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DESERT ENVIRONMENT NEWSLETTER

ENVIS Centre on Combating Desertification
ICAR-CAZRI

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From the Desk of ENVIS Co-ordinator

Our new Chairman of ENVIS Committee: Dr. O.P. Yadav

You will all be pleased to know that Dr. O.P. Yadav, has taken over as Director, ICAR-CAZRI on 21 Dec., 2015. He is also the new Chairman of ENVIS Committee at CAZRI, Jodhpur. Dr. OP Yadav, Director, ICAR-Central Arid Zone Research Institute, Jodhpur has more than 25 years of experience in research and research management in the field of agriculture. He has distinction of leading the national research programs on pearl millet and maize and has taken several new initiatives to further enhance the development and adoption of new agricultural technologies. He has extensively worked in arid regions of India and is well versed with strengths and opportunities of agricultural and allied systems in desert ecosystem and is committed to improving the livelihood opportunities of desert dwellers. His work has addressed several strategic research issues leading to better understanding of crop adaptation to drought stress environments and helping in evolving appropriate strategies for developing stress-adapted crops and cultivars.

Dr. Yadav has a sound exposure at international level. He has worked in USA and UK and has also represented India in several overseas conferences in Italy, France, Australia, UK, Mexico and USA. He is widely travelled in African continent as well. He has been involved in several committees at state, national and international levels and has played a key role in policy advocacy of research priorities in agriculture. Dr. Yadav is recipient of several coveted awards at national and international levels. He is Fellow of National Academy of Agricultural Sciences (NAAS) and several other professional societies.

With his taking the mentorship of ICAR-CAZRI, ENVIS Centre on Combating Desertification is surely going to move forward under his able leadership.

Suresh Kumar
Co-ordinator, ENVIS

Message from Chairman

Desert covers 17% of worlds land mass and harbor high biodiversity despite low primary productivity. Six percent of the world's population living in desert includes some of the poorest and marginalized people in the world. The deserts and drylands hold nearly one third of terrestrial global carbon stock. These deserts with extremes of climate and wide spread intensive land degradations permit only those species adapted to such situations and processing special genes to "switch on" to life even during drought, periodic floods, high temperatures, frosts, cold and heat waves. Many of these can be donor of such genes to other crops to tide over effects of climate change in future. In view of these unique adaptive features, biodiversity in desert has attracted attention at all levels: scientific, administrative, at both national and international level. Hence, this issue of Desert Environment Newsletter is focused on these new found micro-hotspots of biodiversity. ENVIS centre on Combating Desertification will continue its strides to provide useful information on such other issues in future, too.

OP Yadav
Chairman, ENVIS Committee

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Know Your Desert

Phyto Diversity (higher plants) in Indian Arid Zone

Conservation of plant diversity for its sustainability is enshrined in Article 7 of Convention on Biological Diversity (CBD) (UNEP, 1992). In order to do this inventorisation of organisms is important prerequisite for its conservation and for proper use. This assumes importance in view of the fact that anthropogenic and development induced changes, compounded by climate change and global warming in arid zone would also be adversely affecting thus enhancing the process of habitat and species loss. In that direction a large number of researchers have generated information on botanical diversity at ecosystem, species and gene level in arid zone of India. We now know that the Indian desert has 682 species belonging to 352 genera and 87 families of flowering plants. Of these 9 families, 37 genera and 63 species are introduced. Poaceae is largest family of 57 genera and 111 species. Phytogeographically, 37% of the botanical species represent African elements, 20.6% Oriental elements, 14% species being tropical, 10.3% cosmopolitan and 9.7% Australian. Nearly 9.4% species are endemic to this region.

The arid plants not only show taxonomic diversity in respect of number of genera and species but also exhibit considerable inter and intra-specific diversity with respect to size, morphology, growth, phenology, chemical constituents and reproductive behaviour. For instance considerable variation in morphology and seed traits has been recorded in natural population of *Commiphora wightii* (Arn.) Bhandari and *Capparis decidua* (Forsk.) Edgew. Brick red is the common flower colour in *C. decidua*, however, yellow flowered plants are also found in Indian desert. Enormous variability in morphological characters of *Aloe vera* (L.) Burm.f. has been seen. *Haloxylon salicornicum* (Moq.) Bunge ex Boiss., *Acacia jacquemontii* Benth and *Calligonum polygonoides* L. exhibit huge variations in morphological and growth traits. In *H. salicornicum*, range of perianth colour and size viz., creamy white, light pinkish white, light pink, pink, pinkish white with large, medium and small type of perianth of distinct colour i.e. creamy white, light pink and dark pink are all evidence of phytodiversity .

This biodiversity also supports the life and work of local people. *Salvadora oleoides* and *S. persica* yield non edible oil. Some 40 species belonging to 21 families yield leaves that can be used as vegetables. 27 species coming from 10 families yield edible fruits; 8 species fiber; 3 crude rope; 8 oils and 7 gums or resins . Besides, many of these are source of medicines. Eleven grasses of fodder value are known from Kutch area of Gujarat.

But now this diversity is threatened. Land use pattern in 12 arid districts of arid Rajasthan clearly indicates that over 70% of the area supports culturable wastes, crop fallows and open community grazing lands all supporting rich biodiversity and yet much less understood. There is considerable information on vegetation types and their successional trends on different habitats in Rajasthan desert. Information also exists on temporal limit to natural regeneration upon protection of degraded habitats on different landforms. Some patterns of biodiversity in grazing lands upon degradation and along edaphic and moisture gradients are also studied. It is therefore necessary to strengthen this activity further so that need based conservation options could be evolved in the form of technology capsules. This will involve multidisciplinary set of recommendations for habitat development and regeneration.

Thrust Areas

Since plant resources are depleting in Rajasthan, survey of existing phytodiversity, their monitoring to assess status at different intervals and arriving at their conservation and utilization strategies should be, therefore, main guiding principles. Further, preparation of concentration and sparseness map of phytodiversity should enable select priority areas for conservation on one hand and know biodiversity rich areas for exploitation by future generations. Long Term Ecological Observatories (LTEOs) are required in this desert. Such LTEOs can use functional groups or guilds as well as Participatory Resources Appraisal (PRA). It could be endeavoured to record changes in the number and distribution of invasive species and rarities (such as endemics, endangered, rare and threatened species) and investigate into causes of the declining species. Rapid assessment criteria of diversity through censuses of indicator/keystone species as well as site monitoring using remote sensing and GIS should be developed.

***Suresh Kumar, *JP Singh, Dipankar Saha and *K Venkatesan**
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Know Your Desert Plants

A TYPICAL DESERT PLANT: *Neurada procumbens*

Neurada procumbens L. (Fig.1) belonging to the family Neuradaceae is popularly known as 'Chapri, Chapari'. Neuradaceae is a small family with 3 genera and 10 species distributed from the Mediterranean region to India and South Africa. In India, it is represented by a monotypic genus *Neurada* L.. The other two genera *Grielum* L. and *Neuradopsis* Bremek. & Oberm., are endemic to South-west Africa. It is distributed in arid regions of North Africa, Arabia, Persia, Afghanistan, Syria, Northern Iran, Pakistan and India. In Rajasthan it grows in Barmer, Bikaner and Jaisalmer districts. Recent surveys by authors revealed occurrence of this plant at only one sandy habitat of Barmer.

Taxonomic characters : It is a diffused or procumbent annual woody herb commonly found on sandy habitats of western Rajasthan. Its leaves are densely hairy on both surfaces and alternate. Flowers white, solitary and born in the axil; Calyx 5, depressed conical above, tube flat, spiny forming conical disc with the ripe carpels; Corolla 5, inserted on the throat of calyx tube, obovate-cuneate or oblanceolate; Stamen 10, inserted on calyx mouth, filaments short; Carpels 10, united with one another and also with the calyx tube, terminated by spinescent style, fruit a depressed cone. Fruit (Fig.2) is softly spiny, flat and compressed. The fruit is star shaped, smooth on the underside but has spines on the upper surface that become sharp when dry. The fruit turns hard and woody at maturity. Each fruit has several seeds. It's flowering and fruiting occurs during October to December. Non glandular and glandular trichomes are present on leaf, petiole and young stem. The non-glandular trichomes are simple unicellular with the base simple or dilated. The trichomes are hooked. The wall is straight, lumen narrow to broad. Glandular trichomes are capitates filiform type with uniseriate and multicellular head. Palynologically, Neuradaceae is relatively primitive family by having heteropolar, sub-succate pollen with tri-radiate scar in the center, this type of grains are also found in Gymnosperm.

Fig.1- Habit: *Neurada procumbens*

Fig.2 - Closeup of fruit of *N. procumbens*

Economic importance : Dried powder of whole plant with goat's milk is used in heat stroke. Its roots are used to relieve toothache and treat bleeding gums. The dried spiny fruit is crushed in water along with same amount of almond (*Prunus amygdalis* Batsch), poppy seeds (*Papaver somniferum* L.), rose flower (*Rosa damascena* Miller), Cham-ghass (*Corchorus depressus*) and cardamom seed (*Elettaria cardamomum* (L.) Maton) and candy (Misri) to prepare a cooling agent locally known as "Thadal". Due to overexploitation, it stands threatened today.

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Technological options

TISSUE CULTURE BASED METHODOLOGIES FOR CONSERVATION OF AGROBIODIVERSITY

In view of loss of biodiversity, efforts are being made to safeguard the plant genetic wealth, comprising wild relatives, primitive cultivars and landraces, weedy forms, unimproved and modern cultivars and genetic testers. Approaches include *in situ* and *ex situ* conservation.

Efforts to conserve genetic resources *ex-situ* in seed gene banks (4°C, -20°C or -196°C) have accelerated in the past decades with an aim to provide ideal storage conditions for extending the mean viability period of the seeds. Successful seed storage depends on effective control of several factors including temperature, seed moisture content, storage atmosphere, etc. in response to storage conditions. Usually orthodox seeds (e.g. cereals, legumes, etc) which are small in size and remain viable at low moisture content of 3-7% are stored in seed gene banks. However, maintenance of genetic resources is difficult for the recalcitrant seeded perennial fruit/ forest trees; oil rich seed species, and seedless vegetatively propagated species. Most of the tropical tree species have non-orthodox or recalcitrant seeds with high moisture content which lose viability on drying. They thus cannot be stored using traditional gene banking at -18 to -20°C and are in general conserved as live plants in field gene banks. Therefore, alternative methods such as in vitro and cryopreservation need to be developed for their more effective conservation. Sometimes, genetically modified material (it is mostly produced using *in vitro* methods) may also be unstable and may require intact conservation for future use.

Concept of *in vitro* conservation came into being in mid 1970s. This method can be used for conservation of all species wherein methods for regeneration of complete plantlets from cultured cells or tissues are available. Germplasm stored as unorganized cells (callus) or suspension cultures carries the risk of development of somaclonal variations but organ cultures using organized meristems is more reliable and stable for conservation and regeneration of plants as per requirement. Following approaches based on *in vitro* technology can be used successfully for conservation of such recalcitrant species which are sensitive to desiccation and freezing.

A) **Cryopreservation -** Cryopreservation is a safe and cost-effective option for long-term conservation of genetic resources at a temperature of -196°C using liquid nitrogen. Seeds, zygotic embryos, somatic embryos, shoot meristems, pollen grains as well as winter buds can be stored successfully using this method. This method ensures indefinite conservation of live cells and tissues provided injury to the cells due to ice crystallization is avoided while freezing or thawing them. Many chemical (using high osmoticum and cryoprotectants), physical (air drying, alginate encapsulation) and freezing (droplet freezing, slow freezing, etc) methods have been successfully devised for some recalcitrant species. Zygotic embryos of oil rich seed species like neem, almond, cashew, Jatropha and winter buds of mulberry, populus, etc can be air dried for cryopreservation followed by their revival in vitro and field transfer as and when required. In species like mango where protocol for *in vitro* multiplication of plants is not available pollen cryopreservation has been achieved successfully, this pollen can be thawed for pollination whenever required. *In vitro* produced somatic embryos and apical meristems in case of vegetatively propagated species like *Dioscorea* (yams) can be cryopreserved using chemical cryoprotectants (vitrification) or by encapsulating them in alginate beads (synthetic seeds).

B) ***In vitro* cultures (Fig.3) –** Maintenance of *in vitro* cultures is the most reliable method for conservation of vegetatively propagated species and trees for which neither seed conservation nor crypreservation protocols are available. Shoot cultures of such species are maintained in a state of slow growth imposed by low temperature, high osmoticum, low light intensity or by using growth retardants. These cultures are subcultured to fresh medium every 12-36 months depending upon the species and growth retardation method used.

Modified culture conditions (Fig.4) – *In vitro* cultures usually show optimal growth at 25-27°C and require subculture at 3-4 weeks interval but storage of cultures (shoots and embryonic cultures) at a temperature of 2-18°C can retard the growth significantly so that subculture duration is extended to 12-30 months. Temperate species can tolerate temperature as low as 5-10°C but tropical species may show signs of chilling injury at such low temperature and therefore are maintained at 15-20°C for growth reduction. Whenever required these

cultures can be brought to normal growth conditions for rooting and field transfer. Reduced light intensity at normal or reduced temperature can further retard the growth of shoots.

Modified culture media – In some cases lowering of salt components of medium to 25, 50 or 75% or reducing sucrose concentration can retard growth of cultures. Alteration in ammonium nitrate concentration was helpful in grapes while replacing sucrose with fructose reduced growth in shoot cultures of papaya. Similarly increase in medium osmoticum using high levels of sucrose, mannitol or sorbitol can prolong the subculture duration. Some growth regulators like abscisic acid (ABA) and chemicals interfering with synthesis, transport or functioning of growth regulators (auxins, cytokinins and gibberellins) like chlormequat (CCC), paclobutrazole, daminozide and triidobenzoic acid (TIBA) when incorporated in the culture media can retard the growth of *in vitro* cultures.

These cryopreservation and *in vitro* conservation techniques can store more material in a limited space with minimum risk of pest and disease infestation, and handy tool for long distance national or international exchange of germ plasm. However, these sophisticated techniques are cost intensive demanding highly skilled manpower and equipments. Appearance of morphological or genetic aberrations in *in vitro* cultures is another associated risk.

In-situ and *ex-situ* conservation strategies should be used as complementary activities in safeguarding particular plant populations. It would be an ideal situation where both may be used to the best advantage to ensure both long-term species survival as well as for adequate supply of germplasm for improvement of related crops.

Fig.3 - *In vitro* repository and National cryogenebank at NBPGR, New Delhi.

Fig.4 – Regeneration of germplasm after cryopreservation as seeds (A – Date palm, B-Jangal jalebi), zygotic embryos (C-Almond, D-Jatropha, E-Neem) and Citrus zygotic embrys stored using (F) chemical methods (vitrification) and (G) sodium alginate beads (synthetic seeds).

Rajwant Kaur Kalia
ICAR-CAZRI, Jodhpur

Know Your Institutions

The Botanical Survey of India, Arid Zone Circle, Jodhpur

The Botanical Survey of India was established in 1890 at Calcutta with Sir George King (The suptd. of the Royal Botanic Garden) as its first ex. Officio Director. Through a succession of development events overtime, BSI now has following objectives:

A. PRIMARY OBJECTIVES

These include : Exploration and inventorisation of phytodiversity in general and Protected areas, Hotspots, Fragile ecosystems, Sacred groves etc in particular; Documentation of phytodiversity in the form of National, State and District Floras; the Floras of Protected areas, Hotspots, Fragile ecosystems, Sacred groves, etc; Monitoring of phytodiversity to evaluate the qualitative as well as quantitative changes in the biodiversity; Identification of threatened species (including endemics), their mapping and populations study and identification of ecosystems needing conservation ; *Ex-situ* conservation of critically threatened taxa in the Botanical Gardens through conventional and biotechnological methods; Bioperspective survey of plant resources of the country to identify economically as well ethno botanically important species for their conservation and sustainable utilization; To prepare National Database on the above, including herbarium collection, type collections and plant distribution etc.

B. SECONDARY OBJECTIVES

These are : Environment Impact assessment studies as may be specifically called for; Pharmacological studies on medicinal plants used by tribals; Phytochemical, palynological and cytological studies to provide additional clues to determine systematic position and taxonomic status of closely related taxa; To collect and preserve the plants and plant products, variously used by the people, in the form of museum exhibits for general awareness amongst the masses; Human resource development and education in the methodology of study of phytodiversity; To organize environmental awareness programmes regarding role of plants in environmental protection and pollution amelioration.

In order to fulfill above objectives, BSI has established 13 Regional Centers of which "Arid Zone Regional Centre", Jodhpur came into being in February, 1972. It is responsible for exploration and inventorization of plant resources of the arid and semi-arid regions of the North-west India viz. Rajasthan and Gujarat.

The main functional unit of Arid Zone Regional Centre of Botanical Survey of India (Figs.5-9) includes herbarium, experimental Botanic garden (attached to the office), museum and an updated library.

Experimental Botanic Garden (Desert Botanic Garden): Established in 1994 in an area of ca 8 acres (Figs.9-10), it has now 300 species of vascular plants and 4 gymnosperms of North-west India and cacti and succulent ca 50 species.

Herbarium: The Herbarium (Fig.7) is holding ca 34,500 specimens of which 18 are type specimens of angiosperms.

Library: This has 4246 (old classic and latest) accessioned books and 2612 back volumes of journals of taxonomy, floristics, ethnobotany, phytogeography and environmental science (Fig.6). Besides, 22 foreign and 10 Indian journals are also being subscribed to update the current knowledge.

Fig.5 - Bioresource building with library

Fig.6 - Library

Fig.7 - Herbarium arrangement with incorporation

Fig. 8 - Museum

Fig. 9 - Experimental Garden

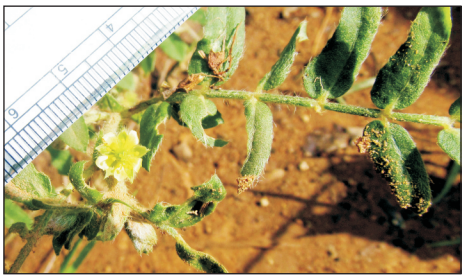


Fig. 10 - Closeup – Flower of *Tribulus rajasthanensis*

Museum (Fig.8) : More than 300 exhibits are displayed depicting folk uses of plants, famine foods, gum and resin, preserved exhibits, medicinal and economic products of plants, aquatic and beautiful plant portraits.

Botanical exploration : Based on field surveys of Rajasthan and Gujarat, more than 900 research papers and 200 research articles & book chapters are pubhshed from here. The Centre has also published 11 books viz. three volumes of Flora of Rajasthan (B.V. Shetty & V Singh, 1987, 1991, 1993); Flora of Banswara district, Rajasthan (V Singh, 1983); Ethnobotany of Rajasthan (V Singh & RP Pandey, 1998); Monograph on Indian subtribe *Cassiinae* (V Singh, 2001); Monograph on *Indian Leucas* R. Br. (Dronapushpi), Lamiaceae (V Singh 2001); Monograph on Indian *Diospyros* L. (Ebony, Persimmon), Ebenaceae (V Singh, 2005); Biodiversity of Desert National Park, Rajasthan (V Singh & Monika Singh, 2006); Biodiversity of Ranthambore Tiger Reserve, Rajasthan (V Singh & AK Srivastava, 2007). Flora of India vol. 9 and three volume of Flora of Gujarat are under publication. This Centre has also reported five new species to science from Gujarat and Rajasthan. These are-

SN	Plant Name	Family	Locality	Collector
1	*Hygrophila schulli* (Ham.) Alm. et Alm. var. *alba* PJParmar var. nov.	Acanthaceae	Kanajari, near Kadi, Gujarat	PJ Parmar
2	*Brachiaria chennaveeraina* Basappa et Muniyamma	Poaceae	Near Gomukh, Mount Abu, Rajasthan	GP Basappa & M Muniyamma
3	*Echinops rajasthanense* RP Panday & V Singh	Asteraceae	Sunda hill, Jaswantpura, Jalore, Rajasthan	BL Vyas
4	*Salvadora persica* L. var. *persica* f. *alba* f.nov. Rao et Chakraborti	Salvadoraceae	Khirlao village, near sardar Samand, Rajasthan	BV Shetty
5	*Tamarix kutchensis* Shetty & Pandey	Tamaricaceae	Kachchh, Gujarat	RP Pandey

B. Projects (on-going):

Currently , scientists here are engaged in studying-

1) Flora of Shoolpaneshwar Wildlife Sanctuary, Narmada, Gujarat;
2) Flora of Navasari district, Gujarat;
3) Flora of Todgarh Wildlife Sanctuary, Rajasthan and
4) Flora of Sariska Tiger Reserve, Alwar, Rajasthan

CS Purohit, Ramesh Kumar, Vinod Maina,
Botanical Survey of India
Arid Zone Regional Centre, Jodhpur

Know Policies and Programmes Related to Combating Desertification

Biological Diversity Act and the National Biodiversity Action Plan

The Biological Diversity Act 2002 was born out of India's attempt to realise the objectives enshrined in the United Nations Convention on Biological Diversity (CBD) 1992 which recognizes the sovereign rights of states to use their own Biological Resources. The Act aims at the conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner and through a just process for purposes of implementing the objects of the Act, it establishes the National Biodiversity Authority in Chennai.

National Biodiversity Action Plan (NBAP)

In pursuance to CBD, India enacted the Biological Diversity Act in 2002. Section 36 of the Act empowers the Central Government to develop national strategies, plans or programmes for conservation and sustainable use of biodiversity, and to integrate biodiversity concerns into relevant sectors.

Pursuant to ratification of CBD, following an extensive consultative process with various stakeholders, a National Policy and Macro-level Action Strategy on Biodiversity was developed, and approved by Committee of Secretaries in 1999, which was submitted to the CBD Secretariat. Thereafter, the Ministry of Environment and Forests implemented an externally-aided project on National Biodiversity Strategy and Action Plan (NBSAP) from 2000-2004, under which 33 state level, 10 eco-region level, 18 local level and 13 thematic action plans were prepared. On the basis of these action plans, a final technical report of NBSAP project was prepared. While this report was accepted in 2005, it was decided that preparation of the NBAP could be taken up only after approval of the National Environment Policy. The Cabinet approved the National Environment Policy in 2006. Thereafter, preparation of National Biodiversity Action Plan (NBAP) was taken up, by revising and updating the National Policy and Macro-level Action Strategy on Biodiversity developed in 1999, and by using the final technical report of the NBSAP project, so that the NBAP is in consonance with the National Environment Policy. Inter-and intra-Ministerial consultations were undertaken on the draft NBAP thus prepared. The revised NBAP incorporating the comments received has been approved by the Cabinet on 6th Nov 2008. The NBAP document has been printed and formally released by the Minister of State, MoEF on 24th Feb, 2009. The document can be accessed on MoEF s website, as well as CBD s website.

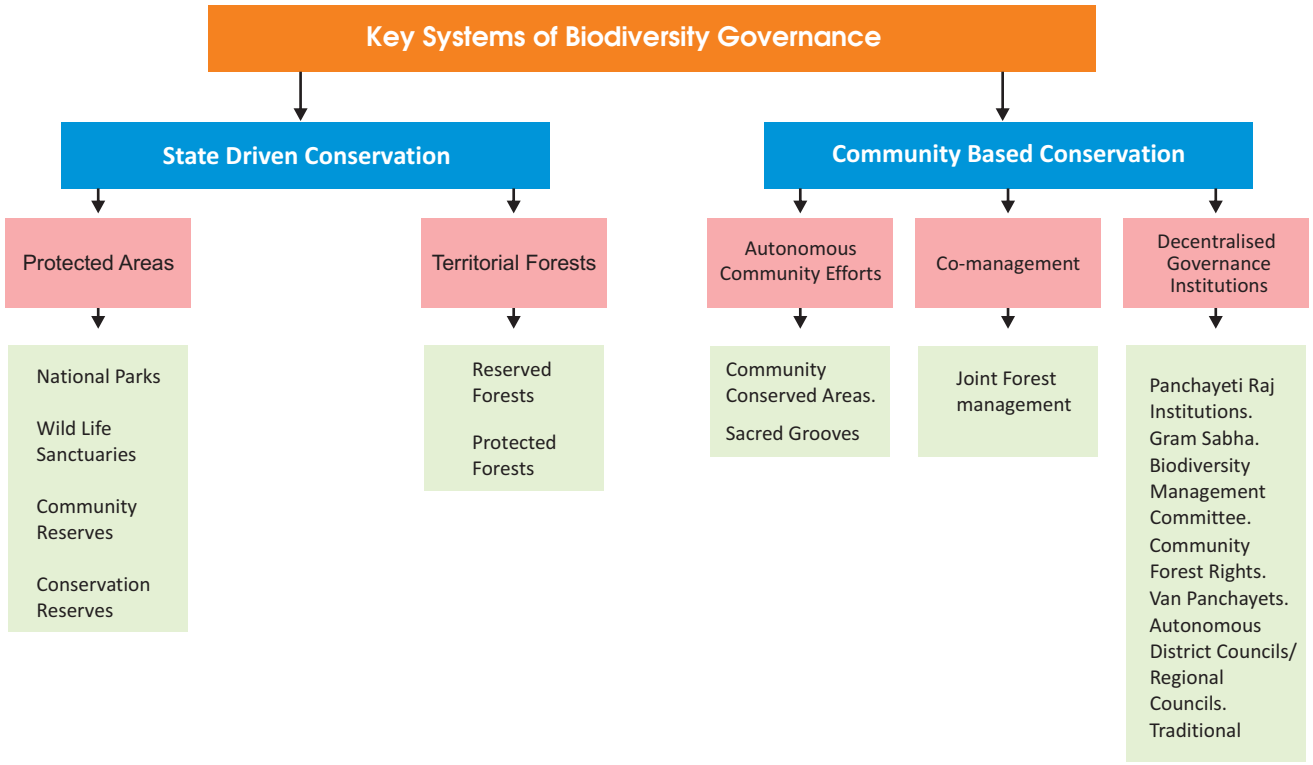
The NBAP draws from the principle in the National Environment Policy that human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature. This Action Plan identifies threats and constraints in biodiversity conservation taking into cognizance the existing legislations, implementation mechanisms, strategies, plans and programmes, based on which action points have been designed. The implementation of the activities listed in NBAP would require substantial inter-sectoral coordination. This is on account of the cross-cutting issues in biodiversity. Apart from the Central Ministries/Departments and their agencies, and State Governments, the other actors involved are local bodies, research institutions, non-governmental organizations and civil society. A tabulated matrix for implementation of key activities of NBAP indicating the implementing agencies and timeframe for each of the activities is given in Chapter 6 of NBAP. Since many of the activities are ongoing, these would be mainstreamed under the existing schemes, securing full utilization of available infrastructure and funds, with marginal to substantial augmentation and further inputs, wherever required on felt need basis. In addition, sources of external funding would also be explored and availed of according to requirements.

India is having the unique political position as its mainland is separated from the rest of Asia by the Himalayas. Three unparalleled factors give India its biological opulence likely the astounding spectrum of habitats and ecosystems existing over a wide range of latitudes and longitudes, confluence of three global centres of origin of life or 'Biogeographic Realms' and India's flora and fauna have been enriched by various elements from

each of these realms apart from its legacy of coexistence of humans and nature and a longstanding tradition of conservation. The unique mosaic of ecosystems and habitats in different bio-geographic zones of India has created a number of biodiversity-rich landscapes and the desert is one of that. India is having both hot and cold deserts.

That is the reason why perhaps many philosophers perceived the desert ecosystem as, "The desert, when the sun comes up...I couldn't tell where heaven stopped and the Earth began'', and from the conservation view point we need to look within and beyond us as "Man has wrested from nature the power to make the world a desert or to make the deserts bloom."

Consequently it is obvious to have a more nuanced vision for sustainably developed desert: one that reflects social and ecological realities and provides a framework against which policies and investments can be assessed. Such a vision should include at least four components based on the intersection between sustainable land management and biodiversity conservation: (i) adapting green economic growth to the desert; (ii) conservation and sustainable management of desert biodiversity with special emphasis on agro-biodiversity in particular ; (iii) land health as the basis for secure food and water provision; and (iv) resilience and risk management in uncertain environments. To achieve this, we need to understand common people's mental construct of biodiversity conservation vis-a-vis parallels of policy sensitization amongst legislators, planners and administrators as well. Key systems of biodiversity governance can be visualized through the following



Dipankar Saha
ICAR-CAZRI, Jodhpur

Knowledge Corner

Biodiversity Informatics in Biodiversity Conservation

Biodiversity offers multiple opportunities for development and improving human well-being. It is the basis for essential environmental services upon which life on Earth depends. Thus, its conservation and sustainable use are of critical importance. A kaleidoscopic view on the following facets needs to put in the backdrop of our mind and as well to envisage various canvasses of the whole ecosystem functions and services, if we really mean to mitigate and adapt in climate change scenario.

> It is that range of biodiversity that we must care for the whole thing-
> rather than just one or two stars - David Attenborough

Conservation of biological diversity entails about ethics of resource use, allocation, and protection and its primary focus is upon maintaining the health of the natural world, its fisheries and habitats and to do so the application of biodiversity informatics is very pivotal in the present digital world.

The term "Biodiversity Informatics" was coined to circumscribe the application of IT tools and technology to biodiversity information, principally at the organismic level. The basic objectives are:

- Mobilizing existing information resources ·
- Increasing research efficiency by timely provision of fundamental data for a steadily increasing number of problems
- Providing the information base and the tools for diverse biodiversity modelling tasks.

Biodiversity Informatics is the application of informatics techniques to biodiversity information for improved management, presentation, discovery, exploration and analysis. It typically builds on a foundation of taxonomic, biogeographic, or ecological information (Fig.11) stored in digital form, which, with the application of modern computer techniques, can yield new ways to view and analyze existing information, as well as predictive models for information that does not yet exist. Biodiversity informatics is a relatively young discipline (the term was coined in or around 1992) but has hundreds of practitioners worldwide, including the numerous individuals involved with the design and construction of taxonomic databases. The term "Biodiversity Informatics" is generally used in the broad sense to apply to computerized handling of any biodiversity information; the somewhat broader term "bioinformatics" is often used synonymously with the computerized handling of data in the specialized area of molecular biology. Biodiversity informatics (different but linked to bioinformatics) may also have to cope with managing information from unnamed taxa such as that produced by environmental sampling and sequencing of mixed-field samples. The term biodiversity informatics is also used to cover the computational problems specific to the names of biological entities, such as the development of algorithms to cope with variant representations of identifiers such as species names and authorities, and the multiple classification schemes within which these entities may reside according to the preferences of different workers in the field, as well as the syntax and semantics by which the content in taxonomic databases can be made machine queryable and interoperable for biodiversity informatics purposes.

Biodiversity Informatics is a priority task for the drylands biodiversity (arid and semi-arid areas) which covers

approximately 40 per cent of the Earth's land surface (Fig.12). The total number of species in the world is estimated to be between 30 –100 million, of which about 1.4 million have been formally described. Although the number of species in drylands is not well documented, it is generally accepted that species diversity is not as rich here as in more temperate or humid regions. But drylands are home to a relatively high number of endemic species — plants and animals uniquely adapted to the variable and extreme conditions of these areas. The International Union for the Conservation of Nature (IUCN) and the World Wildlife Fund (WWF) identify 234 Centres of Plant Diversity (CPD) worldwide, of which 42 are within drylands.

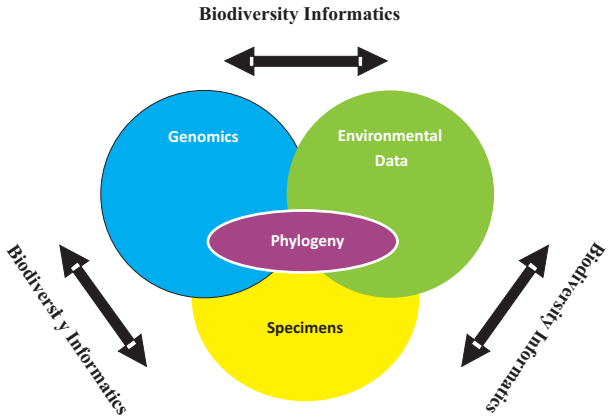


Fig. 11 - *Various Subsets of Biodiversity Informatics and its inter-relationship*

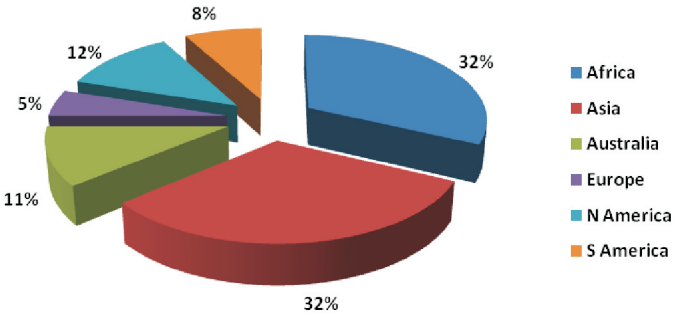


Fig.12 - *Global Distribution of Drylands*

At the regional level, ICAR-CAZRI has completed a agro-biodiversity baseline survey in three districts of Rajasthan (Jodhpur, Jaisalmer and Barmer) being an action very much in line with the global strategies of the Convention of Biological Diversity (CBD) during United Nations Decade on Biodiversity (2011-2020). Apart from the baseline survey, "Digitization and Database Development of the Botanical Collections from Indian Arid Zone" being the very basis of Biodiversity Informatics Management has also been initiated to have all the digitized information of more than 7000 collections in a web accessible interface by incorporating accessibility, inclusiveness, efficiency and accuracy (Fig.13). Thus, Biodiversity Informatics Management System so developed will enable access to plant biodiversity data that are fit-for-use by scientists and decision makers working on biodiversity conservation and sustainable development.

Fig.13 - *Herbarium as Arid Plants Repository of ICAR-Central Arid Zone Research Institute (Aiming for Collections, Maintenance, Curation, Digitization and Informatics Management)*

Dipankar Saha, *JP Singh and CB Pandey
ICAR-CAZRI, Jodhpur
*ICAR-CAZRI, Jaisalmer

Events by ENVIS CAZRI

"Customised Hands-on Bhuvan Training Program for ENVIS Centers" - MoEF & CC, New Delhi sponsored two days training programme for ENVIS Centres was held at National Remote Sensing Centre (NRSC), ISRO, Jodhpur during 15th and 16th October, 2015. ENVIS-CAZRI facilitated in organising this training. Twenty five participants from 22 ENVIS Centres comprising both thematic and State/UT Centres attended this program. This training aimed to have skill development in creating and disseminating content relating to the themes assigned to ENVIS Centres in geo-spatial platform in Bhuvan portal. Senior Scientists from NRSC, ISRO demonstrated how Bhuvan portal resources could be used for enriching the content of ENVIS websites. It was emphasized that features of Bhuvan portal may be used by State and Thematic ENVIS Centres for further dissemination of information. It was inaugurated by Dr S.N. Rao, Director of NRSC, Jodhpur. The valedictory function was chaired by Sh. M. Kannan, Economic Advisor, ENVIS Directorate, MoEF & CC, New Delhi. He also released the DEN Volume 17 (1, 2 and 3) on this occasion.

Theory Training

Hands on Session

Release of DEN (17.1, 17.2 & 17.3) by Sh. M. Kannan, Economic Advisor, ENVIS Directorate

The ENVIS Family

Fig.14 - Views of Bhuvan Hands-on Training at Jodhpur

Conferences

DATE	TOPIC	PLACE
	NATIONAL	
October 26-28, 2015	2nd Indo-Global Summit & Expo on Veterinary	Hyderabad, India
December 12-14, 2015	3rd International Conference on Environmental Friendly Agriculture & Horticulture in Planning of a Smart City Bhopal, India	Bhopal, Madhya Pradesh, India
	INTERNATIONAL	
November 16-19, 2015	Desert Technology 12th International Conference DT12	Cairo, Giza, Egypt
November 20-21, 2015	International Conference on Agriculture, Livestock and Forestry (ICALF 2015)	Makassar, Indonesia
November 20-24, 2015	23rd International Grassland Congress	New Delhi, India

News

Endangered plants find fertile ground in arid Thar

RESEARCH Scientists are finding ways to rebuild populations of rare plant species

Dinesh Bothra
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JODHPUR: The inclusion of 60 Indian plant species in the Critically Endangered and 141 in the Endangered categories by the Red List of the International Union for Conservation of Nature (IUCN) undoubtedly paints a dismal picture of preservation efforts in the country.

But, working away from the limelight, the Central Arid Zone Research Institute (CAZRI) has been carrying out experiments for the preservation and reintroduction of endangered plant species in the Thar desert.

And the results, scientists said, is encouraging.

Dr Suresh Kumar, principal scientist at CAZRI, said donor genes that provide resistance to plants against adverse effects of climate change were identified a decade ago by our scientists and the CAZRI was now researching ways to conserve such species.

This conservation programme for endangered and critically endangered species was initiated in 2008 with financial support from the Ministry of Environment and Forests (MoEF).

In the first phase, as many as 17 threatened and vulnerable desert species were regenerated and conserved successfully in the Desert Botanical Garden at CAZRI in Jodhpur which the MoEF has recognized as the lead garden in the Arid Zone of India, Dr Kumar said.

Providing details on the ongoing research programme by CAZRI, Dr Kumar said the institute is now participating in another mega-conservation programme of the department of biotechnology to prevent extinction of other rare, endangered, threatened and endemic species under a team of four scientists. He added that ecological modelling of five other sensitive species had also been done to find potential areas of their distribution and also for reintroduction to rebuild their populations.

Using the information generated by this ecological modelling, saplings of threatened species prepared in the Desert Botanical Garden were reintroduced in suitable areas.

The reintroduction of three species has proved to be successful — Ceropegia bulbosa (104) saplings were reintroduced in Machia Biological Park, Jodhpur, and showed 90% survival rate, attained 60 cm height in two months and flowering was observed in 51% of the plants.

"In order to conserve these plants as field gene banks with people's participation, it was considered essential to integrate it with some economic activity. We therefore designed an alternate land-use system of growing threatened species with fruit plants as orchards," said Dr Akath Singh, senior scientist (horticulture).

"Our efforts in the past four years to grow seven varieties of guava along with Caralluma edulis have been successful in the experimental plots."

Thus, a multipronged approach of off-site conservation and natural conservation, field gene bank and reintroduction into native sites has given different models or options to foresters and desert farmers to adopt such a model on their lands.

This is expected help increase green cover, reduce sand-drift, improve the environment and also grow the income of farmers.

These are also potential candidates for bio-prospecting and may well become components of commercial products in the near future besides being biological curiosities.

The team is now raising awareness and imparting conservation training with the involvement of communities and the forest department.

SIXTY NATIVE PLANTS ARE CRITICALLY ENDANGERED

(Clockwise from top) Neurada procumbens, Calligonum polygonoides and Glossonema varians. HT PHOTOS

Hindustan Times Dec. 20, 2015

Alternative farming: Villagers in western districts show the way

shoebkhan@timesgroup.com

Jaipur: As world leaders deliberate ways to mitigate adverse effects of climate change at the United Nations Conference of Parties (COP21) in Paris, villagers in the parched areas of western Rajasthan have already shown the way by adopting alternate farming practices.

Not only have their yield per hectare of traditional crops like millets, guar, moong, moth ben and cow pea increased, they have moved onto climate ready cultivars like wheat and mustard. Besides, fruits like green berries, pomegranate, cordia myxa (Lasura) for nutrition has raised their income levels by 25%.

These villagers in several areas of Jodhpur, Jaisalmer and Barmer are scientifically supported by the Union government funded Centre Arid Zone Research Institute (CAZRI) in Jodhpur with International Crops Research Institute for Semi-Arid Tropics (ICRISAT) based in Hyderabad.


ICRISAT
Women trying techniques of sustainable farming in Jodhpur

Dry lands leading to poverty is one of the core issues at the ongoing climate summit in Paris. Global leaders will discuss alternate means of agriculture, crops, agro-forestry and pasture cultivation for providing livelihood to the millions. The average rainfall in the dry lands in Rajasthan is less than 230 mm, which is suitable for growing conventional crops (millets, guar, moong, moth ben and cow pea) enough to sustain for 8-10 months. For fetching drinking water, the villagers have to scale kilometres in the area which is fast turning into a desert, adding to the poverty of families.

This region has witnessed a sharp rise in the frequency and length of dry spells adversely impacting crop and fodder yields due to climate variability or climate change in the recent decades. The social impact was mass migration of humans and livestock reported in the dry areas, which face drought every second year.

Times of India Dec. 01, 2015

Huge fall in water table due to rise in surface temp: CAZRI

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Jaipur: A report of Centre for Arid Zone Research Institute (CAZRI), Jodhpur, says that the temperature has risen by one degree Celsius in past four decades in western Rajasthan which has impacted its 12 districts as it increased the annual average groundwater consumption by 44%.

The rise of one degree mean temperature has been attributed to the global warming, according to the recent report by CAZRI, which calculated the impact of climate variation on the total irrigated area in these 12 districts — Barmer, Bikaner, Ganganagar, Hanumangarh, Churu, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali and Sikar.

These districts have seen a rise in surface heating, reduction in rainfall, change in crop pattern and low milk productivity of livestock in last two decades, says the report which further points out that unusual heating of the surface has been happening since the mid 1980s.

Here, the estimated total cropped area is 1.17 crore hectare land, of which total irrigated area is 31.64 lakh hectare.

Instead of 3,516 million cubic metre (mcm) water required for irrigating 31.64 lakh hectare land based on the past years of irrigation pattern, the rise in temperature meant that additional 1,570 million cubic metre water would be required to irrigate the same land.


Twelve districts have seen a rise in surface heating, reduction in rainfall, change in crop pattern in the last two decades

For example, Barmer requires additional 71 mcm water to irrigate its land while Nagaur needs additional 238 mcm water for its irrigated land. Therefore, it resulted in depletion of groundwater which is also the main water resource for domestic use and livestock.

The average depth of borewells has gone from 250-300 feet up to 800 feet. "The water beyond 300 feet is not considered suitable for humans, livestock and soil. The depleting water table has further increased the cost of extracting underground water," said Rakesh Goyal, a senior scientist who submitted this report to Indian Council of Agricultural Research.

The study also focussed on the rising rate of evapotranspiration requiring more water per hectare to irrigate crops. The average evapotranspiration rate in these districts varied from 1,502 mm for Nagaur to 2,177 mm for Barmer annually in 2013. It has registered a rise of 3% to 10% in the entire region. Along with irrigated areas, the water consumption has also increased for domestic use and livestock. The water consumption by the livestock which was 2.2% in 2005 increased to 2.4% in 2015.

The share of water for domestic needs was 6.5% in 2005. It jumped to 7.1% adding burden on the available water resources.

Despite excessive use of water, the study points out that over the years, 20%-40% loss of yield was recorded in mustard and other Rabi crops. The green pastures reduced, which in turn affected weight and milk production of livestock. The agricultural output has also fallen, putting an end to sustainable productivity.

In its study, the CAZRI explains that the immediate need is to switch over to arid farming, introduce livestock production management, take measures for effective soil conservation and make efforts to harness renewable energy resources.

Times of India Dec. 02, 2015

अन्य किसानों के लिए प्रेरणा बने जैविक खेती करने वाले किसान | जैविक फसल की लागत कम और गुणवत्ता में भी आगे

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बारह साल बाद इस सितंबर में बारिश न होने से बदली जलवायू ने रासायनिक खेती की बजाय जैविक खेती का विकल्प खुला कर दिया है। काजरी में तैयार मॉडल के आधार पर जैविक खेती से मुनाफा कमा रहे राज्य के कई किसान खेत में ही वर्षा जल संरक्षण, लाभदायक कीटों का संरक्षण खाद, कीट नियंत्रित बनाकर अन्य किसानों के लिए प्रेरक के रूप में सामने आए है। अब राज्य में शुष्क क्षेत्र के अनुकूल खेती को बढावा देने के लिए केंद्रीय शुष्क क्षेत्र अनुसंधान संस्थान (काजरी) जिले के दो गांवों को भी आदर्श जैविक गांव के रूप में विकसित करेगा। पिछले 40 दिनों से राज्य में बारिश की एक बूंद भी नहीं हुई लेकिन राज्य में काजरी के एकमात्र प्रमाणित जैविक फार्म में ग्वार, तिल मूंग, जीरे की खड़ी फसल तैयार है। 12 प्रजातियों के वृक्ष भी लगे हुए है। अब इसी तर्ज पर जिले के दांतीवाड़ा और मथानिया क्षेत्र के उजलिया गांवों को आदर्श जैविक गांव के लिए चयनित किया है। दांतीवाड़ा में तिल व मूंग और उजलिया में जीरे व इसबगोल का जैविक उत्पादन किया जाएगा। यहां जैविक खेती के लिए किसानों को प्रशिक्षण और जैविक बीज उपलब्ध कराए जाएंगे।


काजरी में शुष्क क्षेत्र के अनुकूल तैयार जैविक फार्म।

इस मौसम में जैविक खेती ही लाभदायक

- किसान खेत में ही बीज, खाद और आम नीम धतूरे से कीट नियंत्रक बना सकेंगे।
- जैविक खेती की लागत रासायनिक खेती से काफी कम।
- रासायनिक खेती से कम हो रही मिट्टी उत्पादकता जैविक खेती बढाएगी।
- स्वास्थ्य के लिए हानिकारक नहीं।
- वर्षा की अनिश्चितता में जैविक खेती फसलों के लिए ज्यादा फायदेमंद।

मेरे 28 बीघा खेत में जैविक खेती से बाजरे और तिल की खड़ी फसल इस मौसम में भी तैयार है। वहीं मैंने तो मिर्ची और गाजर की बुवाई की है वह भी थोड़ी तैयार हो गई है। जैविक खेती में बदलती जलवायु का कोई खास असर नहीं है।

- गोरधन राम, नेवरा,
तहसील ओसियां।

कई किसानों ने उठाया लाभ

पिछले 40 दिनों से कोई बारिश नहीं हुई है। ऐसे में ये जैविक खेती कम पानी भी पनप सकती है। राज्य के कई किसान इस खेती से लाभ उठा रहे हैं।

-ए.के. शर्मा,
वरिष्ठ वैज्ञानिक, काजरी जोधपुर।

मैंने अपने 31 में से 20 बीघा में मूंग, मोठ, ग्वार, बाजरा और तिल की फसल जैविक खेती से तैयार की है। इससे तैयार आलू का स्वाद मीठा होता है। रासायनिक खेती में जहां पेस्ट्रीसाइट मिलाने पड़ते है जैविक खेती में फसल को सीधे ही पोषक तत्व मिल जाते हैं। इस फसल की मांग भी बढ रही है।

- गणपत सिंह राठौड़,
रणीसर गांव, तहसील फलौदी।

Patrika Oct.2, 2015

ENVIS CAZRI Website

Following Statistical Databases of Rajasthan (Arid Zone) can be accessed in CAZRI-ENVIS Website

- Crops- Area, Production and Productivity
- Rainfall Distribution
- Human Population - Rural, Urban
- Livestock - Cattle, Buffalo, Sheep, Goat, Camel, Poultry
- Working Human Population
- Density of Human Population
- Sex Ratio
- Irrigation by Canal, Tank, Wells, Tubewells
- Agricultural Equipments - Animal Cart, Electrical Pump set, Oil Engine Pump Set, Plough, Tractor
- Fertilizer Consumption
- Landuse Pattern - Forest, Barren and Uncultivated land, Cultivated waste land, Current Fallow, Net Area Sown, Non Agriculture Use, Old Fallow, Pasture and Grazing, Trees and Groves
- Electricity Consumption - Industrial, Commercial, Domestic and Residential Uses
- Temperature
- Humidity
- Mineral Production

Compiled by Shweta Mathur and Akshay Bhardwaj
CAZRI, Jodhpur