CAZRI DEN NEWS

Volume 9 (2) July-December 2007

RECENT FLOODS IN THAR DESERT: SOME LESSONS

Western Rajasthan, containing the Thar Desert, is a region of low rainfall (average annual 100-450 mm). The major rainy season here is July-September when the southwest monsoon brings in much (80-90%) of the year's total rainfall. There is large inter-annual variability in the rainfall, leading to the occurrence of droughts and floods of different magnitudes. Floods are rare, but not uncommon, and occur in response to short periods of high intensity rainfall events. Another peculiarity of flood here is its highly localized nature during any particular year, even when the total monsoon rainfall in the region as a whole is above the average. It is, therefore, not uncommon to record flood in some districts when the total rainfall in other districts and in the region is much lower, or even below the average. For example in 1979, when large parts of Pali and Jodhpur districts, containing the northern half of the Luni basin, experienced extreme flood that took a toll of >300 humans and ~10 thousand livestock, most other districts experienced moderate to severe drought. The 1990 flood was more concentrated in the southern half of the Luni basin (in Jawai catchment), in the districts of Pali, Jalor and Sirohi. By contrast, droughts generally occur across the region with some spatial variability in its intensity during a typical drought year.

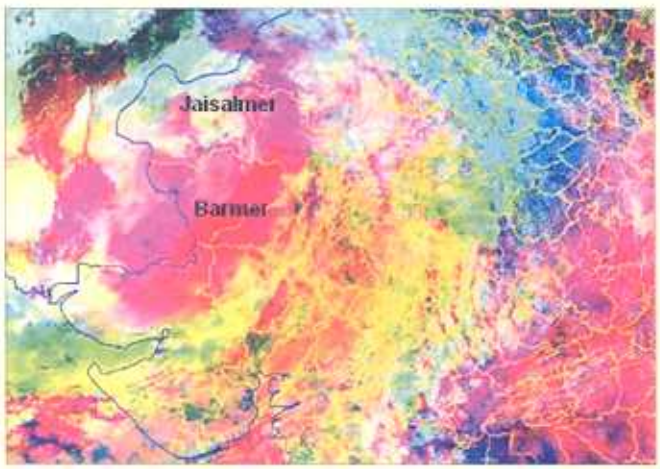

Fig. 1. Thick rain-bearing cloud over Barmer-Jaisalmer area during 19-22 August 2006. The storm moved anti-clockwise from SE (red) to NW and W (pink) and dissipated after crossing into Pakistan from Barmer border. This colour composit is created using NASA's Modis images for 19, 20 and 22 August 2006.

Flood has different meaning to different segments of a society. Scientifically it could be defined as a high-water stage in which water overflows its natural or artificial banks on to a normally dry land, such as a river overtopping its banks to flow through its riparian plain. Put in other words, flood occurs when a stream cannot keep the volume of water within its banks. For a common man flood is synonymous with the loss of human life and property due to inundation and washing away of habitations and belongings by the flowing water. Yet, flood is also beneficial in the long run, especially as it enriches the soil with nutrients and fills up the aquifer in inundated tract.

The southern part of Thar Desert experienced high monsoon rainfall during 2006 and 2007 (Fig. 1), which caused localized flood, especially in Pali, Barmer and Jaisalmer districts. In 2006 the rainfall during 17-24 August created flood in parts of Pali, Barmer and Jaisalmer district, when on an average 150 to 450 mm rainfall was recorded at various stations, much of it coming in 1-2 days (Fig. 2).

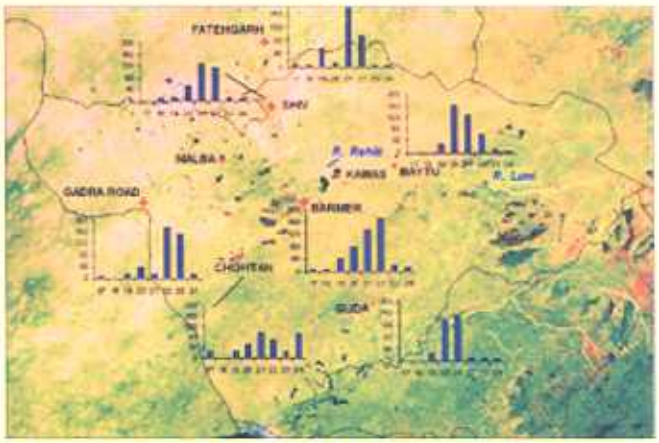

Fig.2. Image-map of Barmer district showing daily rainfall pattern during 17-24 August 2006.

The most spectacular impact was felt in the shallow sandy terrain in the very dry northwestern part of Barmer district, where catchment areas of a number of dry streams, partly covered by moving sand dunes due to the absence of sufficient flow-generating rainfall for years, got exceptionally high discharge. A number of structures that were constructed during the past decades in the upstream areas of the catchments to conserve the usually meager flow, breached almost simultaneously under the high intensity rainfall, resulting in a huge surge of water through the dry channels. A number of sand dunes that had grown along the path of the streams were cut through and the topsoil was washed away over a large area. Some old and abandoned channels were also revived. To understand the flow path of surging water under such high-intensity rainfall, a GIS and remote sensing based channel simulation was carried out for the affected area, and the results matched with the actual ground features after the flood. It revealed the part revival of a hitherto unknown major right-bank tributary of the Luni River.

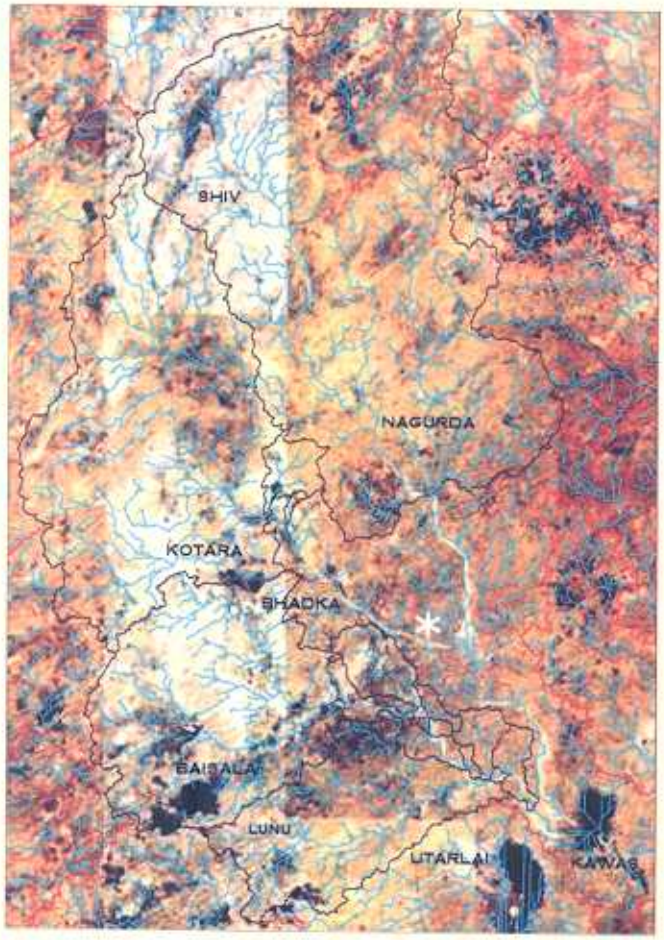

Fig. 3. Simulated channel network from DEM (turquise) and the derived 4th order subcatchments of the Rohili River system (black lines) till Kawas depression (dark), superimposed on the post-flood Google image (2007), showing revival of old channels that remained disused and partly buried for long. New courses were few, like a SEward course downstream of Bhadka (white star).

Earlier it was believed that the Lik River, originating near Pokaran was the westernmost right-bank tributary of the Luni, but the 2006 flood revealed a longer right-bank tributary from near Mehreri in Jaisalmer district that flowed past Bisu, Nagurda and then carried the waters of Rohili River catchment from Shiv-Kotara area and other streams from the Baisala hills catchment and the Lunu hills catchment, to Kawas and beyond. Thus it had four major subcatchments up to Kawas depression (remnant of a former lake with thick gypsum bed that is now mined). Beyond Kawas the stream possibly used to meet the Luni to the south of Sindri, but got subsequently dismembered by high sand dunes. Erratic rainfall in this very dry area does not allow streams in all subcatchments to flow simultaneously. The Lunu and Baisala catchments experience flow more frequently than the Rohili, while the Mehreri-Nagurda catchment experiences flow rarely, the last major flow being recorded about 70 years ago when Shiv-Fatehgarh area received ~300 mm rainfall in 3 days. Kawas witnessed less damage then because the depression was less deep and habitation fewer.

Thus, even in a desert the old and the abandoned stream courses (palaeochannels) are potential sites for disaster if their passage is obstructed. The Luni Basin flood in 1979 created havoc mainly due to partial occupation of the old and abandoned channels of the Luni and its tributaries in Jodhpur-Bilara-Pali-Balotra area, or habitations closer to banks. Bilara town, downstream of a dam on the Luni (Jaswant Sagar dam, constructed 1892; capacity 53 mcm), was saved from flood fury by a former Luni course (the Banganga) in between the present Luni and the town, which accommodated the flood discharge.

In July 2007 the upper Luni catchment received a short burst of high-intensity rain during 4-6 July. The dry Jaswant Sagar dam got filled up in a single day (6 July), and breached the next morning (Fig. 4). An analysis of rainfall pattern showed that a deep monsoon depression over the Lilri and the Raipur Luni subcatchments was the principal cause of the havoc, when Jaitaran town (382 mm), Chaupra Raj Sagar (430 mm), Raipur (261 mm), and Raipur Luni dam (229 mm) received very high rainfall. Jaswant Sagar dam received 244 mm, while stations further upstream received lesser rain (Merta City 178 mm, Pisangan 159 mm, Pushkar 121 mm).

Fig. 4. Breaching of the Jaswant Sagar dam on the Luni.

A hugh volume of water gushed out through the breach to flow past Bhawi and Lamba towards Bala and Pithasni, threatening many villages downstream. Fortunately, a major left-bank palaeochannel of the Luni exists near Malkosni (upstream of Bala), which is known further downstream as the Reria Nadi, flowing past Parasla Kalan, Hariara and Malkosni to Rohat and beyond (Fig. 5.).

Fig. 5. Reria Nadi, a palaeochannel of the Luni River.

This palaeochannel had carried some of the Luni's discharge during the 1979 flood, and became a true saviour of mankind after the dam breached on 7 July 2007, despite the fact that with time it has taken an obtuse bend at the point of deflection from the Luni. As soon as the water level rose along the main stream to the level of this palaeochannel a large volume started flowing through it, and the settlements beyond Bala became less threatened. Since global warming can increase the frequency of such extreme events, we have to value our terrain through proper understanding for our own safety.

AMAL KAR, PC MOHARANA and AS RAO

EXOTIC *ACACIA SENEGAL* (KUMAT)

OCCURRENCE

Acacia senegal (linn) Wild, a member of mimosaceae, is a small tree of 3-6m height with umbrella-shaped crown. It is a typical tree of Sahel in Africa from Senegal to Red Sea and essentially limited to the area between 11° and 16° North, with a wide range of rainfall (100 to 800mm). It also occurs widely in tropical Africa from Mozambique, Zambia to Somalia, Sudan, Ethiopia, Kenya, Tanzania, Nigeria and in South Asia in India and Pakistan. In India it is a typical tree of arid region with a low rainfall of 100-250mm. It is drought resistant and tolerates prolonged dry period of 10-11 months, with maximum temperature reaching 50°C with strong winds, but susceptible to frost. It occurs mostly on sandstone and skeletal soils and widely distributed in western Rajasthan and Gujarat (Fig.1).

Fig 1 Distribution of *Acacia senegal* in Western Rajasthan

GUM PRODUCTION

Gum exudes from cracks in bark of trees, mostly in the dry season, with little or none in the rainy season. In some areas, a long strip of bark is torn off for exuding the gum. In Africa, it is regularly tapped from trees, which are about 6 years old, by making narrow transverse incisions in bark in February to March. In about a month, tears of gum form on surface are gathered. Trees begin to yield gum between 4-18 years of age. In Sudan the annual yields from young trees range from 188 to 2856 g (av.900 g), and from older trees, 379 to 6754 g (av. 2 kg). In India, however the productivity is low, varying from 175 to 550g tree^{-1} year^{-1}. Wide variation in gum production exists in respect of sites, annual rainfall and geographical location.

Superior genotype for higher gum production: To screen and identify a superior genotype for higher production of gum Arabic, seeds of genetically superior five provenances of *Acacia senegal* from African countries were procured from Centre Technique Forestier Tropical Laboratier (CTFT), France. Plants raised were evaluated at Central Research Farm, Jodhpur and Regional Research Station, Jaisalmer of Central Arid Zone Research Institute. Provenance from Nigeria was identified as superior in establishment, higher survival, fast growth performance and gum production (Table 1). Seed production is greatly influenced by the annual rainfall and age of the plant. During drought year the moisture stress condition overrides the effect of age, resulting in drastic reduction in seed production even in mature trees.

Table1. Growth performance and gum yield of Nigerian *Acacia senegal* at Jaisalmer

Age of plants (years) tears/plant	Height (cm)	Crown (cm^2)	Collar diameter (mm)	Gum production (g/plant)	No. of gum ball
Initial	40	-	3.7	-	
4	145	163	38.4	45 to 177	4-to 15
8	246	282	58.5	155 to 295	6 to 17
12	277	336	72.2	230 to 360	5 to 21

For taking gum production, the Nigerian Provenance was put to light pruning above major ramification in August. Gum exuding started by 40-55 days and hardened gum tears were collected afterwards (Fig. 2). Gum production ranged from 230-360g plant^{-1}. The number of gum tears ranged from 5 to 21 with a wide range of 5 to 40g. The yield varies from year to year. The gum Arabic produced was light yellowish, transparent, crystalline, with negligible impurities. The gum from exotic *Acacia senegal* not only conforms to Pharmacopoeia of Indian specifications of Indian gum but the ash content, water insoluble matter and loss on drying was observed far less than the permissible limit.

Fig. 2. Natural exudation of gum from above tree

Silvi-cultural management: To raise commercial plantation for higher gum production, quality planting stock should be planted at proper spacing, depending on site conditions and type of plantation stands aimed:

- Monoculture on rocky and gravely site: 3x3m or 4x3m
- Silvi-pastoral system: 5 x 5m or 10 x 5m
- Agri-silvi-cultural system: 10 x 10m.

In agri-silvicultural system, Kumat supports good yield of crops like millet, beans and groundnut. The quality seedling can be raised by planting water-soaked seeds (24 hours) in polytube of 25 x 10 cm size or root trainer container of 250 cm^3 volume. The potting media for nursery should be prepared by mixing compost: pond soil: sand in 1:1:1 ratio for polytube and compost and sand in 4:1 ratio for root trainers. In nursery, seed is sown in February to get plantable size seedlings (~50 cm tall) in July-August when monsoon sets in. The planting should be done in 30x30x30cm or 45x45x30cm size pit after filling them with compost and soil in 1:1 ratio. The plant should be watered at planting and again after one week if rain fails after planting. In good monsoon year, plants get established in six months and become hardy to sustain harsh climatic environment. However, for better success 1-2 watering is advised during summer in the first year of plantation. Post-planting care and pruning should be taken regularly from fourth year onwards for development of good stand and higher gum production.

TRANSFER OF TECHNOLOGY AND ITS IMPACT

CAZRI has made successful attempts to take its improved technologies to the fields to benefit the stakeholder like the State Forest Department and the farmers through massive drive of trainings and demonstrations in TOT (Transfer of Technology) program. Close linkages between farmers and KVK is maintained in these studies. In selected villages, CAZRI has planted Kumat on farmers' fields.

The State Forest Department has included Kumat in their afforestation program and in past three years about 1.5 lac seedling of *Acacia senegal* were planted in Jaisalmer Forest Division alone, of which about 80% seedlings are surviving and growing well (District Forest Officer, Jaisalmer 2007, personal communication). In addition, about 15000 seedlings of Nigerian *Acacia senegal*, raised through seeds supplied by Regional Research Station of CAZRI at Jaisalmer were planted in Baramsar, Dhanua and Kishanghat. Another 15000 seedlings are to be planted in 2007-2008 monsoon season. Popularization of CAZRI's gum Arabic production technology through publication of research and popular articles in various journals and magazines, coverage in print media (India Today, Rajasthan Patrika, Dainik Bhaskar and Dainik Nav Jyoti) as well as electronic media (DD, ETv) enthused many farmers of Lawan, Baramsar, and Sodakor villages in Jaisalmer district for adoption on their farms. Motivated farmers request for planting material of Kumat to CAZRI-RRS Jaisalmer to plant it on their farms. These farmers are provided with limited number of seedlings and in case demand is more they are guided to approach the District Forest Officer who raises seedlings in bulk and supply to farmers at subsidized rates. Good liaison exists with officials of state forest department and other development agencies.

FUTURE PROSPECTS AND STRATEGIES

In arid region of western Rajasthan, there is good scope for extending area under large-scale plantation for production of gum Arabic. Out of the 20.8 million ha area of arid western Rajasthan, cultivated area is only 11.9 million ha. Remaining area covered under forest, barren and uncultivable, pasture, oran (temple lands) and community grazing land etc, can be used for commercial plantation of *Acacia senegal*.

Some thrust areas for future research are:

- Successful development of vegetative methods of propagation.
- In-depth research needed to study tree-to-tree, site-to-site and seasonal variation in gum quality.
- Trial plots need to be established in forest and farm plantations to measure variability in gum yield.
- There is a need to assess the size and suitability of wild gum-yielding Acacia resources for further improvement.
- Detailed studies are required on management of soil and plant nutrition for equilibration of energy to harness maximum gum productivity from commercial plantations.

RS MERTIA, RAJENDRA PRASAD, LN HARSH
MC BHANDARI and HA KHAN

UNESCO Workshop

An International Workshop on "Ensuring the Future of Drylands Towards Implementing the MAB Agenda for a Sustainable Future of Drylands" was jointly organised by UNESCO within the framework of Man and Biosphere (MAB) programme and the Govt. of India during 11-15 Nov., 2007. The workshop was jointly hosted by the Ministry of Environment and Forest, Government of India, Central Arid Zone Research Institute (CAZRI) and Arid Forest Research Institute (AFRI), Jodhpur. It was attended by representatives of international and national organizations (ICAR, CRIDA, IGFRI, CIAH, ICFRE, ICRISAT, SACEP and UNESCO) and dryland experts from 12 countries (Afghanistan, Bangladesh, Bhutan, China, Egypt, India, Iran, Israel, Nepal, Pakistan, Russian Federation and Sri Lanka). The workshop was a follow-up to the International Scientific Conference on "The Future of Drylands" held in Tunis (Tunisa) in June 2006 in context of the 2006 International Year of Deserts and Desertification, in order to identify the specific research priorities for dryland countries, particularly in Asia and other countries affected by desertification.

SDNP-ENVIS Project

Under SDNP-ENVIS project, the ENVIS Centre on Desertification took up the projects of preparing two databases, namely - (i) Flora of Indian Desert, and (ii) Subject Experts of Desert Environmentalists in India.

Flora of Indian Desert : The database contains 694 records. Each record provides a brief summary of the desert plants in India, and contains seven fields: Scientific name, Local name, Family, Description (including flowering/fruiting and field notes), Herbarium specimen, Uses and Key words. A user may search the database on three parameters, as per his requirement, such as (a) Scientific name (b) Local name (c) Family name. A soft copy of this database has been distributed to the ENVIS Centres and to related institutes/departments.

Subject Expert (Desert Environment) : To collect the relevant information for this database we explored the ICAR Directory of Scientists and Annual Reports of various ICAR Institutes, Agricultural Universities and related organisations like DRDO, DMRC, AFRI, etc. A user may search the information on following parameters: Name, Designation, Qualification, Post held, ARS Discipline, Name of Institute/University/Organisation. The database contains 190 records.

Forthcoming Conferences and Events

International Conference on Developments in Visualization and Virtual Environments in Geographic Information Science, 7-9 January 2008 at Institute of Space and Earth Information Science, Chinese University of Hong Kong, HKSAR, China. Contact: vge2008@cuhk.edu.hk

GIS and Water Resources V: 2008 AWRA Spring Specialty Conference, 17-19 March 2008 at American Water Resources Association, San Mateo, California.

Contact: http://www.awra.org/meetings/San_Mateo2008/registration.html

Optical Sensor Use for Biomass/Yield, March (Dates n.a.) 2008, Uzbekistan/Urgench, organised by ICARDA-CAC/ Zef-UNESCO. Contact: http://www.icarda.cgiar.org/Events_Exp.htm

The 10th International Barley Genetics Symposium (IBGS), 5 - 11April 2008, Alexandria, Egypt, organised by ICARDA/FAO. Contact: http://www.icarda.cgiar.org/Events_Exp.htm

International Conference on Livestock and Global Climate Change, 14 - 17 May 2008, Hammamet, Tunisia, organised by ICARDA-NARP, BSAS, IRESA, OEP, EAAP, INRA, FAO, ILRI, The Ministry of Agriculture and Water Resources in Tunisia. Contact: http://www.icarda.cgiar.org/Events_Exp.htm

Workshop on Sloping Land Management, May or Jun (Dates n.a.) 2008, Tajikistan, organised by ICARDA-CAC/Soil Science RI. Contact: http://www.icarda.cgiar.org/Events_Exp.htm

Climate Change Workshop linked with the 9th International Congress on Dryland Development, November (Dates n.a.) 2008, Alexandria, Egypt, organised by Global COE/ICARDA.

Contact: http://www.icarda.cgiar.org/Events_Exp.htm

Recent CAZRI publications

Taming the Desert. 16p.November 2007. CAZRI, Jodhpur.

Growing Ber (*Ziziphus mauritiana* Lam) for Sustainable Income and Employment in Arid and Semi-arid Regions. Eds. P.R. Meghwal, M.A. Khan, J.C. Tewari. 26p. 2007. CAZRI, Jodhpur.

Untapped Potential of Multipurpose Tree in Arid Lands: Kumat (*Acacia senegal*). Eds. R.S. Mertia, Rajendra Prasad, L.N. Harsh & M.C. Bhandari. 2007. CAZRI, Jodhpur.

Maru Krishi Chayanika (in Hindi). Ed. Madhu Bala Charan. 76p. Jan.-Dec. 2006. CAZRI, Jodhpur.

VISIT ABROAD

H.L. Kushwaha, USA, from 01.11.2007 to 15.12.2007, on Norman E. Borlaug Fellowship.

K.P.R. Vittal, France, from 20.08.2007 to 24.08.2007, to participate in Oasis Pre-Proposed Workshop Organised by ICRISAT/ICARDA.

Amtul Waris, Michigan State University, USA, from 09.07.2007 to 30.06.2008, on Fullbright Hubert H Humphery Fellowship Programme.

Central Arid Zone Research Institute, Jodhpur 342 003, INDIA

ENVIS : Desert Environment Newsletter, Volume 9, Issue 2 (July-December 2007)

Editors: Dr. D.C. Ojha, Dr. Amal Kar and Dr. Manjit Singh

Computer Layout Design: R.K. Dave

Web: www.cazri.res.in E-mail: dcojha@cazri.res.in Fax: 0291-2788706 Phone: 0291-2786931

Evergreen # 0291-2434647