

BRS SEMINAR SERIES PRESENTS:

A SPECIAL BRS SEMINAR

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Climate Risks/Opportunities Management and Decision Making: An International Initiative between Australia and India

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Climatic changes, droughts, floods, heat/cold waves, pests, diseases and poverty dynamics is a complex phenomenon demanding multi-disciplinary management of early warning systems, risk assessment, insurance and mitigation. Excessive melting of Himalayan glaciers, higher frequency of extreme events like cyclones and even tsunamis have been experienced in India during the past 15 years. About 58% of India, 300 million people and 150 million animals are vulnerable to droughts. A relief program of US\$4.4 billion by the Government of India alone and 29 million tons reduction in food grain during the 2002 drought indicates the vast dimension of the economic losses and related human misery. About 670 extreme weather events are experienced every year in India. Satellite based information and communication technology using GPS, GIS, satellite platforms, modeling etc. are called upon to assess impact and manage delivery of relief, insurance and adaptation. This seminar will provide insights into how India is dealing with such issues.

Climatic Risks/Opportunities, Management and Decision Making: An International Initiative Between Australia and India



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PAST AND CURRENT PARTNERSHIPS

(UWS, QDPI, NSW DPI, Indian Agriculture Research System)

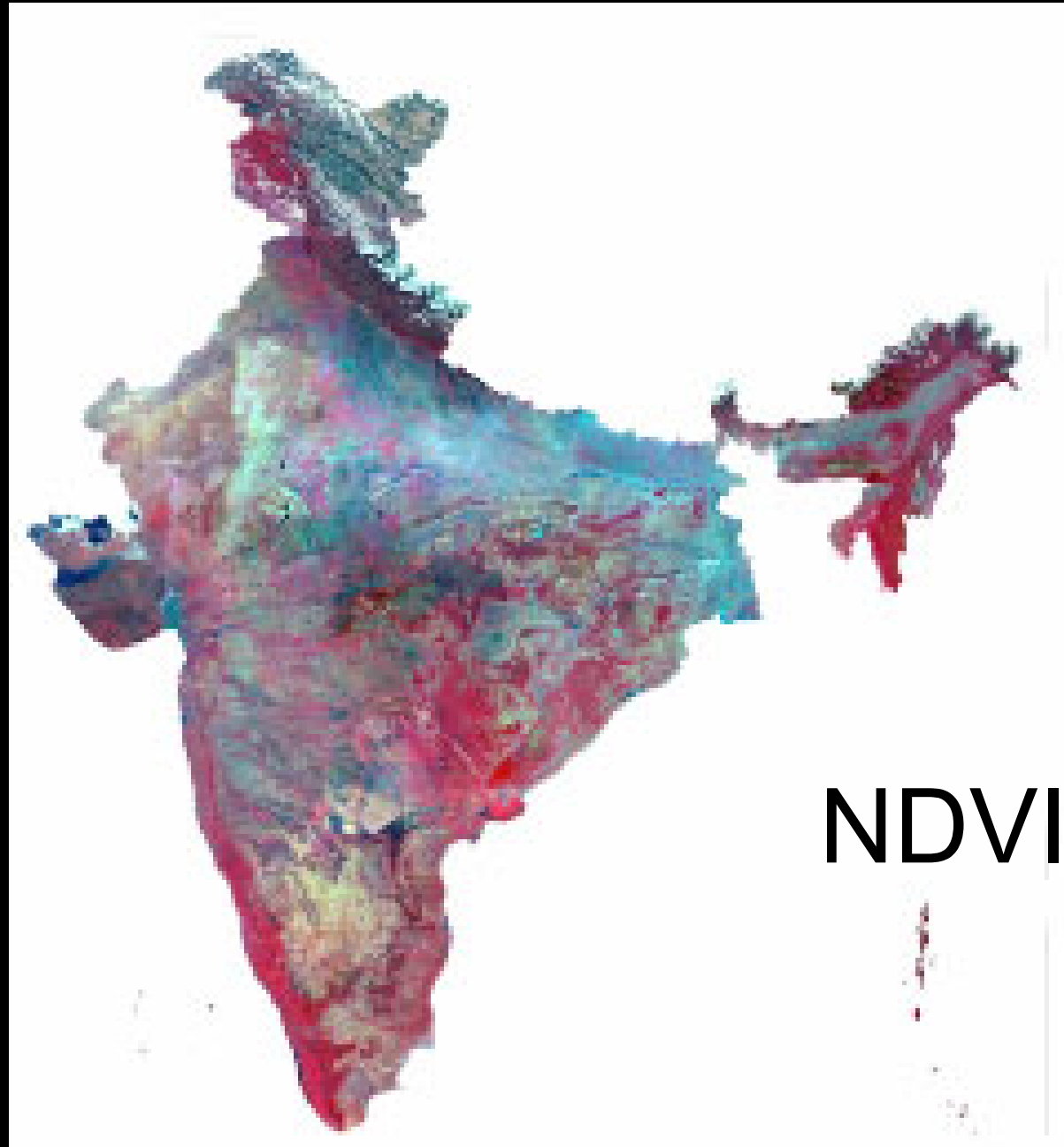
- Climate and disease risk management (Australia-India Council)
- Climate and disease risk management in the Asia-Pacific region (APN)
- Capturing the benefit of seasonal climate forecast in agricultural management (ACIAR- completed)

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- Development of weather-based forewarning systems for crop pests and diseases (ICAR/World Bank)
- Management responses to seasonal climate forecasts in mixed cropping systems of southern India's semi-arid tropics (APN)



A lot of experience, capacities, knowledge, partnerships and genetic resources exist in Australia and India. We can synergize complementarities for providing better service to the society.



NDVI MAP

- India is a multi-ethenic, multi-linguistic and a vast democracy.
- Present population of 1.1 billion is supported by 328 million hectares of geographical area or 142 million ha net cultivated area.
- Per capita net cultivated land = 0.13 ha
- Per capita forest = 0.06 ha
- Per capita utilizable water = 1020 m³
- Range among basins = 300-2761 m³
/capita





60% population depend on agriculture.



Urbanization is 28%.



Its Gross Domestic Product can be decomposed:

 Knowledge based or service sector	-	55%
 Manufacturing/industry	-	25%
 Agriculture	-	20%

National Agriculture Research System

- Indian Council of Agriculture Research
- Clearing house for all international partnerships
- 6000 scientists working in 96 institutes and 86 ACRIPS
- Nine Divisions
- NRM Division has 13 institutes and 1000 scientists
- 40 State Agricultural Universities.
- 30,000 scientific/Teaching personnel
- About 25% budget they receive from ICAR
- Carry out All India Coordinated Research Project. 75% cost is shared by ICAR and 25% by SAUs
- Contract Research for ICAR

Climatic / Weather Changes



Sometimes it becomes a political issue but latest instrumentation, analysis and modelling of earth systems reveals build up of:



CO₂, methane, nitrous oxides and other gases



Global warming is internationally accepted, however, projections about the rate in the increase of temperature are debatable.

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Dynamics of spatial and temporal distribution of rainfall, extreme weather events, forecasting, mitigation and risk management are global concerns.



80% of world agriculture and 60% of the Asian agriculture is unirrigated and is a major priority of poverty reduction, livelihood, income and employment opportunities.



Out migration is common in drought, flood and cyclone affected areas.

Indian Scenario of climatic change



All glaciers of Himalayas have been inventorized by RS, GPS, GIS and IT systems.



Some of the glaciers were mapped and bench marked in 1962.



Excessive melting and retreating of glaciers, rise in temperature and sea levels have been reconfirmed periodically.



Higher occurrences and uncertainties of extreme weather events especially during the past 15 years are well documented.

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On an average India experiences 500 extreme weather events (13 types) in a year distributed across the country.



A multidisciplinary net work of research in climate change.



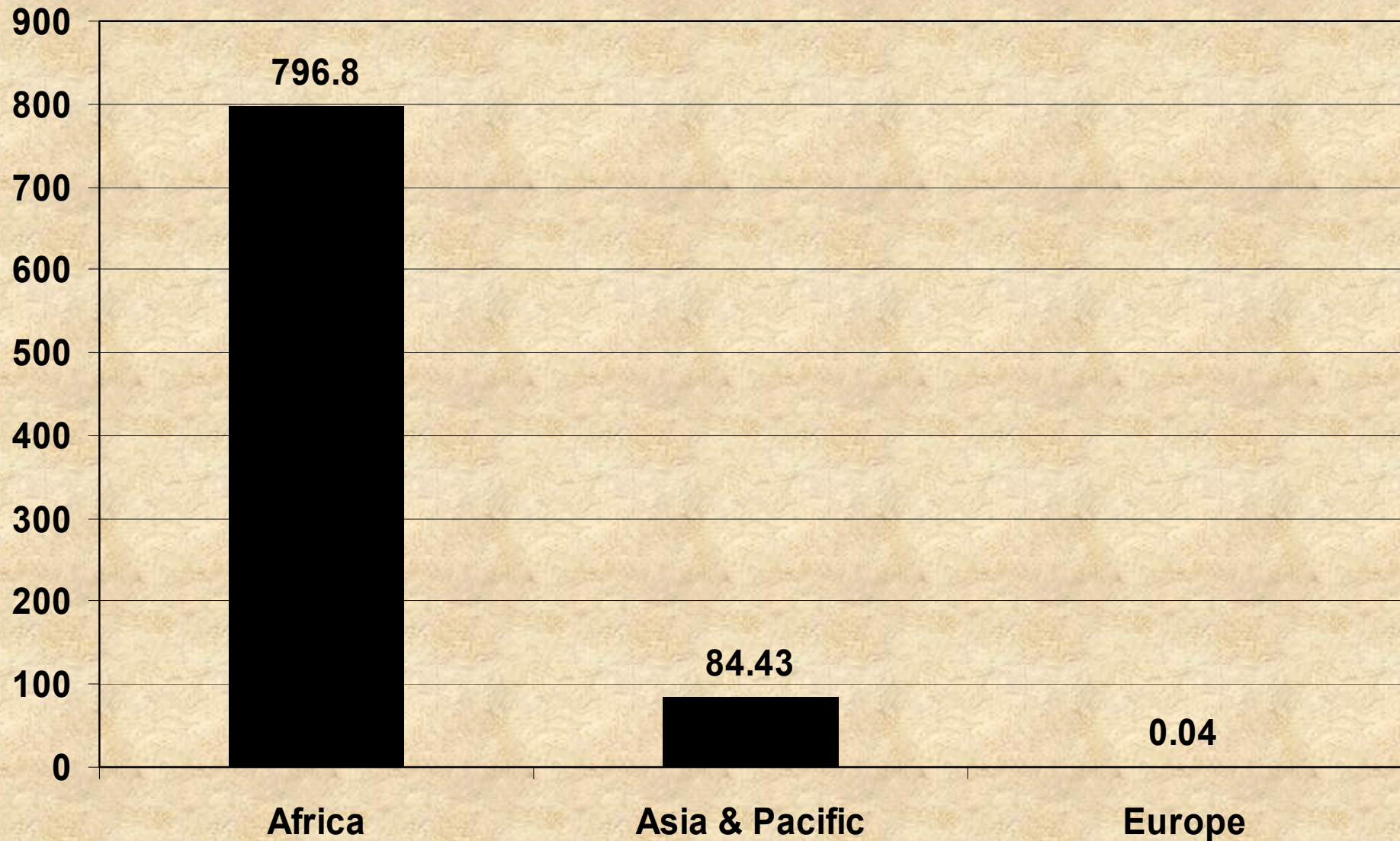
Energy and water are the top most priorities of India's domestic and international polices and investments.



Droughts are the extreme manifestation of climate and there is a lot of indigenous technical knowledge.

Drought Vulnerability Index among continents

Persons killed / million exposed during 1980-2000



Summarized Effects of Droughts in the World (1900-2005)

✓ Number of events	-	822
✓ Persons affected	-	2.2 billion
✓ Persons killed	-	10 million
✓ Homeless families	-	68,000
✓ Damages	-	US\$ 57 billion

✓ 30% of continental surface is afflicted by droughts.

✓ More than 500 millions live in drought prone area of the world.

Vulnerability of India

Event

% Geographical Area
affected

Earthquake

50

Drought

28

1918 (70%)

1987 (47%)

2002 (56%)

Floods

12

Cyclone

08

During 1871 to 2006 (135 years) India witnessed six severe & 17 major droughts

Severe drought
years

Area weighted average
rainfall deficit (%)

1877

-31

1899

-29

1918

-26

1972

-25

1987






-19

2002

-19

In spatial terms frequency of deficit rainfall ranges from once in 2.5 years to 15 years (six fold variation)

Impacts of Latest Drought 2002

-  **56% of land was afflicted.**
-  **Country average rain was deficit by –19% whereas it was –62% for north-west region.**
-  **The month of July receives 80% of total monsoon rainfall and 51% deficit in 2002 was disastrous.**
-  **70 major water reservoirs were deficit by 33% as compared to average of previous 10 years.**
-  **Hydro-electric power generation was lost by 13%.**

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- 🔥 Groundwater level in 55% wells declined by 2-4 m.
- 🔥 Food production was reduced by 29 million tons.
- 🔥 18.5 million hectares could not be sown in the rainy season.
- 🔥 Total agricultural loss of US\$ 8.6 billion lowered GDP by 3.1%.
- 🔥 1250 million person-days employment in agricultural operations was lost.

Contd../..

- 🔦 Calamity relief of US\$ 4.4 billion was disbursed.
- 🔦 Banks suspended recovery of loans from the farmers.
- 🔦 Subsidy on agricultural inputs, deferment of loan recovery costed US\$ 1.5 billions.
- 🔦 Contingency crops were planned on 1.5 million hectare.

Contd../..



110 million cattle were maintained in 15000 cattle camps.



Three million tons of fodder was transported through railway and road networks.



About 0.2 million self help groups & NGOs served the society.



1.5 billion liters of water was transported every day.

Water banks



Drinking water was a critical requirement during drought 2002 and even indigenous transport like camel drawn tanker were deployed for maintaining supply

Cold Waves 2002-03



A broad view of the young mango plants damaged by frost at the Research Farm, Selakui. In the background unaffected 3 ha plantation of Kinnow is seen.

Cold Wave Damages



Mango:

Depending upon age 40-100% damage



Papaya:

40 to 83% damage



Winter Maize:

70-80% loss in seed setting in 70,000 ha




Inland:

Mortality was 87% in Mrigal, 33% in

Culture Fish

Rohu, 7% in Catla and nil in Grasscarp

Effect of increase in temperature (maximum & minimum) from normal on grain yield (per cent deviation) of wheat

Month	Time period	Temperature increase from normal (°C)					
		1°C	2°C	3°C	4°C	5°C	6°C
February	1-14 th Feb	+1.7	-1.6	-1.8	-3.9	-7.7	-7.3
	 15-28 th Feb	-0.4	-4.1	-5.1	-9.9	-14.2	-16.4
March	1-15 th March	-2.7	-3.3	-6.0	-9.5	-9.5	-13.0

Grain yield (kg.ha) decreased at following rates for each degree centigrade rise in temperature:

- 95 during 1st fortnight of February
- 167 during 2nd fortnight of February
- 105 during 1st fortnight of March

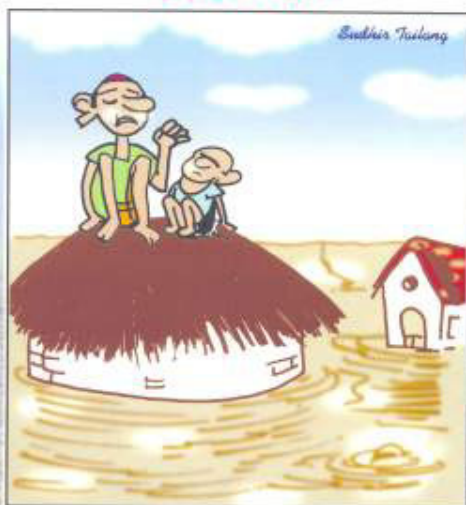


Custard Apple is tolerant to High temperatures but not mango

Cold Wave of 2002-2003: Impact on Agriculture

Thursday, June 19, 2003- Hindustan Times, New Delhi

HERE & NOW



60 people died here in the cold wave, 80 in the recent heat wave, and so far, 35 in the floods

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HEAT WAVE OF MARCH 2004 IMPACT ON AGRICULTURE

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Drought Management Strategies

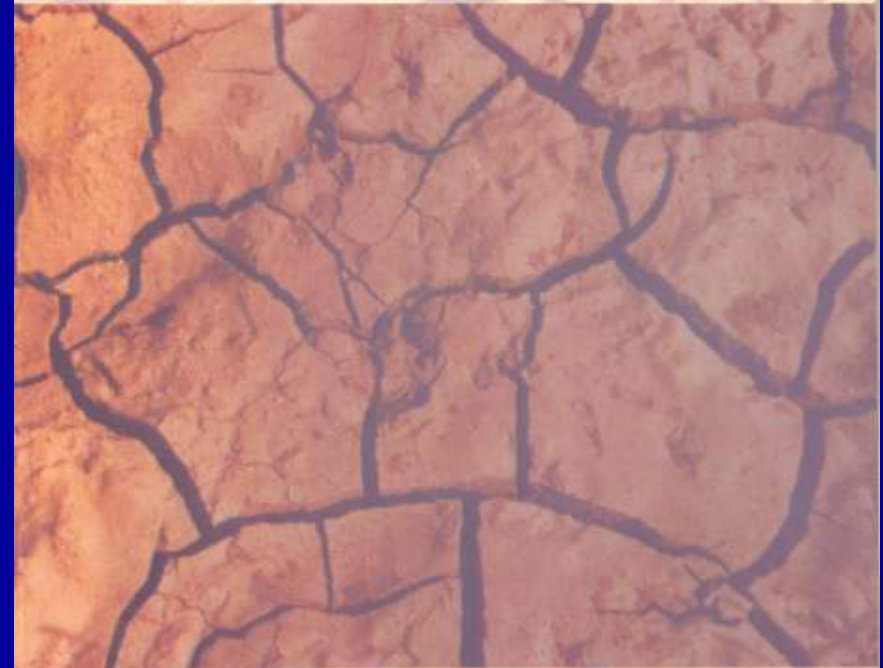


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NEW DELHI

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DROUGHT 2002

Report-1



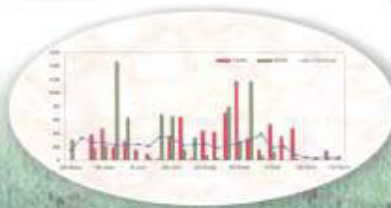
A REPORT



DEPARTMENT OF AGRICULTURE & COOPERATION
MINISTRY OF AGRICULTURE
GOVERNMENT OF INDIA, NEW DELHI - 110001

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Impact of excess rains on yield, market availability and prices of onion



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National Horticultural Research and Development Foundation

Nashik, Maharashtra

Research & Development Products

- ✓ Research on drought was targeted by delineating India into 20 agro-ecologies and 60 sub-zones. Length of growing periods which can be supported by climate, physiograph and soil, etc. were analyzed. Crops and varieties were evolved to match with the length of growing period.
- ✓ Marker assisted selections for drought tolerance in Pearl millet, Moth/cluster bean, Sorghum, Barley, Wheat, Maize and rice are common.

Contd../.

R & D

- ✓ A cross between drought tolerant wheat variety C-306 and high yielding WL-711 is available in the Gene Bank of India.
- ✓ Drysdale – Australian wheat with 10% higher yield is a released variety.
- ✓ Moth Bean and Cluster Bean with a very deep root system and maturing in 60 to 75 days have been evolved.
- ✓ Genetically tailored mustard varieties with different maturity periods are in the market.

R & D

- ✓ Pearl millet varieties with 75 to 90 days to maturity are under cultivation.
- ✓ Some of spices (cummin, coriander), medicinal plants (*Aloevera*), pharmaceutical gums, natural dyes are unique and endemic to semi-arid, arid and desert agro-ecologies.
- ✓ Drought tolerant grass species and varieties.
- ✓ Most of R&D focused on grass production, however, shrubs like *Acacia saligna* are more relevant to goat, camels, etc. for providing resilient livelihood.

Contd../..

R & D

- ✓ A variety of halophytes like *Atriplex* for enhancing fodder and feed supplies and sources of genes exist round the world for attempting transgenic.
- ✓ Highly drought tolerant, thornless Cactii could be a potential source of fodder, vegetables, edible fruits and drinks (Takila in Mexico).
- ✓ Multi-purpose trees like *Prosopis cineraria* with 30-40 m vertical and horizontal dimensions of root system are there. Similar is the case with some fruit trees.

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R & D

- ✓ Many indigenous techniques of *in situ* rainwater conservation, water harvesting, storage, groundwater recharging are available



R & D

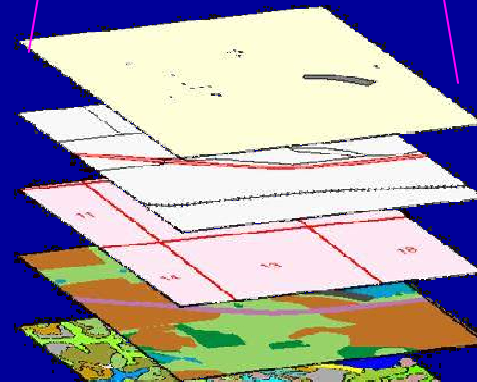
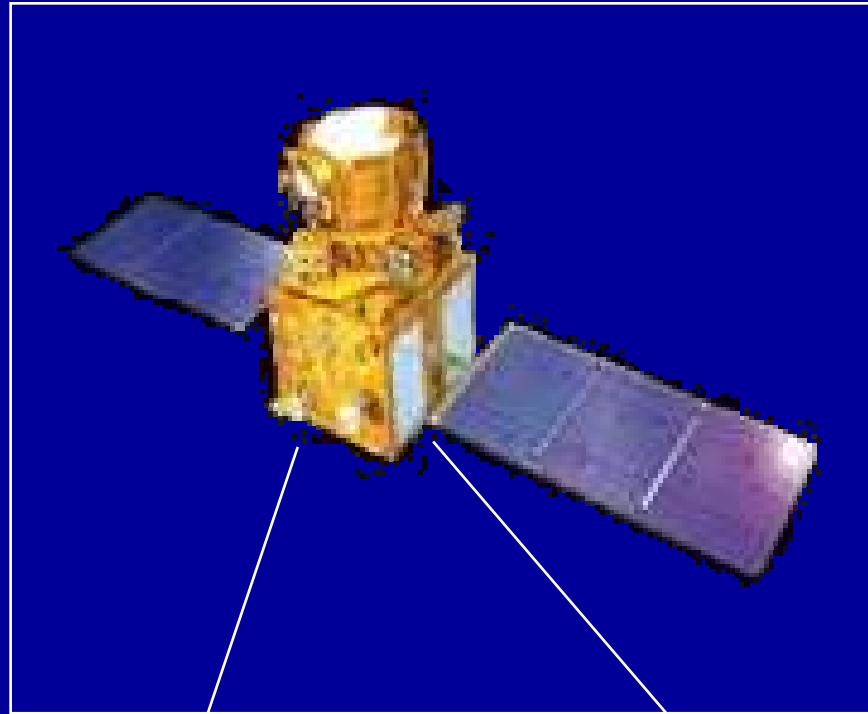
- Livestock is a resilient system of livelihood in the desert ecologies.
- A great diversity in biotic and abiotic tolerant breeds of sheep, goat, cattle, camel and plants types exist across the world.
- Physiological flexibility by reducing urine and faecal output under heat and water stress is well known in Indian breeds of sheep, goat, cattle, etc.

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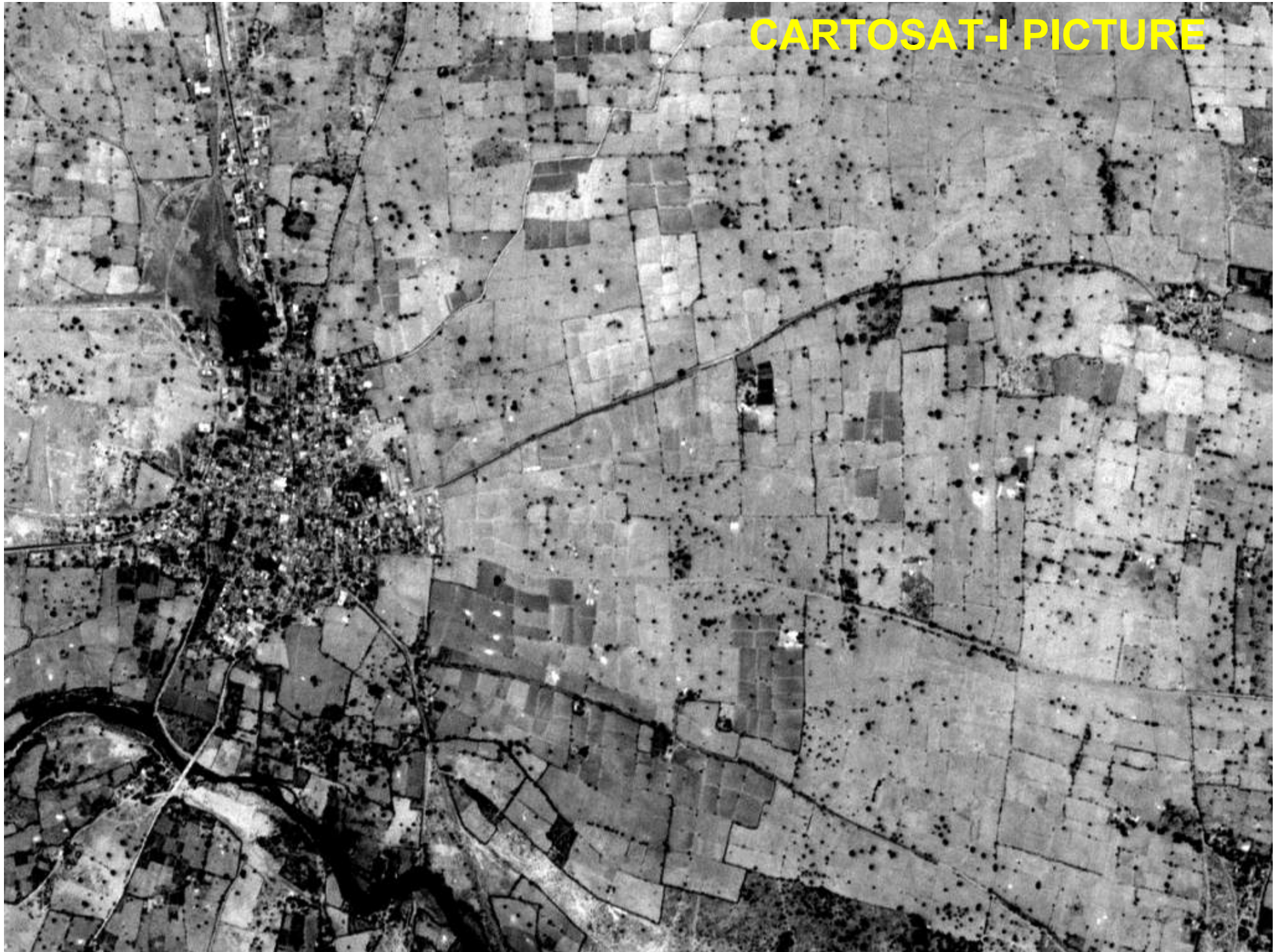
R & D

- Blood haemoglobin, total plasma protein, albumin, inorganic phosphorus, urea and urine electrolytes remained invariant even at half the normal watering of specific sheep and goats breeds.
- Sheep and goats were remarkably tolerant to solar exposure and saline water (upto 4000 ppm) abundant in Indian deserts.
- *Tharparkar* and some other cattle breeds maintain milk and fat production during hottest and driest months of the year.

A Satellite platform



CARTOSAT-I PICTURE



Information Technology

Geo-informatics



Geo-spatial data from various satellite platforms.



Synoptic and repetitive information.



GIS & GPS integrative tools for maps generation.



Geospatial decision support tools for identifying vulnerable and risk prone regions.



Pay load of three India satellite cover every part of the country in one or two days to analyze NDVI, crop stress, drought, pests, disease, nutrient deficiency.

Contd./...



Operation parameters for modelling and atmospheric research.



National Agriculture Drought Assessment and Monitoring System in 14 sensitive states. Generates monthly reports on NDVI.



Four layers of knowledge, information, data and presentations are created.



Communication through internet, websites, TV channels.



A joint satellite with France with advanced measurement for drought analysis is being launched this year.



In one state rainfall is being recorded in each village by Tiping Bucket rain guages. This data is transferred to a central data warehouse through mobile telephones network. Computer analyzes this data simultaneous and generates maps on the screen.



Repeated broadcasts on T.V. and radio network.






Newspapers, magazines.



Free toll phone nos. 1551.

Institutions and Structures

Long, medium and short range forecasting in India

-  80% rain falls in four months of June to September or south-west monsoon.
-  First forecasting in April using 8 Parameters Power Regression and Probabilistic model by IMD.
-  Forecast is updated in July using 10 Parameters Power Regression and Probabilistic model.

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Institutions

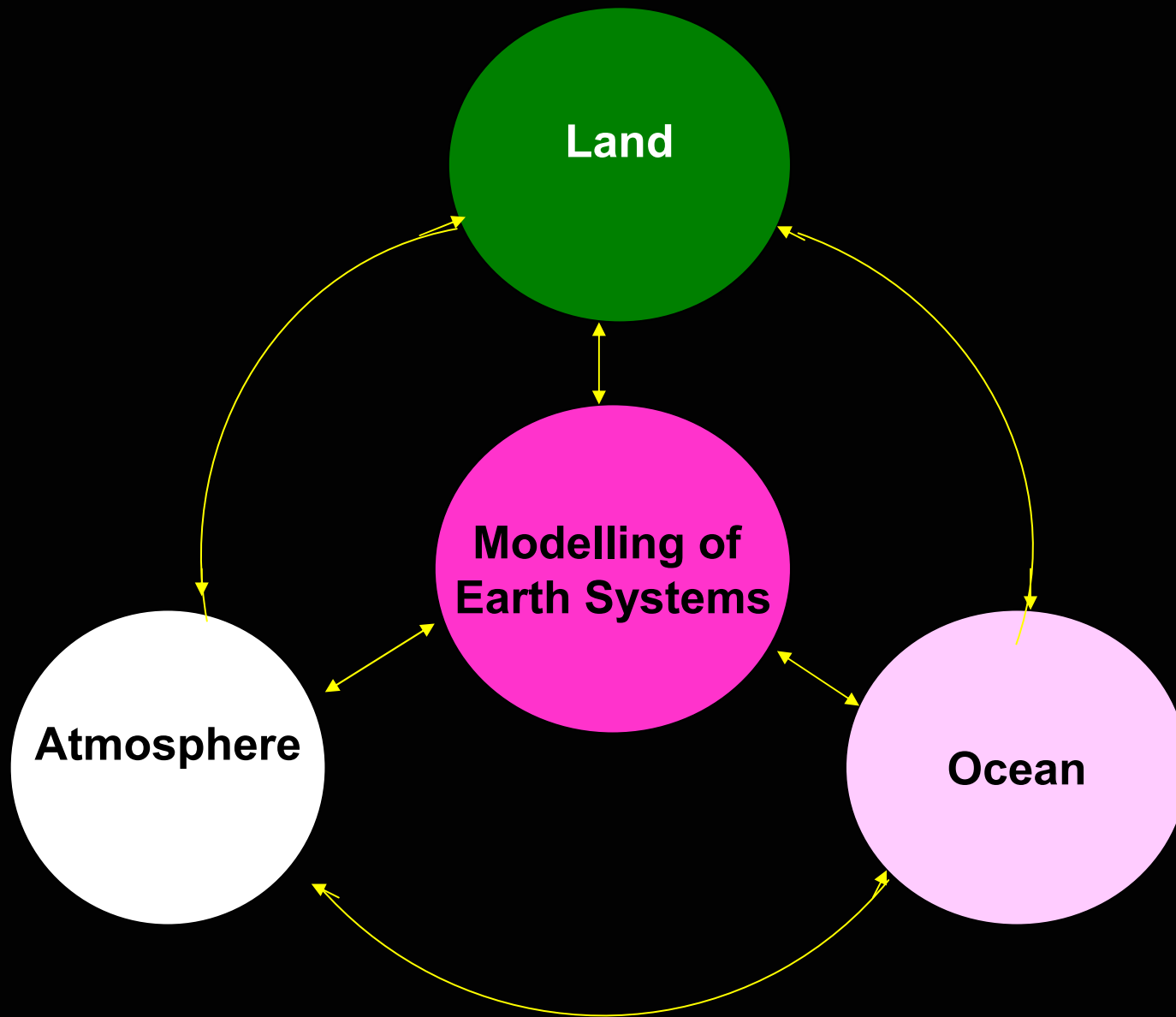
IMD also considers experimental forecasts and inputs of:

1. Indian Institute of Tropical Meteorology
2. Indian Institute of Sciences
3. Space Application Centre
4. Centre for Mathematical Modelling and Computer Simulations
5. National Centre for Medium Range Weather Forecasting
6. Agro-met Services of ICAR
7. Seismological Institute
8. UK, Europe and three agencies of USA

Convergence for Organizing Critical Mass

USA has National Ocean and Atmospheric Administration. India is re-organizing a Ministry of Earth Sciences by converging and networking of fragmented 11 departments, institutions and agencies. It will be one step ahead of USA.

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Nature Serves Society through Complex Resource Dynamics

National Disaster Management Authority

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graph TD; A[National Disaster Management Authority] --> B[Prime Minister of India  
Chairperson]; B --> C[Ex-Army General  
Vice-Chairman in the rank of Cabinet Minister]; C --> D[Five Expert Members  
In the rank of Minister of State]; D --> E[Home Ministry  
Overall Nodal Ministry]; E --> F[Ministry of Agriculture & Cooperation  
Sub-nodal Agency for Droughts];
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Prime Minister of India

Chairperson

Ex-Army General

Vice-Chairman in the rank of Cabinet Minister

Five Expert Members

In the rank of Minister of State

Home Ministry

Overall Nodal Ministry

Ministry of Agriculture & Cooperation

Sub-nodal Agency for Droughts

Policy and Governance Underpinning

- Since 1951 Finance Commission of India makes budgetary provision of Calamity Relief Fund for an immediate quick alleviation of distress.
- Almost all the states prepared manuals for estimating losses to provide relief after 1950s.
- A Relief Commissioner at the Federal and State level is provided.

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Governance

- A Weather Watch Group consisting members of concerned ministries and professionals meet every Monday at 1100 hrs. at Delhi. It provides early warning information.
- A National Disaster Management Institute was set up in Delhi in 2002.

Risks and Opportunities Assessment

- ✓ Rainfall (spatial and temporal variability), droughts, floods and other extreme events cause enormous social, economic and environmental impacts.
- ✓ Surface and ground water supplies for various utilities are also precipitation dependent.
- ✓ Heat and cold wave system of northern India originates from Mediterranean region (Iran).
- ✓ Every state has manuals for assessing economic losses for the purpose of relief.

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Risk Assessment

- ✓ Remote sensing and satellite platform provide quick assessment.
- ✓ About 64 to 80% underground water resources of drought prone regions of India are of poor quality. Safe drinking for human being, livestock and wildlife is upper most risk.
- ✓ Out-migration disrupts social fabrics and education of children become major casualty.

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Risk Assessment

- ✓ Drought effects manifest after 2 or 3 years in perennial crops, livestock and groundwater deficits.
- ✓ Flood years of India followed by higher productivity due to recharging of the under drought water resources.
- ✓ It takes 4-5 years to remedy multi-dimensional damages of cyclones, super-cyclones and *tsunamies*.

Risk Management

- Food, fodder, feed, water and credit banks for immediate distress alleviation.
- Daily, short, medium and long range forecasting. Value is added by including forecast on pests, diseases, prices and marketing, etc.
- Insurance of loanee farmers was introduced in 1985.
- Cut off productivity for claims was based on average of the best five out of preceding seven years yield (2-3% premium).

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Risk Management

- Only 10-12% of the 127 million farming units are insured.
- The problem was about quick estimations of economic losses.
- Triggering event (rainfall deficit) based new insurance products are now more attractive.

CLAIMS PAYOUT TABLE

% Deficiency	Claim payout (% of SI)
0%	0
10%	0
20%	0
30%	10%
40%	15%
50%	25%
60%	35%
70%	45%
80%	75%
90%	100%

PREMIUM (%)

4.12

1.79

% Deficiency	Claim payout (% of SI)
0%	0
10%	0
20%	0
40%	10%
50%	15%
60%	20%
70%	30%
80%	40%
90%	70%
100%	100%

World Bank is financing US\$ 235 million National Agricultural Innovation Project to ICAR. The projects are going to be awarded on competitive basis. Ads will appear very soon for bids.