatum, monoicum, orientale (*)	Loranthaceae	Ch	G	-	G, Su, AN
Washingtonia filifera	Arecaceae	M	G	-	Introduced in UP, M
Withania somnifera (*)	Solanaceae	Ch	FH	20	Wastelands, common

Plant Communities	Soil depth cm	pH_2	EC_e dS m^{-1}	Org.C %	Na	K (me l^{-1})	Ca+Mg
Nalsarovar, Gujarat							
18. *Scirpus littoralis,*	0-15	9.9	25.2	0.25	169.0	4.0	57.5
Cynodon dactylon,	15-30	9.8	15.2	0.18	109.8	3.0	30.0
Cyperus sp.(low lying)	30-60	10	12.1	0.08	74.5	3.6	35.0
Sampla, Haryana							
19. *Heliotropium*	0-15	8.4	30.6	0.18	74.5	3.6	43.2
curassavicum, S.fruticosa,	15-30	8.3	14.31	0.15	68.5	2.5	31.5
Cynodon dactylon	30-60	8.5	19.7	0.08	75.6	2.3	30.7
	60-90	8.5	23.9	0.06	78.8	1.5	37.5
20. *Tamarix troupii,*	0-15	8.5	35.4	0.30	93.5	11.2	75.0
Plucheria lanceolata,	15-30	8.1	29.1	0.28	100.5	11.8	51.5
Cynodon dactylon,	30-60	8.5	28.7	0.20	102.8	12.3	63.4
Sporobolus marginatus,	60-90	8.3	28.5	0.11	109.8	12.9	57.4
S.fruticosa							
21. *H.curassavicum, S.*	0-15	9.0	29.6	0.28	91.3	10.2	79.0
fruticosa, Launea	15-30	8.5	19.1	0.15	51.1	2.9	1.5
aspleniifolia, Blumea	30-60	8.0	19.6	0.11	43.5	2.6	58.4
lacera							
Pachpadra, Rajasthan							
22.*Prosopis juliflora,Aeluropus*	0-15	8.1	43.0	0.25	262.2	2.8	-
lagopoides,Suaeda fruticosa,	15-30	7.9	34.0	0.21	189.4	2.4	-
Sporobolus marginatus	30-90	7.8	37.8	0.16	102.5	2.0	-
23.*S.fruticosa,A.lagopoides*	0-15	8.6	49.9	0.27	947.2	6.2	-
Cressa cretica, Cyperus	15-30	8.4	40.8	0.21	805.1	5.8	-
bulbosus, Trianthema	30-60	8.2	36.0	0.19	368.0	2.5	-
triquetra, S.marginatus,	60-90	7.8	30.8	0.16	437.0	2.4	-
Sphaeranthus indicus							
Lunsarkar, Rajasthan							
24. *Cressa cretica,*	0-15	8.5	48.9	0.31	1060.0	8.3	-
A.lagopoides, Tamarix sp.,	15-30	8.4	45.6	0.28	839.4	8.2	-
Suaeda fruticosa	30-60	8.4	41.0	0.21	947.4	5.7	-

Plant Communities	Soil depth cm	pH_2	EC_e dS m^{-1}	Org.C %	Na	K	Ca+Mg
					me l^{-1}		
Hanumangarh, Rajasthan							
25. *Species of Haloxylon, Salsola, Tamarix, Suaeda, Sporobolus*	0-15	-	63.4	0.29	1311.1	5.5	-
	15-30	-	29.8	0.21	485.9	4.7	-
	30-60	-	22.1	0.18	329.8	4.1	-
26. *Acacia tortilis, Calligonum polygonoides, Salsola baryosma, Leptadenia pyrotechnica*	0-15	7.8	29.8	0.26	220.6	4.3	-
	15-30	7.6	26.3	0.18	185.7	4.0	-
	30-60	8.0	21.9	0.14	78.8	3.0	-
27. *Capparis decidua, Prosopis juliflora, P. cineraria, Salvadora oleoides, Zizyphus nummularia*	0-15	7.8	20.8	0.19	189.3	3.0	-
	15-30	8.0	17.0	0.15	105.6	2.0	-
	30-90	8.5	15.4	0.12	40.9	1.0	-
Sambar Lake, Rajasthan							
28. *Species of Suaeda, Sporobolus, Trianthema, Salsola, Dactyloctenium, Xanthium, Sphaeranthus, Launea*	0-15	8.1	57.0	0.29	708.4	3.0	-
	15-30	7.8	40.8	0.19	368.0	2.0	-
	30-90	8.3	37.8	0.15	56.6	1.0	-
On the way from Jodhpur to Ajmer							
29. *Species of Suaeda, Cressa, Trianthema, Sporobolus, Aeluropus, Fagonia*	0-15	7.9	48.9	0.18	619.6	2.0	-
	15-30	8.0	39.7	0.11	406.7	1.0	-
	30-90	8.7	30.1	0.08	216.6	1.0	-
On the way back from Bharatpur to Mathura (U.P.)							
30. *S.persica, Diospyros montana, Capparis decidua*	0-15	7.6	33.1	0.21	149.0	3.0	-
	15-30	8.0	29.4	0.17	108.1	2.1	-
	30-60	8.2	25.5	0.09	95.4	0.9	-
	60-90	8.6	18.4	0.07	79.0	0.9	-
31. *Species of Tamarix, Salvadora, Prosopis, Suaeda, Capparis*	0-15	8.0	51.1	0.19	619.8	4.0	-
	15-30	8.2	22.4	0.09	295.4	3.0	-
	30-90	8.3	29.9	0.06	198.6	2.0	-
32. *Species of Sporobolus-Suaeda and Sphaeranthus*	0-15	8.5	41.0	0.20	564.0	2.0	-
	15-30	8.3	37.4	0.13	460.0	2.0	-
	30-60	8.0	25.2	0.08	195.0	1.0	-

- = *not observed*

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
Sutera dissecta	Scrophulariaceae	Th	G	-	Marshy places G
Syzygium cuminii (*)	Myrtaceae	M	G	14 (pH9.5)	Cultivated
S. heyneanum,ruscifolium	Myrtaceae	M	G	14	G, Or,S, O
Tamarindus indica (*)	Caesalpiniaceae	M	G	14 (pH 9.8)	Most localities
Tamarix articulata (*)	Tamaricaceae	M	FH	60	Most localities
T .dioica (*)	Tamaricaceae	N	H	50	P, T, GC, H, R, O
T. ericoides (*)	Tamaricaceae	N	H	48	P, L, S, M, H, O
T. gallica (*)	Tamaricaceae	N	H	87	Gh, S, T, GC, M, H, O
T. stricta	Tamaricaceae	N	H	50	G, O
T .troupii (*)	Tamaricaceae	N	H	42	Most localities
Taverniera cuneifolia (*)	Papilionaceae	Ch	G	14	R, G, O
Tecomella undulata	Bignoniaceae	M	G	16	GC, O
Tephrosia purpurea (*)	Papilionaceae	Ch	G	20	P, S, T, GC, Gh, R, O
T. villosa (*)	Papilionaceae	Ch	G	12	D, H, G, R, O
Teramnus flexilis	Papilionaceae	Ch	G	12	S,OR
Terminalia arjuna (*)	Combretaceae	Ph	G	16 (pH 9.8)	Cultivated
T. billirica (*)	Combretaceae	M	G	14 (pH 9.6)	Cultivated
T. catappa (*)	Combretaceae	M	FH	24	G, AP, TN, AN
Tetragonia tetragonoides *(*)*	*Aizoaceae*	*Th*	*G*	*17*	*G, M, O*
Thespesia (Azanza) lampus *(*)*	*Malvaceae*	*Ch*	*G*	*14-18*	*S, west coast*
Thevetia peruviana (*)	*Apocynaceae*	*N*	*FH*	-	*Su, O*
Thuarea involuta (*)	*Poaceae*	*HCr*	*H*	*20-30*	*Coastal areas*
Timonius jambosella	*Rubiaceae*	*T*	*G*	-	*AN sandy beaches*
Trachys muricata	*Poaceae*	*Cr*	*G*	-	*G, R, O*
Tragus roxburghii	Poaceae	Th	FH	24	P, Sau, T, GC, O
Trapa natans	Trapaceae	He, HH	G	-	Common in lakes
Trewia nudiflora (*)	Euphorbiaceae	M	G	-	S, O
Trianthema crystallina	Aizoaceae	Th	G	12	Ra, D, H
T. decandra (*)	Aizoaceae	Th	G	10	O, Ra, GC, G
T. govindia (*)	Aizoaceae	Th	G	24	D, H, O
T. hydaspica	Aizoaceae	Th	G	10	O
T. portulacastrum (*)	Aizoaceae	Th	G	26	Most localities

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
S. verticillata	Poaceae	Th	FH	14	T, GC
Sida cordifolia (*)	Malvaceae	Th	G	14 (pH9.5)	H, Pu, Ra, G, O
S. rhombifolia (*)	Malvaceae	Th	G	14 (pH9.5)	H, Pu, G, Ra, O
Simmondsia chinensis (*)	Simmondsiaceae	N	G	12 (pH9)	Cultivated
Sisymbrium irio	Brassicaceae	Th	G	17	H, Ra, G, O
Solanum incanum (*)	Solanaceae	Ch	G	14	H, O
S. nigrum	Solanaceae	Th	G	18	L, GC, H, O
S. stramonifolium (*)	Solanaceae	Ch	G	20	H, O
S. surattense (*)	Solanaceae	Th	G	28	GC, Gh, R, H, O
S. trilobatum (*)	Solanaceae	Ch	FH	30	G, Or, Sau, Ma, Su
Sonchus arvensis/ oleraceous(*)	Asteraceae	Th	G	18	H, Ra, G, O
Sparganium stolonifera	Sparganiaceae	Ch	G	20	Marshy, North India
Spergularia rubra (*)	Caryophyllaceae	Th	G	16	H, Pu, O
Sphaeranthus africanus (*)	Asteraceae	Th	FH	30	P, GC, O
S. indicus (*)	Asteraceae	Th	FH	48	P, S, T, GC, O
Spirodela polyrrhiza	Lemnaceae	HH	G	-	Stagnant water
Sporobolus airoides	Poaceae	Th	FH	24	O
S. coromandelianus, diander	Poaceae	Th	FH	36	L, Gh, T, GC, M, H,O
S. fertilis	Poaceae	Th	FH	20	G, O
S. helvolus	Asteraceae	Th	H	24	P, S, T, GC, Gh, O
S. maderaspatenus	Poaceae	Th	FH	20	G, H, O
S. marginatus	Poaceae	Cr	H	50	Throughout
S. spicatus, tenuissimus	Poaceae	Th	FH	20	G, H, O
S. tremulus	Poaceae	Th	FH	28	L, S, R, O
S. virginicus	Poaceae	Cr	FH	32	Sea shore, G, M
Stenotaphrum dimidiatum	Poaceae	Cr	FH	14-20	Sea shore, AP, TN, K
Stephania japonica (*)	Menispermaceae	Cp	G	19	Among bushes, R ,O
Sterculia rubiginosa (*)	Sterculiaceae	N	G	20	Along coast AN
Suaeda fruticosa (*)	Chenopodiaceae	Ch	H	72	Most localities
S. maritima	Chenopodiaceae	Ch	H	50	H, O
S. monoica	Chenopodiaceae	Ch	H	60	GC, O
Suriana maritima	Surianaceae	Ch	G	-	Coastal

The sodic soils support very restricted natural vegetation, comprising only a few species. *Prosopis juliflora* (an introduced species) has established widely in sodic soils forming gregarious patches, particularly on abandoned lands along roadsides and railway tracks. *Acacia nilotica, Salvadora oleoides, S. persica, Capparis deciduas, C. sepiaria* and *Clerodendrum phlomidis* are among the prominent woody species on high pH soils, while *Acacia leucophloea, A. eburnear, Mimosa hamata, Prosopis cineraria, Butea monosperma, Diospyros tomentosa, Balanites roxburghii*, and *Maytenus emerginatus* are frequent on slightly low (up to 9.0) pH. Among bushes of *Capparis* and *Salvadora*, climbers such as *Asparagus racemosus, Cocculus pendulus, C. hirsutus, Cayratia trifolia, Momordica dioica, Mukia maderaspatana, Achyranthes aspera, Withania somnifera* and *Ichnocarpus prutescens* are quite common. *Calotropis procera, Datura metel, Adhatoda vasica* and *Ziziphus nummularia* form isolated patches. Among herbaceous species *Desmostachya bipinnata, Sporobolus marginatus, S. coromandelianus, S. diander, Chloris virgata, Cynodon dactylon, Dichanthium annulatum, Euphorbia hirta, E. thymifolia, Trianthema triquetra, Suaeda fruticosa, S. maritime, Pluchea lanceolata*, and *Kochia indica* are prominent. During rainy season *Cassia tora, C. occidentalis, Abutilon indicum, Croton bonplandianum, Eclipta prostrata, Phyllanthus fraternus, Amaranthus viridis, Corchorus* spp., *Chenopodium ambrosioides, Trianthemum portulacastrum* and many other forbs form association with many grasses and sedges particularly in protected areas.

In stagnant shallow waters (saline, brackish or fresh) species such as *Typha elephantine, Phragmites australis, , Eichhornia crassipis* and various species of *Cyperus, Fimbristilis, Ipomoea, Paspalum, Juncus, Vetiveria, Echinochloa* and *Scirpus* are common. *Spacciolepis interrupta* is common tall grass in Orissa, Bihar and Tamil Nadu and *Urochondra setulosa* forms clumps in swamps of Gujarat. *Saccharum spontaneum* is common throughout in swamp areas. Free-floating *Azolla, Lemna, Spirodela* and other aquatic plants are quite frequent. The comprehensive list of inland species along with their lifeforms and relative distribution is documented in Table 5. Some of these species also overlap the coastal associates of mangroves. The information is based on survey but for update information some literature has also been consulted.

Table 5. Classification, life forms, salt tolerance and distribution of common inland salt tolerant plant species.

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m⁻¹)	Important Locations
Abelmoschus moschatus (*)	Malvaceae	Ch	FH	16	Coastal AN, S, O
Abrus precatorius (*)	Papilionaceae	Cl	G	10-16	Coastal AN
Abutilon bidentatum	Malvaceae	Ch	G	12	H
A. f ruticosum	Malvaceae	Ch	G	20	R
A. hirtum	Malvaceae	Ch	G	12	H
A. indicum (*)	Malvaceae	Ch	G	16	H, M, R, O
Acacia auriculiformis	Mimosaceae	N	G	12	Introduced, common
A. aneura	Mimosaceae	N	G	12 (pH 9.4)	Introduced
A. bonasiansis	Mimosaceae	N	G	12 (pH 9.4)	Introduced
Acacia catechu (*)	Mimosaceae	M	G	10(pH9.5)	H, S, O
A. cavenia	Mimosaceae	M	G	10	Introduced
A. cyanophylla	Mimosaceae	N	G	10	Introduced
A. cyclops	Mimosaceae	N	G	14	Introduced
A. dealbata (*)	Mimosaceae	M	G	10	Introduced
A. eburnea	Mimosaceae	N	G	12	MP, UP
A. erubescens	Mimosaceae	N	G	10 (pH 9.4)	Introduced
A. farnesiana (*)	Mimosaceae	N	G	40	H, Gh, GC,UP, Su, O
A. gerrardii	Mimisaceae	N	G	12 (pH 9.4)	Introduced
A. goetzei	Mimisaceae	N	G	12 (pH 9.4)	Introduced
A. greggii	Mimisaceae	N	G	12 (pH 9.4)	Introduced
A. .hockii	Mimosaceae	M	G	12	Introduced
A. holosericea	Mimosaceae	M	G	12	Introduced
A. .jacquemontii	Mimosaceae	N	G	12	P, Gh, H, R, GC, O
A. karroo	Mimisaceae	N	G	12 (pH 9.4)	Introduced
A . lenticularis	Mimosaceae	M	G	16 (pH 9.4)	Introduced
A. leucophloea (*)	Mimosaceae	M	G	16(pH9)	H, M, AP, G, R, O
A. macrothyrsa	Mimisaceae	N	G	12 (pH 9.4)	Introduced
A. modesta	Mimisaceae	N	G	14 (pH 9.4)	Introduced
A. nilotica (*)	Mimosaceae	M	G	46(pH10)	Most localities
A. pennata	Mimosaceae	M	G	12 (pH 9.4)	Introduced
A. polyacantha (*)	Mimisaceae	N	G	12 (pH 9.4)	WB, B, UP, AP, TN
A. pseudoeburnea	Mimisaceae	N	G	12 (pH 9.4)	Introduced
A. salicina	Mimisaceae	N	G	12 (pH 9.2)	Introduced
A. schweinfurthii	Mimosaceae	N	G	12 (pH 9.4)	Introduced in UP

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m⁻¹)	Important Locations
Salix tetrasperma (*)	Salicaceae	M	G	18	R, G, Sau, O
Salsola baryosma (*)	Chenopodiaceae	N	H	51	Most localities
S. kali (*)	Chenopodiaceae	N	H	28	H, O
Salvadora oleoides (*)	Salvadoraceae	M	FH	48 (pH 9.7)	Most localities
S. persica (*)	Salvadoraceae	M	FH	60	GC, R, O
Sarcostemma acidum (*)	Asclepiadaceae	Cp	G	-	Ra, M, G, H, O
Sarothamnus scoparius	Papilionaceae	Th	G	-	GC, O
Sapium indicum (*)	Euphorbiaceae	N	G	28	Behind mangroves, S
Schoenefeldia gracilis	Poaceae	Th	G	24	P, O
Scirpus articulatus (*)	Cyperaceae	Cr	FH	24	G, Su, Or, O
S. grossus (*)	Cyperaceae	Cr	FH	26	G, Ra, O
S. holoschoenus	Cyperaceae	Cr	FH	20	Ra, O
S. inclinatus, juncoides, lacustris, tabernaemontani	Cyperaceae	Cr	FH	15-20	O
S.littoralis	Cyperaceae	Cr	FH	40	GC,O
S.roylei	Cyperaceae	Cr	FH	30	P,Ra,H,G,O
S. triqueter	Cyperaceae	Cr	FH	20	Along east coast
S.tuberosus (*)	Cyperaceae	Cr	FH	60	O,GH,S,T,GC,O
S. validus	Cyperaceae	Cr	FH	40	G,O
Scolo macrophylla	Flacourtiaceae	M	FH	24	Along coasts
Securinega leucopyrus (*)	Euphorbiaceae	Cp	G	14 (pH 9.4)	H, D, Pu, O
Sehima nervosum	Poaceae	Cr	G	16	MP, Peninsular India
Sericostoma pauciflorum	Boraginaceae	Ch	G	24	P, O
Sesbania bispinosa(*), *cannabina, rostrata*	Papilionaceae	Th	G	12 (pH 9.4)	H, O, also cultivated
S. grandiflora(*), *javanica*	Papilionaceae	M	G	12	Introduced
S. procumbens, roxburghii	Papilionaceae	Th	G	-	Introduced
S. sesban (*)	Papilionaceae	Ch	G	12 (pH 9.4)	Common
S. speciosa	Papilionaceae	N	G	-	South India
Sesuvium portulacastrum	Aizoaceae	Th	H	40	P, L, Gh, S, GC, O
S. sesuvioides	Aizoaceae	Th	H	40	P, L, Ra, G
Seseli diffusum (*)	Apiaceae	Th	G	27	G, WB, O
Seteria glauca	Poaceae	Th	G	14	L, H, O
S. sphacelata	Poaceae	Th	G	16	Cultivated
S. tomentosa	Poaceae	Th	G	12-16	Common

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
Pseudoraphis spinescens	Poaceae	Cr	FH	16	R, G, TN, O
Pulicaria angustifolia	Asteraceae	Th	FH	14	R, G, O
P. crispa (*)	Asteraceae	Th	FH	24	P S, GC, M, H ,O
P. foliolosa	Asteraceae	Th	FH	20	H, M, O
P. rajputanae	Asteraceae	Th	FH	24	P
P. wightiana	Asteraceae	Th	FH	24	P, S, T, GC
Punica granatum (*)	Punicaceae	N	G	12 (pH 9.4)	Cultivated
Pupalia lappacea (*)	Amaranthaceae	Cp	G	-	H, M, O
Ranunculus contoniensis, sceleratus, trichophyllum(*)	Ranunculaceae	HH	G	-	Stagnant waters
Raphia vinifera	Arecaceae	M	G	30	Introduced
Remirea maritime (*)	Cyperaceae	Cr	FH	20	G, S, O
Reseda aucheri, pruinosa (*)	Resedaceae	Ch	g	-	R, G
Rhodamnia trinervia (*)	Myrtaceae	Sh,T	G	-	Coastal AN, O
Rhus sinuata	Anacardiaceae	Ch	G	22	D, Ra, K, AP, O
Rhynchelytrum repens	Poaceae	Th	G	14 (pH 9.6)	Introduced
Rhynchosia, capitata, minima(*)	Papilionaceae	Th	G	14	H, GC, O
Ricinus communis (*)	Euphorbiaceae	N,Ch	G	14	Cultivated
Rorippa dufia (*)	Brassicaceae	Th	G	15	H, UP, O
Rotala densiflora, rotundifolia	Lythraceae	Th	G	-	R, Su, G,O
Rumex crispus (*)	Polygonaceae	Th	G	-	H, O
R. dentatus (*)	Polygonaceae	He	G	-	H, G, O
R. maritimus (*)	Polygonaceae	He	G	-	W, B, G, O
Ruppia maritima	Rupiaceae	HH	FH	10-16	Su, O
Sabal palmetto	Arecaceae	M	G	-	Introduced
Saccharum arundinaceum (*)	Poaceae	Cr	G	10-20	Wastelands
S. bengalense	Poaceae	Cr	G	20	M, P, H, GC, Gh, O
S. spontaneum (*)	Poaceae	Cr	G	26	M, P, H, GC, GH, O
Sacciolepis interrupta	Poaceae	Cr	G	12-18	G, Or, WB, O
Sagittaria sagittifolia (*)	Alismataceae	He	G	-	H, Pu, D, WB, O
Salicornia bigelovii	Chenopodiaceae	Ch	H	28	Introduced
S. brachiata	Chenopodiaceae	Ch	H	48	GC, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
A. seyal	Mimosaceae	M	G	14 (pH 9.4)	Introduced in UP
A. sinuate (*)	Mimosaceae	M	G	-	Introduced
A. tortilis	Mimosaceae	M	G	30	R, H, G, O
Acalypha indica (*)	Euphorbiaceae	Ch	G	16	H, G, R, O
Acanthospermum hispidum(*)	Asteraceae	Th	G	18	G, R, H
Achyranthes aspera (*)	Amaranthaceae	Ch	G	14	Most localities
Adhatoda zeylanica (*)	Acanthaceae	Ch	G	16 (pH 9.5)	H, M, O
Aegle marmelos (*)	Rutaceae	M	G	14(pH 9.2)	Cultivated
Aeluropus lagopoides	Poaceae	He	H	70	Most localities
Aerva persica (*)	Amaranthaceae	Ch	FH	18	P, L ,Gh, S, H, O
A. pseudotomentosa (*)	Amaranthaceae	Ch	FH	24	P, Gh, R, Ra, O
Aeschynomene indica (*)	Papilionaceae	Ch	G	14	G, H, MP
Agave americana (*)	Agavaceae	Cr	FH	18	R, Ra, G, O
A. cantala	Agavaceae	Cr	FH	18	Introduced
A. sisalana (*)	Agavaceae	Cr	FH	21	GC, Ra, O
Ageratum conyzoides (*)	Asteraceae	Th	G	18	Most localities
Agropyron acutum	Poaceae	Ch	FH	32	Introdued
A. elongatum	Poaceae	Ch	FH	30	O
Aizoon canariense	Aizoaceae	Th	FH	18	R, O
Albizia lebbeck, procera (*)	Mimosaceae	M	g	14	Widely planted
Alhagi pseudalhagi (*)	Papilionaceae	He	FH	18	H, GC, G , MP, UP, O
Allophyllus cobbe (*)	Sapindaceae	N	FH	24	AN, O
Alocasia macrorrhiza (*)	Araceae	Cr	FH	20	Su, G
Aloe barbadensis (*)	Liliaceae	Cr	FH	18	Cultivated
Alpinia allughas	Zingiberaceae	Cr,	HH	G	- Su, O
Alternanthera ficoidea	Amaranthaceae	Th	G	14	G, O
A. paronychioides	Amaranthaceae	Th	G	12	Gu, O
A. pungens (*)	Amaranthaceae	Th	G	16	H, R, O
A. sessilis (*)	Amaranthaceae	Th	G	16	H, R, GC, O
Althaea ludwigii	Malvaceae	Th	G	15	H
A. officinalis (*)	Malvaceae	Th	G	30	H, GC, R, O
Alysicarpus heyneanus	Papilionaceae	Ch	G	14	Gu, O
A. monilifer (*)	Papilionaceae	Ch	G	24	Most localities
A. rugosus	Papilionaceae	Th	G	28	GC, G, O
A. vaginalis	Papilionaceae	Th	G	14	G, H
Amaranthus gracilis (*)	Amaranthaceae	Th	G	14	Most localities

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
A. hybridub	Amaranthaceae	Th	FH	18	Cultivated
A. spinosus (*)	Amaranthaceae	Th	G	16	Pu, H, G, K, O
Amberboa ramose (*)	Asteraceae	Th	G	18	H, G, O
Amischophacelus axillaris (*)	Commelinaceae	Th	G	16	G, Ra, H, AN, O
Ammania baccifera (*)	Lythraceae	Th	G	14	Su, G, R, O
A. desertolum, multiflora, salicifolia, senegalensis (*)	Lythraceae	Th	G	8-12	Su, G, R, O
A. desertolum, multiflorum, salicifolia, senegalensis	Lythraceae	Th	G	12-16	Marshy places
Anabasis setigera	Chenopodiaceae	Ch	FH	28	O
Anacardium occidentale (*)	Anacardiaceae	Ph	G	10	K, AP, Ke, AN
Anagallis arvensis	Primulaceae	Th	G	8	Common weed
Anethum graveolens/sowa (*)	Apiaceae	Th	G	12	Cultivated
Andrachne telephioides (*)	Euphorbiaceae	Ch	FH	21	O
Anogeissus pendula	Combretaceae	N	G	14	D, Ra, G, H, UP
A. rotundifolia	Combretaceae	N	G	16	Ra, O
Anticharis glandulosa, senegalensis (*)	Scrophulariaceae	Th	G	18	P, Ra, H, O
Antidesma acidum (*)	Euphorbiaceae	Ch	G	16	Sea coast AN
Apluda mutica	Poaceae	Th	G	12	Black cotton soils
Aponogeton crispum, natans	Aponogetonaceae	HH	G	12	Stagnant waters
Areca catechu (*)	Arecaceae	M	G	14	Ke, AN
A. triandra (*)	Arecaceae	M	G	16	AN
Argemone mexicana (*)	Papaveraceae	Th	G	20	Most localities
Aristida adscensionis	Poaceae	Th	G	24	R, H, O
A. cyanantha, funiculata	Poaceae	Th	G	24	P, S, H, Gh, O
A. histricula	Poaceae	Th	G	16	R, H
A. setacea	Poaceae	Th	G	24	P, H, O
Arnebia hispidissima (*)	Boraginaceae	Th	G	16	R, Ra, H, O
Artemisia maritima (*)	Asteraceae	Ch	G	20	Cold desert
A. scoparia (*)	Asteraceae	Ch	G	20	Ra, G, H, O
Arthrocnemum fruticosum (*)	Chenopodiaceae	Ch	H	56	Introduced
Arundinella leptochloa	Poaceae	He	G	12	H, O
A. nepalensis	Poaceae	He	G	16	H, Gu, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
Polygala abyssinica	Polygalaceae	Th	G	-	R, Saurashtra
P. chinensis (*)	Polygalaceae	Th	G	-	G, MP, O
P. erioptera	Polygalaceae	Th	G	20	H, P, GC, O
P. amphibium, hydropiper, limbatum, orientale, pulchrum	Polygonaceae	Th	G	-	Marshy places
Polygonum aviculare (*)	Plumbaginaceae	Th	G	16	G, Su, R, O
P.barbatum, glabrum,	Polygonaceae	Th	G	10-14	Common in ditches
P. plebeium (*)	Polygonaceae	Th	G	20 (pH 9.4)	Common in ditches
Polypogon elongatus	Poaceae	Ch	G	-	G, O
P. maritimus	Poaceae	Ch	G	20	G, O
P. monspeliensis	Poaceae	Ch	G	-	G, O
Pongamia pinnata (*)	Papilionaceae	M	G	40	Many localities
Portulaca oleracea (*)	Portulacaceae	Th	FH	20	Most localities
P. pilosa (*)	Portulacaceae	Th	FH	14-20	H, O
P. quadrifida (*)	Portulacaceae	Th	FH	20	P, H, O
P. tuberosa (*)	Portulacaceae	Th	FH	20-30	G, Su, O
Portulacaria afra	Portulacaceae	Ch	FH	22	G, O
Potamogeton (many species)	*Potamogetonaceae*	HH	G	-	Free floating
Potentilla supine (*)	Rosaceae	HCr	G	-	R, G, O
Prosopis alba	Mimosaceae	M	FH	30 (pH 9.8)	Introduced
P. articulata	Mimosaceae	M	FH	24	Introduced
P. caldenia	Mimosaceae	M	G	(pH 9.8)	Introduced
P. chilensis	Mimosaceae	M	FH	40 (pH 9.8)	Introduced
P. cineraria (*)	Mimosaceae	M	G	28	Most localities
P. farcata	Mimosaceae	M	FH	30	Introduced
P. glandulosa	Mimosaceae	M	G	20 (pH 9.8)	Introduced
P. juliflora	Mimosaceae	M	FH	42 (pH 10)	Most localities
P. laevigata	Mimosaceae	M	G	(pH 9.8)	Introduced
P. nigra	Mimosaceae	M	G	(pH 9.8)	Introduced
P. pallida	Mimosaceae	M	G	(pH 9.6)	Introduced
P. tamarugo	Mimosaceae	M	G	18	Introduced
P. velutina	Mimosaceae	M	G	(pH 9.8)	Introduced
Psidium guajava (*)	Myrtaceae	N	G	14 (pH 9.5)	Cultivated
Psoralea corylifolia (*)	Papilionaceae	Ch	G	24	P, G, MP, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
pterocarpum (*)	Caesalpiniaceae	Ph	G	17	AN, O
Pemphis acidula	Lythraceae	Ch	G	18	West coast, AN
Pentatropis capensis (*)	Asclepiadaceae	Cp	G	-	Among bushes, R,Su,O
P. spiralis (*)	Asclepiadaceae	Cp	G	-	Ra, M, G, H, O
Peplidium maritimum	Scrophulariaceae	Th	G	-	Marshy places R
Pergularia daemia (*)	Asclepiadaceae	Cp	G	-	GC, H, M, O
Periploca aphylla (*)	Periplocaceae	Ch	FH	18	R, G, O
Phoenix canariensis	Arecaceae	M	G	20	Introduced
P. dactylifera (*)	Arecaceae	M	G	18-24	O
P. pusilla (*)	Arecaceae	N	G	20	Introduced
P. reclinata	Arecaceae	M	G	18	Introduced
P. sylvestris (*)	Arecaceae	M	G	24	GC, O
Phragmites australis	Poaceae	Cr	FH	30	R, O
P. karka	Poaceae	Cr	FH	30	R, G, H, Pu, O
Phyla nodiflora (*)	Asteraceae	He	G	18	Most localities
Phyllanthus fraternus (*)	Euphorbiaceae	Th	G	14	P, GC, H, O
P.maderaspatensis (*)	Euphorbiaceae	Th	G	15-	GC, H, O
Physalis longifolia	Solanaceae	Th	G	17	Coastal R, G, AP, Sau
P. minima (*)	Solanaceae	Th	G	20	S, GC, H, O
Pisonia aculeate (*)	Nyctaginaceae	N	G	14	O
P. alba (grandis) (*)	Nyctaginaceae	M	G	15	O
Pistia stratiote (*)	Araceae	He	G	-	R, G, O
Pithecellobium dulce (*)	Mimosaceae	M	G	24 (pH 9.6)	Planted
Plantago amplexicaulis, baphula(salina) (*)	Plantaginaceae	Th	G	12	P, H, G, O
P.major, ovata,psyllium(*)	Plantaginaceae	Th	G	14 (pH 9.4)	Cultivated G, H, O
Pluchea arguta	Asteraceae	Ch	G	14	R, G, O
P. indica	Asteraceae	Ch	G	18	H, O
P. lanceolata (*)	Asteraceae	Ch	G	20	H, Pu, UP, O
P. tomentosa, wallichiana	Asteraceae	Ch	G	18	R, O
Plumbago zeylanica (*)	Plumbaginaceae	Ch	G	14 (pH 9.4)	Many localities
Polycarpaea corymbosa (*)	Caryophyllaceae	Th	G	-	H, Ra, G, Su, O
Polycarpon prostratum (*)	Caryophyllaceae	Th	G	-	D, H, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
A. setosa	Poaceae	He	G	16	R, G, O
Arundo donax (*)	Poaceae	He	G	14	GC, O
Asparagus adscendens, dumosus, gonocladus, gracilis, officinalis, plumosus, racemosus, sarmentosa (*)	Liliaceae	Cp	G	14-20	Various localities (mostly among bushes and also culticated)
Atriplex aegeptifolia	Chenopodiaceae	Ch	H	50	Introduced
A. amnicola	Chenopodiaceae	Ch	H	60	Introduced
A. argentea	Chenopodiaceae	Th	H	38	Introduced
A. barclayana	Chenopodiaceae	Ch	H	48	Introduced
A. canescens	Chenopodiaceae	Ch	H	60	Introduced
A. cinerea	Chenopodiaceae	Ch	H	60	Introduced
A. confertifolia	Chenopodiaceae	Ch	H	50	Introduced
A. crassifolia	Chenopodiaceae	Ch	H	50	Introduced
A. cuneata	Chenopodiaceae	Ch	H	50	Introduced
A. halimoides	Chenopodiaceae	Ch	H	50	Introduced
A. halimus	Chenopodiaceae	Ch	H	50	Introduced
A. holocarpa	Chenopodiaceae	Th	H	50	Introduced
A. hortensis	Chenopodiaceae	Th	H	40	Introduced
A. lentiformis	Chenopodiaceae	Ch	H	56	Introduced
A. nummularia	Chenopodiaceae	Ch	H	60	Introduced
A. nuttalis	Chenopodiaceae	Ch	H	50	Introduced
A. patula	Chenopodiaceae	Th	H	50	introduced
A. repens	Chenopodiaceae	Ch	H	60	Introduced
A. rosea	Chenopodiaceae	Th	H	30	Introduced
A. semibaccata	Chenopodiaceae	Ch	H	20	Introduced
A. stocksii	Chenopodiaceae	Ch	H	48	G, R
A. undulata	Chenopodiaceae	Ch	H	50	G, O
A. vesicaria	Chenopodiaceae	Ch	H	40	Introduced
Azadirachta indica (*)	Meliaceae	M	G	16 (pH 9.4)	Most localities
Azolla pinnata	Azollaceae	HH	G	12	Free floating, ditches
Bacopa floribunda, monnieri(*)	Scrophulariaceae	Cr	G	8-14	Marshy places
Balanites aegyptiaca (*)	Balanitaceae	N	G	14	H, G, Pu, UP, MP, O
Barleria acanthoides	Acanthaceae	Ch	FH	20 (pH 9.6)	G, H, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit ($dS\ m^{-1}$)	Important Locations
B. prionitis (*)	Acanthaceae	Ch	FH	24(pH 9.6)	G, H, MP, UP, O
Basella alba (*)	Basellaceae	Ch	FH	22	Ke, WB, AP, AN, O
Bergia ammannioides	Elatinaceae	Th	G	14	Su, G, R, O
B. capensis	Elatinaceae	Th	FH	20	Su, G, R O
B. suffruticosa	Elatinaceae	Ch	G	14	R, O
Beta vulgaris	Chenopodiaceae	He	FH	25	Cultivated
Bidens biternata (*)	Asteraceae	Th	G	10	H, Pu, UP, G, Ra, O
Blastania garcini	Cucurbitaceae	Th	G	14	GC, H, O
Blepharis linariaefolia	Acanthaceae	Ch	G	20	P, M, GC, R, O
Blumea lacera (*)	Asteraceae	Th	G	18	P, H, M, GC, R, O
B. laciniata	Asteraceae	Th	G	16	H, GC, O
B. mollis	Asteraceae	Th	G	14	H, O
B. obliqua	Asteraceae	Th	G	18	H, G, GC, O
Blyxa echinosperma	Hydrocharitaceae	HH	G	-	Ditches, G, AN
Boerhaavia diffusa (*)	Nyctaginaceae	Ch	G	20	P, Gh, S, T, G
B. repanda	Nyctaginaceae	Ch	G	20	G, C, M, H, R, O
B. verticellata	Nyctaginaceae	Ch	G	20	P, R, O
Borassus flabellifer (*)	Arecaceae	M	G	24	AP, O
Borreria articularis (*)	Rubiaceae	Th	G	12	Common weed
Bothriochloa intermedia	Poaceae	Ch	G	18	H, R, GC, O
B.pertusa,glabra,ischaemum	Poaceae	Ch	G	20	Most localities
Brachiaria mutica	Poaceae	He	FH	30	H, GC, O
B. ramosa	Poaceae	He	FH	20	H, GC, P, O
Brassica juncea, napus (*)	Brassicaceae	Th	G	12	Cultivated
Breynia retusa (*)	Euphorbiaceae	N	FH	20	S, R, AN
B. vitis-idaea (*)	Euphorbiaceae	N	FH	20	Along coaast
Bulbostylis barbata (*)	Cyperaceae	Ge	FH	24	P, L, Gh, S, T, O
Butea monosperma (*)	Papilionaceae	M	G	18	H, G, MP, O
Butomus umbellatus	Alismataceae	He	G	14	H, D
Byttneria andamanensis (*)	Sterculiaceae	N	FH	18	AN, O
Caesalpinia crista (*)	Caesalpiniaceae	Ch	FH	18	Or, H, AN, AP, TN
C. jayabo/ nuga (*)	Caesalpiniaceae	Ch	FH	20	Coastal areas
Caesulia axillaris	Asteraceae	Th	G	14 (pH 9.4)	R, P, H, Ra, MP, O
Calendula officinalis (*)	Asteraceae	Th	G	10(pH 9.2)	Ornamental

Species	Family	Life Form	Adapta-bilityClass	Salinity limit ($dS\ m^{-1}$)	Important Locations
Operculina riedeliana	Convolvulaceae	Ch	FH	-	AN
Opuntia dillenii, O. elatior,	Cactaceae	N	FH	18 (pH 9.2)	M, P, H, G, Ra, O
O. ficus-indica, vulgaris(*)	Cactaceae	N	FH	16 (pH 9.2)	H, G, Ra, GC, S, O
Oryza sativa (*) *(many varieties)*	Poaceae	Th	G	14 (pH 9.6)	Cultivated crops
Ottelia alismoides (*)	Hydrocharitaceae	HH, He	G	-	Stagnant water
Oxalis corniculata (*), *latifolia*	Oxalidaceae	He	G	-	Marshy places
Oxystelma secamone (*)	Asclepiadaceae	Ch	G	-	Among bushes, O
Palaquium obovatum	Sapotaceae	M	G	-	O
Pandanus odoratissimus, tectorius, thwaitsii, utilis	Pandanaceae	N	FH	12-20	Or, Su, AN,O
Panicum antidotale (*)	Poaceae	Cr	G	20	P, H, M, O
P. laevifolium	Poaceae	Cr	G	12 (pH9.4)	Cultivated
P. maximum (many vars.)	Poaceae	Cr	G	12(pH9.4)	Cultivated
P. turgidum	Poaceae	Ch	G	20	P, S, T, O
Paramignya angulata (*)	Rutaceae	Ch	G	-	Along coasts
Parkinsonia aculeate (*)	Caesalpiniaceae	N	FH	20 (pH 9.8)	Most localities
Parthenium argenatum	Asteraceae	Ch	G	8-12	Cultivated
P. hysterophorus	*Asteraceae*	*Th*	*G*	*14 (pH 9.6)*	*Common weed*
Paspalidium punctatum	*Poaceae*	*Cr*	*G*	*16*	*R, G, O*
Paspalum conjugatum (*)	Poaceae	Cr	G	24	P R, O
P. distichum, notadum	Poaceae	Cr	G	50	Introduced, S, AN, O
P. plicatulum	Poaceae	Cr	G	20	Introduced
P. scrobiculatum(*), *vaginatum*	Poaceae	Cr	G	25	Coastal areas
Pavonia arabica, ceratocarpa, patens	Malvaceae	Th	G	14-16	R, G, O
Pedilanthus tithymaloides (*)	Euphorbiaceae	N	G	-	O
Peganum harmala (*)	Zygophyllaceae	Ch	G	13	O
Pelargonium capitatum (*)	Geraniaceae	Ch	G	-	O
Peltophorum					

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m⁻¹)	Important Locations
Mentha arvensis (*)	Lamiaceae	HH	G	-	G, R, O
M. cardiaca, longifolia, piperita, rotundifolia, spicata (*)	Lamiaceae	Th	G	8-12	Cultivated
Merremia gangetica	Convolvulaceae	Th	G	16	H, GC, O
M. hederacea	Convolvulaceae	Th	G	14	R, GC, O
*Mesembryanthemum crystillium**	Aizoaceae	Ch	H	20	O
Mimosa hamata	Mimosaceae	N	G	20	H, GC, R, O
M. rubicaulis	Mimosaceae	N	G	18	R, O
Mitragyna parviflora (*)	Naucleaceae	M	G	12	O
Modiola caroliniana	Malvaceae	Ch	G	-	O
Mollugo pentaphylla (*)	Aizoaceae	Th	G	16	GC, R, O
Momordica balsamina (*)	Cucurbitaceae	Th	G	-	H, R, GC, O
Momordica dioica (*)	Cucurbitaceae	Th	G	-	H, R, GC, O
Monochoria vaginalis (*)	Pontederaceae	He, HH	g	-	South India, Su, AN
Myriostachya wightiana	Poaceae	Cr	FH	14-20	Coastal S, R, O
Najas graminea, indica, kurziana, marina, minor	Najadaceae	HH	G	-	Many localities, stagnant water
Nechamandra alternifolia	Hydrocharitaceae	HH	G	-	R, Gu, O
Nelumbo nucifera	Nymphaeaceae	He, HH	G	-	Marshy ditches
Neptunia oleracea (*)	Mimosaceae	HH	G	-	Marshy ditches
Nerium indica (*)	Apocynaceae	N	G	-	Cultivated
Nicotiana plumbaginifolia	Solanaceae	Th	G	12-18	Common
Nymphaea alba, nauchali, stellata (*)	Nymphaeaceae	He, HH	G	-	Marshy, stagnant water
Nymphoides cristatum, indicum, parvifolium	Gentianaceae	He, HH	G	-	Marshy, stagnant water
Oligochaeta ramosa	Asteraceae	Th	G	14	P, S, GC, H, O
Oligomeris linifolia	Resedaceae	Th	G	-	H, Ra, O
Oncosperma horridum(*)	Arecaceae	M	G	-	Introduced
O. tigillarium (*)	Arecaceae	N	G	-	Introduced

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m⁻¹)	Important Locations
Calligonum polygonoides(*)	Calligonaceae	N	G	30	H, R, Ra, O
Callistemon lanceolatus (*)	Myrtaceae	N	G	20	Cultivated
Calotropis gigantea (*)	Asclepiadaceae	Ch	G	20	Gh, G, K, O
C. procera (*)	Asclepiadaceae	Ch	G	30	Most localities
Canscora diffusa	Gentianaceae	Th	G	14	R, G, O
Capparis cartilagina, grandis, spinosa	Capparidaceae	N	FH	18 (pH 9.6)	Reported from R, G
Capparis deciduas (*)	Capparidaceae	M	FH	24 (pH 9.6)	Most localities
C. sepiaria (*)	Capparidaceae	N	FH	24 (pH 9.6)	Most localities
C. zeylanica (*)	Capparidaceae	N	FH	14 (pH 9.2)	Most localities
Capsella bursa-pastoris(*)	Brassicaceae	Th	G	12	H, Ra, G, O
Cardamine trichocarpa	Brassicaceae	Th	G	12	H, Ra, G
Carex divisa	Cyperaceae	He	FH	36	G, H, O
C. fedia	Cyperaceae	He	FH	36	H, O
C. songorica	Cyperaceae	He	FH	30	G, O
Carissa carandus (*)	Apocynaceae	N	FH	12	Cultivated
C. grandiflora (*)	Apocynaceae	N	FH	10	Introduced
C. inermis (*)	Apocynaceae	N	FH	12	South India
C. spinarum (*)	Apocynaceae	N	FH	14	H, M, O
Carthamus oxyacantha(*)	Apocynaceae	Th	G	14	H, Ra, G, UP, O
Cassia angustifolia (senna) (*)	Caesalpiniaceae	Th	G	14 (pH 9.4)	H, M, O, cultivated
C. auriculata (*)	Caesalpiniaceae	N	G	22	GC, Ra, G, H, P, O
C. italica	Caesalpiniaceae	N	FH	18	P,G ,O
C. javanica	Caesalpiniaceae	N	G	12	Planted
C. occidentalis (*)	Caesalpiniaceae	Th	G	10	H, M, O
C. siamea (*)	Caesalpiniaceae	M	G	16	Cultivated
C. tora (*)	Caesalpiniaceae	Th	G	12 (pH 9.2)	H, M, O
Casuarina cristata	Casuarinaceae	M	FH	16	Introduced
C. cunninghamiana	Casuarinaceae	M	FH	20	Introduced
C. equisetifolia	Casuarinaceae	M	FH	40	Introduced
C. glauca	Casuarinaceae	M	FH	40	Introduced
C. junghuhniana	Casuarinaceae	M	FH	25	Introduced
C. leptoclada	Casuarinaceae	M	FH	18	Introduced
C. littoralis	Casuarinaceae	M	FH	18	Introduced
C. obesa	Casuarinaceae	M	FH	20	Introduced

Species	Family	Life Form	Adapta-bilityClass	Salinity limit ($dS\ m^{-1}$)	Important Locations
C. paludosa	Casuarinaceae	M	FH	16	Introduced
C. stricta	Casuarinaceae	M	FH	18	Introduced
Catharanthus roseus (*)	Apocynaceae	N	G	12 (pH9)	Cultivated
C. pusillus (*)	Apocynaceae	N	G	12	Cultivated
Cayratia carnosa (*), repanda	Vitaceae	Ch	G	20	In littopral stands
Cenchrus biflorus (*)	Poaceae	Th	G	14	P, S, T, M, H, O
C. ciliaris	Poaceae	Th	G	14	P, S, T, M, H, O
C. prieurii	Poaceae	Th	G	10	P, H, Pu, Ra, O
C. setigerus	Poaceae	Ch	G	14	P, S, T, M, H, O
Centella asiatica (*)	Apiaceae	Ch	G	14	Ra, H, Pu, O
Ceratophyllum demersum (*)	Ceratophyllaceae	HH	G	12	Rivers, ditches
Chenopodium album (*)	Chenopodiaceae	Th	FH	16 (pH9)	H, M, GC, O
C. ambrosioides (*)	Chenopodiaceae	Th	FH	14 (pH9)	H, Pu, O
C. blitum, botrys(*), *glaucum, hybridium*	Chenopodiaceae	Th	FH	18	Cold desert
C. murale	Chenopodiaceae	Th	G	16 (pH9)	H, M, GC, O
Chloris barbata	Poaceae	Th	FH	12 (pH9)	H, Pu, G, O
C. bournei	Poaceae	Th	FH	12	G, O
C. dolichostachya	Poaceae	Th	FH	12	G, O
C. gayana	Poaceae	Th	FH	16(pH9)	H, M, O
C. montana	Poaceae	Th	FH	14	G, O
C. virgata	Poaceae	Th	FH	16(pH9)	H, M, GC, O
Chrozophora oblongifolia	Euphorbiaceae	Ch	FH	14	H, G, R, Ra, O
C. prostrata	Euphorbiaceae	Th	FH	12	H, G, R, Ra ,UP,MP,O
C. rottleri (*)	Euphorbiaceae	Th	FH	16	H, G, R, Ra ,O
Chrysanthemum indicum(*)	Asteraceae	Th	G	12 (pH9)	Cultivated
Chrysopogon aciculatus	Poaceae	Cr	G	16	Peninsular India
C.aucheri,fulvus,serrulatus	Poaceae	Cr	G	14	G, R, MP, O
Cirsium arvensis (*)	Asteraceae	Th	G	12	H, G, R, O
Cissus quadrangularis (*), repanda	Vitaceae	Tw	G	-	H, D, littoral AN, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit ($dS\ m^{-1}$)	Important Locations
Lobularia maritime (*)	Brassicaceae	Th	G	-	O
Lopholepis ornithocephala	Poaceae	Cr	G	-	Coastal sandy areas
Lophotocarpus guyanensis	Alismataceae	He	G	-	H, Pu, D
Ludwigia adscendens, hyssopifolia, octovalis, perennis, prostrata (*)	Onagraceae	He	G	10-14	Marshy places G, R, P, H, O
Lycium barbarum (*)	Solanaceae	N	G	24	P, M, H, O
L. europaeum	Solanaceae	N	G	-	R, O
Lycopersicon peruvianum	Solanaceae	Th	G	-	R, O
Maerua oblongifolia (*)	Capparidaceae	Ch	G	14 (pH 9.4)	H, O
Malachra capitata (*)	Malvaceae	Th	G	18	G, O
Malaleuca leucadendra (*)	Myrtaceae	M	G	-	M, WB, TN,O
Malva parviflora (*)	Malvaceae	Ch	G	-	D, H, O
Malvastrum coromandelianum(*)	Malvaceae	Ch	G	22 (pH9.5)	Common
Mapania cuspidata	Cyperaceae	Cr	FH	18	AN, Su
Mariscus squarrosus	Cyperaceae	Cr	FH	28	P, GC, M, N, R, O
Marsilea minuta(*), *quadrifolia*	Marsileaceae	He	G	-	Marshy places
Matricaria chamomilla(*)	Asteraceae	Th	FH	24	Cultivated
Maytenus emarginata (*)	Celastraceae	N	G	14 (pH10)	P, H, GC, O
M. royleanus (*)	Celastraceae	N	G	14 (pH10)	H, O
Mazus pumilus	Scrophulariaceae	Cr	G	-	Marshy places
Mecardonia procumbens	Scrophulariaceae	Cr	G	-	Marshy places
Medicago denticulata	Papilionaceae	Th	G	10 (pH 9.4)	Common winter weed
Melaleuca leucadendron	Myrtaceae	M	FH	-	P, H, R, O
Melanocenchris jacquemontii	Poaceae	Th	G	20	O
Melastoma malabathricum	Melastomataceae	Ch	FH	18-24	Coastal regions AN
Melia azedarach (*)	Meliaceae	M	G	12 (pH 9.2)	Planted widely
Melilotus alba (*)	Papilionaceae	Th	G	12 (pH 9)	Common winter weed
M. indica (*)	Papilionaceae	Th	G	12 (pH 9)	Common winter weed
Melothrina maderaspatana (*)	Cucurbitaceae	Th	G	14 (pH 9.4)	Common in hedges

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m-1)	Important Locations
Justicia simplex	Acanthaceae	Th	G	14	P, O
Kalanchoe pinnata (*)	Crassulaceae	He	FH	14	GC, H, O
Kleinhovia hispida (*)	Sterculiaceae	N	G	-	Coastal TN, WB
Kochia indica	Chenopodiaceae	Th	H	20(pH10)	H, GC, O
K. prostrata	Chenopodiaceae	Th	FH	18(pH10)	H, O
K. scoparia	Chenopodiaceae	Th	FH	18(pH10)	Ra, G, H, O
K. trichophylla	Chenopodiaceae	Th	FH	-	Reported introduced
Lagascea mollis	Asteraceae	Th	G	12	G, MP, Ra, O
Lagenandra ovata	Araceae	He	G	-	Ke, G, O
Laggera alata/ aurita (*)	Asteraceae	Th	G	12	H, G, Ra, O
Lannea coromandelica (*)	Anacardiaceae	M	G	-	WB, AN, G
Lantana camara, indica,rugosa	Verbinaceae	Ch	G	-	Common
Launaea aspleniifolia (*)	Asteraceae	Th	G	-	G, Ra, O
L. glomerata	Asteraceae	Th	G	18	P, GC, GH, R, O
L. mucronata	Asteraceae	Th	G	12	G, R, O
L. nudicaulis	Asteraceae	Th	G	20	P, H, GC, R, O
L. sarmentosa (*)	Asteraceae	Th	G	24	P, GC, R, O
Lemna minor (many others) (*)	Lemnaceae	HH	G	10-14	Common in ditches
Lepidium latifolium (*)	Brassicaccae	Th	G	14	H, Pu, HP, O
L .ruderale (*)	Brassicaceae	Th	G	-	HP, cold desert
Leucas aspera (*)	Lamiaceae	Th	G	-	G, TN, AP, O
L. lavandulaefolia (*)	Lamiaceae	Th	G	-	G, R, TN, AP, AN, O
L. urticaefolia	Lamiaceae	Th	G	-	G, S, AP, H, Pu, Ra, O
Leptadenia pyrotechnica	Asclepiadaceae	Ch	G	-	G, R, UP, M, Ra, H
L. reticulata (*)	Asclepiadaceae	Ch	G	-	G, R, UP, M, Ra, H
Leptochloa fusca	Poaceae	Cr	H	40 (pH10)	H, O
L. panicea, chinensis	Poaceae	Cr	FH	20	H, O
Leptothrium senegalensis	Poaceae	Cr	G	16-20	Ra, G, O
Leucas lavandulaefolia	Lamiaceae	Th	G	24	P, M, O
L. urticaefolia	Lamiaceae	Th	G	26	H, Ra, G, O
Limnophila chinensis, indica, heterophylla, rugosa (*)	Scrophulariaceae	Cr	G	-	Marshy places
Lindernia antipoda, crustacea(*)	Scrophulariaceae	Cr	G	-	Marshy places
Livistonia chinensis	Arecaceae	M	G	-	Introduced

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m-1)	Important Locations
Citrullus colocynthis (*)	Cucurbitaceae	Cp	G	24	P, M, H, R, O
Cleome brachycarpa (*)	Cleomaceae	Th	FH	24	P, S, T, GC, Ra, O
C. scaposa(gracilis)	Cleomaceae	Th	G	14 (pH 9.4)	Ra, G
C. viscose (*)	Cleomaceae	Th	G	18	P, S, H, GC, O
Clerodendrum inerme (*)	Verbenaceae	N	FH	22	Cultivated, also coastal
C. infortunatum (*)	Verbenaceae	Ch	G	18	AN
C. phlomidis (*)	Verbenaceae	N	G	14	Gh, M, H, O
C. viscosum (*)	Verbenaceae	Ch	G	16	Coastal AN
Coccinea grandis	Cucurbitaceae	Cp	G	14	P, M, H, O
Coccoloba uvifera (*)	Polygonaceae	Ch	FH	16-30	Behind beaches G, Ma
Cocculus hirsutus, pendulus (*)	Menispermaceae	Cp	G	14	P, H, GC, R, O
Cochlearia cochlearioides	Brassicaceae	Th	G	15	GC, O
Cocos nucifera (*)	Arecaceae	Ph	G	20	AN, Ke, AP,K,TN,WB
Coix lachryma-jobi (*)	Poaceae	Th	G	14	WB, K, O
Coldenia procumbens (*)	Boraginaceae	Th	G	14	Most localities
Colophospermum mopane	Caesalpiniaceae	N	G	16 (pH 9.6)	Cultivated (Ra, H)
Commelina benghalensis (*)	Commelinaceae	Th	G	14	H, Ra, R, G, O
C. nudiflora (*)	Commelinaceae	Th	G	14	H, Ra, R, G, Su, AN,O
Convolvulus hirsutus	Convolvulaceae	Th	G	15	P, M, H, O
C. microphyllus (*)	Convolvulaceae	He	FH	24	P, S, M, H, T, O
Conyza semipinnatifida	Asteraceae	Th	G	14	P, S, O
Corallocarpus epigeus	Cucurbitaceae	Th	G	17	R, M, O
Corbichonia decumbens	Aizoaceae	Ch	G	18	R, O
Corchorus aestuans(*), *capsularis* (*)	Tiliaceae	Th	G	12	Pu, H, M, GC, O
C. depressus (*)	Tiliaceae	Th	G	12	P, S, H, M, GC,Gu, O
C. tridens	Tiliaceae	Th	G	12	P, S, T, H, M, GC, O
C. trilocularis	Tiliaceae	Th	G	14	H, Pu, O
Cordia dichotoma (*)	Cordiaceae	M	G	14	H, O
C. monoica	Cordiaceae	N	G	17	R, S, O
C. rothii (*)	Cordiaceae	M	G	18	H, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m-1)	Important Locations
C. wallichii (*)	Cordiaceae	M	G	14	G, AN, O
Cotula anthemoides	Asteraceae	Th	G	12	H, O
Crambe maritima	Brassicaceae	Th	G	15	H, GC, O
Crataeva odora (*)	Capparidaceae	N	G	14 (pH 9.6)	H, G, R, Ra
C. roxburghii	Capparidaceae	Ch	FH	15	WB, O
Cressa cretica (*)	Convolvulaceae	Th	H	49	Most localities
Crinum asiaticum (*)	Amaryllidaceae	Cr	G	20	Introduced, Su, AN
C. defixum (*)	Amaryllidaceae	Cr	G	17	R, G, AN
C. latifolium (*)	Amaryllidaceae	Cr	G	16	AN
C. ornatum	Amaryllidaceae	Cr	G	14	AN
C. pratense	Amaryllidaceae	Cr	G	16	R, G
C. pusillum	Amaryllidaceae	Cr	G	16	AN
C. toxicarum	Amaryllidaceae	Cr	G	16	AN
Crotalaria burhia	Papilionaceae	Ch	H	42	P, H, R, O
C. medicaginea	Papilionaceae	Th	G	12	H, GC, O
C. mucronata (*)	Myrtaceae	Ch	G	16	S, R, AN
C. retusa (*)	Papilionaceae	Th	G	12	G, R, O
Croton bonplandianum	Euphorbiaceae	Th	G	14	H, M, GC, R, O
Cryptocoryne retrospiralis (*)	Araceae	He	G	12-	R, O
Cucumis callosus (*)	Cucurbitaceae	Th	FH	24	P, S, GC, M, H, R, O
C. prophetarum (*)	Cucurbitaceae	Th	G	14	S, GC, M, H, R, O
Cyamopsis tetragonoloba (*)	Papilionaceae	Th	G	12	Cultivated
Cymbopogon flexuosus, martini, citrates, coloratus (*)	Poaceae	Cr	G	10-14	
Cultivated				(pH 9.2-9.6)	
Cynodon dactylon (*)	Poaceae	He	G	32	Most localities
Cyperus arenarius	Cyperaceae	Cr	G	24	P, O
C. bulbosus	Cyperaceae	Cr	FH	30	P, S, T, GC, M, H, R,O
C. compressus	Cyperaceae	Cr	FH	20	S, GC, R, O
C. conglomeratus	Cyperaceae	Cr	FH	20	G, R, O
C. corymbosus	Cyperaceae	Cr	FH	30	G, H, R, O
C. exaltatus	Cyperaceae	Cr	FH	30	R, O
C. flavidus	Cyperaceae	Cr	FH	20	S, R, O
C. imbricatus	Cyperaceae	Cr	FH	20	S, R, AN, O
C. iria (*)	Cyperaceae	Cr	FH	24	P, S, T, R, GC ,GH, O

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m-1)	Important Locations
Hoppea dichotoma (*)	Gentianaceae	Th	G	-	R, G, O
Hydrilla verticillata	Hydrocharitaceae	HH	G	-	Stagnant water
Hybanthus enneaspermum (*)	Violaceae	Th	G	10	Peninsular regions
Hydrocotyle javanica (*)	Apiaceae	He	G	18	AP, K, O
Hydrolea zeylanica	Hydrophyllaceae	Cr	FH	-	G, Su, AN
Hydrophylax maritima	Rubiaceae	Cr	FH	-	Along sandy beaches
Hedyotis biflora (*)	Rubiaceae	Th	G	10	Su, AN, O
H. corymbosa, umbellata (*)	Rubiaceae	Th	G	10	Common R, H
Hydrophylax maritima	Rubiaceae	Th	G	10	Coastal sand
Hygrophila auriculata	Acanthaceae	Ch	G	-	G, MP, Ra, H
H. phlomoides (*)	Acanthaceae	Th	G	14	P, Ra, O
H. salicifolia (*)	Acanthaceae	Th	G	14	R, O, H, MP, G
Hyphaene indica	Arecaceae	M	G	-	West coast
H. thebaica (*)	Arecaceae	M	G	-	Introduced
Indigofera cordifolia	Papilionaceae	Th	G	20	P, GC, O
I. enneaphylla/ linnaei	Papilionaceae	Th	G	20	P, S, H, GC, O
I. hochstelleri	Papilionaceae	Th	G	17	H, GC, O
I. linifolia (*)	Papilionaceae	Th	G	20	P, T, GC, O
I. oblongifolia (*)	Papilionaceae	Th	G	20	P, T, GC, O
I. sessiliflora	Papilionaceae	Th	G	-	GC, O
I. tinctoria (*)	Papilionaceae	Th	G	-	O
Ipomoea alba (*)	Convolvulaceae	Th	G	-	O
I. aquatica (*)	Convolvulaceae	He,HH	G	14	Water bodies
I. campanulata (*)	Convolvulaceae	Ch	FH	-	AN
I. carnea (*)	Convolvulaceae	Ch	G	-	P, H, GC, O
I. gracilis (*)	Convolvulaceae	Ch	FH	-	AN
I. pes-caprae (*)	Convolvulaceae	Ch	FH	-	Coastal areas
I. pes-tigridis (*)	Convolvulaceae	Ch	FH	-	Coastal areas
I. tuba	Convolvulaceae	Ch	FH	-	Su, AN
Ischaemum muticum (*)	Poaceae	Cr	FH	16	Coastal areas
I. pilosum	Poaceae	Cr	G	14	MP, AP, G, O
Jatropha curcas (*)	Euphorbiaceae	N	FhG	14	Most localities
J. glandulifera (*)	Euphorbiaceae	N	FH	16	G, O
J. gossypifolia (*)	Euphorbiaceae	N	FH	16	G, H, O
J. multifida (*)	Euphorbiaceae	N	FH	16	G, H, AN, O
Juncus (many species)(*)	Juncaceae	Cr	FH	14-22	Marshy places

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
Gloriosa superba (*)	Liliaceae	Ch	G	16	R, G, AN
Glossocardia bosvallea (*)	Asteracea	Th	G	20	G, H, Pu, Ra, O
Glycosmis mauritiana	Rutaceae	N	G	16	AN, Su,
Glyptopetalum calocarpum	Celastraceae	N	FH	18	AN, Su, Ke, O
Gnaphalium indicum	Asteraceae	Th	G	18	S, GC, O
G. purpureum	Asteraceae	Th	G	17	P, GC, O
Gomphrena celosoides (*)	Amaranthaceae	Th	G	20	most localities
Gorbichonia decumbens	Aizoaceae	Th	G	12	R
Grewia subinaequalis(*), *tenax*	Tiliaceae	M	G	14	Planted, Pu, H, G, Ra
Gynandropsis gynandra	Cleomaceae	Th	G	13	H, GC, O
Gyrocarpus americanus	Gyrocarpaceae	M	FH	20	Sea shore AN
Halogeton glomerata	Chenopodiaceae	Ch	FH	24	O
Halopyrum mucronatum	Poaceae	Cr	G	12-16	Coastal areas
Haloxylon multiflorum	Chenopodiaceae	N	FH	24	Gh, O
H. recurvum	Chenopodiaceae	N	H	28	P, Gh, T, GC, O
H. salicornicum	Chenopodiaceae	N	FH	24	P, Gh, GC, O
Hedyotis biflora,corymbosa	Rubiaceae	Th	G	16	Common weeds
Heliotropium bacciferum	Boraginaceae	Th	FH	20	R, G, O
H. curassavicum	Boraginaceae	Th	H	34	H, GC, R ,O
H. indicum (*)	Boraginaceae	Th	FH	18	H, GC, O
H. marifolium	Boraginaceae	Th	FH	20	M, R, O
H. ovalifolium (*)	Boraginaceae	Th	FH	20	R, O
H. subulatum	Boraginaceae	Th	FH	20	R, G, O
H. supinum	Boraginaceae	Th	FH	18	R, G, Ra, O
Hemidesmus indicus (*)	Periplocaceae	Ch	G	16	R, Su, O
Heylandia latebrosa	Papilionaceae	Th	G	14	R, GC, MP, O
Hibiscus obtusifolius	Malvaceae	Th	G	24	P, S, O
H. palmatus	Malvaceae	Ch	G	20	R, G, O
H. trionum	Malvaceae	Ch	G	14	R, G, O
Hippomane mancinella	Euphorbiaceae	N	G	12	O
Hippophae rhamnoides	Elaegnaceae	M	G	-	O
Holarrhena antidysenterica	Apocynaceae	N	G	-	WP, O
Holoptelea integrifolia	Ulmaceae	N	G	-	O
Homonoia riparia (*), *retusa*	Euphorbiaceae	Ch	G	-	G, O
Hordeum vulgare (*)	Poaceae	Th	G	14	Cultivated

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m^{-1})	Important Locations
C. javanicus	Cyperaceae	Cr	FH	24	Gh, R, P, S, T, O
C. kyllinga (*)	Cyperaceae	Cr	FH	20	H, Pu, MP, G, O
C. laevigatus	Cyperaceae	Cr	G	20	Gh, R, O
C. malaccensis	Cyperaceae	Cr	FH	25	Su, O
C. odoratus	Cyperaceae	Cr	H	30	Su, AN, O
C. pangorie	Cyperaceae	Cr	FH	20	Su,, O
C. procerus	Cyperaceae	Cr	FH	20	S, R, H, O
C. rotundus (*)	Cyperaceae	Cr	FH	28	Most common
C. stoloniferus (*)	Cyperaceae	Cr	FH	16	R, O
C. triceps (*)	Cyperaceae	Cr	FH	20	S ,M, R, O
C. tuberosus	Cyperaceae	Cr	FH	28	P, S, T,R, H, O
Dactyloctenium aegyptium (*)	Poaceae	Th	FH	18	Common
D. sindicum	Poaceae	Ch	G	26	Common
Dalbergia sissoo	Papilionaceae	M	G	14 (pH 9.6)	Planted widely
Dalechampia scandens	Euphorbiaceae	Ch	G	15	R, S, G, O
Datura innoxia (*)	Solanaceae	Ch	G	20 (pH9)	Common
D. metel (*)	Solanceae	Ch	G	2 0(pH9)	Common
Desmodium triflorum (*)	Papilionaceae	Th	G	18	H, GC, O
Desmostachya bipinnata(*)	Poaceae	Cr	FH	18 (pH10)	H, GC, Ra, Pu, O
Dichanthium annulatum	Poaceae	Cr	G	40 (pH 9.6)	Most localities
D. aristatum,caricosum	Poaceae	Cr	G	20 (pH 9.6)	Most localities
D. parviflorum	Poaceae	Cr	G	16 (pH 9.6)	Konkan
Dichrostachys cinerea (*)	Mimosaceae	Ch	G	16 (pH 9.4)	Common
Digera muricata (*)	Amaranthaceae	Th	G	14	P, S, T, GC, M, H, R,O
Digitaria adscendens	Poaceae	Th	FH	24	P, S, T, GC, R, O
D. ciliaris, longiflora	Poaceae	Th	FH	24	P, S, G, T, O
D. pennata	Poaceae	Th	FH	28	R, O
Dinebra retroflexa	Poaceae	Th	G	16	Black cotton soils
Diospyros cordifolia (*)	Ebenaceae	N	FH	20 (pH 9.2)	H, UP, G, Ra
D. ferrea	Ebenaceae	N	FH	18 (pH 9.6)	East coast
D. melanoxylon	Ebenaceae	M	Fh	18 (pH 9.6)	Black soil regions
Dodonaea viscosa (*)	Sapindaceae	Ch	G	14	Coastal, cultivated
Dracaena angustifolia (*)	Liliaceae	Ch	G	15	AN, cultivated
Dregea volubilis (*)	Asclepiadaceae	Ch,Cl	G	14 (pH 9.6)	H, G, UP, Pu
Echinochloa colonum	Poaceae	Th	FH	20 (pH9)	Most localities
E. crus-galli (*)	Poaceae	Th	G	20 (pH9)	Most localities

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m⁻¹)	Important Locations
E. frumentacea(*), stagnina	Poaceae	Th	G	20	G, R, O
Echinops echinatus (*)	Asteraceae	Th	G	24	P, S, T, R, H, GC, O
Eclipta prostrata (*)	Asteraceae	Th	FH	28	Most localities
Eichhornia crassipes (*)	Pontederiaceae	He,HH	G	12	Stagnant water
Elatine ambigue, americana	Elatinaceae	Th	G	16	Gujarat coast, O
Eleocharis dulcis (*)	Cyperaceae	Cr	FH	20	H, R, G, R, O
E. palustris	Cyperaceae	Cr	FH	20	H, Pu, R, G, Su, O
E. spiralis	Cyperaceae	Cr	FH	20	G, Su, O
Eleusine compressa	Poaceae	Ch	G	30	P, S, T, R, H, GC, O
E. indica (*)	Poaceae	Ch	G	30	M, H, O
Emblica officinalis (*)	Euphorbiaceae	N	G	14 (pH9.5)	Cultivated
Enicostema hyssopifolium (*)	*Gentianaceae*	*He*	*G*	*24*	*P, MP, H, O*
Ephedra foliata	Ephedraceae	Ch	FH	18	P, GC, H ,O
E. gerardiana (*)	Ephedraceae	Ch	FH	20	Cold desert
Eragrostis ciliaris	Poaceae	Th	FH	24	P, O
E. curvula	Poaceae	Th	FH	20	GC, O
E. diarrhena	Poaceae	Th	FH	20	H, O
E. pilosa	Poaceae	Th	FH	24	P, S, T, R, O
E. .tenella (*)	Poaceae	Th	FH	24	GC, H, O
E. tremula	Poaceae	Th	FH	24	P, S ,T, H, O
E. unioloides	Poaceae	Th	FH	20	GC, R, K, G, H, O
Erigeron bonariensis	Asteraceae	Th	G	20	H, GC, R, O
E. canadensis	Asteraceae	Th	G	24	Most localities
Eruca sativa (*)	Brassicaceae	Th	G	14	Cultivated
Eucalyptus calphylla	Myrtaceae	M	G	14	Introduced
E. camaldulensis (*)	*Myrtaceae*	*M*	*FH*	*40 (pH 9.4)*	*Planted*
E. crebra, calphylla	Myrtaceae	M	G	20 (pH 9.2)	Introduced
E. deglupta, ficifolia, grandis	Myrtaceae	M	G	12-18	Introduced, coastal
E. gomphocephala	Myrtaceae	M	G	15 (pH 9.2)	Introduced
E. goniocalyx	Myrtaceae	M	G	17 (pH 9.2)	Introduced
E . largiflorens	Myrtaceae	M	G	16 (pH 9.2)	Introduced
E. leucoxylon, megacornata, melanophloia,microtheca,					

Species	Family	Life Form	Adapta-bilityClass	Salinity limit (dS m⁻¹)	Important Locations
morrisii	Myrtaceae	M	G	12-18	Introduced
E .occidentalis	Myrtaceae	M	G	28	Introduced
E. odorata	Myrtaceae	M	G	20	Introduced
E. populnea	Myrtaceae	M	G	16	Introduced
E robusta, rudis, saligna	Myrtaceae	M	G	14-17	Introduced
E .sideroxylon	Myrtaceae	M	G	18 (pH 9.2)	Introduced
E .tereticornis (*)	Myrtaceae	M	FH	36 (pH 9.4)	Introduced
E. terminatus, tessellaris, torelliana	Myrtaceae	M	G	14-18 (pH9.2)	Introduced
Euphorbia atoto (*)	Euphorbiaceae	Ch	FH	20	Coastal AN
E. granulata (*)	Euphorbiaceae	Th	G	24	Most localities
E. hirta (*)	Euphorbiaceae	Th	G	28	Most localities
E. hypercifolia (*)	Euphorbiaceae	Th	G	16	Central India
E .jodhpurensis	Euphorbiaceae	Th	G	24	Most localities
E. microphylla (*)	Euphorbiaceae	Th	G	20	H, Pu, R, G, O
E. prostrata (*)	Euphorbiaceae	Th	G	24	P
E. thymifolia (*)	Eyphorbiaceae	Th	G	32	Most localities
Evolvulus alsinoides (*)	Convolvulaceae	Th	G	24	P, GC, R, H O
Fagonia cretica (*)	Zygophyllaceae	Th	FH	28	P, S, T, R, GC, O
Faidherbia albida (*)	Mimosaceae	M	G	16	Introduced
Farsetia hamiltonii (*)	Brassicaceae	Th	G	18	Most localities
F. jacquemontii	Brassicaceae	Th	G	16	Pu, Ra, H, O
Feronia limonia (*)	Rutaceae	M	G	14	H, G, Ra , MP, UP, O
Festuca rubra	Poaceae	Cr	G	12 pH (9.4)	Ra, G, H, O
Ficus heterophylla (*)	Moraceae	N	G	14	GC, R, O
F. hispida (*), microcarpa	Moraceae	N	G	12-17	GC, R, G, Ra,O
Filago germanica	Asteraceae	Th	G	12-18	G, Ra, H, O
Fimbristylis annua (*), cymosa, complanata, halophila	Cyperaceae	Cr	FH	20-26	G, R. Su, AN, O
F. littoralis, miliacea (*)	Cyperaceae	Cr	FH	26	P, GC, G, Su, AN, O
F. polytrichoides	Cyperaceae	Cr	FH	20-30	Su, R, G, S, O
F.spathacea, sub-bispicata	Cyperaceae	Cr	FH	30	Su, coastal marshes
Flacourtia indica (*)	Flacourtiaceae	Ch, N	G	16	S, O
Frankenia pulverulenta (*)	Frankeniaceae	Th	G	15	Ornamental
Fumaria indica (*)	Fumariaceae	Th	G	12	Common weed
Geniosporum tenuifolium	Lamiaceae	Th	G	16	Along beaches in TN
Gisekia pharnaceoides (*)	Aizoaceae	Th	G	24	Common
Glaux maritima	Primulaceae	Ch	H	18	Introduced