Climate Resilient Practices: NICRA Experiences

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What sectors of agriculture in India contribute to greenhouse gas emissions?

- Rice cultivation: 23%
- Enteric fermentation: 59%
- Emission from soils: 12%
- Manure management: 5%
- Crop residues: 1%

Source: India’s Initial National Communication on Climate Change, 2004
Climate Variability and Change

Climate variability
Climate variability refers to variations of the climate
- in the mean state, and
- in other statistics, such as standard deviations and the occurrence of extremes.

Climate change
Climate change refers to a long-term change in the state of climate, that can be identified by changes in the means and/or changes in the variability.

Climate change also include gradual and/or abrupt changes of the frequencies and intensities of extreme events.

Variability around the mean as a "characteristic" of the climate.

Change of the characteristics of climate. Here, a change in the mean state is shown.
Climate Change: Indian Scenario

Rainfall
No long term trend noted. Regional variations seen, increase in summer rainfall and decrease in number of rainy days.

Temperature
0.6°C rise in ST during 100 years. Projected increase 3.50 to 5°C by 2100.

CO2
Per capita emission of 0.3 t carbon in 2004.

Extreme events
Increased frequency of heat wave, cold wave, droughts and floods observed during last decade.

Sea level rise
Rise of 2.5 mm/year since 1950.

Glaciers
Retreating noted in Himalayas.
• Significant decreasing trend of monsoon season rainfall noticed in the eastern part of India, Kerala, HP and Uttarakhand.

• Significant increase has been noticed in some parts of southern peninsula, western UP, WB and J&K.

• Different levels of significance are shaded with colours.

Guhathakurta and Rajeevan, 2006
Climate Analysis

• Rainfall Trends
• Rainfall Shifts
• Drought Analysis
• CWR for different crops

Drought Probability

AICRPAM
Early season: Delayed onset, prolonged dry spells after onset

Mid-season: Inadequate soil moisture between two rain events

Late season: Early cessation of rains or insufficient rains
Currently available technology can cope with short term impacts eg. Wheat

![Bar chart showing change from mean yields of 2000-07 for various adaptation strategies.]

- Impact
- Current variety and improved management
- Improved variety and current management
- Improved variety and altered management
- Improved variety and improved management and NRM
100 Districts selected for Technology Demonstration

National Initiative on Climate Resilient Agriculture

Map not to scale
Process

- Identification of vulnerable districts
- Choosing representative village cluster
- Characterization of climatic stresses
- Need assessment and baseline
- Formation of VCRMC
- Finalization of interventions through a participatory process
- Implementation and monitoring

*The unique feature is the flexibility in interventions depending on the real time weather*
Village Climate Risk Management Committee (VCRMC)

<table>
<thead>
<tr>
<th>Name of the VCRMC</th>
<th>Village name</th>
<th>No. of members</th>
<th>Bank details</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCRMC, Sanora, Barodi</td>
<td>Sanora, Barodi</td>
<td>12</td>
<td>Bank details</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Name of Bank, A/C no. Amount (Rs.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Panjab National Bank, Branch-Datia (M.P.) 0638000101265901 3210.00</td>
</tr>
</tbody>
</table>

Name of VCRMC – Sh. Ratan Singh Yadav (President), Sh. Umashankar Sharma (Secretary), Sh. Chhatrapal Pateria (Treasure), Sh. Kallu Sharma, Sh. Rajesh Sharma, Sh. Sobran Parihar, Sh. Moolchandra Namdev, Sh. Raju Sharma, Sh. Munna Lal Yadav, Sh. Sugreev Yadav, Sh. Devi Singh, Sh. Lakhan Singh Yadav (Members).
Launch at the Village sites

In each launch all the stakeholders in the district were brought together.

..and the programme objectives are explained
Farmers awareness programs on Climate Change

Faizabad
Parbhani
Dapoli
CRIDA
Module I: Natural resources

Interventions related to soil health, in-situ moisture conservation, water harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage where appropriate, artificial ground water recharge and water saving irrigation methods.

Module II: Crop Production

Drought/temperature tolerant varieties, advancement of planting dates of rabi crops in areas with terminal heat stress, water saving paddy cultivation methods (SRI, aerobic, direct seeding), frost management in horticulture through fumigation, community nurseries for delayed monsoon, custom hiring centres for timely planting, location specific intercropping systems
Module III: Livestock and Fisheries

Use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, preventive vaccination, improved shelters for reducing heat stress in livestock, management of fish ponds/tanks during water scarcity and excess water, etc.

Module IV: Institutional Interventions

Institutional interventions either by strengthening the existing ones or initiating new ones relating to seed bank, fodder bank, commodity groups, custom hiring centre, collective marketing group, introduction of weather index based insurance and climate literacy through a village weather station will be part of this module.

Documentations of indigenous coping mechanisms in all the 100 districts is part of this component (which will be made as a compendium)
Key Interventions and Outcomes

Small Change at Individual Farmer, House Hold, Village will contribute immensely to total to Cause and Affect!
Crop Based Approaches

- Crops and varieties that fit into new cropping systems and seasons
- Development of varieties with changed duration
- Varieties for high temperature, drought, inland salinity and submergence tolerance
- Crops and varieties that tolerate coastal salinity and sea water inundation
- Varieties which respond to high CO2
Local germplasm as a source of “climate ready traits”
Short duration drought tolerant cultivars: Answer to reduced duration due to climate change

<table>
<thead>
<tr>
<th>Location</th>
<th>Crop</th>
<th>Variety</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varanasi</td>
<td>Rice</td>
<td>Vandana</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Pigeonpea</td>
<td>T-21</td>
<td>176</td>
</tr>
<tr>
<td>Phulbani</td>
<td>Pigeonpea</td>
<td>T-21</td>
<td>160</td>
</tr>
<tr>
<td>Arjia</td>
<td>Maize</td>
<td>Surya</td>
<td>70-75</td>
</tr>
<tr>
<td>Anantapur</td>
<td>Groundnut</td>
<td>Vemana</td>
<td>105-110</td>
</tr>
<tr>
<td>Indore</td>
<td>Soybean</td>
<td>JS-90-41</td>
<td>87-98</td>
</tr>
<tr>
<td>Rewa</td>
<td>Rice</td>
<td>Kalinga-3</td>
<td>90</td>
</tr>
<tr>
<td>Akola</td>
<td>Cotton</td>
<td>AKH-081</td>
<td>150-160</td>
</tr>
<tr>
<td>Bijapur</td>
<td>Sunflower</td>
<td>KBSH-1</td>
<td>90-95</td>
</tr>
<tr>
<td>Solapur</td>
<td>Sorghum</td>
<td>Mauli</td>
<td>105-110</td>
</tr>
<tr>
<td>Hisar</td>
<td>Pearlmillet</td>
<td>HHB-67</td>
<td>60-62</td>
</tr>
<tr>
<td>Bangalore</td>
<td>Fingermillet</td>
<td>GPU-26</td>
<td>90-105</td>
</tr>
</tbody>
</table>

Source: CRIDA, Hyderabad, India
In-situ Moisture Conservation
Most effective means of soil & water conservation.

BBF, CF and ridge furrow are important for Maharashtra.

Ridge/Furrow is for water conservation and draining out excessive moisture during heavy rain spells.

Soybean and Maize saved with ridge furrow systems in black soils of MP when more than 120 mm rainfall received in a day

Machinery and village custom hiring centre need
BBF Technology for Black Soil Regions of Central and Western India

@ Black soils of Maharashtra, MP, Gujarat, North Karnataka
@ Dryland Farming Mission of Maharashtra: got 10000 BBF makers
@ Per day 10 ac/BBF = 300 ac/BBF for month
@ 10-12 lakh ha during one month sowing window
@ Benefits are during drought and Excess rainfall (draining out)
@ Last kharif: BBF sowed Soybean and Maize were saved in lakh ha in Malwa region of MP
@ Cost of BBF maker is Rs 11000/-
Farm Pond Based System-Adilabad

Convergence with MGNREGA
On farm water harvesting

✅ On Farm Reservoir (OFR) technology in Chhattisgarh, Orissa and Jharkhand created major impact on drought management during kharif.

✅ The Government of Chhattisgarh included this technology in the drought relief programme.

✅ Ridges and furrows system in cotton in vertisols. Additional yield of 500 kg/ha over farmers’ practice. *(In situ moisture conservation and drainage)*

Source: NATP, CRIDA
Agro-forestry systems to provide more stable incomes during years of extreme weather events (eg. India)

- Neem + Cowpea
- Guava + stylo
- Faidherbia Albida + Sorghum
- Mango + Greengram
- Leucaena + Sunhemp

CRIDA
Shelter belts for moderating micro climate.

- Shelter belts reduce wind velocity
- Moderate temperature
- Reduce evaporative loss and conserve soil moisture
Impact of the intervention

1. Saving in 25 liters of D in transplanting
2. Saving in 5 hours in tractor operation
3. Saving in 35 Man days in uprooting and transplanting of seedlings
4. Pump set hours reduced by 3 /ha
Strategies for Efficient Management of Soil, Water and Nutrients

- Land use based on land capability
- *In situ* moisture conservation
- Rainwater harvesting and recycling
- Efficient use of irrigation water
- Conservation agriculture
- Energy efficiency in agriculture and irrigation
- Use of poor quality water
Zero-Tillage
Improved Productivity at Less Cost

- Saves Rs.2500/ha in bed preparation
- Early sowing improves wheat yield by 5-15%
- Saves water (25-30 %)
- Reduce *Phalaris minor* (40-50 %)
- Ensures timely planting

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (million ha)</th>
<th>Savings (Rs. in million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-01</td>
<td>0.05</td>
<td>125</td>
</tr>
<tr>
<td>2001-02</td>
<td>0.2</td>
<td>500</td>
</tr>
<tr>
<td>2002-03</td>
<td>0.3</td>
<td>750</td>
</tr>
<tr>
<td>2003-04</td>
<td>1.0</td>
<td>2500</td>
</tr>
<tr>
<td>Total (2000-2004)</td>
<td></td>
<td>3875</td>
</tr>
</tbody>
</table>

Source: NATP, Irrigated
Bed Planting: A Water-Wise Technology

- 20-25% Saving in irrigation water
- Opportunity for crop diversification
- Suitable for mechanical weeding & reduces herbicide use

Source: NATP Irrigated Ecosystem
Managing sea water intrusion in coastal areas: *Doruvu/Kottai* technology

<table>
<thead>
<tr>
<th>Traditional system</th>
<th>Improved system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Shallow pond</td>
<td>• Deep (upto 20 ft) open well</td>
</tr>
<tr>
<td>• More land required, Less water stored</td>
<td>• Horizontal flow of under ground water enabled in to the well through pipes</td>
</tr>
<tr>
<td>• Less water for pumping</td>
<td>• More water stored, small land required</td>
</tr>
<tr>
<td>• Manually irrigated</td>
<td>• More water to pump and irrigate crops</td>
</tr>
<tr>
<td>• Small area covered</td>
<td></td>
</tr>
</tbody>
</table>
District: Saran, Bihar

Community Nursery for Staggered Seedling Production
Staggered Community Nursery

Gumla, Jharkhand

Objective:
Coping strategy towards erratic rain fall

Staggered date of sowing

25/6/12  01/7/12  08/7/12  15/7/12  22/7/12
6/12  7/12  7/12  7/12  7/12
<table>
<thead>
<tr>
<th>Intervention</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance of seed bank</td>
<td>-Quality seed of submergence tolerant and short duration late transplanted rice varieties for flood affected area</td>
</tr>
<tr>
<td></td>
<td>-Quality seed of summer rice and toria for rabi</td>
</tr>
</tbody>
</table>
Jagdalpur
Chattishgadh

Output of one activity
Leads to another activity
In the farm holding

@ resilient
@ Carbon efficient
@ family is central point
2. Farm Pond
Component- Fishery+ Horticulture+ Duckery
Area- 2.5
No of pond renovated- 3 nos
No of Farmer Benefited- 25 no

To increase water productivity, water use efficiency and better Land Husbandry Practices

- It will store run-off water.
- Recharging of ground water.
- Increase the availability of moisture.
- Provide life saving irrigation during drought.
- Generate employment.

Fishery- Catla, rahu and mirgal
Duckery- Khaki cambel, White runner
Horti- Coconut, Mango & Banana
Integrated Farming system Model at Village Tahakapal, Dist. – Bastar, Chattishgadh
Huge scope for research on livestock shelter
Soil Health Improvement

Component Aims:
SHM will aim at promoting location as well as crop specific sustainable soil health management including residue management, organic farming practices by way of creating and linking soil fertility maps with macro-micro nutrient management, appropriate land use based on land capability, judicious application of fertilizers and minimizing the soil erosion/ degradation.

- Strengthening of Soil Testing Lab
- Data Bank
- District Map
- Promotion of INM, organic farming, micro nutrients etc.
- Reclamation of Alkali Soil
- Reclamation of Acid Soil
- Development of Shifting Cultivation Areas
- Training & Demonstration on SHM
Minimize Field Burning of Crop Residues

ICAR-CRIDA-NMSA

Status: Crop Residue Burning in Rainfed Crops
**Technology:** On-farm Generation of Organic Matter for Soil Health and Reduced Input Cost and Higher Productivity

**Domain Scale for Upscaling:**
1) Southern Karnataka (10 Districts) (10 lakh ha)
2) Vidarbha Region and Kharif Fallow Regions of Maharashtra (Black soil regions)(7 Districts)
   1) Kharif fallow regions of Northern Karnataka (Black soils) (5 Districts)
   2) Kharif Fallow regions of Southern Tamil Nadu (Black soil ) (3 Districts)
   3) Other irrigated regions: between two crop seasons
Village Level C Positive Interventions

Glyricidia on farm bunds

Tank Silt

Tank silt application

Greengram crop residue incorporation in the soil after harvesting

Cotton residue

Vermicomposting

Legume Cover Crops

Zero till maize

CRIDA
Model of Whole Village Participation in Low Carbon Economy

- @Residue Burning
- @Cowdung cakes
- @Biogas for household cooking
- @Biogas for water lifting generator
- @55 Women farmers
- @Vermicompost for high value crops

Linked with More and Heritage Markets
Silt Technology for Soil Health, Mid-Season Droughts and Improved Crop Productivity

20 Tractors per ac makes the difference in soil properties

- NMSA with MGNREGA
- Caution: Test for salinity particularly for legume crops
- Promote in Dryland Horticulture with drip systems + tank silt + organic mulch (Water requirements will be reduced to 2/3rd.

Domain Region: Red soils and light textured alluvial soil regions
Conservation Agriculture (CA) in Rainfed Systems

Impact of CA on possibility of taking horsegram during post rainy season after Maize in light textured Alfisols with about 700 mm rainfall regions. Otherwise mono-cropped area!
• Parliamentary committee on agriculture recommended preparation of district level Contingency plans for various situations

• CRIDA made 580 District Contingency Plans (Till Now)

• The contingencies covered are droughts, floods, heat and cold waves, frost, unseasonal rains, cyclones etc.

• Effective operationalisation of these contingency plans requires reliable district level forecasts of all types

• Dedicated district level contingency plan implementation cells will be set up in XII plan under NMSA under the overall supervision of DoAC
Crop Calendar and Rainfall Pattern

<table>
<thead>
<tr>
<th>Stages</th>
<th>Presowing</th>
<th>Seedling</th>
<th>Vegetative</th>
<th>Reproductive</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 weeks</td>
<td>3 weeks</td>
<td>6 weeks</td>
<td>6 weeks</td>
<td>5.5 weeks</td>
</tr>
<tr>
<td>Water requirement</td>
<td>40-60mm</td>
<td>50-70mm</td>
<td>170-190mm</td>
<td>180-200mm</td>
<td>40mm</td>
</tr>
</tbody>
</table>

Rainfall required

Source: Vivek Pawale, Galileo Weather Risk Management Ltd
Main objective of this study is to establish Carbon balance of agriculture (in terms of t CO₂ equivalents) using EX-ACT model.

Schematization of the modular EX-ACT structure (Source: Bernoux et al., 2010)
**C-Source**

* Non forest land use change
* Waste lands to Agriculture
* Efficient crops/cultivars
* Crop residue burning
* Incorporation in paddy
* Livestock feed
* Increase fertilizer inputs particularly N
* Method of application
* Manure collection
* Intensive tillage

**C-Sink**

* Reduced crop residue burning
* Green manure
* Green leaf manuring
* Conservation Agriculture
* Water management practices like drip irrigation system
* Crop residue recycling
* Agro forestry
* Efficient crops and systems
* SSNM
* Balanced fertilizer use
* INM
* Water saving rice systems
* Better feed in livestock
* Manure pit management
* Tank silt application
* Biogas plants linked with vermi composting
Eight National Missions

- National Mission for Sustainable Agriculture
Open Top Chambers at CRIDA - Plant growing conditions
Thank You