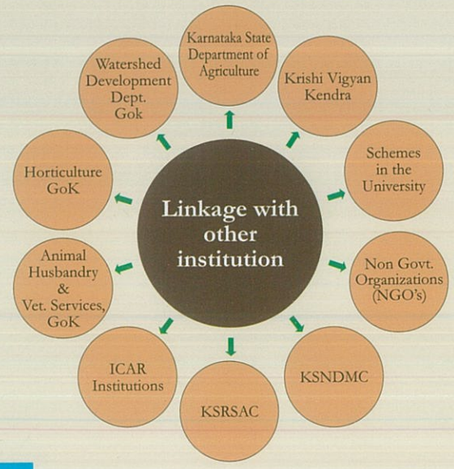
Most Responsive Centre Award

Best AICRPDA centre Award

Vasanth Rao Naik Award

Linkages

Established in close association with agri related institution/ agencies. The project contributed for establishment of Watershed Development Department, Boochetana, Boo-samruddhi, Krishibhagya and Drought Proofing Action Plan.



Future programmes

- Drought proofing
- Next Generation Technologies for Reduced runoff farming
- Precision dryland production practices
- Conservation Agriculture and low cost technologies
- Catchment-Storage Command relationship for enhancing water productivity in micro-watersheds
- Soil health and sustainability
- Organic farming under drylands
- Site specific nutrient for field crops and nutrient formulations for horticulture crops.
- Foliar nutrition for drought proofing
- Small farm mechanization
- Validation of potential ITKs and their up scaling in farmers fields
- Strengthening linkages with other line departments

For more details contact
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ALL INDIA CO–ORDINATED RESEARCH PROJECT FOR DRYLAND AGRICULTURE
BENGALURU

CENTRE AT A GLANCE

भकृअनुप
ICAR

Directorate of Research
University of Agricultural Sciences
GKVK, Bengaluru - 560 065

2019

Karnataka has 2nd largest area under dry farming (7.0 m ha) next to Rajasthan. Five out of ten Agro-Climatic Zones in Karnataka are classified as dry zones covering 63 per cent of the total geographical area and 70 per cent of the net sown area, with substantial contribution to agricultural production from dry lands.

The All India Co-ordinated Research Project for Dry land Agriculture (AICRPDA), University of Agricultural Sciences, GKVK, Bengaluru centre was established 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 dry land 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 predominated with finger millet based cropping system (Fig. 1).

The centre is located at GKVK campus, Bengaluru at 12° 35' North latitude and 77° 35' East longitude and at an altitude of 930 metres above mean sea level.

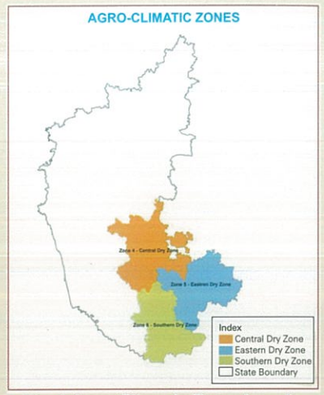


Fig. 1 Agro-Climatic Domains of AICRPDA Bengaluru

Details of Dry zones of Karnataka

Parameters	Central Dry Zone (ACZ -IV)	Eastern Dry Zone (ACZ-V)	Southern Dry Zone (ACZ-VI)
Annual Rainfall	612 mm (Bi-modal distribution, June-Sep-52% and Oct-Dec 30%)	794.5 mm (Bi-modal distribution, May-Sep-53.3%and Oct-Dec-29%)	742.5 mm (Bi-modal distribution, June-Sep-43% and Oct-Dec-31.2%)
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 loamy to clay (9%)	Red loamy (49%), Red sandy (18%), Red laterite (33%)	Red gravelly to sandy loam (>50%), Red loam (< 50 %)

Mandates

- Optimize natural resources use (rainfall, land and water) to minimize soil & rain water loss and environmental degradation
- To evolve simple technologies 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 transfer and evaluate improved dryland technologies in the farmer's fields

Research Focus

The research at AICRPDA, Bengaluru centre is being focusing on location specific problems considering the agro-climatic zones, predominant rainfed production systems and socio-economic conditions with major emphasis on rain water management, soil health management, crops and cropping systems, drought mitigation strategies and contingency planning, alternate land use systems, energy management and farm mechanization. The on-station research findings were evaluated at farmer's fields through ORP till 2017 and presently as Rainfed Integrated Farming

System (RIFS) under On-Farm Research (OFR) mode. A project on National Innovations on Climate Resilient Agriculture (NICRA) was initiated during 2011 with major focus on development and application of improved production and risk management technologies through strategic and action research for enhancing resilience to rainfed agriculture covering crops and livestock, timely crop-weather agro-advisories, real time contingency cropping, reducing drudgery and ensuring timely operations through custom hiring centre, rain water harvesting and multiple use of harvested water in multi disciplinary approach to enable higher economic returns and livelihood security to the farmers.

The technologies relating to dryland agriculture evolved over 50 years are conceptualized to demonstrate in crystallized form as **'Dryland Technology Park'** at Dryland Agriculture Project since 2007 for the benefit of farmers, visitors and dignitaries visiting the centre. Since then annually about 5 – 12 lakh farmers, extension functionaries and policy makers are visiting the park.

The important technologies developed at the centre for the benefit of dry land farmers are:

I. Soil and water conservation

- **Soil erosion:** Open end contour bunds, live / vegetative bunds (*Khus* and Nase grass), sowing across the slope, graded bunds, graded border strips with reduced cross section (0.36 m^2 for deep red soils). Diversion channels with 0.38 m^2 section for 1 ha catchments with a land slope of 2.5 per cent
- ***In-situ* moisture conservation:** Contour cultivation with dead furrow at 3-10 m interval, fall ploughing, strip cropping, ridges and furrows across the slope, tied ridges, deep tilling up to 30 cm for crops like maize and pigeonpea

- **Management of excess runoff water:** Water harvesting structures – Farm ponds (250 m^3 ha^{-1}) with brick lining or brick compartments, with soil and cement (8:1) along with LDPE sheet reduces seepage
- **Drought during crop growth:** Frequent inter cultivation to create dust mulch, reducing plant population, protective irrigation during critical stages from harvested farm pond water and organic mulching through crop residue incorporation acts as barrier for runoff flow, improves infiltration and increase soil moisture

- **Management of non-arable lands:** In shallow soils with low rainfall 'V'- ditches on contour diversion channels instead of pit and bund planting of upright growing trees, staggered 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/ ravine reclamation structures and deep trenches reduces running water force
- Establishment of pasture system using drought hardy grass (Kikuyu grass) and legumes (*Stylosanthus hamata*) to reduce runoff water
- **Recharging of Bore well:** Pit of 3 m x 3 m x 2.85 m around low yielding bore-wells, punching casing pipes at lower 1 m depth, filling filter beds viz., boulders, stones of varying sizes, mosquito mesh, charcoal and sand to percolate runoff water recharges the ground water

II. Cropping system

- **High yielding varieties:** Finger millet: MR-1, MR-6, GPU-28, ML-365, HR-911 and GPU-48, Cowpea: IT- 38956-1*, Horse gram: PHG-9, Green chilli: Samrudhi*, Hybrid maize: Hema (NAH -1137) and Nithyashri (NAH-2049), Groundnut: GKVK-5, KCG-6, Sunflower: KBSH – 44, 55, Niger : KBN-1

(*Developed at DLAP)

- **Double cropping:** Finger millet based double cropping systems viz., field bean / cowpea / sesame / horse gram green manure / forage crops (fodder maize, fodder bajra, sweet sorghum) during pre-monsoon (May) followed by *Kharif* finger millet to suit bi-modal rainfall distribution
- **Contingency crop:** Crop selection based on sowing window

Sowing month	Crops
May	Sesamum, cowpea, pigeonpea, castor, jowar
June	Pigeonpea, groundnut, castor, finger millet, maize
July	Maize, groundnut, finger millet, field bean, castor,
August	Finger millet, foxtail millet, proso millet, little millet, grain amaranth, cowpea, field bean, sunflower, niger
September	Finger millet (transplanted), foxtail millet, proso millet, little millet, cowpea, field bean, horse gram, niger

- **Intercropping:** Climate smart intercropping systems evolved are

Sowing time	Intercrops	Row ratio
May-June	Pigeonpea + Maize	1:1 or 4:1
	Pigeonpea + Cowpea / Field bean	1:1
	Castor + Finger millet / Niger	1: 2
June	Groundnut + Pigeonpea	8:2
	Groundnut + Castor	8:1
June-July	Finger millet + Pigeonpea	8:2 or 10:2
	Finger millet + Field bean	4:1 or 8:1
August-September	Horsegram + Niger	8:2


Finger millet + Field bean (4:1)


Groundnut + Castor (8:1)


Pigeonpea + Fieldbean (1:1)


Groundnut + Pigeonpea (8:2)


Finger millet + Pigeonpea (8:2)


Pigeonpea + Cowpea (1:1)

Bud Nipping in castor for higher productivity

- Removing apical meristem with hands/knife to encourage only one apical bud to grow robustly per week
- First nipping to be carried out at 45 to 50 days after sowing by retaining primary branch with spike and removing all other branches
- After a week, the secondary branch with spike is retained and other branches are removed
- This has to be done in a staggered manner till 5-6 spikes are retained per plant in a season
- Reduced humidity and better aeration in the micro climate leads to reduced incidence of botrytis disease and facilitate single harvest
- This can avoid bushiness and facilitate intercropping finger millet (1:2) and field bean (1:1)

III. Soil health management

- Balanced application of NPK is essential for improving crop yields in *Alfisols*
- Phosphorus and Potassium applied as basal dose while, nitrogen in two splits
- For Finger millet crop: seeds mixed with Diammonium phosphate (DAP) up to 50 kg ha^{-1}
- Band placement of fertilizers using seed-cum-fertilizer drill is better than broadcasting
- Application of10 t ha^{-1} FYM or 5 t ha^{-1} maize residue or 2 t ha^{-1} gypsum reduces soil crust formation and enhance crop yield
- Deep tillage breaks subsurface hard pan, improves soil texture and moisture retention
- Liming in red soils at 45 % calcium saturation or lower (0.5 t ha^{-1}) is beneficial for improving the productivity (25 %) of groundnut, cowpea, blackgram and sunflower
- Application of zinc sulphate @ 10 kg ha^{-1} and boron as borax @ 5 kg ha^{-1} along with N, P and K based on soil test results
- Integration of FYM @ 10 t ha^{-1} + 100 % Rec. NPK has stabilized the yield of finger millet over 40 years with sustainable yield index (SYI) of 0.70 without impairing the soil health
- Rotation of finger millet with groundnut improves the productivity as compared to mono cropping of finger millet

- Glyricidia plants on the bunds (300-325 plants ha^{-1}) and its incorporation supplements 25- 35 kg N ha^{-1}
- Integration of GLM + 50 % NPK improves the finger millet yield and save 50 % N
- Horse gram during early *Kharif* produces15-18 t ha^{-1} bio-mass
- Incorporation of crop residues improves crop yield
- Pigeonpea produces litter fall of 2 t ha^{-1}, recycles 17-41 kg nutrient ha^{-1}
- Root stubbles of finger millet (1.6-2.6 t ha^{-1}) and hybrid maize (1.6-2.6 t ha^{-1}) accounts for a nutrient recycling of 19.2-31.5 kg ha^{-1}
- Combination of FYM + GLM (Glyricidia) or GLM + FYM + Crop residues supplies 50 % N and helps to maintain soil organic carbon
- Application of tank silt up to 10 t ha^{-1} helps in improving soil properties and crop productivity

IV. Drought management

- Contingency crop plan with suitable crops and varieties to be sown at appropriate time during rainy season. eg., finger millet long duration variety (MR-1), medium duration varieties (GPU-28 and ML-365) and short duration variety (GPU-48) for early, delayed and late monsoon, respectively. For late *kharif,* cowpea (IT 38956-1), horsegram (PHG-9), sunflower and small millets (barnyard, little, foxtail and kodo millet) can be sown
- Dry sowing of finger millet and transplanting instead of direct sowing through staggered nurseries for crops like finger millet /chilli
- Thinning, inter-cultivation, mulching, harvesting grain crop for fodder (Maize) and vegetable purpose (pulse crop) instead of seeds, protective irrigation from the harvested farm pond water at critical stages and organic mulching using crop residues

MR-1

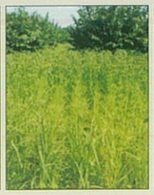
GPU-28

ML-365

GPU-48

V. Alternate land use system

- Raising fast growing, narrow canopy trees like silver oak, casuarina, melia etc. on field bunds in east west direction
- Silvi-pasture systems on non-arable lands viz., *Acacia auriculiformis,* Pongamia, *Dalbergia sisso* and Tamarind with *Stylosanthus*
- Foreshore plantation of *Acacia nilotica*
- Agri-horti system (Mango / Sapota/ Amla+ finger millet, custard apple + finger millet/ fodder maize)
- Integrated Farming System with dryland technologies helps in maintaining nutritional and livelihood security of farmer, besides acting as insurance against the total crop failure


Farm mechanization and energy management

Primary / Deep tillage: Tractor drawn MB plough, disc plough, deep trencher, sub-soiler, chisel plough, disc harrows, hoes, cultivators (Spring tyne), spike tooth harrow (Halube), Post hole digger.

Sowing: Bullock drawn seed–cum–fertilizer drill for groundnut, seed–cum–fertilizer drill for finger millet, animal drawn finger millet seed drill and tractor drawn seed–cum–fertilizer drill for finger millet and groundnut, Multi-crop seed drill for intercrops, groundnut seed planter / rigid tyne 9 row seed planter, bullock drawn groundnut seed drill, manually operated push – pull type seed drill for small seeds, Clod crusher and crust breaker.




After care: Sweep / duck foot hoe, bent tyne hoe, ridger hoe, hand weeders, power weeder, grubber weeder, tractor drawn mechanical weeder with 8" wide narrow wheels. Tractor mounted sprayers, hand operated Partha sprayer, knap sack sprayer.

Harvesting: Use of tractor mounted reaper for finger millet sole crop, power tiller mounted reaper for finger millet, improved steel sickles with bent handles for manual harvesting.

Post harvest processing: Multi crop thresher, hand operated groundnut decorticators, three in one sheller (Groundnut, maize and sunflower), maize sheller, motorized winnower.

Custom hiring centre: Established custom hiring centres at NICRA villages.

Operational Research Project (ORP)

The operational research project for dryland was initiated by ICAR during 1976-77 and functional till 2017-18 in 6 different clusters viz., Baichenahalli cluster, Koratagere (2015-16 to 2017-18), Alanatha cluster, Kanakapura (2010-11 to 2015-16), CM Halli cluster, Nelamangala (2007-08 to 2009-10), MN halli, Doddaballapura (1998-99 to 2002-03) and Rajanukunte, Doddaballapur (1976-77 to 1997-98) served as a bridge between the research station and farmers.

National Innovations on Climate Resilient Agriculture (NICRA): is in operation at Chikkamaranahalli cluster, Nelamangala Taluk, Bengaluru Rural district since 2011. The technical interventions taken are:

- **Real time contingency plan:** Different finger millet, groundnut, pulse based crop/cropping systems are being demonstrated and assessed at farmer's field
- Rainwater harvesting (*in-situ* and *ex-situ*) and its efficient utilization through farm pond and borewell recharge
- Efficient Energy use and Management
- Alternate Land use/Farming systems
- Custom hiring centre


On Farm Research (OFR) on Rainfed Integrated farming System (RIFS)

The on-farm research for RIFS for dryland project was initiated during 2018-19 at Kalenahalli cluster, Tumkur with the following objectives

- Characterization of traditional rainfed farming systems for identification of production constraints and problem prioritization
- On-farm assessment/refinement / strengthening of traditional rainfed farming systems with improved rainfed technologies
- To optimize on-farm integration of farm enterprises for enhanced farm income, resource/ input use efficiencies, and employment opportunities.

Award / Accolades

The centre has been bestowed with several awards. The significant ones are

- **National Productivity Award** from ICAR, New Delhi during1987-88
- **Centre of Excellence** from ICAR during 2004
- **Best Field demonstration prize** by UAS (B) *Krishimela* (Agriculture fair) for the past ten years (2007-2018)
- **Most Responsive Centre** award for the year 2008-09 from CRIDA, Hyderabad
- **Shri Choudhary Devilal outstanding AICRP Award** - 2009 from ICAR
- **"A" grade** during Director General, ICAR interaction meeting at NAAS Complex, New Delhi during April, 2011
- During 2012-13 and 2013-14 centre received **Best AICRPDA centre** award from CRIDA
- **ICAR-Vasanth Rao Naik** award 2015-16 for outstanding contribution in the field of research application in dryland agriculture from ICAR


2007


2008


2009


2010


2011


2013


2014


2015


2017


2018

Best Field demonstration prize