GOVERNMENT OF ANDHRA PRADESH

IDC | ICRISAT DEVELOPMENT CENTER

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

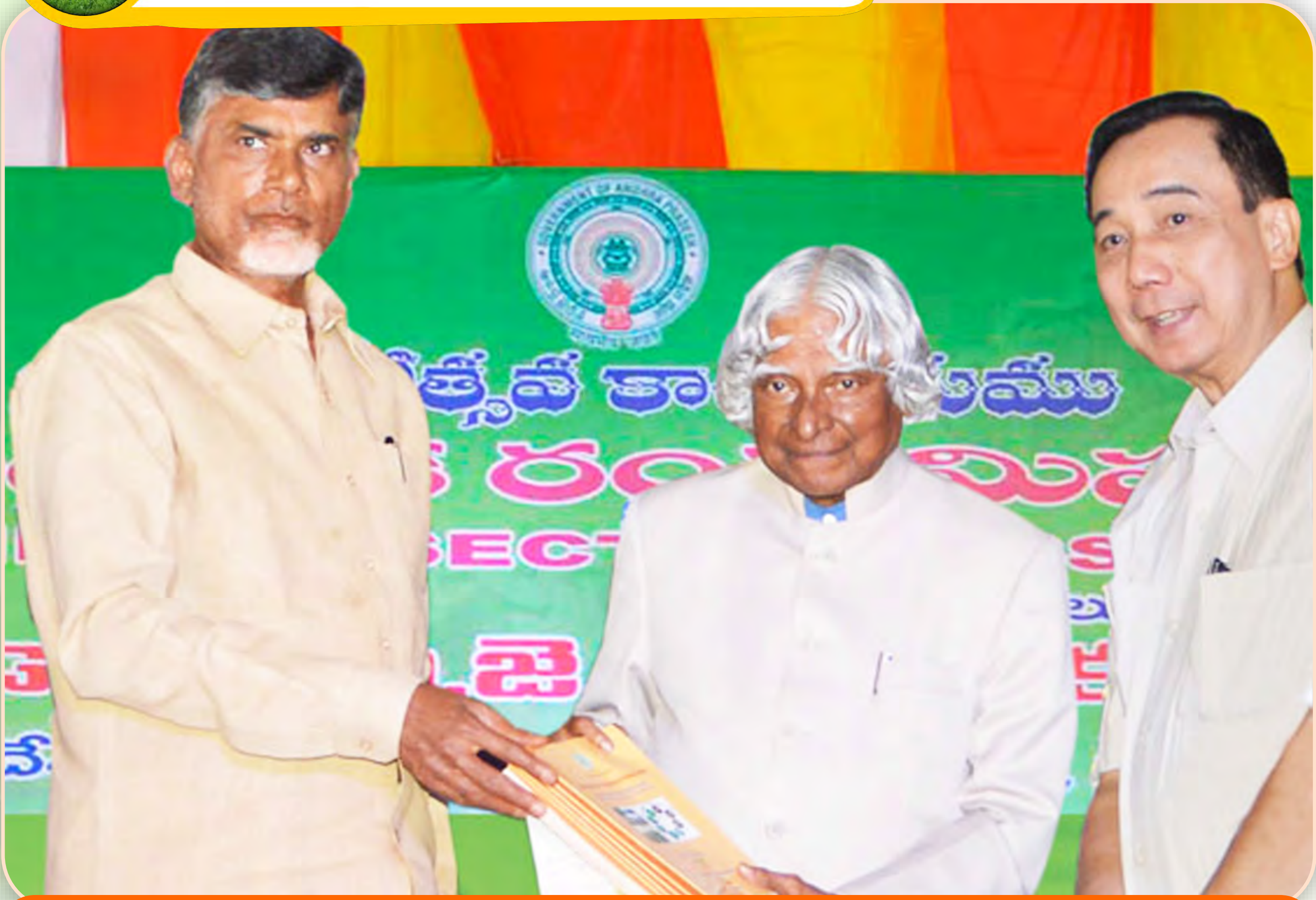
Rythu Kosam

Transforming Agriculture in Andhra Pradesh: Primary Sector Mission

Vision

The sunrise state of Andhra Pradesh, under the Swarnandhra Vision, aspires to become one of the top three states in India by 2022 in terms of socio-economic development and ease of doing business; it also aims to achieve a ***developed state*** status in the country by 2029. Fast-paced, yet sustainable double-digit growth, delivered through a combination of programmatic and project interventions, with a focus on sustainable and inclusive development is the strategy. To achieve its vision, the state government has charted out a multi-pronged strategy comprising seven Missions (Primary Sector Mission, Social Empowerment Mission, Knowledge and Skill Development Mission, Urban Development Mission, Industry Sector Mission, Infrastructure Mission and Service Sector Mission), five Grids (Water Grid, Road Grid, Power Grid, Natural Gas Grid and Fiber Optic Grid) and five Campaigns (*Pedarikam Pai Gelupu* (Victory over poverty), *Polam Pilustondi* (Farmland beckons), *Badi Pilustondi* (School is calling), *NeeruChettu* (Water and Trees) and *Swacha Andhra* (Clean Andhra)). Among the seven missions, Primary Sector Mission (*Rythu Kosam* Mission) is aiming at achieving double-digit growth in agriculture and allied sectors. A massive outlay of investments by the government over a five-year period (2015-2020) is planned for agricultural development through consortium- and science-led approaches by bringing state, national and international partners on board.

Background



The Primary Sector Mission, to transform agriculture and allied sectors, was launched by Hon'ble Ex-President of India, Dr. APJ Abdul Kalam, along with Hon'ble Chief Minister of Andhra Pradesh, Mr. N Chandra Babu Naidu on 6th October, 2014 in the presence of ICRISAT Director General, Dr. William D Dar at Kalyandurg, Anantapur district in Andhra Pradesh.

As part of the Andhra Pradesh *Swarnandhra* Vision 2029, the Hon'ble Chief Minister Sri N Chandra Babu Naidu has committed to transform the Primary Sector Mission (*Rythu Kosam*), comprising of agriculture and allied sectors through a new strategy jointly prepared by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the Government of Andhra Pradesh, Acharya NG Ranga Agricultural University (ANGRAU), Dr. YSR Horticultural University and other stakeholders. The *Rythu Kosam* strategy is being operationalized in a phased manner.

Consortium partners

Partners:

Line departments of the Government of Andhra Pradesh (Department of Agriculture, Horticulture, Sericulture, Animal Husbandry, Fisheries, Irrigation, Marketing and Rural Development)

Acharya NG Ranga Agricultural University

Dr. YSR Horticultural University

Sri Venkateswara Veterinary University

Private industries

National and international agricultural research institutes and

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

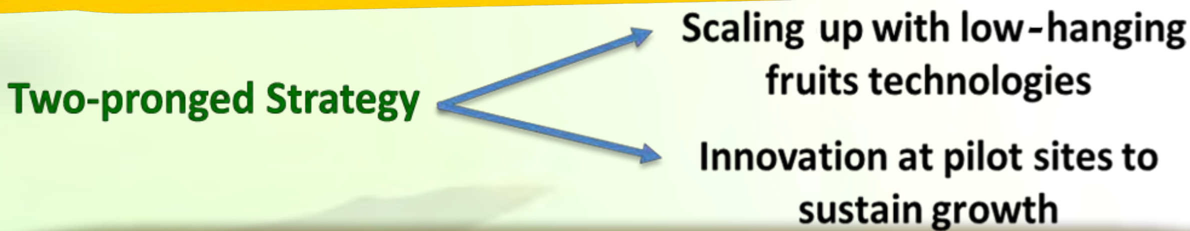
Towards achieving double-digit growth

The operationalization of *Rythu Kosam* strategy is to benefit 3.5 million farming families in the state.

Mr. SP Tucker (Spl. Chief Secretary (Planning), Government of Andhra Pradesh) and Dr. David Bergvinson (Director General, ICRISAT) signed a Memorandum of Understanding (MoU) on 17th January 2015 to support state farmers with technology.

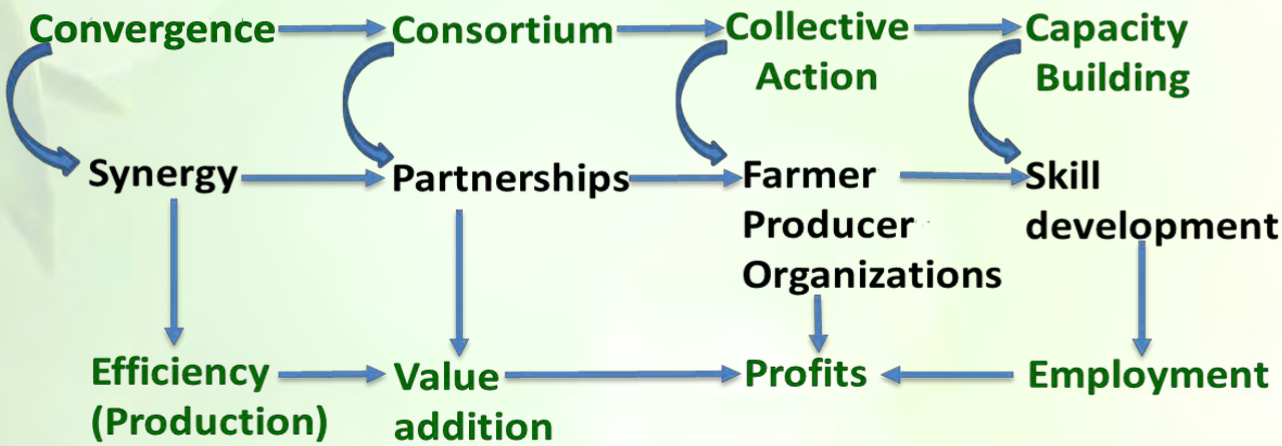
Hon'ble Chief Minister of Andhra Pradesh, Mr. N Chandra Babu Naidu in discussion with Director General, Dr. David Bergvinson and Dr. Suhas P Wani of ICRISAT.

Two-pronged strategy



The *Rythu Kosam* adopted a two-pronged strategy to achieve double-digit growth that is sustainable.

We used the proven approach of the 4 C's: Convergence, Consortium, Collective Action and Capacity Building, to bring in partnerships, establish Farmer-Producer Organizations (FPOs), improve skill development, and synergize the entire process. This will enable efficiency in production, creation of employment, value addition and higher profits for farmers across the state of Andhra Pradesh.



Innovate and Converge Efficiency (ICE)

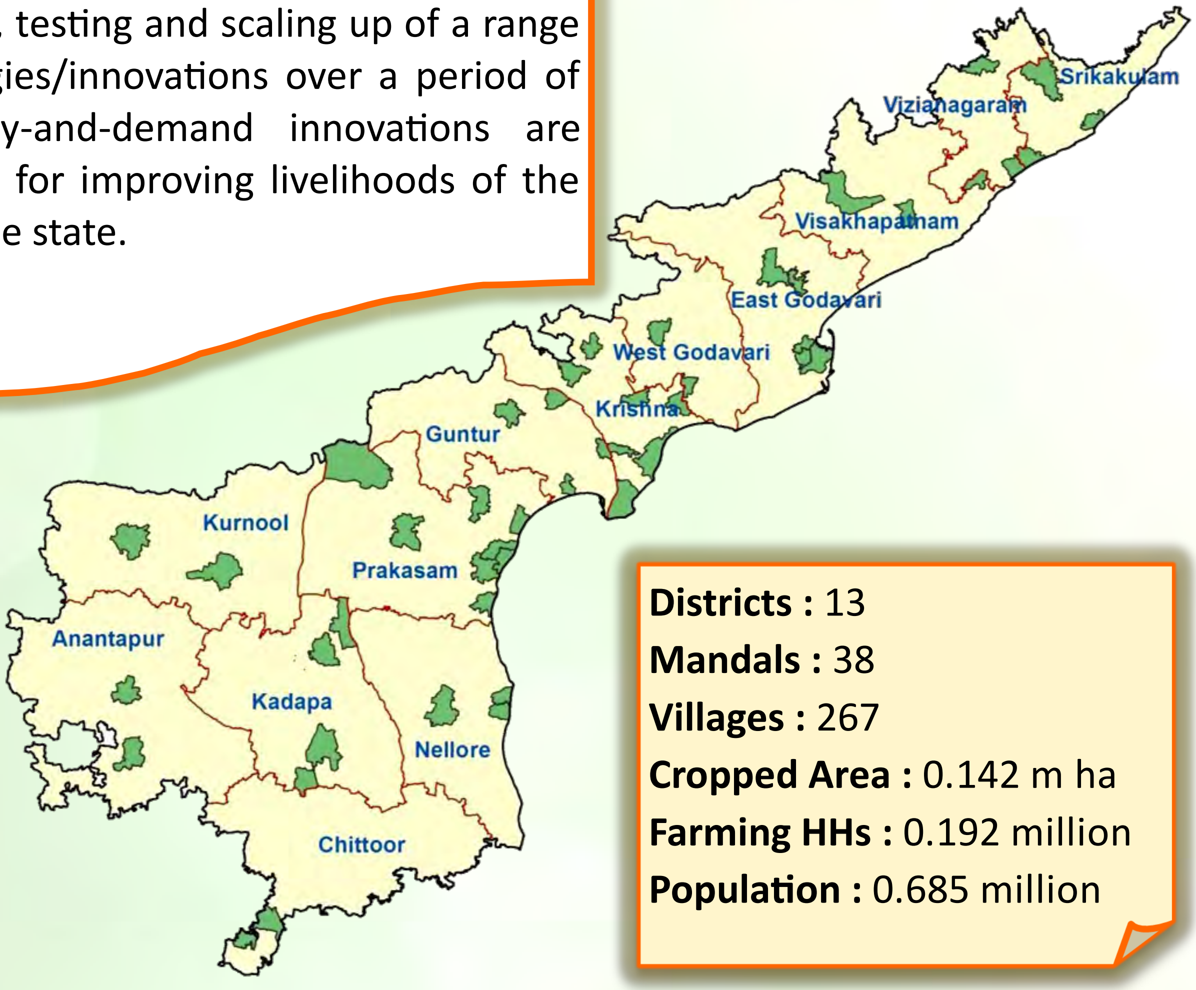
Innovate
- Technologies
- Partnerships
- Institutions
- Policies

Converge
- Schemes
- Departments
- Resources
- Communication

Efficiency
- ICT
- Science-led Interventions
- Value Addition
- Market Linkages

Innovate at pilot sites

Thirteen pilot sites corresponding to the 13 districts of the state, representing different agroecologies, have been identified for introduction, testing and scaling up of a range of technologies/innovations over a period of time. Supply-and-demand innovations are being tested for improving livelihoods of the farmers in the state.



Districts : 13

Mandals : 38

Villages : 267

Cropped Area : 0.142 m ha

Farming HHs : 0.192 million

Population : 0.685 million

Representative pilot sites

Roughly 8892 ha of fishery area (including both prawn and shrimp cultivation) are covered under mission interventions. The total pilot site area represents about 1.75% of the cropped area in the state. Approximately 1.4% of the state's population is also covered in these pilot sites.

An entry point : Soil Health Mapping

By using stratified sampling protocol, as many as 5319 soil samples were collected from pilot sites and analyzed in partnership with farmers. Multiple nutrient deficiencies such as that of organic carbon (59%), available zinc (52%), sulphur (47%), boron (32%) and calcium (29%), in addition to phosphorus (23%), were observed. Most farmers are unaware of these deficiencies that hold back their productivity and profitability. Soil analysis results and nutrient management (including micronutrients) recommendations, are being disseminated through awareness campaigns, meetings, soil health cards and wall writings.

Baseline survey

A baseline survey covering about 5000 farmers was conducted to benchmark and understand their issues and the required interventions. This was followed by:

- Soil health mapping.
- Block/village-level fertilizer recommendations
- Promotion of deficient micro- and secondary nutrients

District	No of samples	% fields with low Org C	% deficient in farmers' fields w.r.t. available nutrients									
			P	K	Ca	Mg	S	Zn	B	Fe	Cu	Mn
Guntur	368	43	5	0	0	0	3	37	1	3	0	0
Prakasam	485	76	22	5	39	6	67	84	40	5	12	2
Nellore	435	39	26	2	4	0	31	34	6	3	1	3
Krishna	270	34	3	0	1	0	7	37	1	2	0	0
West Godavari	333	51	10	6	38	13	33	35	26	0	2	0
East Godavari	368	57	38	4	44	2	68	52	53	0	1	0
Anantapur	315	83	32	9	31	2	79	87	61	8	21	0
Chittoor	495	55	17	22	27	0	51	23	60	1	3	1
Kadapa	439	65	19	5	29	0	47	64	30	4	7	0
Kurnool	443	89	29	2	26	1	56	81	32	2	10	0
Vizianagaram	499	57	35	12	46	2	50	58	41	0	2	0
Srikakulam	447	61	27	13	58	2	46	38	31	0	3	0
Visakhapatnam	422	44	32	3	36	0	80	49	31	0	1	0
Andhra Pradesh	**5319**	**58**	**23**	**6**	**29**	**3**	**47**	**52**	**32**	**2**	**5**	**0.5**

Building soil carbon

In 2016, in addition to vermicomposting, >2000 farmers in the 13 pilot sites were shown how to increase organic carbon in the soil through microbial consortia culture by recycling on-farm agricultural waste. Shredders were introduced on a shared basis to chop hardy plant material such as branches of pigeonpea, cotton, coconut and palm trees for faster decomposition during composting. *In situ* generation of organic matter on bunds and biomass generation was demonstrated through the nitrogen-rich green manure plant *Gliricidia.* (As many as 100000 seedlings were planted on farm boundaries in 2016).

Shredding of woody biomass

Shredding machines for chopping hardy biomass (which is usually burnt) for composting (using microbial consortia and using best management practices).

Pheromone traps

About 100 pheromone traps were installed in each district for pest monitoring and need-based guidance on pesticide usage, use of biological control measures (parasites, predators) and plant-based insecticides.

Rainwater harvesting

In the year 2015-16 more than 80,000 rainwater harvesting structures were constructed through MGNREGS and IWMP; 10,000 soil moisture conservation structures were built by the Government of AP. Extensive construction of farm ponds was also carried out for providing life-saving irrigation in convergence with MGNREGS .

In the year 2015 *Rabi* season, officials used 687 rain guns and protected 3682.63 ha of crop. In 2016-17 due to severe drought, it was proposed to use around 15,000 rain guns and on any given day as much as 40468.56 ha could be protected from permanent withering.

In the year 2016, the government of Andhra Pradesh initiated water provisioning from available sources on 132335.44 ha in Rayalaseema and 28328 ha in total in Guntur, Prakasam and Srikakulam districts.

Per drop more crop

- In the year 2015-16, micro-irrigation project covered 0.6 million ha (0.44 m ha drip and 0.16 m ha sprinklers). The available potential in AP for micro-irrigation is 1.65 million ha.
- Water budgeting at mandal level and advisories based on automated hydrology gauging stations (automatic weather station grid of 10 x 10 km^2) led to conservation and efficient use of water.

In Situ rainwater conservation

In situ moisture management was achieved through Broad Bed and Furrow system, Ridges and Furrows, and other landform interventions to enhance green water (soil moisture) storage in soils. Productivity was enhanced through increased and efficient use of rainwater.

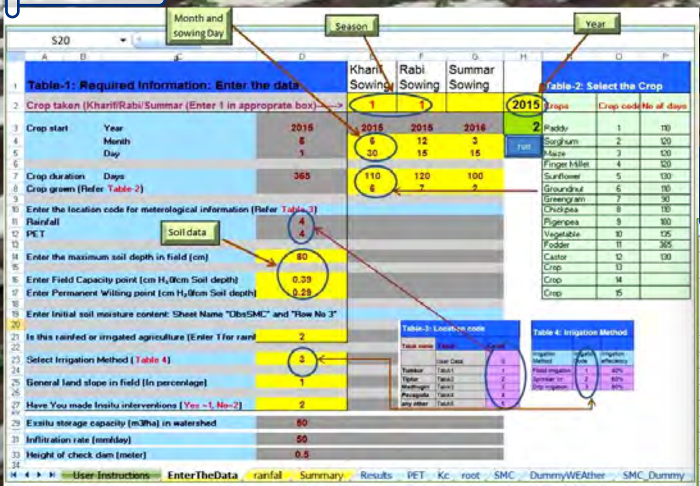
Micro irrigation systems

Effective use of Micro Irrigation Systems and techniques such as fertigation, polyhouses (for horticulture), shade nets, tissue-culture in banana, etc. was made for regulated supply and efficient use of water and nutrients. High-yielding cultivars were evaluated for adaptation to biotic and abiotic stresses, and to enhance/sustain productivity.

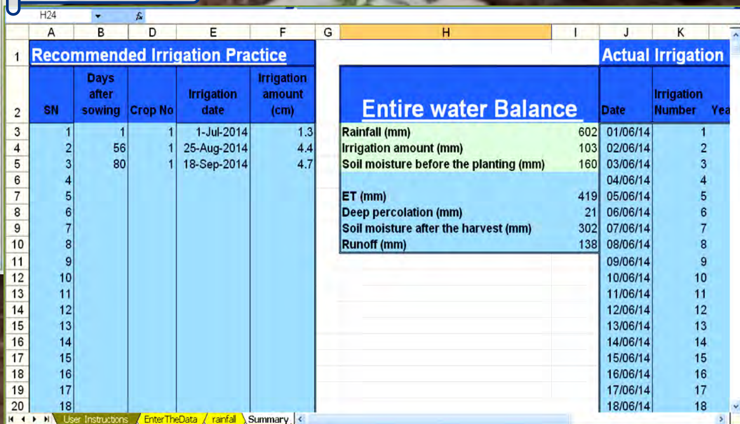
Water Impact Calculator - Need based irrigation scheduling

The water impact calculator, a generic decision-support tool for efficient irrigation scheduling, was initiated in K Kota mandal in West Godavari district. As many as 100 irrigation scheduling cards were distributed; about 15% savings in irrigation was observed by farmers for plantation crops like oil palm. This model is slowly being scaled up in other districts.

Input



Output



Improving mechanization through Custom Hiring Centers

Paddy machine transplanting during 2015-16:
Kharif : 20.23 ha (E Godavari); *Rabi* : 80.93 ha (E Godavari)
Farmers Practice : 5.8 t/ha ; Machine planting : 6.5 t/ha
The improvement in the yield is 13%

On-farm mechanization was improved by promoting Custom Hiring Centers for smallholders. Direct-seeded rice was popularized in 500,000 ha.

To develop pilot sites as sites of learning and field laboratories for new technologies, ICRISAT introduced Private-Public Partnership in the pilot site of East Godavari districts under the Rythu Kosam Program with farmers, Kubota India, Department of Agriculture and NGOs. This partnership helps farmers to reduce the cost of cultivation by reducing labor charges and increasing the crop yields.

Improved post-harvest management

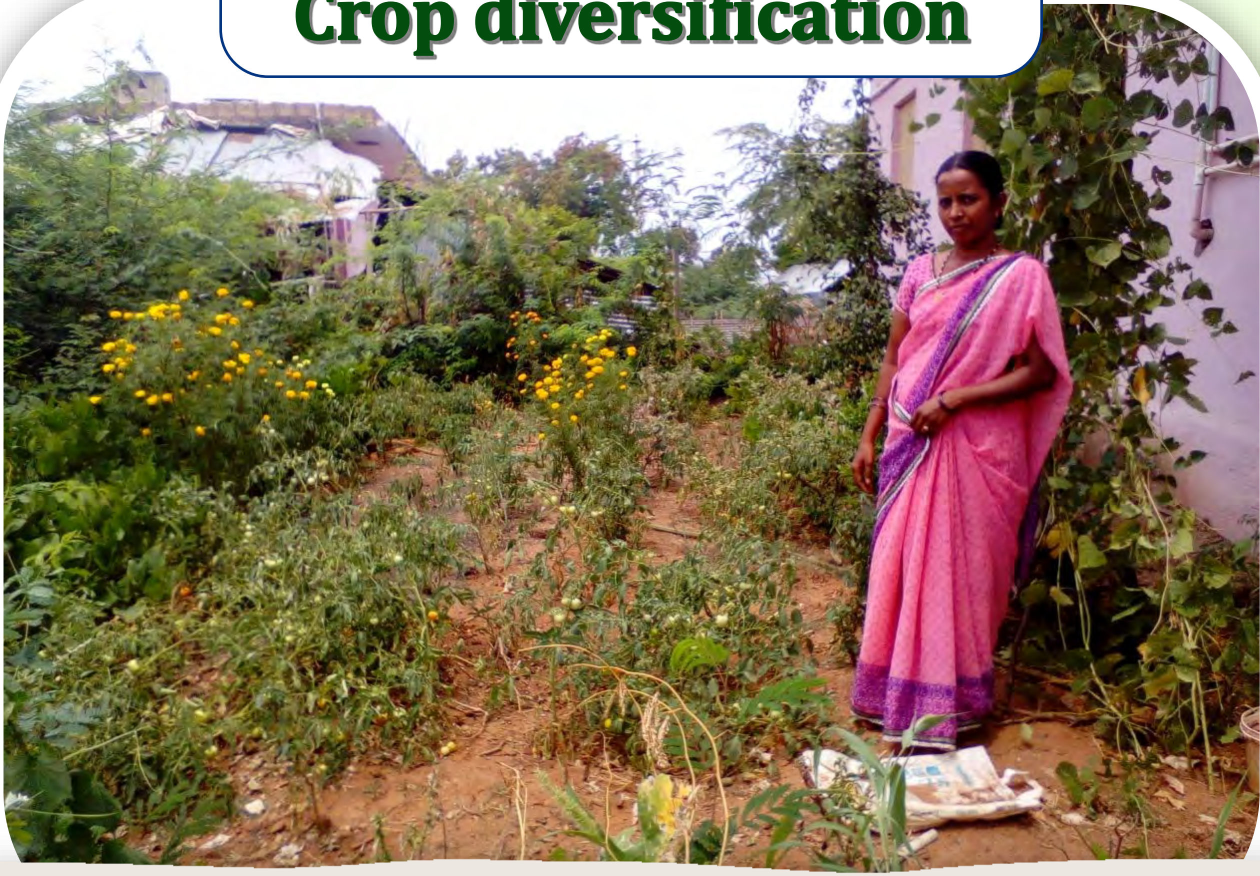
Science for Society, an NGO, has come up with an innovative solution to minimize post-harvest losses. They undertake processing and value addition in five pilot districts with their solar dryers for drying chilies, tomatoes, ginger, etc. The time to dry is reduced by 60% - 70%; post-harvest losses are cut down by 20% with the use of this inexpensive solar dryer.

Mechanized transplanting using Easy Planter

On-farm mechanization is encouraged through the use of Easy Planters (for transplanting vegetables), BBF maker-cum-seeders (for preparing broad beds and furrows), Plastic Mulch Layers or Ridge-making machines for conserving soil moisture.

ICRISAT demonstrated crop cutting methods in the presence of farmers and Agricultural Officers in Yeleswaram mandal, comparing machine-transplanted fields with control fields to understand the yield difference between the two. It was observed that, on an average, the machine-transplanted fields showed an increased yield of around 3-5 bags (75 kg each) than the farmer-practice fields, apart from saving around ₹ 7500/ha in labor costs.

Crop diversification

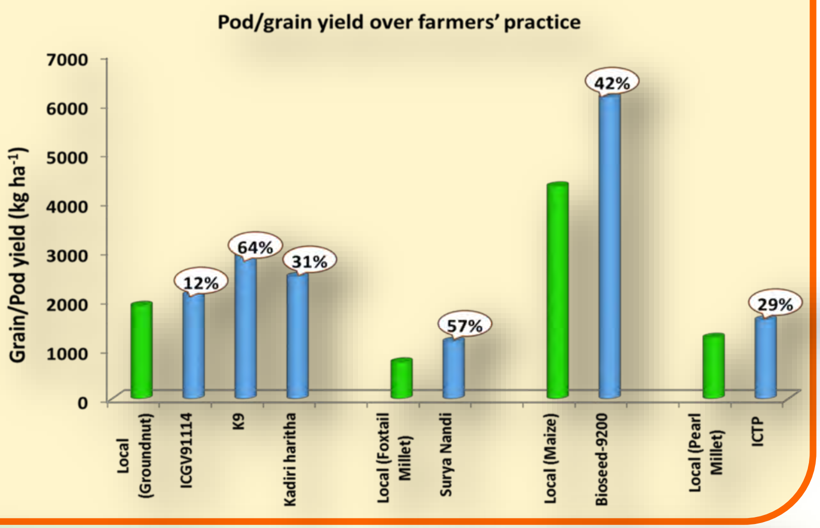


Crop diversification through efficient use of water, using high-value crops and nutritious fruits, vegetables and legumes, can lead to sustainable development and alleviation of malnutrition, while simultaneously improving rural livelihoods. Climate-resilient, dual-purpose, nutrient-dense and drought-tolerant smart foods such as millets and pulses in drought-prone areas such as the Rayalaseema region can benefit the farmers. Kitchen gardening can especially benefit women and children.

Climate smart cultivars to help the farmers

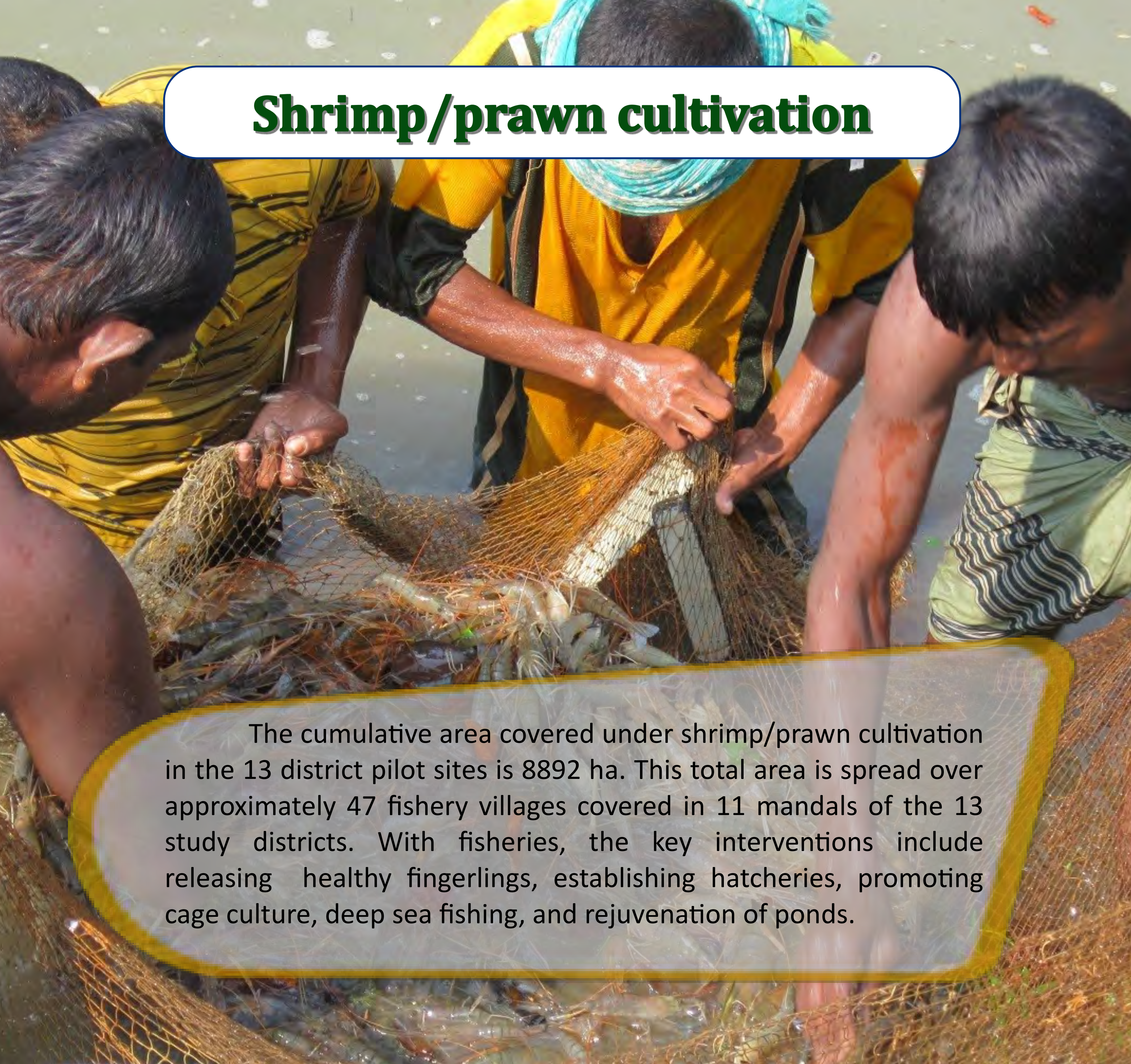
With ever changing climate scenario, higher crop yields were recorded with improved and climate smart cultivars

- 12-64% in groundnut - (ICGV 91114, K 9, Kadiri haritha)
- 57% in foxtail millet (Suryanandi)
- 42% in maize (Bioseed 9200)
- 29% in pearl millet (ICTP 8203)



Adopting climate smart methods and science-led technologies

With agriculture employing 62% of the state population but contributing only 17% to GSDP, it becomes vital to help farmers across Andhra Pradesh to bridge this huge gap. This will increase food and nutritional security and make Andhra Pradesh one of the top three states in agricultural development by the year 2022.



Shrimp/prawn cultivation

The cumulative area covered under shrimp/prawn cultivation in the 13 district pilot sites is 8892 ha. This total area is spread over approximately 47 fishery villages covered in 11 mandals of the 13 study districts. With fisheries, the key interventions include releasing healthy fingerlings, establishing hatcheries, promoting cage culture, deep sea fishing, and rejuvenation of ponds.

Micronutrients

Widespread deficiencies of multiple nutrients has resulted in the use of micronutrients in the farmer fields. The use of gypsum (247 kg/ha), zinc sulphate (24.7 kg/ha) and borax (2.47 kg/ha) (recommended doses) resulted in 20-40% increase in productivity and improved soil health.

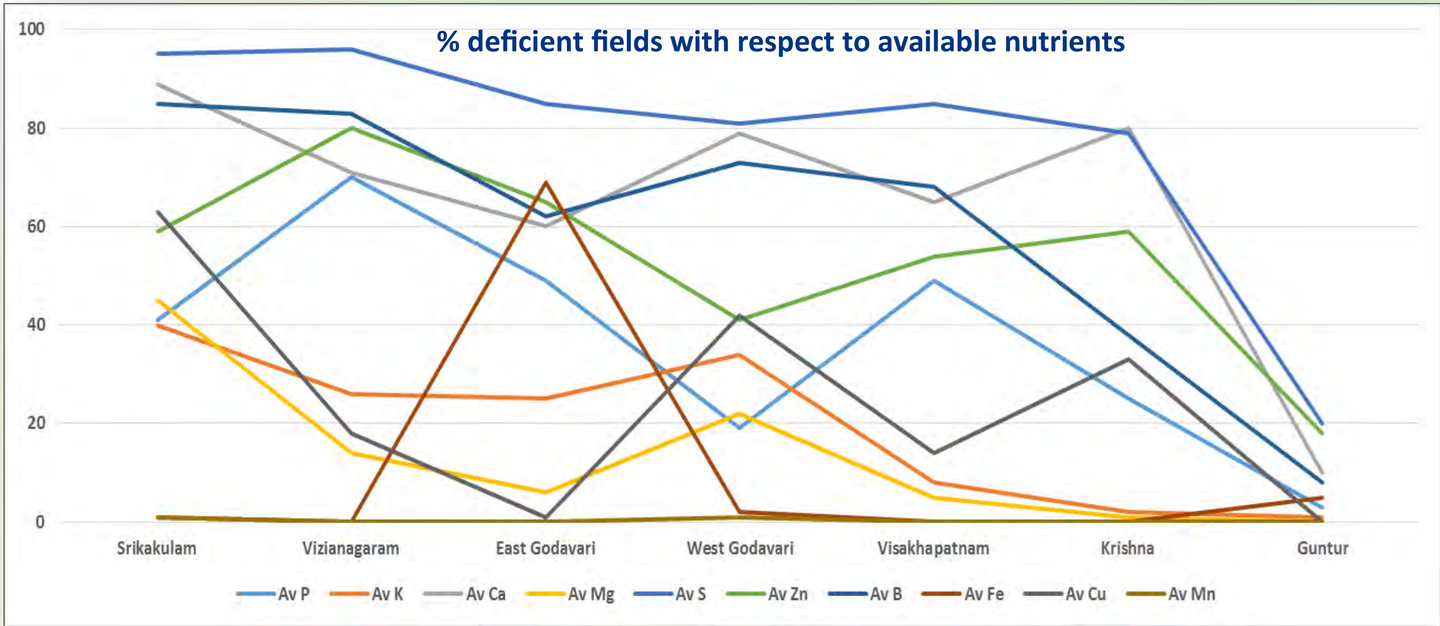
Soil Health Analysis

Rejuvenation of soil health through need-based fertilizer application, including micronutrients, in approximately 750,000 ha was initiated as a part of the project. As many as 0.4 million soil samples were analyzed in the year 2015 and 0.6 million was planned for the year 2016 by the DoA. ICRISAT and SAUs are providing analysis for micronutrients. As much as ₹ 11000 million GVA was added through micronutrient and secondary nutrient addition during the year 2015-16.

As many as 1.6 million soil health cards were distributed to farmers, along with recommendations for micronutrients. Micronutrient application resulted in 20%-40% increase in crop productivity. Seed replacement of improved cultivars in 217,000 ha resulted in 10% to 60% productivity improvement.

Soil health mapping of fruit orchards: collection of 6345 soil samples from fruit plantations across 13 districts undertaken by Department of Horticulture through ICRISAT and ANGRAU.

District	% Fields with low C	% deficient horticulture fields w.r.t. available nutrients										No of samples
		Av P	Av K	Av Ca	Av Mg	Av S	Av Zn	Av B	Av Fe	Av Cu	Av Mn	
East Godavari	71	49	25	60	6	85	65	62	69	1	0	992
Guntur	41	3	1	10	0	20	18	8	5	0	0	294
Krishna	68	25	2	80	1	79	59	38	0	33	0	2709
Srikakulam	90	41	40	89	45	95	59	85	1	63	1	641
Visakhapatnam	77	49	8	65	5	85	54	68	0	14	0	207
Vizianagaram	89	70	26	71	14	96	80	83	0	18	0	869
West Godavari	78	19	34	79	22	81	41	73	2	42	1	633
Grand Total	**74**	**36**	**16**	**73**	**10**	**82**	**59**	**56**	**11**	**28**	**0**	**6345**



Promotion of organic methods

- Promotion of organic farming in around 131 clusters, each having 10,000 –125,000 ha area under certified organic farming.
- As much as 800,000 ha area under natural farming by adopting low-cost farming techniques.

Improving extension services:

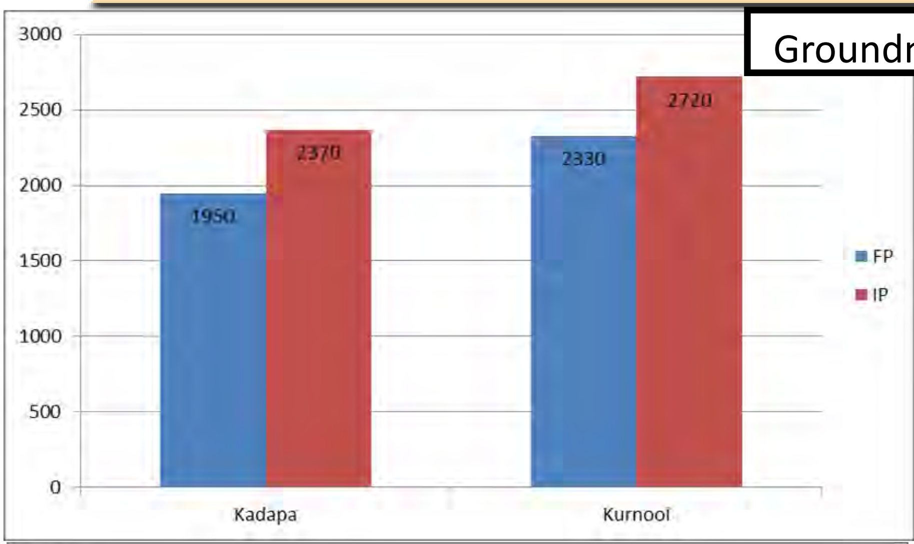
Over 6000 multipurpose extension officers were posted. Around 4500 demonstrations of best farming practices were carried out in each 10-ha cluster. Also, a tablet-based extension system was implemented with the distribution of 6000 tabs through extension staff.

Dryland cereals and fodder promotion

Millets were sown in about 140,000 ha in rainfed regions. Also, fodder promotion in the pilot areas was conducted by demonstrating high-yielding and nutritious multicut sorghum (CSH 24 MF) variety.

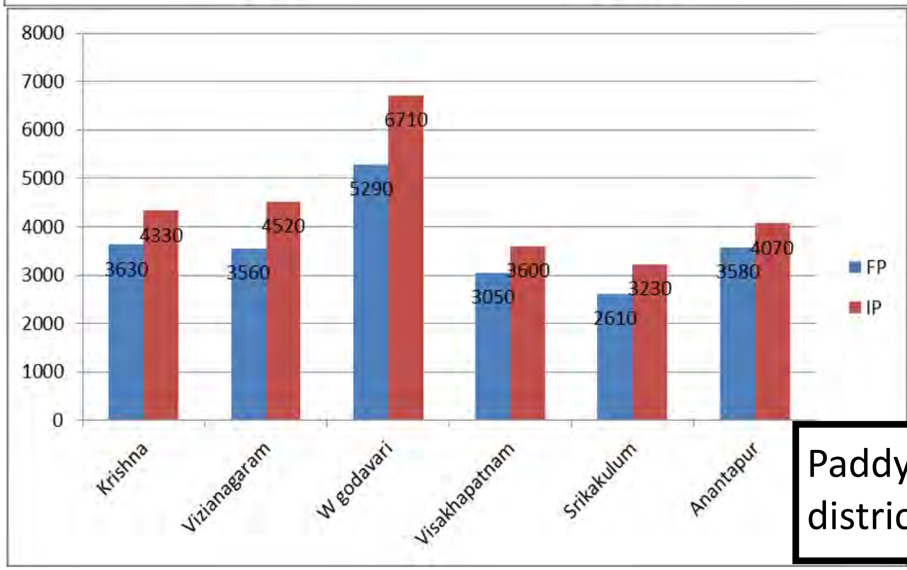
Marching towards success

Aquasap an experiment that has yielded great success:

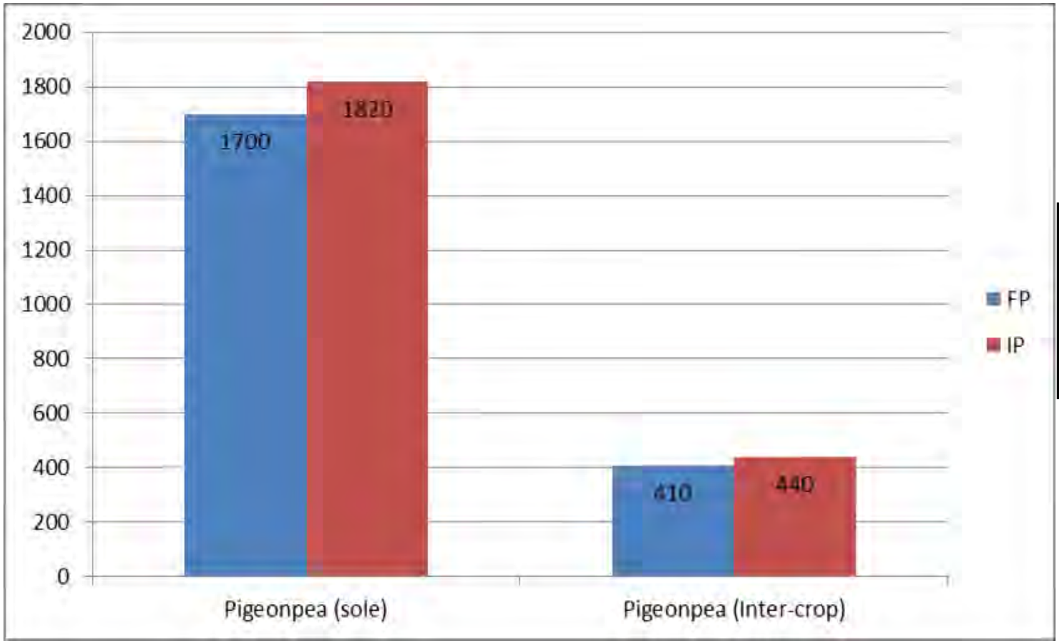


Groundnut pod yield during 2015-16

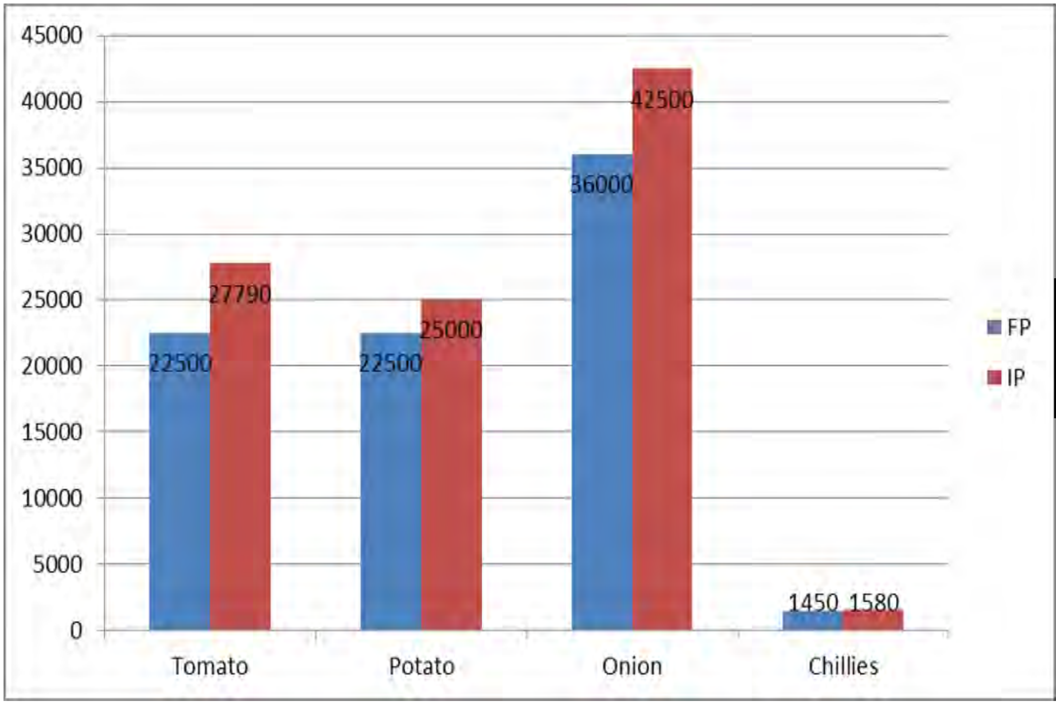
Aquasap is a 100% organic extract/fertilizer from seaweeds and contains macro & micro nutrients, essential amino acids and plant growth hormones that provide a major boost to crop yield by accelerating metabolic function. The use of this organic seaweed extract gives an increase of yield by 10-30% in crops like groundnut, paddy, pigeonpea, tomato, potato, onion and chillies.



Paddy grain yield during 2015-16 in districts



Pigeonpea grain yield during 2015-16



Vegetables yield during 2015-16

Launch of FPOs

On 6th August 2016, the Hon'ble Chief Minister of Andhra Pradesh, Mr. N Chandra Babu Naidu launched 1,000 Farmer-Producer Organizations (FPOs), for which ICRISAT will be providing technical support. Each FPO, having around 1,000 members, will deal with more than one commodity to ensure year-round sustainability. The target is to bring one million farmers under FPOs. The launch of the FPOs was held in Anantapur district, Andhra Pradesh, and 12 corporates signed Memoranda of Understanding covering different commodities to support the FPOs

These FPOs will provide necessary inputs to the members and also provide market linkages for the farm produce of its members. The scale of operations will enable members to save money on inputs and also get a better share of the market price by working directly with corporates. These FPOs will also serve as knowledge delivery institutions for the farmer.

Sl. No	Sectors	No. of FPOs	No. of farmers
1	Agriculture	314	2,85,222
2	Horticulture	345	2,74,153
3	Animal Husbandry	238	2,45,000
4	Fisheries	105	1,07,808
	Total	**1,002**	**9,12,183**

Seed production

ICRISAT helped farmers register with the AP State Seed Certification Agency which monitors and certifies the foundation seed upon harvest. The foundation seeds were procured by the AP State Seeds Development Corporation Ltd. at a rate 20% higher than the market rate.

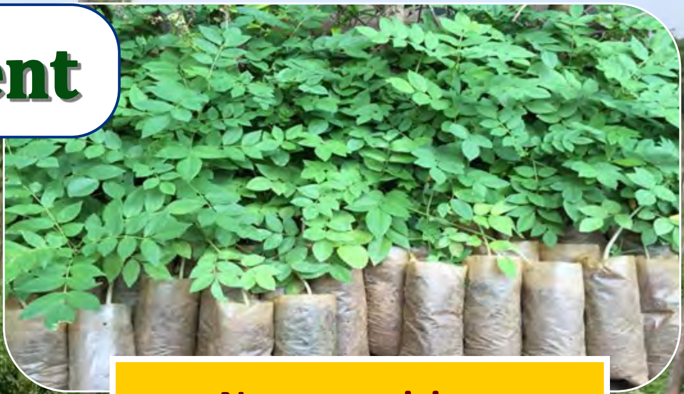
Piloted foundation seed production in farmers' fields during *kharif* 2016

- 12000 kg groundnut in 100 farmers' fields
- 600 kg pigeonpea in 120 farmers' fields

Piloted foundation seed production in farmers' fields during 2015-16

- 544,000 kg groundnut in 335 farmers' fields (212.46 ha);
- 172,000 kg pigeonpea in 130 farmers' fields (108.45 ha);
- 3,700 kg black-gram in 36 farmers' fields (37.23 ha)

Women empowerment



Nursery raisings

As a part of the program, more than 1000 women farmers in 2015 and about 5000 women farmers in 2016 were trained and enabled to start kitchen garden-scale vegetable cultivation for family nutrition. Women were provided with seed kits.

Also, fodder promotion through multi-cut, high-digestibility sweet sorghum cultivation (~300 women farmers) for boosting livestock-based livelihoods was initiated.

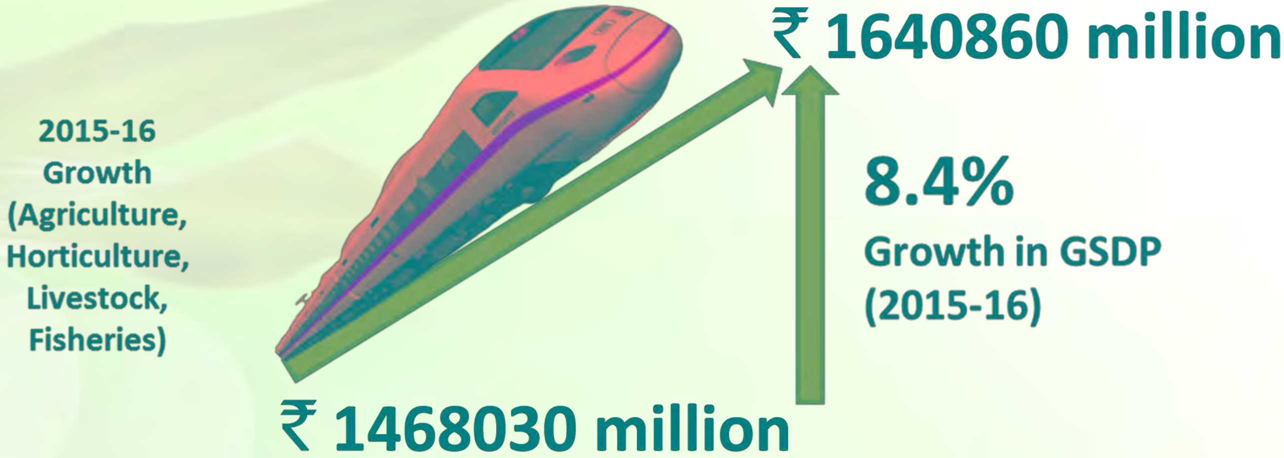
Promoting Digital Agriculture

The use of digital technology for effective delivery, monitoring and information dissemination has been emphasized as a part of the project. This use of ICT for innovative extension systems is achieved by distributing Green SIM cards to 900 farmers.

Also, ICRISAT, in collaboration with Microsoft, piloted climate/weather information services and advisories in Kurnool and Kadapa (to about 500 farmers). Moreover, remote sensing technology and satellite imageries were used to map irrigated crop area in Nellore.

Achievements

During the year 2015-16, the state has achieved double-digit growth; for the primary sector, it has achieved 8.4% growth.



2015-16

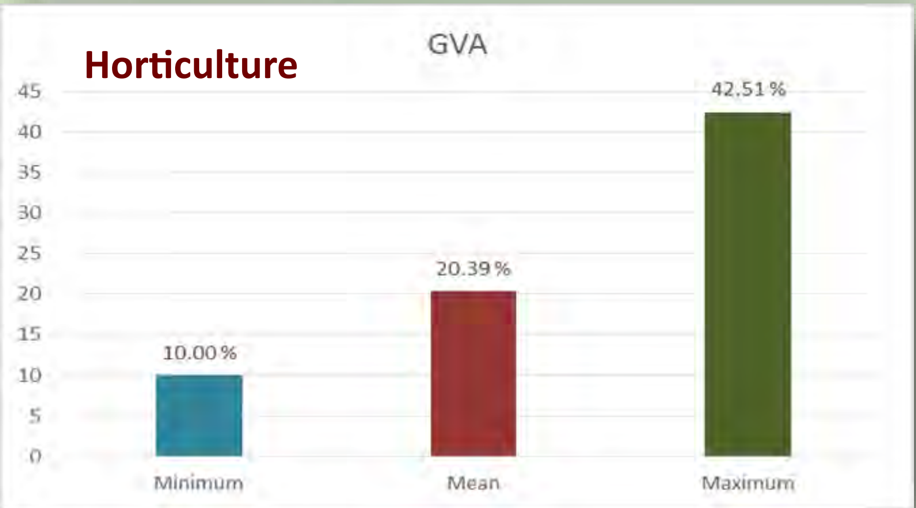
One of the breakthrough achievements is the river linking and inter-basin water transfer of Godavari-Krishna link through Pattiseema Lift Irrigation Scheme (LIS) (500 TMC of floodwater transferred) to meet water demands of parched Rayalaseema farmers.

Impacts

Pilots for Innovation - GVA % increase

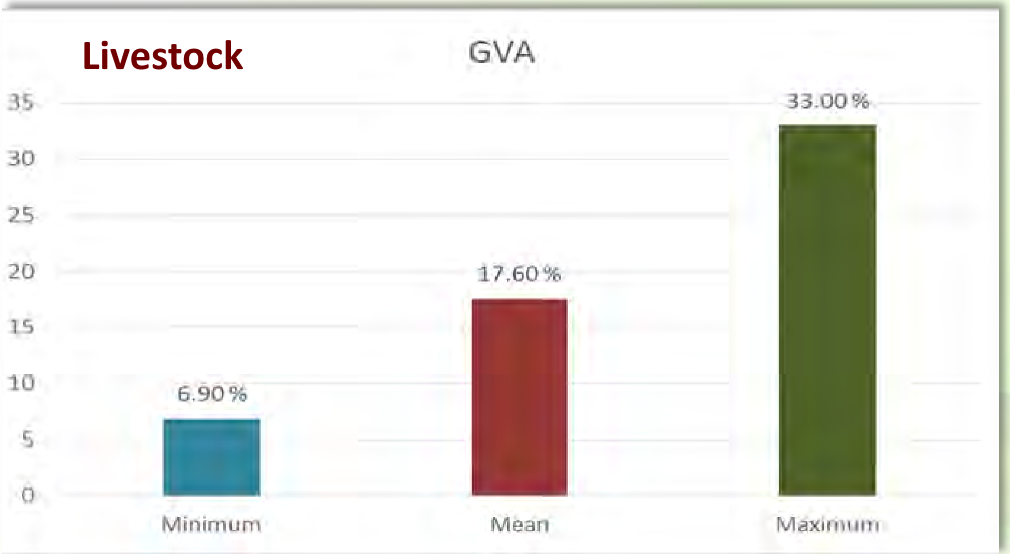
* Visakhapatnam [groundnut (62.04 %), maize(15.85 %), blackgram (2.90 %), paddy(18.4 %), finger millet(25.58 %),horsegram(0.69 %), sesame (29.09 %), sugarcane(3.50 %), greengram (23.81 %)]

* Prakasam [pigeonpea(188 %), blackgram(172 %), cowpea(222 %), paddy(52 %)]



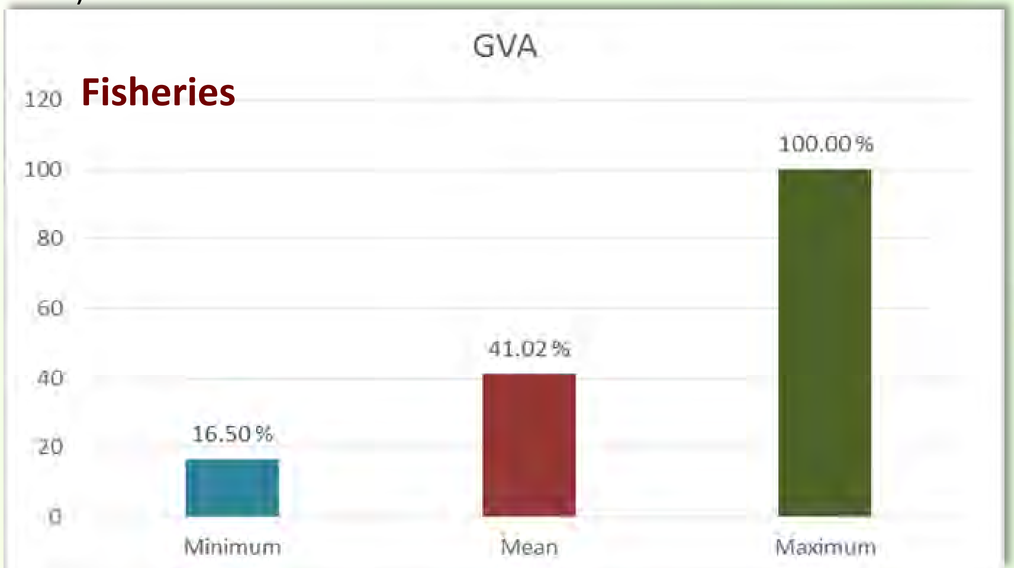
**Kadapa [vegetable production (10 %)]

*Kurnool [Tomato (84 %), onion (18 %), cluster bean(30 %), chilly (50 %)]



Anantapur [milk (13.34 %), meat (4.2%), egg (6.9 %)

Kadapa [milk (8 %), meat(15 %), egg (10%)]



Nellore

Guntur (production doubled)

Success Stories

Micronutrient application fetches higher yields for farmer in Kurnool district

Ramanjaneyu G from Nelathalamari village in Devanakonda Mandal in Kurnool district has been cultivating onions since the last 14 years. In 2015, he cultivated onions in 0.44 ha of red soil, downsizing his land from 1.214 ha because of fluctuating onion prices in the market. Onion is an excellent crop under mild climatic conditions and in areas where extreme heat, cold and excessive rainfall are not prevalent. Ramanjaneyu used farmer practice seed and harvested 11 tons in 0.44 ha of land using micronutrients and secondary nutrients.

After 45 days, the seedlings were transplanted to the prepped land and one cycle of irrigation was given before transplanting the seedlings.

- The farmer also used four 50-kg bags of DAP thrice during the crop cycle, as a fertilizer for increasing the soil pH.
- Pesticides to control thrips were sprayed 8 times per crop cycle and 2 liters of pesticide was used per cycle.
- Onion bulbs become mature when the plant stops producing new leaves and the leaves turn slightly yellow.
- When 60-70% of the leaves are dry and slightly drooping, the crop can be harvested.
- Laborers pulled out the bulbs and 0.44 ha produced about 300 bags of onions, each bag weighing 40 kg.

It was during the initiation of the *Rythu Kosam* project that Ramanjaneyu heard about the term micronutrients. Staff from ICRISAT visited his field and advised him about the benefits of applying gypsum, zinc sulphate and boron. After applying I00 kg of gypsum, 10 kg of zinc sulphate and 1 kg Agribor (boron), the farmer harvested 11 tons of onion.

Cost of cultivation:

Details	Expenses incurred in ₹
Cost of land preparation before sowing	4400-5000
Labor costs for planting onion	15,000
Cost of 20 kg seed and micronutrients	13000
Cost of 3 bags of NPK fertilizer	3840
Cost of 12 bags of DAP fertilizer	15000
Cost of pesticide for 8 applications	12000
Cost of harvesting	4500
Cost of filling 300 bags	9000
Grading costs	6000
Transportation costs	30000
Total costs	1,12,340

Table1: Cost of production (INR) of one crop cycle of onion on 0.44 ha of land.

Post harvest income:

- In 2014, Ramanjaneyu was under heavy losses of more than ₹ 100,000 due to crash in the market rates. Each kg of onion fetched him just ₹ 4.
- However, in 2015, with the surge in onion prices in the market at ₹ 2,200 per 100 kg (Tadepalligudam market), Ramanjaneyu reaped a profit of more than ₹ 150,000 from onion crop alone.

Enhancing productivity through balanced nutrient management and climate smart variety of groundnut

Groundnut is the mainstay of dryland farmers. Unfortunately, the crop is highly dependent upon timely and frequent rains in the *kharif* season. Hence, most marginal groundnut farmers double up as agricultural workers too. Of late, the rising costs of raising groundnut crops has pushed the farmers into greater debt. The yields are also very low, dependent on timely rains and range from 12 to 37 bags/ha.

Many farmers typically did not apply micro- and macronutrients in the pilot villages. This shows their poor understanding of the concept of balanced nutrient management. As part of the *Rythu Kosam* project, the Department of Agriculture and ICRISAT helped address the issue of nutrient management, and quality seed distribution and production.

Mr. Surendranath Reddy owns 0.6 ha of rainfed land in Gummireddypalli village of Venkatagirikota Mandal in Chittoor district. His land was less fertile with poor quality soil, low organic carbon content and low nutrient content, which resulted in very low crop production and productivity. The awareness program conducted jointly by the DoA and ICRISAT staff under the *Rythu Kosam* project opened the doors to success for Mr. Reddy. He actively participated in the meeting to find out ways for getting successful yields.

He came forward to adopt new technologies. Soil samples were collected from his and his fellow farmers' fields and analyzed in ICRISAT labs; soil 'health cards' were issued to the farmers detailing fertilizer recommendations.

Mr. Reddy selected groundnut for this initiative and received ICGV 91114 seed from ICRISAT and other inputs from the DoA on the 50% subsidy. He applied macronutrients (NPK) to the crop based on soil test results. He added micro and secondary nutrients such as zinc sulphate at 24.7 kg/ha, gypsum at 247 kg/ha and Borax 2.47 kg/ha for the first time in his field. The recommended plant population was maintained by following proper spacing.

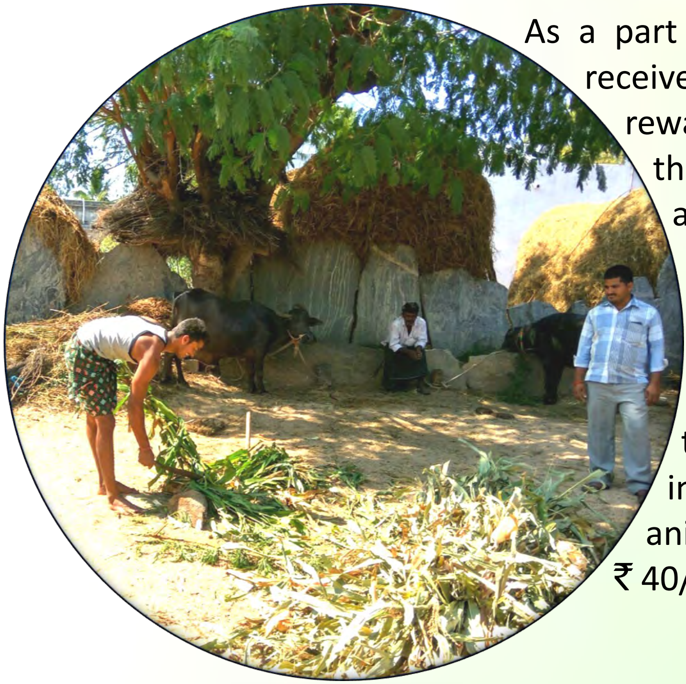
Mr. Reddy saw a significant improvement in the crop growth compared to his previous practices of micronutrient application and local variety use. The net income estimated with the improved technology (Variety + application of micronutrient) was nearly ₹ 47498.1/ha compared to a mere ₹ 12103/ha under traditional practices.

Table: Impact of micronutrient application and improved groundnut variety on crop yield and net income in Venkatagirikota Mandal, Chittoor District during the year 2015

Groundnut			
Variety	**ICGV 91114**	**K 6**	**K 6**
Micronutrients	Yes	Yes	No
Cost of cultivation (ac)			
Field preparation	2300	2300	2300
Seed + Sowing cost	3780	4100	4100
Fertilizer cost + Labor	2090	2090	1250
Weeding cost	1000	1000	1000
Pheromone trap	Yes	Yes	No
Pesticide spray	No	No	500
Harvesting + Threshing	2260	1950	1950
Total cost of cultivation (ha)	28232.1	28256.8	27417
Groundnut pod yield(Kg/ ha)	1803.1	1185.6	988
Farmer price (Kg^{-1})	42	40	40
Gross Income (₹/ha)	**75730.2**	**47424**	**39520**
Net income (₹/ha)	**47498.1**	**19167.2**	**12103**

Increased milk yields with CSH 24 MF sorghum fodder benefits farmer in Anantapur district

Adikeshava Naidu from Bandlapalle village in Penukonda mandal in Anantapur district has been having great success with CSH 24 MF sorghum green fodder. He has 2 milch buffaloes and before the *Rythu Kosam* project, he was obtaining only 4 liter milk/buffalo/day with fat content of 7%.



As a part of the *Rythu Kosam* project in 2015, the farmer received the new variety of sorghum and has been reaping rewards ever since. He received 2 cuttings and sowed the new variety under the guidance of ICRISAT staff and an NGO, SAMATHA in 0.04 ha. After feeding the new variety mixed with other varieties of green fodder, he received 6 liter milk/buffalo/day with fat content 7.5%. The net income increase was ₹ 2,400/buffalo and almost ₹ 5,000/month from the two milch animals. The overall milk yield has now increased by 120 liter/month from the two milch animals. With increased fat content, he sells the milk at ₹ 40/liter.

With the increased income, he has decided to expand the area under the new sorghum variety.

In drought-prone Rayalaseema region, farmer uses municipal wastewater to prepare vermicompost

Valamkondu Nagaraju, a farmer from Devanakonda village and mandal in Kurnool district has reaped huge rewards by the use of municipal wastewater to prepare vermicompost. In the last few years, his borewell was running dry and there was severe water shortage in his village.

He was given a vermibed on subsidy by the Department of Horticulture and started preparing compost. In the initial years, he used water from his borewell and incurred large costs due to the use of a 5-hp pump to draw water from a drying well. However, he slowly expanded his production to 10 vermibeds.

It was during the *Rythu Kosam* project in the year 2015 that he observed the work done by ICRISAT and decided to divert municipal wastewater into his vermibed area by diverting the water from the main canal into his sump. For this method, he only needed a 1-hp pump and supplied the water through microsprinklers. He also added 5 more vermibeds to this project.

He now sells about 30 tons of vermicompost at ₹ 6 per kg, making a profit of ₹ 2 per kg and a net income of ₹ 60,000/year. He requires about 200 liters of waste water/bed/week and can now use fresh water for agricultural and household purposes instead.

As a part of the project, ICRISAT staff has also been helping the farmer to maintain vermicompost quality and to adopt better storage methods, moisture control and sieving methods.

He has also started the business of selling worms for vermicomposting. He has sold worms to 40 farmers at ₹ 100/kg. He sells only 20 kg of worms to each farmer at one time. With this business, he has reaped a net income of ₹ 80,000 so far, and has recently received an order of worms from 200 farmers .

Madhyam culture in paddy fields proves super successful for farmer

Sugali Nagaraju Naik from Kondampalli village in Penukonda mandal in Anantapur district has 0.809 ha of irrigated land and predominantly grows paddy in his fields.

After the initiation of the *Rythu Kosam* project in 2015, staff from ICRISAT and SAMATHA NGO approached him and broached the idea of using Madhyam culture in his field.

After conducting a training and awareness program about the methods of aerobic composting using Madhyam culture, the farmer was impressed with the technique used and decided to adopt it in 0.202 ha of his paddy field. He also compared the method with the usual farmer's practice in 0.202 ha.

Parvathi Bai, mother of Sugali Naik, displays paddy harvest from Madhyam culture plot

Awareness and training program on aerobic composting using shredders

With the farmer's practice, Naik got 15 bags of paddy (100 kg each) and procured a net income of ₹6000 by selling at ₹ 1100/bag. With the Madhyam culture method, the farmer obtained 22 bags and made a net income of ₹17,350. His profits had increased by almost 3 times. With this success, Naik has decided to expand the area of farming under compost prepared using microbial culture.

Component	Farmer's practice (₹)	Madhyam culture demo plot (₹)
Seed cost(30 kg)	1000	1000
Fertilizer cost + Labor	7500	5350
Neem oil and other miscellaneous costs	2000	300
Madhyam culture	----	200
Total cost of cultivation (0.202 ha)	10500	6850
Gross Income (₹/0.202 ha)	16500	24200
Net income (₹/0.202 ha)	**6000**	**17350**

Farmer following the method

Reducing malnutrition in women and children through kitchen gardens

In India, the problem of malnutrition in women and children is a serious issue; 38.7% of children are considered stunted (low height for age), 29.4% are considered underweight (low weight for age) and 15% are considered wasted (low weight for height). About 34% women in the country are malnourished. At the same time, many women and children are getting dissociated from nature and there is an urgent need to increase awareness about balanced nutrition as well as environment protection. Both the objectives could be achieved through a simple initiative like the *Nutri-School and Kitchen Garden* where students and women are trained to grow vegetables in their school premises or home backyards or in pots on terraces and balconies in city homes.

15 families and 5 hostels tended 4' x 10' plots near their homes to grow vegetables, with seeds and guidance from ICRISAT.

Objectives:

- Involving women and school children for growing kitchen gardens to teach them skills for survival and enhance awareness about environment.
- Educating them on farming practices to improve life skills and strengthen bonds with soil.
- Making use of available resources for growing nutritious vegetables, improving nutrition, health and source money for activities targeted for their improvement.

Most low-income families in the villages have a diet of rice, starch water, and a dilute rasam (broth). They eat few legumes or vegetables. Once they make a habit of tending kitchen gardens, they take an important step in improving their family nutrition.

ICRISAT staff motivated the villagers of pilot sites to dig out a plot for planting vegetables. Totally, 10 villages, 15 families and 5 Schools (SC+BC Government hostels) came forward to prepare the plots. The members loosened the soil and committed to watering and protecting the plants from animals. ICRISAT staff then inspected the preparations. After inspection, families received seeds for **Tomato, Brinjal, Cluster beans, Okra (Bhindi), Bottle gourd (Sora), Bitter gourd (Kakara), Ridge gourd (Beera), spinach (Palak) and Amaranthus (Totakura)**, etc.

Taste of success: Kitchen gardens!

2015: In the pilot site Santipuram, Venkatagirikota mandals around 10 villages, 15 families and 5 SC Hostels planted vegetables with a yield of 23– 85 kg per plot. At the local prices of ₹ 25-30/ kg, most families realized a benefit of at least ₹ 650 and up to ₹ 2010 worth of vegetables per family. The cost of seeds provided by ICRISAT per family.

Backyard nutritional kitchen gardening at Dandikuppam village, Santipuram mandal, Chittoor district *Kharif* season-2015

Some families have also started collecting seeds (Variety) and saving them for the next year. ICRISAT also requested families to give back about ₹50 worth of vegetables, which are then given to old -age homes or to families with malnourished children within the village. In case a family suffers a crop failure, then no vegetables are collected from them. From 2016,ICRISAT also plans to collect old variety seeds back in a systematic way to develop a seed bank in the pilot site villages.

Marine fisheries FPO to help cut out intermediaries and increase income for farmers

Samyuktha Fisheries Producer Company, which was registered in September 2015, through NABARD's support and with SNEHA (a local NGO) as facilitator, has 425 member farmers. It is based in Etimandipallepallu village, Kruttivennu mandal, Krishna district. The farmers come from 30 villages on the coastline of Krishna district. The NGO organized awareness and exposure visits to most of the member farmers to fish markets at Narsapur, Chennai and Bhimavaram. This enabled farmers to realize the advantages of coming together collectively to bargain higher prices in the markets, as they were cheated by middlemen in their villages who gave only 40-50% of prices that they earned in these markets..

The FPO established three collection centers, an ice factory and also placed cooling boxes with a weighing machine in each of the collection center. They deal with a wide range of marine products such as fish, prawn and crabs. The FPO managed bank linkages in facilitating their member farmers to get credit facility of ₹ 3 million through Indian Bank and Saptagiri Cooperative Bank. There is huge need for working capital for farmers, which is informally met through moneylenders, who happen to be members of the FPO. Also, loans are provided to farmers ranging from ₹ 5000 to ₹ 100,000 without interest. However, the farmer had to sell their marine catch to the money lender at a lower price, about ₹ 5 below the prevailing market price per kg. A detailed participatory action planning exercise was conducted by the FPO, and proposals have been submitted to Fisheries department for ₹ ten million. The action plans include fish drying platforms, nets, ice boxes, tool kits, plastic trays, life jackets, salaries for at least two staff members.

The FPO is interested in cultivating of Casuarina trees in the sandy soils to generate additional income for farmer members. After the initiation of the *Rythu Kosam* Project, and as per the recent state FPO policy guidelines, the government has envisioned setting up 1000 FPOs to benefit at least one million farmers during the initial stages of the project.

Japanese technology in Indian farmlands

The benefits to the farming community of partnerships between public research institutes and private companies have been demonstrated in East Godavari district, Andhra Pradesh, India, where machine transplantation has reduced the cost of cultivation by half, as well as increased yields by around 750 kg per ha.

Developing farmer field laboratories and sites of learning to pilot new technologies, ICRISAT has introduced machine transplanting on a pilot basis under the Private-Public Partnership (PPP) mode in 16 ha under the *Rythu Kosam* program. ICRISAT and the pilot site farmers entered into a PPP agreement with Kubota India, a Japanese farm machinery company.

Several awareness programs were conducted in the pilot village of Lingumparthy in Yeleswaram mandal, educating the farmers about the benefits of adopting machine transplanting, from cost reduction to increased yields .

Nearly 120 farmers showed interest in being part of the pilot initiative. Data such as preferred seed variety, date of sowing, proposed area of machine transplantation, etc. was collected from them.

Kubota procured seeds of the farmer-preferred varieties, raised a nursery of different varieties of paddy at the Marteru Research Station (West Godavari), transported the saplings to the farmers' fields and transplanted them using the machine, in the first week of August 2015.

The cost incurred by the farmer for this was ₹ 7,500 per ha, which was half of what a farmer usually spends for the above work. Another issue addressed through this intervention is labor shortage, which is a major problem in this village.

Through crop cutting method in machine-transplanted fields and control fields, it was demonstrated that on an average, the machine-transplanted fields showed increased yield of around 3-5 bags (approximately 75 kg per bag) compared to the control fields.

In *rabi* (postrainy season) 2015-16, farmers from Siripuram village, located adjacent to Lingumparthy village, also came forward and joined the PPP mode. The area under machine transplantation has now expanded to 80 ha.

Under the *Rythu Kosam* program, Kubota India will set up a Custom Hiring Center in the pilot village, where farmers will have access to all farm equipment of the company and can hire them for their fields on a first-come, first-served basis.

Indigenous farmers as groundnut seed producers

Indigenous farmers in Andhra Pradesh, India, for the first time have cultivated groundnut on their lands, leading to improved incomes. They earned about ₹ 87,500 to ₹ 125,000 per ha while they spent, on an average ₹ 8,000 to ₹10,000. With technical inputs and training under the *Rythu Kosam* project of the Government of Andhra Pradesh, these farmers successfully produced foundation seeds from the breeder seeds of improved groundnut varieties provided by ICRISAT.

Yarlagadda village, though not one of the project villages, was found to be ideal for piloting the *rabi* groundnut, as they have an irrigation source, ideal soil type and farmers interested in cultivating groundnut for the first time on their land.

Seven villages were chosen as part of the pilot project and at least 30 farmers identified in each village. A farmer from Lakkonda village, East Godavari district, was extremely pleased with the outcome and said that he and his wife could earn ₹ 40,000 within three months by cultivating the groundnut variety provided by ICRISAT. "We spent only on seeds and did not hire any workers during the cultivation," he pointed out. He said more farmers in his area were showing interest in groundnut cultivation.

About 13 ha land belonging to 15 farmers was brought under groundnut seed cultivation. The farmers were given 2 tons of breeder seed (K 6 and K 9 varieties obtained from Agriculture Research Station, Kadiri) and they obtained a yield of 25 tons of foundation seeds.

Crop cutting experiments conducted by ICRISAT showed that the crop productivity in these fields varied from 1.9 to 2.4 tons per ha for K 9 and from 2 to 3.2 tons per ha for K 6 variety, which is nearly twice the average productivity of Anantapur district.

ICRISAT helped the farmers register with the AP Seed Certification Agency, which monitored and certified the foundation seed upon harvest. The foundation seeds were procured by the AP State Seeds Development Corporation Ltd at a rate 20% higher than the market rate. While the farmers could obtain ₹ 45-50 per kg in the market, the AP State Seeds Development Corporation Ltd. bought the seeds at ₹ 60 per kg .

ICGV 91114 groundnut variety helps farmer earn rich dividends

Mr. B Muninarayana Raju, a small landholding farmer owns 0.4 ha of rainfed land in Venkatagirikota mandal in Chittoor district. Chittoor district has favorable climatic conditions for quality groundnut seed production, which can generate a good income for the farmers. As an initiative for the *Rythu Kosam* project, seed production of high-yielding, drought-tolerant groundnut variety ICGV 91114, developed by ICRISAT in the pilot site, was experimented in the farmers' field.

ICGV 91114 is short-duration, Spanish variety of groundnut, which matures in 95- 100 days in the rainy season and is tolerant to intermittent and terminal droughts. It has 52% oil content and 17% protein content. This variety has a shelling percentage of nearly 70%. Hundred seed weight is about 41 g and potential pod yield is about 2 tons/ ha, with good quality fodder .

With the help of Department Of Agriculture and ICRISAT staff, fields were selected for seed production and soil samples were also collected from the respective fields. Soil samples were analyzed in ICRISAT and the soil health cards were issued to the respective farmers. ICRISAT supplied the breeder seed of ICGV 91114 to the farmers for seed production.

B Muninarayana Raju, who witnessed the activity, was inspired to carry out the seed production of ICGV 91114 in his field during the rainy season of 2015. The recommended seed production practices were followed and the farmer applied recommended soil test-based micronutrients.

He harvested 1.3 tons of groundnut pods, of which he sold 910 kg (26 bags of 35 kg each) of pod at a rate of ₹ 46/kg to the farmers of the neighboring village earning ₹ 41,860. Remaining seed (385 kg in 11 bags) was stored to serve as a seed for sowing in the next rainy season of 2016.

Kitchen gardens for improved nutrition

K.Lakshmi, a landless laborer, lives in Ch. Rajam village of Ranasthalam mandal of Srikakulam district. She is 36 years old and lives with her family of 5 members.

As a part of the *Rythu Kosam* project, she received a seed kit to help improve nutrition in her family and also save money. Before the Kitchen Garden Project, she would purchase vegetables from the weekly market for their daily consumption and was spending ₹ 700 to 800 per month.

The kitchen garden has helped Lakshmi save money and provide improved nutrition for her family

When she attended the awareness workshop conducted by ICRISAT, she was interested to grow vegetables in her backyard. On completion of the workshop she received a seed kit which contained the seeds of brinjal, bhendi (okra), tomato, ridge gourd and leafy vegetables.

She established a kitchen garden in the month of July 2015 in an area of approximately 0.020 ha. After the first growing cycle, she was not only producing enough quantity of vegetables to feed her family but also had a surplus vegetables which she distributed to her neighbors and relatives.

Every month she harvests 20-25 kg of vegetables worth ₹ 750. Just by spending half an hour in the garden, she manages to improve nutrition and also save money for the family.

The kitchen garden project has clearly changed the daily life of this family and they stopped purchasing vegetables from the weekly market.

Changing the trend in vegetable cultivation

Pandals/trellises are special structures used for twining vegetables. Weak climbers utilize this support, which protects the produce from soiling and increases exposure to sunlight and aeration, thereby increasing the number of flower buds, ultimately resulting in more fruit of superior size and quality. In general, vegetables (cucumber, ridge gourd, bitter gourd, melon, pumpkin eggplant, pepper, tomato, chilly) need proper support for their growth and development. Cultivation of vegetables on, both permanent and semi-permanent pandals can increase productivity of twining vegetables.

Lack of awareness or high initial costs prevent farmers to take up cultivation using pandals. Lakshmi Narayana who lives in Patha Nimma Thorlada village, Amudalavalasa mandal in Srikakulam District, has changed this trend.

The farmer earlier used to grow vegetables through traditional methods and over a period, realized lesser profits. He was looking for an opportunity to access the latest technologies to multiply the net profits.

With the help of the Horticulture Department, he started erecting semi-permanent pandals. The farmer cultivated bottle gourd in an area of 0.404 ha. The total cost incurred by the farmer was ₹ 76530 towards various components like bamboo poles, G.I. pipes, twine, etc., required for erection of semi-permanent pandals.

The growth of bottle gourd vines was luxuriant and promoted vigorous flowering. The yield recorded in 0.404 ha was 13.25 ton giving an income of around ₹ 53,000. The average increase in yield was 2.75 ton with a profit of ₹11,000 in comparison to conventional method used in the previous years. The farmer can maintain the semi-permanent pandals for a minimum period of three years, cultivating three crops per year on the same structures. Even though the erection charges are more in initial stages, substantial net profit will accrue in the next two crops.

The farmer is planning to expand cultivation to other 1.22 ha. He expects to earn ₹6,00,000 net returns in coming three years because vegetables

WAY FORWARD

- Increased convergence of schemes, planning & funding.
- More coverage of area in terms of cropping.
- Timely availability of quality inputs in the form of a package.
- Strengthening capacity building and increasing extension system.
- Focused and increased involvement of leadership at district level.
- Intense and regular monitoring of extension staff and NGOs working in pilot site areas.
- Especially in Rayalaseema districts, there is a need for climate smart, high-value, nutritious and market-driven crop diversification.

As part of the Andhra Pradesh *Swarnandhra* Vision 2029, the Honorable Chief Minister Sri N Chandra Babu Naidu has committed to transform the Primary Sector Mission (*Rythu Kosam*), the agriculture and allied sectors, through a new strategy and then to operationalize it in a phased manner over the five-year period (2015-2020). It has been initiated by using a consortium approach by bringing state, national, and international partners on board.

As many as 13 pilot sites corresponding to the 13 districts of the state have been identified for introduction, testing and scaling up of a range of technologies over a period of time in pilot sites covering 267 villages from 38 mandals in 13 districts.

Some of the breakthrough achievements include rejuvenation of soil health through need-based fertilization including micronutrients in 750000 ha, rainwater harvesting structures, soil moisture conservation structures, micro irrigation and provision of rain guns. Also, promotion of organic methods, improving extension services, transplanting through machinery via PPP, production of foundation seed with certification and sowing of millets in about 140000 ha in rainfed regions are some of the other achievements. Recently, a project of setting up 1,000 FPOs, for which ICRISAT will provide technical support, was launched by the Hon'ble Chief Minister.

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