Linkages:

- Karnataka State Department of Agriculture, Government of Karnataka
- Watershed Development Department, Government of Karnataka
- Department of Horticulture, Government of Karnataka
- Department of Animal Husbandry and Veterinary Services, Government of Karnataka
- AICRP Schemes in the University
- Non- Government Organizations (NGO's)

Future programmes:

- National Initiative on Climate Resilient Agriculture (NICRA)
- Conservation Agriculture
- Catchment-Storage Command relationship for enhancing water productivity in micro-watersheds
- Contingency crop planning and management
- Integrated nutrient management
- Foliar nutrition for drought proofing
- Participatory varietal selection
- Small farm mechanization and development of custom hiring system
- Validation of potential ITKs and their up scaling in farmers fields
- Strengthening linkages with other line departments

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ALL INDIA CO-ORDINATED RESEARCH PROJECT FOR DRYLAND AGRICULTURE

CENTRE AT A GLANCE

DIRECTORATE OF RESEARCH
UNIVERSITY OF AGRICULTURAL SCIENCES
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2014

ALL INDIA CO-ORDINATED RESEARCH PROJECT FOR DRY LAND AGRICULTURE, UAS, GKVK, BANGALORE- 560 065

About the Centre

The All India Co-ordinated Research Project for Dryland Agriculture (AICRPDA), University of Agricultural Sciences, GKVK, Bangalore centre was started during August, 1970 under the joint auspicious of Indian Council of Agriculture Research (ICAR) and Canadian International Development Agency (CIDA). The project is catering the research needs of dryland farmers of Southern Karnataka comprising of Central Dry Zone (Zone- IV), Eastern Dry Zone (Zone-V) and Southern Dry Zone (Zone-VI) consisting of red loamy soils with finger millet based cropping system.

The Operational Research Project (ORP) centre was initiated during 1976 to transfer, assess and to refine the dryland technologies developed at the main centre in the farmer's fields. The Centre is located at GKVK campus, Bangalore about 4 km to National Highway No.7.

Mandate of AICRPDA:

- To optimize the use of natural resources (rainfall, land and water) to minimize soil and rain water loss and environmental degradation.
- To evolve a simple technology for sustainability, increase crop productivity and economic viability.
- To increase stability of crop production over years by way of improvements in natural resources and crop management systems and alternate crop production technologies matching to weather aberrations.
- To develop alternate and sustainable land use systems.
- To evaluate the transfer of improved dryland technology in the farmer's fields.

Mandate of Operational Research Project:

- To understand the strength and weakness of the traditional system of dryland agriculture.
- To evaluate the performance of each component of dryland technology under farmers management conditions.
- To assess the technology refinement, diffusion and to provide feedback to the scientists of main centre.
- To identify operational and institutional constraints in the transfer of dryland technology.
- To provide consultancy services to the extension agencies for transfer of dryland technology.

Research Focus

The research at AICRPDA, Bangalore centre has been focusing on location specific problems considering the agroclimatic zones, predominant rainfed production systems and socio-economic situation with major emphasis on rain water management, integrated nutrient management, energy management, crops and cropping systems, contingency planning, tillage and farm machinery, drought mitigation strategies and alternate land use system. The on-station research findings of the centre are being evaluated on farmer's fields through Operational Research Project (ORP) for up scaling of rainfed technologies. Another project on National Initiative on Climate Resilient Agriculture (NICRA) was initiated during 2011 with major focus was on issues such as development and application of improved production and risk management technologies through strategic and action research to enhance the resilience to rainfed agriculture covering crops and livestock. Issuing timely crop-weather agro advisories, real time contingent cropping, reduction of drudgery and ensuring timely operations through custom hiring centre, rainwater harvesting and multiple use of water are undertaken in NICRA project through multi disciplinary approach to enable higher economic returns and livelihood security to the farmers.

Domain areas of AICRPDA, Bangalore

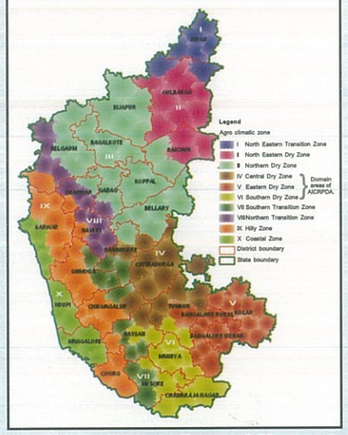


Fig: 1 Agro-Climatic Zones of Karnataka

Details of Dry zones of Karnataka

Parameters	Central Dry Zone (ACZ No.4)	Eastern Dry Zone (ACZ No.5)	Southern Dry Zone (ACZ No.6)
Annual Rainfall	604.8 mm (May-Oct- 80% Bi-modal distrbution)	768.5 mm (2 peaks, May-October- 82%)	717.8 mm (Bi-modal, May- Oct. 70%)
Length of Growing Period	90-100 days	90-120 days	85-125 days
Soils	Red sandy loam (51%), Shallow to medium black (28%), Deep black (12%), Red loam to clay (9%)	Red loamy (49%) Red sandy (18%) Red laterite (33%)	Red gravelly to sandy loam (>50%), Red loam (< 50 %)

Successful rainfed technologies:

The research findings and recommendations made with regard to different problems for the benefit of dry land farmers are given hereunder;

I Soil and water conservation:

- Soil erosion: Open end contour bunds, live bunds (Khus and Nase grass), graded border strips, sowing across the slope, graded bunds, graded border strips with reduced cross section (0.36 m^2 for deep red soils to reduce runoff to 36 % of annual rainfall on a land slope of 2.5 %). Diversion channels with 0.38 m^2 section are suitable for a catchments size of one hectare with a land slope of 2.5 per cent, stones or Khus grass to be provided at vertical intervals of 0.5 to 1 meter, waterways stabilization with Agave.

- *In-situ* moisture conservation: Crop cultivation across the slope with dead furrow at 10 m interval, fall ploughing, strip cropping, ridges and furrows across the slope, dead furrow between crop rows, ridge tieing, deep tilling up to 30 cm for crops like maize and pigeonpea.
- Management of excess runoff water: Water harvesting structures – Farm ponds with soil and cement (8:1) lining with LDP sheet to reduce seepage.

- Drought during crop growth: Frequent inter cultivation to create dust mulch, reducing plant population, protective irrigation during critical stages from farm pond and organic mulching.
- Management of non-arable lands: In shallow soils with low rainfall, 'V'- ditches on contour diversion channels instead of pit and mound planting for tree species, staggered catch pits (0.5 m D x 0.5 m W x 1.0 m L) in non-arable lands, stabilization of drainage line with gully check, nala bunds, check dams/ stop dams/ ravine reclamation structures to reduce the running water force. Planting multipurpose tree species on contours, establishment of pasture system using drought hardy grass (Kikuyu grass) and legumes (*Styloxanthus hamata*)

II Crop improvement

- High yielding varieties recommended for dryland areas: Finger millet: MR-1, MR-6, GPU-28, GPU-66, GPU-48, ML-365; Pigeonpea: TTB-7, BRG-1, BRG-2; Cowpea: IT-38956-1*, Field bean: HA-3, HA-4, Horse gram: PHG-9*, Green chilli: Samrudhi*, Hybrid maize: Hema (NAH -1137) and Nithyashri (NAH-2049), Sunflower : KBSH – 44, Niger : KBN–1

(*Developed at DLAP)

III Cropping Systems

a) Inter-cropping systems

	Sowing time	Crops	Ratio of rows
Erratic rainfall	May-June	Pigeonpea- Maize	1:1
	May-June	Pigeonpea- Short duration Cowpea	1:2
	May-June	Sorghum - Pigeonpea	2: 1
	May	Sesame - Pigeonpea	10:2 & 3:1
	May- June	Castor - Niger/Finger millet	3: 1
	June - 1st fortnight of July	Finger millet - Pigeonpea	10:2/8:2
	June - 1st fortnight of July	Groundnut -Pigeonpea	8:2
	June	Groundnut -Castor	8:1
	June- July	Finger millet - Field bean	8:1 / 10:1
	June -1st fortnight of August	Finger millet-Soybean	4:1
	August- September	Horse gram - Niger	8:2




b) Double cropping System

	Sowing time of first crop	Double cropping System
Efficient Utilization of pre-monsoon rains	April - May	Sesame – Finger millet
	May - 1st fortnight of June	Fodder crop* - Finger millet
		Fodder crop*-Chilli
		Fodder crop – French bean
	May	Cowpea – Finger millet
	April – May	Greengram – Finger millet
	April – May	Blackgram- Finger millet


* Harvest fodder crop at 65 – 70 days after sowing

c) Bud nipping in rainfed castor for higher productivity:

Removal of the apical meristem by using hands/knife to encourage only one apical bud to grow robustly at a time. First nipping is to be carried out at 45 to 50 days after sowing by retaining primary branch and primary spike and removing all other branches. After a week, the secondary branch and secondary spike are retained and other branches to be removed. This has to be done in a staggered manner till 5-6 spikes are retained per plant in a season.

IV Alternate land use system

- Sustainable Income:
- Raising fast growing, narrow canopy trees like silver oak and casuarina on field bunds in east west direction. They can be harvested after 7 to 8 years for additional income
- Silvi pasture systems on non-arable lands like mixing of forest trees like *Acacia auriculiformis,* Pongamia, *Dalbergia sisso* and Tamarind with *Styloxanthus sps*
- Foreshore plantation of *Acacia nilotica*
- Agri-horti system (Mango-finger millet), (Sapota- finger millet)
- Sustainable income and efficient utilization of on-farm resources: Adopting Integrated Farming System by using the dryland technologies for crop production, animal component and income generating activities.
- System approach: Farming system involving crops, livestock component and dryland horticulture helps in maintaining nutritional security and livelihood security of farmer, besides providing insurance against the total crop failure.

V. Drought mitigating measures

- Variation in onset of monsoon/drought/moisture stress: Contingency crop plan with suitable crops and varieties to be sown at different times of the rainy season. *eg.,* in finger millet long duration variety *viz.,* MR-1, medium duration variety *viz.,* GPU-66, and short duration variety *viz.,* GPU-48.for early, delayed and very late monsoon. For late *kharif*, cowpea-IT 38956-1, horsegram-PHG-9, Sunflower and small millets *viz.,* barnyard millet, little millet, foxtail millet and kodomillet can be sown.
- Delayed Monsoon: Dry sowing of finger millet. transplanting instead of direct sowing by having staggered nurseries ready in crop like finger millet /chilli
- Drought during crop growth: Increased thinning, inter-cultivation, mulching, harvesting a grain crop for fodder, harvesting a pulse crop (wherever possible like in pigeonpea, cowpea and field bean) for vegetable purpose instead of seeds, protective irrigation from the harvested water in the farm pond at critical stages with organic mulch.

  (Practices to be adopted in addition to the routine dryland technologies for drought situations)

VI Nutrient Management:



- Imbalanced Nutrition: Application of phosphorus and potassium are essential along with nitrogen for improving the dryland crop yields in *Alfisol.*
- Time and method of application: Phosphorus and potassium to be applied as basal dose whereas, nitrogen should be applied in two splits. For finger millet crop, seeds can be mixed with Diammonium phosphate (DAP) up to 50 kg/ha and taken up sowing. Band placement of fertilizers through seed-cum-fertilizer drill is better than broadcasting.
- Surface soil crusting: Crop yields reduced by 30- 40% due to soil surface crusting. Use of organic manure (10 t/ha FYM or 5 t/ha maize residue or 2 t/ha gypsum) reduced the crust formation and reduced the finger millet yield loss in *Alfisols.*
- Hard pan in the sub- soil surface: Soil profile inversion or mixing (30 cm depth) improved the soil texture, moisture retentivity leading to improved dryland crop yield.
- Secondary nutrient management: Liming of red soils at 45% calcium saturation or at lower doses (0.5 t/ha) was beneficial for improving the groundnut productivity. Cowpea, blackgram, sunflower and groundnut responded for application of sulphur and improved the yield by 25 per cent.
- Micronutrient management: Groundnut, maize and finger millet responded to application of Zinc and Boron. Application of zinc as zinc sulphate @ 10-12.5 kg/ha and boron as borax @ 10 kg/ha along with N, P, and K depending on soil test results increases seed yield by 15-21 per cent in finger millet, 8-31 per cent in pulses and 15-37 per cent in oil seeds compared to farmers' practice.

- Sustainable crop yield and soil health: Integration of FYM @ 10 t/ha + 100 % Rec. NPK stabilized the yield of finger millet at 3225 kg/ha over 30 years with sustainable yield index (SYI) of 0.70 without impairing the soil health. Rotation of finger millet with groundnut improved the finger millet productivity by 25-30 per cent as compared to monocropping of finger millet.

- Augmentation of green leaf manure (GLM) on farm land for integrated nutrient management: Raising glyricidia plants on the bunds (300-325 plants/ha) produced biomass to supply 25- 35 kg N/ha besides fixing atmospheric N (30-50 kg/ha). Integration of GLM + 50 % NPK improved the finger millet yield by saving 50 % Rec. NPK fertilizer and maintaining good soil health. The yield of finger millet (26-27 q/ha) with 50 % rec. NPK after horse gram was higher with inter-terrace management. Horse gram as early *Kharif* crop produced a bio-mass of 15-18 t/ha.

- Crop residue management: Incorporation of crop residues improved the finger millet grain yield. Pigeonpea and early sown horse gram produced higher litter fall (2 t/ha), recycling 17-41 kg nutrient /ha, while finger millet and hybrid maize produced root stubbles (1.6-2.6 t/ha) accounting for a nutrient recycling of 19.2-31.5 kg/ha.
- Maintenance of soil organic carbon: Combination of FYM + GLM (Glyricidia) or GLM + FYM+ Crop residues to supply 50 % N and 50 % Rec. NPK fertilizer was beneficial to maintain the soil organic carbon leading to higher finger millet yield.
- Green manuring: Growing of horsegram during early kharif and *in-situ* incorporation in the soil enhances the soil fertility and reduces the nitrogen by half of the recommended dose in the next finger millet crop.
- Potassium management: Application of recommended dose of nitrogen and phosphorus along with enhanced dose of potassium *i.e.,* 50:40:37.5 kg NPK/ha enhances the yield of rainfed finger millet.

VII Farm mechanization and energy management

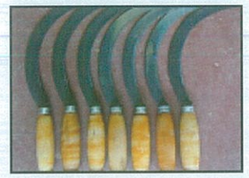
- Primary / Deep tillage - Dwindling of draught animal population and low energy level and seed bed preparation: Use of tractor drawn MB plough, disc plough, deep trencher for deep ploughing as a substitute for chisel plough, disc harrows of different type, hoes, cultivators (Spring tyne), spike tooth harrow (Halube)

- Seed germination and emergence: Use of clod crusher and crust breaker
- Simultaneous seeding and fertilizer application: Use of bullock drawn seed–cum–fertilizer drill for groundnut, five row 30 cm row spacing finger millet seed–cum–fertilizer drill, tractor drawn finger millet seed drill, tractor drawn seed–cum–fertilizer drill for finger millet and groundnut for large scale sowing

- Faster seeding of crops: Use of groundnut seed planter / rigid tyne 9 row seed planter, bullock drawn seed drill for groundnut (GKVK model), manually operated push – pull type seed drill for small seeds.
- Drudgery for weed control, intercultivation: Use of sweep / duck foot hoe, bent tyne hoe, ridger hoe, different types of hand weeder, power weeder (chopping and incorporation of green leaf), grubber weeder, tractor drawn mechanical weeder with 8" wide narrow wheels.

- Plant protection equipments suitable for different category farmers: Use of tractor mounted sprayers for field crops, tractor mounted orchard sprayer for mango and sapota, hand operated Partha sprayer for very small holdings, knap sack sprayer of light weight (Plastic) for small and marginal farmers.
- Timely harvesting: Use of tractor mounted reaper for finger millet sole crop, power tiller mounted reaper for finger millet and paddy for small holdings, different types of improved steel sickles with bent handles for manual harvesting.
- Drudgery and high cost for digging pits for orchard / plantation crops: Use of 18" diameter size Post hole digger with a capacity of up to 50 pits/hour.

- Threshing and post harvest processing: Use of multi crop thresher, hand operated groundnut decorticators of different types, three in one sheller for small holdings (Groundnut, maize and sunflower), maize sheller for small holdings, motorized winnower for finger millet and light crops.



- Custom hiring centre: Certain implements have restricted usage only during certain part of the year and hence their purchase by the farmers is limited. In those cases, the implements can be hired from the custom hiring centres at the villages.

Operational Research Project:

Operational Research Project is located in Alanatha cluster, Kanakapura taluk, Ramanagara district, Karnataka operating since 2010 comprising of five villages (Alanatha, Mahadevapura, Arjunahalli, Arjunahallithandya and Eregowdana Doddi). The technologies on rain water management, nutrient management, cropping systems, participatory varietal selection and energy management are being validated in the farmer's field by providing major critical inputs.

National Initiative on Climate Resilient Agriculture (NICRA):

The NICRA research project, Bangalore centre is in operation at Chikkamaranahalli cluster, Nelamangala Taluk, Bangalore rural district, Karnataka since 2011. Based on the farmers need, technical interventions have been taken up under different themes.

- Real time contingency plan: Different crop/cropping systems are being evaluated under farmer's management conditions.
- Rainwater harvesting *(in situ and ex situ)* and efficient use
- Efficient Energy use and Management
- Alternate Land use/Farming systems for carbon sequestration and ecosystem services

One custom hiring centre with essential farm implements was established at Chikkaputtayyanapalya.

Outstanding recognitions to the centre

- "**National Productivity Award**" from ICAR, New Delhi for Model Mittemari Watershed for rainfed agriculture for the year 1987-88.
- Adjudged as "**Centre of Excellence**" by the ICAR during 2004 and considered for Centre of Support for infrastructure development.
- "**Best Field demonstration prize**" by UAS (B) in *Krishi mela* (Agriculture fair) for the past six years (2007-2013).
- "**Most Responsive Centre**" award for the year 2008-09 by CRIDA, Hyderabad.
- "**Shri Choudhary Devilal outstanding AICRP Award**" for the year 2009 by ICAR, New Delhi.
- "**A" grade for the AICRPDA and ORP Bangalore Centre** in the Director General, ICAR interaction meeting held at NAAS Complex, New Delhi during April, 2011.