July - December 2018

Volume 20 (3-4)

DESERT ENVIRONMENT NEWSLETTER

ENVIS Centre on Combating Desertification

ICAR-CAZRI

In this issue :

Hosted by
ICAR- Central Arid Zone Research Institute
Jodhpur

Supported by
Ministry of Environment, Forests and Climate Change
Government of India

Published by
ENVIS CENTRE
on Combating Desertification

From the desk of chairman

Dear Readers,

Orans (sacred groves) and *Gauchars* (village grazing lands) are the most important common property resources and play a vital role in livestock based agriculture economy in the hot arid region. They have specific significance to provide ecosystem services for the inhabitants like provisioning (water, food, fuel wood, gums and resins, medicinal herbs etc.) and regulating (pollination and water purification etc). Being a vital traditional heritage sites/ micro-biodiversity reserves, these sacred woodland patches even retain feasible population of rare and threatened species. Due to over exploitation, dilution of traditional conservation practices/beliefs and natural vagaries, they are in degraded state particularly in terms of understory perennial grass cover. However, these common property resources still play as major forage resource base to animals (both livestock and wildlife) and also a source of multiple-use livelihood support system to inhabitants. Further, in view of global climate change scenario, *Orans* will have greater impact on biodiversity and livelihood support system. Therefore, there is an urgent need for accelerating their vegetation recovery process and also sustainable utilization. Need of effective grazing policy, working towards community participation and awareness campaigns, applying appropriate soil and water conservation measures, reintroduction of locally threatened and rare plant species, rehabilitation of water storage structures inside the *Orans*, developing database for all *Orans* irrespective of their extent etc. are important measures for rehabilitation of such resources.

I am happy that this issue has briefly discussed these aspects.

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Know Your Desert

Orans (sacred groves) as Biodiversity Heritage Sites: Case Study of 'Aain Mata Oran' from Indian Thar Desert

For several decades the biodiversity conservation has been on international policy agendas. But biodiversity is still decreasing at an appalling pace. To reverse this trend increased effort of the global community with its local and regional actions are necessary. Usually, conservation efforts have been focused on protected areas. The areas of high biodiversity are to a large extent located in landscapes where people live and work. Consequently successful maintenance of biodiversity in these areas is at stake. Apart from all these, in rural landscapes, biodiversity is often dependent on traditional resource management practices. Thus many researchers suggested about some conservation strategies wherein a combination of approaches encompassing firstly for the entire landscapes, and secondly, considering the landscape as a social–ecological system with all the relevant interactions between people and nature is being practiced and this is reflected by the concept of ecosystem services that focuses on benefits humans get from ecosystems. Presently this has become a mainstream approach to conservation as it is biodiversity that assures flow of ecosystem services to the society.

Conservation of plants and other natural reserves has been an integral part of cultural ethos of indigenous communities in many parts of the world who considered themselves as being linked in a web of spiritual relationship with their biophysical environment. In Indian nature, worship dates back to the Vedic period (5000 B.C.) and is based on the premise that all creations of nature have to be protected. Sacred groves are such an undeniable entity of this eternity. Since last few decades scientists are trying to define sacred groves and in this directions Hughes and Chandran (1998) tried to define sacred groves as "Segments of landscape containing vegetation, life forms and geographical features, delimited and protected by human societies under the belief that to keep them in a relatively undisturbed state is expression of an important relationship of humans with the divine or with nature." The sacred groves have been reported from different continents of the world such as Africa, Asia, Europe, Austro- pacific region and Americas. In India, there has been no comprehensive survey of the sacred groves at the national level, but approximately 13,720 sacred groves have been reported so far. Experts also express that the actual number could be much higher and could be in the range of 100,000 – 150,000.

The earliest documented work on sacred groves in India is that of Brandis (1897), the first Inspector General of Forest. Sacred groves reported from different parts of India are locally known by different names for example, "Sarna" or "Dev" in Madhya Pradesh "Devrai" or "Devrahati" in Maharashtra,"Sarnas" in Bihar,"Orans" in Rajasthan, "Devarabana" or "Devarakadu" or "Rulidevarakadu" or "Nagabana" etc. in Karnataka, "Kovilakadu" in Tamil Nadu "Kavu" in Kerala, "Dev van" in Himachal Pradesh, "KI Law Lyngdoh" or "Ki Law Kyntang" in Meghalaya, "Sarana" or "Jaherthan" in Jharkhand and "Lai Umang" in Manipur. The culture and society of Rajasthan is very rich and *Orans* and *Gauchar* lands are the real privileges given by their culture. In the past, *Orans* and *Gauchars* were the mainstay of livestock farming in the area. The productivity of these areas, however, decreased due to heavy grazing pressure. Researchers also inferred that about 80 per cent of areas of these community forests in arid and semi arid tracts of Rajasthan are in poor condition due to excessive grazing, wind erosion and land degradation.

Aain Mata Oran

The Great Indian Desert, also known as 'Thar Desert', being one of the most densely populated deserts of the world. As per 2011 census, India's arid land is having 27.12 million people, with a population density of 129 persons per square km (compared to 3 to 6 in other deserts around the world). 'Aain Mata' *Oran* is located in Sodakore village in Jaisalmer district having the population of 1521 and consists of 236 households. Animal husbandry and agriculture is the most important livelihood of this village. The village *Oran* is named Aain Mata after their deity (Jagdamba / Kumtarai Jogmaya). The

*Brandis D. 1897. Indigenous Indian Forestry: Sacred Groves in Indian Forestry, Working Oriental Institute, UK. pp. 12-13.

*Hughes D.J. and Chandran Subash M.D. 1998. Sacred Groves around the earth: an overview. Paper presented in the workshop on The role of sacred groves in conservation and management of Biological Resources, KFRI, Pechi.

livestock used to come here for grazing and water all through the year and there is no restriction on the usage of the *Oran*. The total area of this *Oran/Gauchar* is 2668 ha, lies outside the village residential area with a temple and a tube-well.

This land is viewed as common property resources and is used for grazing but there is no tree felling usually within this area, as it is considered as sacred land. The villagers consider this *Oran* as most sacred one and their faith in the goddess prevents them in cutting of trees and all other forms of vegetation. Thus the state of vegetation is fairly good in this *Oran*. More than 2000 ha out of the total area of 2668 ha are with full of vegetation and accounts for more than 65 per cent of the total *Oran* area. The rest of the area is sparsely vegetated. The Aain Mata *Oran* is a part of a larger *Oran* named 'Bhadariya *Oran*'. This *Oran* area has traditionally been exclusively reserved for cattle grazing. Thus *Oran* is the only areas that includes good amount of vegetation within very degraded surroundings.

Biodiversity Heritage

It was mentioned by villagers and Mr. Papu Singh- the ex-Sarpanch (village head) that there are over fifty types of plant species found in the 'Aain Mata' *Oran* of Sodhakore. Plant diversity of the *Oran* is dominated by shrubs of Bordi (*Ziziphus nummularia*) and Kair (*Capparis decidua*) and grass species like Sewan (*Lasiurus sindicus*) and Gantiya (*Dactylotenium sindicum*) are thriving on it. If we look into a proverb of local society related to Kair and Ber i.e; *"Keh Rahim kaise tire, Kair-Ber ke sang! wa Dholat ras aapne, baki faatat ang"*, then any one can understand how the *Oran's* association of plant types are unique in their composition. The meaning of this proverb is "Rahim says that how can Kair and Ber stay together because one is full by its sweetness and another one cuts their body parts". But in this *Oran* Kair and Ber stay together in large numbers. The overall condition of vegetation in this *Oran* is fairly good and the dominating species are Khejri (*Prosopis cineraria*), Ber (*Ziziphus* spp), Kair (*Capparis decidua*), Kumat (*Acacia senegal*), Rohida (*Tecomella undulata*), Babul (*Acacia nilotica*), Aak (*Calotropis procera*), Sewan (*Lasiurus sindicus*), Jaal/Pilu (*Salvadora oleoides*), Tumba (*Citrullus colocynthis*), Lana (*Haloxylon salicornicum*) etc. which provides sustenance to land thereby to community.

The birds found in this Oran include Godawan (Great Indian Bustard), parrot, crows, eagles, sandgroose, honey buzzards, babblers, kites etc. whereas the animals like desert fox, deer, rabbit, wild boar, chinkara, wolf, blackbuck, hedgehog, Nilgai etc. are also found in this area. Different kind of reptiles like monitor lizard, russell's viper, saw scaled viper, spiny tailed lizard, common krait, gecko, etc. are also present. This *Oran* also works as protector of watersheds/water sources. There are several *Talabs/ Nadis* (traditional water harvesting structures), open well and tube wells in this area. The name of one pond is Badhiya Nadi and another one is Dhaneri Nadi. Water of Badhiya Nadi is for human and of Dhaneri Nadi is for livestock's and other animals.

Talabs/Nadis have been constructed at a place in any *Oran* to have maximum run-off. The *Talabs/ Nadis* are the principle source of water for the village and the Gram Panchayat looks after de-silting of these water bodies. The Nadis (water sources) are reported to be repaired and maintained following Shramadan (voluntary labor) and also supported by Panchayat under MGNREGA.

Managing Governance

Villagers also mentioned that this *Oran* is not usually been encroached by villagers for dwelling or agricultural purposes. The people in the village are aware of the benefits of this *Oran* and the significance of this land for their livestock. Over

10000 livestock are depending on this *Oran* and this motivates them to protect it towards grazing purposes apart from its strong religious significance associated with their deity. In the case of any encroachments, the elders have set the rules like penalty which is Rs. 5,100/- as a repayment to the community including social boycott. However, till date, only few such cases have been registered. During the community member's interviews, it was categorically stated and understood that the majority of the encroachments was done by maneuvering the officials and mainly done by the powerful and influential households in the village. Maintenance of the *Oran* and its management is co-ordinated by the village community. The village community prevented privatization of *Oran* land by any individuals and there are strict norms to prevent felling of trees and its poaching. In the interviews local people given the feedback that there have not been any remarkable efforts to develop the *Oran* or the *Gauchar*; though plantation is being carried out in this *Oran*. The villagers are also keen to grow palatable grasses and fodder trees if the funds are provided. The periphery of the *Oran* is respected by all the villagers who graze their livestock. The villagers are also allowed to collect dry and fallen wood for fuel and funeral fires, including leaves for fodder.

Inferences

There are no examples of inter-village conflicts which may create hindrances in the governance of this *Oran*. The size of the *Oran* as well as their necessity for the communities survival is definitely contributing to the social solidarity and accountability towards the norms and thereby towards supporting the local management. The *Oran* holds fairly good amount of vegetation like trees, shrubs and grasses compared to all other categories of the Common Property Resources (CPRs). *Oran* provides ample fodder sources for the livestock and plays a very important role in the lives of local communities. The majority are well aware of the sensitive situation of the environment and show consideration and restriction towards private usage in the *Oran*. However, due to the promotion of tourism in the area, a hotel opened in the vicinity of the *Oran* and the hotel owner is taking full advantage of this *Oran*.

The encroachment is mainly towards construction of community facilities like schools, bus stops, water conservation, power houses and military camps, but keeping in view the quantum of total land area under CPR, this type of developmental encroachment appeared to have no bearing on the overall status of the CPRs. Finally it may be concluded that given the difficult conditions of the area, the community has been fairly successful in managing their *Oran*. Therefore, it deserves a special status looking towards the importance of biodiversity conservation. There is also an urgent need to start and maintain PBR (Public Biodiversity Register) to record taxonomic, ethno-botanical, ethno-zoological and DNA fingerprinting with an aim to tag property rights on all the life forms present in this *Oran*. There should be further initiative to spread greater awareness amongst masses about the medicinal benefits of innumerable herbs, plants and trees which flourishes in this *Oran*. Women play a very crucial role in conservation of *Oran* and thereby sustaining livelihoods of local commune. Therefore, women need to be empowered in decision making. People from the villages who are actively involved with the governance of *Oran* should be in regular contact with their counterparts from other villages so as to learn about and implement newer ideas and policies, if any. These also need to be recurrently derived research outlook towards contextual relevance of *Orans* like it's impact and is in turn impacted by agricultural and animal husbandry practices in the surrounding areas, role of *Orans* in soil quality, nutrient recycling, energy management in terms of firewood etc. *Orans* are playing a greater role in climate change adaptation mechanism; therefore, KRAPAVIS is scaling up its experiences to other part of the state particularly to Thar Desert, which would certainly contribute profoundly to this cause.

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Rehabilitation of *Orans* (sacred groves) in Western Rajasthan

In western Rajasthan, *Gauchars* (common grazing lands) and *Orans* (sacred groves) are an important source of forage resources for the huge livestock population (Total Rajasthan 577.32 lakhs and 310.69 lakhs in western Rajasthan per 19th livestock census of 2012) as well as for wild life. They are very important common property resources (CPRs) in rural backdrop of western Rajasthan. Perennial woody vegetation (shrubs/trees) in the *Orans* have an important role in providing nutritious browse to animals, particularly during the lean period when the grasses have dried up. So, they are vital for the traditional livestock rearing activity which is the mainstay of the economy of this region. *Orans* are also the source of minor forest produce/non timber forest produce (NTFPs) like edible fruits, gums & resins, medicinal herbs etc to the inhabitants. *Orans* or *Dev Vans* (sacred lands or sacred groves) are the patches of woodlands preserved in the name of local deities and/or saints. These patches are testimony of the traditional conservation measures of woody perennials and are the repositories of rich biodiversity of indigenous species existed in a natural silvi-pasture system. State of Rajasthan has nearly 25000 scared groves and other sanctified ecosystems. The Rajasthan State Forest Policy also recognized the importance of *Orans*. Western Rajasthan has considerable area under the *Orans* and some of the *Orans* have very large area. In Jaisalmer district total area covered by *Orans* is >70,000 ha covering most of the habitats and plant communities. Due to over exploitation of the resources, they are in degraded state and these lands are losing desirable grasses/herbaceous, woody perennial species resulting in habitat degradation in the form of erosional hazards. Further, loss of fauna also goes along with the degradation of these areas. It is now obvious that many more analytical and factual information are required on how to put these existing *Orans* in a better form and manage it in a better way for their sustainable utilization and proper conservation.

Orans have social-cultural, ecological and economic significance to a great extent and are having a specific significance to ecosystem services for local communities, like provisioning (water, food, fuel wood, medicinal herbs etc.) and regulating (pollination and water purification etc). Being a vital repository of regional biodiversity, they even retain viable populations of rare and threatened species. *Orans* are also a source of multiple-use livelihood support system. They provide fuel wood and minor non-timber produce like edible fruits like Bordi (*Ziziphus nummularia*), Kair (*Capparis decidua*), Phogla from Phog (*Calligonum polygonoides* L.), Sangri from Khejri (*Prosopis cineraria*), Kumat (*Acacia senegal*), Khipoli from Kheep (*Leptadenia pyrotechnica*); gums and resins, honey, fibres, medicinal herbs etc. to the inhabitants. Gums from *Acacias* particularly from trees of Kumat (*A. senegal*) and shrubs of Bawli (*Acacia jacquemontii*) not only provide gum for their own consumption but also as livelihood support as additional income. *Ziziphus* shrubs/trees provide fresh as well as dry fruits to inhabitants. The *Orans* in Jaisalmer district with natural stands of Lana (*Haloxylon salicornicum*) are the source of wild mushroom locally called as *Khumbi*. Inhabitants of the area also generate income through collection of these produce and its sale in local market. The Bur grass (*Cymbopogon jwaruncusa*) is collected by the inhabitants for religious use and also for broom-making. *Orans* also provide habitat for water storage and nest-sites for wildlife and birds.

Biodiversity of *Orans*

Floral Diversity

Most of the *Orans* in western Rajasthan harbor rich native floral biodiversity encompassing most of the landforms. They have habitat specific woody perennials and other species associations adapted to harsh climatic conditions.

i. Woody perennials (shrubs/trees): Some of these *Orans* in Jaisalmer district still maintain the diversity of indigenous trees and shrubs particularly species of Bordi (*Ziziphus nummularia*), Kumat (*Acacia senegal*), Mitha Jal (*Salvadora oleoides*), Khara jal (*S. persica*) Kair (*Capparis decidua*), Khejri (*Prosopis cineraria*), Gondi (*Cordia gharaf*), Gangeran (*Grewia tenax*), Lana (*Haloxylon salicornicum*), Sinia (*Crotalaria burhia*), Kheep (*Leptadenia pyrotechnica*) etc. In Degrai Ji *Oran*, Jaisalmer, one can still find the diverse plant type of Kair (*C. decidua*) from shrub to tree form, and big size trees of *Ziziphus* species as well.

ii. Herbaceous perennials: Among grasses Sewan (*Lasiurus sindicus*) was the most prominent grass in the area, which was degraded to a greater extent. Murath (*Panicum turgidum*) in dune areas and Karad (*Dichanthium annulatum*) in depression areas are also found. Colocynth (*Citrullus colocynthis*) locally known as Tumba occurs in most of the areas. The ground vegetation mostly consisted of perennial grasses like Tantia (*Dactyloctenium sindicum*), Gathia (*Ochthochloa compressa*) and annual grasses like Bhurat (*Cenchrus biflorus*), Lampa (*Aristida* species) etc. Among herbaceous legumes Bekria (*Indigofera cordifolia*) is the dominant species in most of the areas. Other non-leguminous species viz. Cham-ghas (*Corchorus depressus*), Santari (*Convolvulus microphyllus*), Dhamasa (*Fagonia indica*), Bakda (*Tribulus pentandrus*), Kanti. (*Tribulus terrestris*) etc. are commonly found.

Faunal Diversity

Wildlife like blue bull, wild pigs, wolf, rabbit, fox, dear, peacocks, snakes etc are present in the *Oran*. A few other species, like Godavan (Great Indian Bustard) which used to roam in these woodlands, is now rarely visible. Few types of migratory birds also visit in these *Orans*.

Threats to Biodiversity

Orans are facing various types of threats and increasing grazing/browsing pressure is one of them. Inhabitants informed that some of the species like Khejri (*P. cineraria*) and Kumat (*A. senegal*) decreased in population in last two to three decades but species like Bordi (*Z. nummularia*) and Kair (*C. decidua*) still maintain their population. Sinia (*Crotalaria burhia*) is also not much affected. However, shrubs like Gangeran (*Grewia tenax*) also showing decreasing trend in their presence. Among the perennial grasses the population of Sewan grass (*L. sindicus*) is decreasing to a greater extent. Murath (*P. turgidum*) is also showing decreasing trend in its natural distribution. The density of climbing shrubs like Andho kheep (*Ephedra ciliata*), Pilwan (*Cocculus pendulus*) etc. are also decreasing. It has been informed by the inhabitants that important medicinal species like Guggal (*Commiphora wightii*) is almost disappeared from the *Oran* and other medicinal herbs like Khiroli (*Glossonema variens*), Kanda/Pyaji (*Dipcadi erythraeum*), Rati biyani (*Tephrosia falciformis*), Pimpa (*Caralluma edulis*) etc. which were once in a sizable population, are now threatened in these areas. Even the population of commonly occurred species like Bhangari (*Blepharis sindica*) and Ringani (*Solanum surattense*) are also showing decreasing trend in their presence. Although *Orans* are being considered as an important village institution wherein traditional beliefs and social obligation have led to limited exploitation and restrictions in accessibility, even then these little ecosystems are facing threats on their existence.

Possible Remedial Steps

Researchers suggested that combating desertification in degraded rangelands is a stepwise process that centred around grazing management. They also codify that initially, it is possible to prevent the process of degradation through management practices by altering the stocking density and animal type. They also inferred that in due course removal of livestock from affected areas and soil/vegetation manipulation will be the obvious measure. Researches also confirmed that major parts of *Orans* and *Gauchars* have become totally bereft of palatable grasses and shrubs, resulting in reduced carrying capacity to support the livestock population on a sustained basis. Due to erosion in their capacity to provide economic benefits in the form of fodder, fuel-wood and small timber, *Orans* and *Gauchars*, which were once the mainstay of the pastoral based rural economy, have lost their relevance in the lives of the rural population at many places. If *Orans* get restored to their potential production level, the gap between the forage supply and demand can be levelled up to some extent with added environmental benefits. A number of remedial steps are required to improve these lands ecologically. These steps include (i) protection for a specific period through a variety of fencing /hedges; (ii) removal of bushes specially the undesirable ones; (iii) reseeding with desirable species of perennial fodder grasses & legumes; and (iv) planting of suitable indigenous shrubs and trees as per habitat and grazing management etc.

Suggestive Measures for Rehabilitation

For management and sustainable utilization of *Orans* following rehabilitation measures are suggested

(a) Grazing/browsing policy: Grazing and browsing both are the most natural ways to utilize the *Orans*. The question of land ownership and tenure needs to be considered in detail. Majority of *Orans* are mostly under Panchayati Raj Institutions (village level governing bodies) and are utilized by local people largely in an unorganized way. Therefore, a sound and specific grazing policy and its proper implementation are needed for their sustainable utilization through solving the question of land ownership and tenure.

(b) Ensuring community participation through awareness campaigns: For management of these rich biodiversity heritage sites, community participation is most important. Organization of awareness camps to active community participation particularly, for the young generation on the significance and conserving the diversity of the Orans is highly needed.

(c) Soil and water conservation measures: There is an urgent need to give more emphasis on available technologies of soil and water conservation measures of hot arid region for fast recovery of natural vegetation.

(d) Improvement in understory vegetation cover: In *Orans*, understory grass cover has been degraded to a great extent due to increase in grazing pressure and shrinking of grazing lands. It is vital to undertake reseeding of suitable perennial grasses as per habitat to increase the vegetation cover and productivity of grass component after soil and water conservation measures.

(e) Reintroduction of locally extinct and rare plant species: Many of the adapted plant species particularly medicinal ones that had vanished from the *Orans* need reintroduction in the *Orans*.

(f) Rehabilitate water storage structures: In most of the *Orans* traditional water storage structures like *Nadi* are not in good condition. There is need to revive and rehabilitate these structure through community participation.

(g) Provision of Incentives: There should be range of incentives to villagers to encourage the traditional conservation practices and to continue them for conservation and sustainable utilization of *Orans*. It will certainly help in management and conservation of these patches of woodlands/natural silvi-pastures.

(h) Developing data base: There is a need to develop a database for all the *Orans* in respect to area covered, their management, social and religious aspects, land & soil type and documentation of flora and fauna (both past and existing species), collection of plant/animal produce by the inhabitants etc. It is also required to collect information on livestock grazing pattern and their grazing/browsing pressure.

(i) Need of Ecological Research: Long term ecological investigations on selected *Orans* for regular monitoring of time scale changes in vegetation complex should be initiated to understand the process of recovery of this damaged ecosystems.

These *Orans* are the micro-biodiversity reserves of woody perennials. In view of climate change, *Orans* will have great impact on biodiversity and livelihood support to the inhabitants. It is expected that attention towards rehabilitation of such precious bio-resources on scientific consideration in this region will lead to conservation of these heritage biodiversity sites as well as promote livestock rearing for livelihood support.

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Know Your Desert Plant

Indigofera oblongifolia Forsk. – An under-utilized shrub of Thar Desert of India

Arid shrubs comprise 17% of total floristic composition covering 70-80% of desert landscape. They are important source of food, fodder/browse, medicinal, fuel-wood which also plays an important role in rehabilitation of degraded wastelands. *Indigofera oblongifolia* Forsk., locally known as 'Jhil' or 'Goilia', is an important and underutilized shrub species of this region. It is widely distributed across tropical Africa, the Middle East and from India to Indonesia. In India, it is distributed in Upper Gangetic Plain and Rajasthan. In western Rajasthan, it is found in a range of habitats including grassland, bushland, open mesophytic dry rocky gravelly, flat aggraded order alluvial plain.

Fig. 1. *I. oblongifolia* in flowering stage

I. oblongifolia is an erect, ashy-grey, much-branched perennial shrub, up to 1.25 to 1.40 m high. The branches are slender, woody, divaricating, and terete. The leaves are simple or imparipinnate, both types on the same branches; leaflets 3-5, alternate, 10-25 x 6-8 mm, elliptic-oblong, more or less hairy above and silvery hairy beneath. The flowers are small, in many-flowered axillary racemes and scarlet in colour. The pods are borne along the whole length of the peduncle. Seeds are oblong, 4-gonous and yellow. Flowering and fruiting is from September to March (Fig. 1).

This leguminous, non-spiny arid shrub, reported as good browse species, leaves are eaten by sheep, goats & camels and have ability to tolerate high browsing pressure in extreme arid condition. It has medicinal importance as an antidote against insect stings, snake bites and swellings for all kinds of poisons and also as an anti-inflammatory. It is named as 'Raktpala' in trade. It is used as toothbrush and as a cure for stomach aches. Boiled root is used as a purgative and stem decoction as a gargle in mercurial salivation and for washing teeth. It is antisyphelitic, the roots improve appetite and also used in rheumatism. It is also used as a remedy in the enlargement of liver and spleen. About ten compounds were reported in it and four of these have been characterized as psyllostearyl alcohol, triacontanol, b-sitosterol and b-sitosterol-b-D glucoside. The antifungal and antibacterial activities of small proteins were reported in the leaves. The leaves extract also exhibits a significant antimalarial and antioxidant effects and protect the spleen tissue from injuries. Being a leguminous species, it is also used as green manure in many parts of Rajasthan. Apart from its economic importance, it is more effective in rehabilitating the degraded lands owing to its ability in greening the bare areas.

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Know Your Institutions

ICAR- Central Sheep and Wool Research Institute, Arid Region Campus, Bikaner

Realizing the potential and compatibility of sheep breeds of arid region of the Rajasthan, the Arid Region Campus (ARC) of the ICAR-Central Sheep and Wool Research Institute was established in 1974 as Division of Carpet Wool and Karakul Pelt Production at Bikaner to conduct research on sheep in arid region of the country. The campus is conducting research on genetic improvement of *Magra*, *Marwari* and *Chokla* sheep breeds of arid region which are suitable for carpet wool production, grassland improvement, nutrition, sheep diseases, wool processing and quality evaluation. The centre has 636 ha of land, overlooks the ranges of sand dunes, pasture dominated with sewan (*Lasiurus scindicus*) and Dhaman (*Cenchrus ciliaris*) and various diversified grasses and trees of arid nature. About 50 ha area is under irrigated crop cultivation and horti-crop system with facilities of three tube wells and canal water. In span of 44 years of functioning, ARC dedicated its efforts and resources earlier for significant achievements of improvement of pelt production from Karakul and its crosses and later on carpet wool production capacity of indigenous sheep by synergizing all facets of research, training, and consultancy and extension activities. Administration cum laboratory complex includes facilities of sheep health lab, Wool testing lab, Central lab, and library, Computer/PME section with NKN/NIC and a conference hall to accommodate around 100 persons. The outdoor venues consists of *Marwari* (700), *Magra* (600) and *Chokla* breeds which provides best genotype to farmers on book value for genetic improvement of sheep flock. Recently Artificial Insemination Lab, Feed Technology Unit and Technology Park have also been established.

Objectives and Mandates:

- Genetic improvement of germplasm of *Magra*, *Marwari* and *Chokla* sheep for carpet wool production and body weight.
- Developing feeding strategies for sheep at different physiological stages and during scarcity period.
- Screening of superior germ plasm through semen evaluation and advancement of age of puberty and getting 3 lamb crops per 2 years through reproductive-physiological interventions.
- To conduct training and extension programme for farmers and entrepreneur to outreach the benefits of research to sheep owners.
- To support and facilitate the research work to the post graduate scholars of State Veterinary University and research Institution for dissertation.

Breed Improvement Programmes

Selection and improvement in Marwari sheep: *Marwari* is one of important carpet wool producing sheep breed of north western arid and semi-arid region of India. The Marwari project became the part of Network Project of Sheep Improvement from August 1992. The main objective of the project is to increase the body weight and Greasy Fleece Yield in *Marwari*. The body weight at 6 and 12 month of age improved by 42 and 46 percent i.e. from sheep 15.9 kg to 22.6 kg and 20.8 kg to 30.4 kg, respectively and adult annual GFY was improved from 1209 g to 1484 g (22.8%) since inception of Network Project. In general, the survivability in all age groups was recorded to be above 97% which is very much desirable for better remuneration to the farmers. The lamb survivability was more than 97 percent in flock. The twinning percentage was

enhanced up to 22 % in comparison to 2-3 % in early years. The genetic gain per year for six month body weight and first six monthly GFY (traits under selection in selection index) were 82.1 g and 2.27 g. More than 1200 superior breeding rams/ram lambs produced in the project, were supplied to the Govt. Agency/Farmers/NGO/ Developmental agency since inception of NWP, so that genetic improvement may be brought in the animals in field.

Magra Field Network Project: *Magra* sheep is found in its purest form in Bikaner and adjoining area of Nagaur, Churu and Jhunjhunu districts of Rajasthan. The wool produced by *Magra* is most suitable for carpet production and is in great demand due to its lustre. The body weights at six and twelve month are 24.0 and 32.0 kg, respectively. Three times shearing is being adopted at farm which produces 2.30 kg annual GFY.

The fibre diameter (32.0 μ), staple length (6.0 cm) and medullation (40-45%) of *Magra* wool are most suitable for carpet production and desired by carpet industry. The genetic gain per year for six month body weight and first six monthly GFY (traits under selection) were 131.40 g and 7.10 g in two clip and 12.40 g in three clip. Around 80-90 rams are being sold to farmers annually for breeding purposes. 100 farmers around Bikaner have been adopted under field project of Network Programme in April, 2013 and 3 centers have been established. Several health camps were organized in field and superior rams of *Magra* were supplied to the adopted farmers resulting in improvement of body weight of progeny by 5.95% to 14.92% at different growth stage and in GFY by 15%. As envisaged in the technical programme fourth centre of project is established in institute and identified as ram rearing centre. A total of 850 *Magra* rams/ram lambs has been sold to the farmers or Government of Rajasthan for genetic/breed improvement during last 10 years. Apart from this, a new initiative has been taken to inspire the sheep farmers for machine shearing with the help of RuTAG, IIT Delhi and ATMA Bikaner. At present there are about 5000 sheep populations being covered in all three centers reared by 65 registered sheep farmers. Every year few good quality ram/ram lambs are being purchased from the field to bring genetic variability in flock and reared at ram raising unit at ARC, Bikaner. The overall mortality in field was reduced to 5-7 percent from 15-20 percent and it was due to different interventions introduced in the field under Net Work Project on Sheep Improvement.

Improvement of Chokla Sheep: *Chokla* is a fine carpet wool sheep breed of arid region. The Project "Evaluation & Improvement of Chokla Sheep for Carpet Wool" was started in April 1992. Afterwards in 2013 *Chokla* project was converted in institute project and shifted to ARC, Bikaner. Since 1992, through intensive selection and improved management, six month weight has increased significantly from 16.51 kg to 24.80 kg. The adult annual Greasy Fleece yield of the breed is 2.40 kg. The overall survivability in all the groups was around 97%. The genetic gain per year for six month body weight and GFY were 99.3 g and 12.2 g. A total of 172 ram lambs/rams and 190 hogget females/ewes were sold in the period of 2011-16 to farmers, State Animal Husbandry Department, Government organization and NGO for rearing and bringing genetic improvement.

Development of complete feed block: Complete Feed Block (CFB) comprising most essential and deficient nutrients in balance proportion was developed and evaluated for lambs which were maintained on pasture grazing for better growth and remuneration at farmer's fields. The CFB was developed in 70:30 ratios of concentrate and roughage using locally available feeds ingredients like Khejri leaves/pods, cakes, maize, barley, Guar/Mung churi, wheat bran, Guar dust and Guar/Groundnut/Sewan straws. Average consumption of CFB in lamb was recorded 357 g/h/d with feed conversion efficiency 3.10. The average weight gain of growing lambs was 132g d^{-1}. Cost of feeding was Rs 6.00 d^{-1}sheep^{-1}.

Supplementary Multi nutrient blocks/Mixture: Multi nutrient mixture were prepared by uniform mixing of molasses 45.4%, wheat bran 37.5%, urea 1%, guar churi 6%, salt 5%, vitamins and mineral mixture 5 percent to cater requirements of digestible carbohydrate, protein, minerals and vitamins in grazing sheep. The formulation was a cost effective and feeding of 200 gm MNM in lambs supports 15 to 20% more body weight than traditional feeding. The cost per animal was estimated Rs 3.35 d^{-1} sheep^{-1}.

Grassland and Forage Production: Techniques for sowing of multicut Jawar (SSG-788), fodder variety of lobia (EC-788), sewan (*L. sindicus*) and removal of weeds and rejuvenation of old sewan pasture were standardized. Silvipasture was established with *Dichrostachys cinerea*, *Acacia tortilis*, *Prosopis cineraria*, *Azadirachta indica, Ziziphus* spp. *Colophospermum mopane* with yield of 26.4-31 q ha^{-1} in sewan pasture (35-39q ha^{-1}). Sewan grass pasture was identified promising and cheaper fodder (Rs 95 q^{-1}) source than other rain fed local crops under drought condition. Application of 50% each organic and inorganic source resulted higher production of dry DM yield than other combinations.

Pelt and wool technology: Technology to preserve the originality of pelt and product with high lustre, softness, suppleness and strength were developed. Centre has developed curing method of preservation of freshly slaughtered, Alum-chrome tanning of sheep skin and lamb pelt and also to dye the two different shades simultaneously. The colour extraction technique of alkaline solution and duration of 60 minute was found suitable. Extraction of colour from different vegetable materials on woollen yarn and mordenting process were optimized. The quality attributes of wool and carpet vis a vis visual grades were established to be used for grading of wool for industrial purposes.

Animal Health Management: Yearly health calendar for vaccination and treatment was prepared on epidemiological studies and is being followed with satisfactory result of reduced mortality to 1-2%. Application of health technology and awareness in the field has brought impact on mortality rate (15-20% reduce to 5%)

Artificial Insemination Laboratory: Artificial Insemination Laboratory was established under Magra Field Unit in which estrus synchronization and artificial insemination programmes are running successfully. Estrus Synchronization with Progesterone impregnated intra-vaginal sponges (indigenous sponge developed by Institute) induces estrus at a time which facilitates timed Artificial Insemination (AI) for ease in management strategic. AI with liquid semen can serve 30-40 ewes per ejaculate and useful in production in production of 3 lamb crops in 2 years and curtailing problematic ewes to reproduction, empty/unproductive days to enhance the income of sheep farmers, is a useful technology for commercial lamb production and getting higher production per sheep in terms of mutton, wool, lambs etc.

Academic and HRD Programme: There is no teaching programme at ARC Bikaner however, the Institute has MOU with State Universities. So the post graduate students of University work in collaboration with ARC and more than 20 students of State universities/ICAR institute completed their MVSc/PhD degree. The institute conducts training and extension programme for farmers and entrepreneur to outreach the benefits of research to sheep owners itself and in collaboration with other State Departments.

Transfer of technology (TOT): Breeding rams of better quality germplasm are being provided to various agencies for genetic improvement at farmers flock and experiments on field level were demonstrated by providing feed block material to lamb, pregnant /lactating ewes under TOT. The technologies related to fodder development and effective utilization of grazing resources are demonstrated. Health of flock being managed as need based treatment by periodical visit and health camps. Technical literature in form of leaflets, pamphlets, posters, documentary video and radio talk were prepared to place technology before stakeholders for awareness.

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Knowledge Corner

Tree based land use systems: an approach towards climate smart agriculture

Climate change will intensify the problem of already scarce resources by making weather more extreme and variable and by decreasing average yields worldwide. Climate change, the greatest global challenge, is already a reality for the farmers of arid regions of India. Furthermore, population growth with limited water and land threatens the vision of sustainable farming without harming the environment. However, the target of sustainable agriculture can be achieved by using the approach of climate smart agriculture. Food and Agriculture organisation (FAO) defines climate-smart agriculture as an approach that sustainably increases productivity, resilience, reduces/removes greenhouse gases while enhancing the achievement of national food security and development goals. An important perspective towards climate smart agriculture will be introduction and expansion of tree based land use systems. Land-Use, Land-Use Change and Forestry report of the IPCC recognized the potential of agroforestry systems to deliver multiple benefits including sequestration of carbon and producing a range of economic, environmental and socio-economic benefits. The 1.2 billion people (20% population of world) directly rely on agroforestry products and different services related to agroforestry. In India about 25 million ha area (8.2 % of the total geographical area), is reported under agroforestry in both irrigated and rainfed agriculture and Rajasthan has third highest area under agroforestry (1.55m ha) in country.

Prosopis cineraria, *Ziziphus* spp, *Salvadora* spp, *Capparis decidua* based agroforestry models with pearl millet, moong bean, moth bean and cluster bean are some of the traditional agroforestry models in arid and semi-arid region of Rajasthan (Fig. 2). However, species like *Hardwickia binata*, *Ailanthus excelsa*, *Dalbergia sissoo* are also gaining popularity among the farmers (Fig. 3). These systems provides large number of end-use products, ensures the food security in drought hit years, maintains soil fertility through control of erosion and hence provide resilience to climate change. *P. cineraria* and *Zizyphus* spp. trees besides improving productivity supply 20-30 kg and 2-3 kg air dried leaves 'Loong' and 'Pala' as fodder, respectively. Besides this a study carried out in ICAR-CAZRI, Jodhpur reveals that 38 years old *P. cineraria* tree 303 kg N, 22 kg P and 64 kg K ha^{-1} yr^{-1} to the soil through its litterfall adds and store 140 kg $tree^{-1}$ carbon in its different tree components. In an another study while evaluating the effect of seven year-old *Acacia tortilis* trees on the microclimate of guar (cluster bean) crop it was observed that the relative humidity under the tree canopy was 7 per cent higher than that sole crop. Beneath *P. cineraria*, pH of the soil was 8.0 as against 8.2 in the open field. Similarly, electrical conductivity under this tree was 0.01 m mhos/cm and 0.20 in the open. The low pH under P. cineraria was attributed to the higher contents of organic matter and soluble Ca and lower content of $CaCO_3$. Similarly, other tree based systems viz. agrihorticulture, silvipastoral, shelterbelts etc. have proved potential in arid zones of Thar Desert. In *Ziziphus* based agri-horti culture system by improving the ber plants by budding the fruit yield increased to 20-30 kg $tree^{-1}$ and farmers started earning Rs 8000-15000 ha^{-1} more income. The system was rather found more profitable than raising the sole crops. Likewise, agroforestry systems using improved existing planting material, improved farming practices, value addition to tree products, introduction of new and alternative industrial wood species can be developed to earn maximum profit and food security accompanied by various ecosystem services viz. improving biodiversity, soil health and water conservation. There is need to improve the market accessibility, access of farmers for improved germplasm and involvement of farmers in planning process to help them in improving their well-being *vis. a vis*. achieving environmental sustainability. Thus, agroforestry has a key role in achieving the mandate of climate smart agriculture being potent instrument for livelihood improvement and adaptation to climate change.

Fig. 2. Traditional agroforestry system on farmer's field

Fig. 3. *Ailanthus excelsa* and *Hardwickia binata* based agroforestry system in Western arid Rajasthan

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Utilizing solar energy in agricultural processing

Food processing industry is the fastest growing sector in the economic world not only in India but on global level. The hurried and life style of people resulted in increased demand of convenience foods. However, it is an appealing business venture in the current scenario but also demanding in terms of energy requirement and consumption. In the recent past lot of research has been done on unconventional energy utilization in the food processing sector. Solar food processing is an emerging technology that provides good quality foods at low or no additional fuel costs and also keeps the nutrition intact. A number of solar dryers, collectors and concentrators are currently being used for various steps in food processing and value addition. Solar cookers, solar ovens and Solar Cabinet Dryer with forced circulation which has been used for dehydration and development of value added products from locally grown fruits, vegetables, leafy greens and forest produce are examples of utilization of solar energy in food processing sector. It can also create employment opportunities among the rural population, especially women.

Solar drying

Solar drying is in practice since the times immemorial for preservation of food and agriculture crops. Open sun drying is an apparent example of utilization of solar energy for drying of agricultural products to increase their shelf life off and season use. This process has several disadvantages like spoilage of product due to adverse climatic condition like rain, wind and dust, loss of material due to birds and animals, deterioration of the material by decomposition due to microbial growth. Also the process is highly labor intensive, time consuming and requires large area. With the advancement of technology and industrial development mechanical drying came in to practice. This process is fast but highly energy intensive and expensive which ultimately increases product cost. Thus, solar drying can be the best alternative of all the drawbacks of open sun drying and mechanical drying (Table 1). Solar dryers used in agriculture for food and crop drying can be proved to be most useful device from energy conservation point of view. It not only save energy but also save lot of time, occupying less area, improves quality of the product, make the process more energy efficient and protects environment also.

Solar dryer is a very useful device for different purposes like

- Agriculture crop drying
- Food processing industries for dehydration of fruits, potatoes, onions and other vegetables
- Dairy industries for production of milk powder, casein etc

Benefits of Solar Drying

- Significant improvement in product quality (colour)
- No contamination by insects, microorganism and mycotoxin
- Reduction in drying time up to 50%
- Reduction of drying and storage losses

- Considerable increase in shelf life of dried products
- Energy efficient process

Table.1 Solar dried Agricultural commodities traded in market

Type	Cereals	Fruits	Vegetables	Others
Food	Maize Wheat Rice Paddy Soybeans Barley	Watermelons Bananas Apple Grapes Mango	Potatoes Cassava Sugar Beet Tomatoes Onion Garlic	Sugarcane Meat Coffee, Cocoa

Principle of solar drying

Solar dryers can be classifies as direct or indirect and passive or active solar energy drying system. Passive solar energy drying systems are conventionally termed as natural circulation solar drying system and active solar energy drying systems mostly termed as hybrid solar dryers. The working principle of these dryers mainly depends upon the method of solar energy collection and its conversion to thermal energy for drying. Fig.4 shows the working principle of open sun drying by using only the energy from sun or solar energy. In this type of drying the crop is generally spread on ground, mat, cement floor where they receive short wavelength solar energy during a major part of the day and also natural circulation. A part of the energy is reflected back and remaining is absorbed by the surface of the crop depending upon the colour of the crop. The absorbed radiation is converted into thermal energy and the temperature of the material starts to increase. However there are losses like the long wavelength radiation loss from the surface of the crop to ambient air through moist air and also convective heat loss due to the blowing wind through moist air over the crop surface. The process is independent of any other source of energy except sunlight and hence the cheapest method, however, has a number of limitations as discussed. In general, the open sun drying method does not fulfil the required quality standards of international market. With the adequate information of the problems of open sun drying a more scientific method of solar energy utilization for crop drying has emerged as solar drying active or passive systems more appropriately depending upon the method of solar energy collection and conversion to thermal energy.

Three distinct sub-classes of either the active or passive solar drying systems can be identified namely,

i. Direct-type solar dryers, ii. Indirect-type solar dryers, iii. Hybrid solar dryers

Direct solar drying: The direct solar drying is also known as cabinet drying. In this method the part of the solar radiation impinging of the glass cover is reflected back to the atmosphere and the remaining is transmitted inside the cabinet. A part of the transmitted radiation is then reflected back from the crop surface and the rest is absorbed by the surface of the crop which causes its temperature to increase and thereby emit long wavelength radiations which are not allowed to escape the atmosphere due to the glass cover. The overall phenomenon causes the temperature rise of the crop. The glass cover in the cabinet dryer thus serve as a source for reducing the losses due to convection which plays an important role in increasing the crop and cabinet temperature.

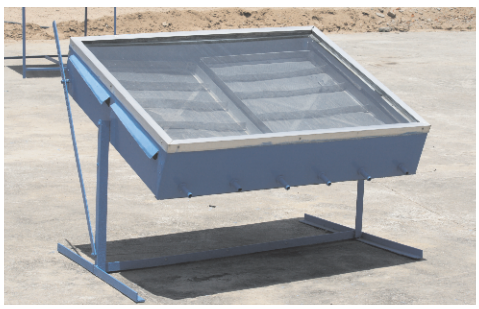

Fig. 4. Solar dryer for drying of fruits and vegetables

Indirect solar drying: Indirect dryers contain vertical shelves to load the crop inside an opaque drying cabinet and a separate unit termed as solar collector is used for heating of the entering air into the cabinet. The heated air is allowed to flow through/over the wet crop that provide the heat for moisture evaporation by convective heat transfer between the hot air and the wet crop. Drying takes place due to the difference in the moisture concentration between the drying air and air in the vicinity of crop surface. The advantages of the indirect solar drying are that they offer good control of drying conditions, quicker, better quality produce, is obtained.it also helps in preventing caramelization and localized heat damage from direct solar radiation due to opaque chamber. These dryers attain higher temperature than direct dryers thus recommended for deep layer drying. Due to prevention from direct radiation they are highly suitable for crops which are photo sensitive. However, they need more capital investment than direct dryers but it is worthwhile keeping in view the quality of produce and efficiency of indirect solar dryers.

Hybrid solar drying: This type of drying combines the features of both the direct and indirect type of solar drying. In hybrid type of dryers thermal energy is generated through the action of incident direct solar radiation and the pre-heated air in a solar collector heater both produces the desired heat for the product drying. Hybrid dryers consist of the same typical structure a solar air heater, separate drying chamber and a chimney and in addition has glazed walls inside the drying chamber so that the incident solar radiation impinges directly on the crop as in direct type of dryers. Several type of material are used in such dryers to absorb/ heat storage like granite, mixture of waxes etc (Fig. 5).

Fig. 5. PCM based Solar Dryer for vegetable and spice crop drying

Solar cooking: Solar cooking is done by means of the suns UV rays. A solar cooker lets the UV light rays in and then converts them to longer infrared light rays that cannot escape. Infrared radiation has the right energy to make the water, fat and protein molecules in food vibrate vigorously and heat up. It is the sun's rays that are converted to heat energy that cook the food; and this heat energy is then retained by the pot and the food by the means of a covering or lid. This occurs in much the same way that a greenhouse retains heat or a car with its windows rolled up. An effective solar cooker will use the energy of the sun to heat a cooking vessel and efficiently retain the energy (heat) for maximum cooking effectiveness.

Concentration of the sun's rays is performed most often by reflecting panels, petals and such surfaces that can "focus" or concentrate the rays of light (UV) to a point or concentration. These reflecting panels are usually made of materials that are shiny and reflective due to the substance used in their manufacture, such as silver, chromium and aluminum. Without a means to concentrate the sun's rays it can take longer to heat objects or surfaces, thus most solar cookers are constructed with reflector panels to speed up the process of heat accumulation.

Absorption of the sun's energy (heat) in solar cooking is best achieved when a surface is dark in color, thus the most common solar oven interiors are usually black in color as well as the color of the cookware used for cooking the food. Dark colors absorb the heat, whereas light colors do not absorb heat well and some colors can reflect the sun's energy away, such as silver for example. Generally, the best cookware for solar cooking is the dark, thin variety because it absorbs the heat (energy) well; and because it is thin, it can then transfer the heat more quickly and evenly to the food.

Retention is the final principle in solar cooking. If a solar cooker is not well insulated and if it does not have a cover or lid, then all of the concentrated heat (energy) and all of the absorbed heat would quickly dissipate into the air and be lost to the surrounding environment. A solar cooker must have the means to "trap" or hold the concentrated heat allowing it to accumulate and to "build up" to sufficiently high enough levels to be able to effectively cook.

A fourth principle, though not vital in all forms of solar cooking (parabolic cooking is one) is: transparency of your retentive materials, or in other words, your lid on a solar oven or your enclosure around your pot/pan on a solar panel cooker needs to be able to allow the sun's rays to penetrate inside to where the food/cooking vessels are located. This ability of the sun to penetrate is usually achieved by using clear glass, or plastic coverings on a solar cooker lid/door/enclosure which then in turn acts as an inhibitor, trapping the heat as well.

The best solar cookers can get as high as 315° C which is very unique indeed. Of course this is a unique cooker that can reach these temperatures. Solar cookers that reach these temperatures are highly specialized and very intricately designed parabolic cookers rather than a traditional solar oven.

A solar oven is usually an enclosed box type cooker with or without the use of reflective panels. Some solar ovens will reach 200° C but most usually cook at temperature ranges between 120° C to 175° C, quite sufficient for cooking most foods. Panel cookers which are similar in principle, use a reflective panel to concentrate sunlight on a cooking pot that is usually covered by a plastic oven bag or glass enclosure to retain the heat. These can reach temperatures of 80° C and more (depending on food) and usually cook between 95° C and 100° C.

Types of solar cookers

(i) Box Cooker: The most common and popular variety is probably the box cooker. Its design is based on the concept of a traditional modern oven where the food is placed inside of an insulated box for purposes of retaining or trapping the solar rays that have been converted to heat energy. In order for the solar rays to covert to heat energy they must be able to reach the cooking utensil (pot, pan) usually passing through a transparent covering (glass, plastic) on the box cooker. The solar UV rays are then converted to longer infrared rays that heat the pot and food. The longer UV rays are not able to pass back out through the glass (transparent) covering and are thus retained inside the box enclosure, creating a build-up of

heat raising the temperature inside to sustainable cooking levels and thus causing the food to cook.). A box cooker can be made out of any type of material such as wood, plastic, cardboard etc. Usually two boxes of varying size are needed in order to be able to fit the smaller one inside of the larger one, thus creating a gap or space around the smaller box which can then be filled with paper, hay, fiberglass etc. to form an insulating barrier between the two boxes to prevent the escape of heat through conduction (Fig. 6, 7 and 8). Manufactured boxes are designed and built with the gap and insulation readymade. Finally a transparent cover on top of the box is needed to permit solar rays to enter the box and at the same time prevent the escape of the (UV) rays that have now become solar energy (heat).The transparent cover can be created by using plastic sheets, glass sheets (preferably tempered so as not to break) or by using oven cooking bags. Reflector panels are usually added for purposes of concentrating the sun rays toward the cooking pot and food for higher cooking temperatures and effectiveness.

These cookers can typically reach temperatures of 150° C which is plenty hot to cook any food you would like. Food containing larger quantities of moisture cannot get much hotter than 100° C so it is not necessary to cook at higher temperatures.

Fig. 6. Box Type Solar Cooker

Fig. 7. Box Type Solar Cooker with double reflector

Fig. 8. Non-Tracing Solar Cooker

(ii) Panel cooker: The panel cooker usually consists of a cooking vessel (pot or pan) which is usually darkened or blackened, an oven cooking bag or transparent glass bowl along with a reflective panel. These panels can be made from aluminium foil over corrugated carton, or from tin or sheet metal panels polished to a high sheen and also with mirrors. The oven bag or glass bowl allows the suns UV rays to penetrate towards the food in turn trapping the energy; (heat) preventing its escape. The reflector panels concentrate the sun light onto the cooking vessel containing the food, in the same way the panels do so on the solar box cookers. A panel cooker is usually simpler and more economical to build and results in the same cooking effectiveness for most all situations. Some panel cookers can achieve relatively high temperatures depending on the pot and the food being cooked. Since most foods cooked in these types of cookers usually contain more moisture (soups, stews, meats etc.) they will usually cook around 110-120 ° C; similar to a slow, or crock cooker.

(iii) Parabolic cooker: Often known as concentrator cookers, these are usually a bit more complicated to construct due to the design and necessary materials, but still are quite common in some areas of the world. The parabolic cooker can reach high temperatures more quickly, therefore cooking is accomplished more rapidly, though more frequent adjustment of the concentrator is needed for maximum effectiveness. It is often necessary to use them under the supervision of experienced hands since they can cause harm if used improperly. Some parabolic cookers are limited in the quantity of food that is possible to be cooked at one time since they usually have only one pot that is suspended in the centre of the path of highest solar energy concentration, but as mentioned earlier they can cook faster. These cookers have been used on a large institutional scale in China for many years along with few other countries.

(iv) Solar Baking: Each type of cooker has its advantages and its disadvantages in baking slow cooking is required to that the raising of food can be achieved otherwise due to instant high temperature cooking scorching the food can happen which can spoil the baked dish. Thus for achieving low temperature cooking initially and afterwards high temperature panel cookers are ideal. Such as breads and cookies cakes etc. low temperature cooking similar to a crock pot then you would probably want a box or panel cooker. If you want the ability to cook in a similar fashion to that of cooking over a conventional stove top or a campfire then a parabolic cooker works great. For baking, a box cooker would be your best

overall cooker. For instant high temperature or conventional cooking for e. g. stews, soups and meats; a pot and panel cooker is great, and also a box cooker works fine for these foods. The combinations and possibilities are increased though when combining the features and characteristics of each type of solar cooker. The type of cooker you use will depend mostly on your needs and likes.

Some solar cooking cook times for various foods in a solar oven or solar panel cooker

Variations are due to the kind or style of solar cooker being used and the quality of the manufacture as well as quantity of food and daily sunshine conditions.

- Bread-from 40-70 minutes (one to two loaves at a time)
- Muffins, cupcakes, dinner rolls- from 20-60 minutes
- Cakes- from 45-70 minutes
- Cookies- from 10-20 minutes (depending on type of cookie)
- Eggs-poached in preheated oven 20 minutes. Hard boiled (baked) 30-60 minutes depending on quantity
- Roast- from 90 minutes to 5 hours (longer cook time at lower temps for moister, more tender meat)
- Chicken- from 90 minutes to 4 hours (longer cook time at lower temps for moister, more tender meat)
- Stews, soups, chili- from 90 minutes to six hours (longer cook time at lower temps for moister, more tender food)
- Casseroles, enchiladas, lasagnas- from as little as 60 minutes to three hours

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Events by ENVIS CAZRI

Green Skill Development Programme

CAZRI-ENVIS Centre on Combating Desertification organized one month training course on "*Plantation Techniques and Utilization of Renewable Energy in Arid Zone*" under Green Skill Development Programme (GSDP), Ministry of Environment, Forest & Climate Change, New Delhi from 11th July to 10th August 2018. Fifteen candidates participated in the programme representing the diverse group. Participants were given hands on training for various plantation techniques and utilization of renewable energy in arid zone.

World Ozone Day

Celebrated World Ozone Day on 16th September, 2018 on the theme *"Keep cool and carry on the Montreal Protocol"* at Jawahar Navodya Vidyalaya, Kalndri, Sirohi. On this occasion lectures, quiz and extempore debate competition for the students were organized. About hundred students actively participated and interacted with the ENVIS team.

News

काजरी में 'शुष्क क्षेत्र में वृक्षारोपण तकनीक और ऊर्जा का उपयोग' पर प्रशिक्षण शुरू

काजरी स्थित मरुस्थलीय पर्यावरण सूचना केंद्र की ओर से बुधवार को हरित कौशल विकास के तहत 'शुष्क क्षेत्र में वृक्षारोपण तकनीक और ऊर्जा का उपयोग' विषय पर एक माह का पाठ्यक्रम और प्रशिक्षण शुरू हुआ। कार्यक्रम के मुख्य अतिथि शुष्क वन अनुसंधान संस्थान के निदेशक डॉ. आईडी आर्य ने कहा, कि इस तरह के पाठ्यक्रम उपयोगी होते हैं। काजरी के निदेशक डॉ. ओपी यादव ने कहा, कि प्रतिभागियों को लगन और मेहनत से प्रशिक्षण प्राप्त करना चाहिए। इस मौके पर डॉ. जेपीसिंह, तीर्थदास ने भी आवश्यक जानकारी दी। संचालन दीपंकर साहा ने किया।

काजरी में नवीकरणीय ऊर्जा पर प्रशिक्षण शुरू

जोधपुर. काजरी स्थित मरुस्थलीय पर्यावरण सूचना केन्द्र की ओर से बुधवार को हरित कौशल विकास कार्यक्रम के अंतर्गत शुष्क क्षेत्र में वृक्षारोपण तकनीकें और नवीकरणीय ऊर्जा का उपयोग विषय पर एक माह अवधि का पाठ्यक्रम एवं प्रशिक्षण शुरू हुआ। कार्यक्रम में शुष्क वन अनुसंधान संस्थान के निदेशक डॉ. आईडी आर्य ने कहा कि इस तरह के महत्वपूर्ण कार्यक्रम से आम लोगों तक वृक्षारोपण तकनीकें एवं नवीकरणीय ऊर्जा उपयोग की जानकारी पहुंचेगी। इससे प्रसार होने से तकनीक भविष्य में बहुत उपयोगी साबित होगी। काजरी के निदेशक डॉ. ओपी यादव ने प्रतिभागियों से कहा कि प्रशिक्षण के हर पहलू को लगन से सीखने की कोशिश कर इसमें दक्षता हासिल करें। प्रधान वैज्ञानिक एवं एनविस समन्वयक डॉ. जेपी सिंह ने हरित कौशल विकास कार्यक्रम के संबंध में जानकारी दी। एनविस के सदस्य सचिव तीर्थदास ने एनविस की गतिविधियों पर प्रकाश डाला। संचालन दीपंकर साहा ने किया।

पत्रिका Thu, 12 July epaper.patri

नवोदय स्कूल में मनाया ओजोन दिवस, काजरी के मुख्य वैज्ञानिक ने बताया ओजोन का महत्व

सिरोही | काजरी मरुस्थलीय पर्यावरण सूचना केंद्र जोधपुर की ओर से जवाहर नवोदय विद्यालय कालंद्री में विश्व ओजोन दिवस का आयोजन किया गया। इसमें नवोदय विद्यालय के कक्षा 9 से 12 तक के 100 विद्यार्थियों ने भाग लिया। काजरी के प्रधान वैज्ञानिक डॉ. जेपी सिंह ने ओजोन दिवस का महत्व बताते हुए कहा कि हमें ओजोन परत के क्षरण को रोकने के प्रभावी प्रयास करने की आवश्यकता है। डॉ. दीपांकर साहा ने ओजोन दिवस के तहत विस्तार से ओजोन के संबंध में प्रस्तुतीकरण किया एवं मॉन्ट्रीयल प्रोटोकॉल के निर्देश को सही तरीके से अपनाकर ओजोन परत के रक्षण के लिए निरंतर प्रयत्न करने पर बल दिया। इसके बाद भाषण एवं प्रश्नोत्तरी प्रतियोगिता का आयोजन किया गया, जिसमें विद्यार्थियों ने अपने विचार प्रस्तुत किए। भाषण प्रतियोगिता में उज्जवल प्रथम, रोहित द्वितीय एवं इशांसी सिंह ने तृतीय स्थान प्राप्त किया। प्रश्नोत्तरी प्रतियोगिता में राकेश प्रथम, अंकित द्वितीय एवं प्रियंका ने तृतीय स्थान प्राप्त किया। इस मौके मुख्य अतिथि उप प्राचार्य एसके दीक्षित व पीडी चारण प्रवक्ता रसायन विज्ञान समेत विद्यार्थी मौजूद थे।

Conferences

DATE	TOPIC	PLACE
	NATIONAL	
10-11th July 2018	Global Inclusive Disaster Management Conference (GIDMC)	India Habitat Centre, New Delhi
23rd September 2018	National Conference on Advances in Science, Agriculture, Environmental & Biotechnology (NCASAEB)	Hyderabad, India
	INTERNATIONAL	
11-12th July 2018	2nd International Conference on Ecology, Ecosystems and Conservation Biology	Toronto, Canada
26-27th July 2018	7th International Conference on Biodiversity Conservation and Ecosystem Management	Seoul, Australia
6-7th August 2018	4th World Congress on Climate Change and Global Warming	Hyatt Regency Osaka, Japan
30-31st August 2018	427th International Conference on Agricultural and Biological Science (ICABS)	Goa, India