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Proven technologies of Acharya N.G. Ranga Agriculture University to double the income of dryland farmers of Andhra Pradesh

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ABSTRACT
Honourable Prime Minister of India while addressing a farmer's rally in Bareilly, Uttar Pradesh on 28th February, 2016 shared his vision on Doubling of Farmers Income by the time the nation celebrates her 75 years of Independence in the year 2022 by taking 2014-15 year income as base year. He has envisioned seven-point strategy to double the famers' income. 1) Focus on Irrigation with "Per Drop, More Crop" 2) Provision of quality seeds and nutrients based on soil health cards of each field 3) Large investments in warehousing and cold chains to prevent/minimize post-harvest crop losses. 4) Value addition through food processing. 5) Creation of a national agricultural market, removing distortions and e-platform across 585 markets. 6) New revolutionary crop insurance scheme to mitigate risks at affordable cost. New crop insurance schemes – Pradhan Mantri Fasal Bima Yojana-Minimum Premium and Maximum Security. 7) Promotion of ancillary activities- poultry, sericulture, beekeeping and fisheries (Report of the first state coordination committee meeting). By keeping this in view Acharya N.G.Ranga Agriculture University, Guntur has taken many initiatives which have given fruitful results in this direction. Most important initiatives among them are 1) promotion of cost reduction technologies like seed treatment, use of own seed, soil test based fertilizer application, ICM, use of machine operated farm improved farm implements etc. 2) Entrepreneurship development through value addition to millets, oilseeds, fruits and vegetables. 3) Promotion of Integrated Farming System (IFS) in place of monocropping system by integrating livestock, sheep, goat, poultry components to agriculture. 4) Farm mechanization- use of improved tools, implements, equipments both bullock and tractor operated were developed to reduce the cost of cultivation and to overcome labour shortage. 5) Promotion of Farmers Producers organizations (FPOs) – strength lies in unity, to improve the bargaining power of farmers they need to be united 6) Use of ICT in agriculture to get farmers problems solved on real time basis through WhatsApp groups, online sale of produce to get remunerative price etc. 7) Crop diversification – instead of growing high risk crops farmers should practice growing of. 8) Demonstration of dryland technologies to overcome the drought conditions. 9) Use of innovative extension methods to reach information to the farmers without communication gap etc. and 10) Promotion of contingency crop planning incase of occurrence of drought are some of the proven technologies adopted by the University to double the farmers income by 2022.
Keywords: dryland, FPOs, IPO

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INTRODUCTION

In India, 60 percent of total cultivated area is under rainfed farming covering major districts. Most of this area is covered by crops like millets, pulses, oilseeds, cotton etc. These areas spread throughout the country i.e. Tamil Nadu, Karnataka, Andhra Pradesh, Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Punjab, Haryana and Uttar Pradesh. In south India the Deccan plateau which is rain shadow area consisting of parts of Karnataka, (Bellary, Raichur, Kolar, Tumkur, Dharwad, Belgam, Gulberga) and Maharashtra (Sholapur, Parbani, Puna, Aurangabad). The dry farming areas in Andhra Pradesh are found in Kurnool, Anantapur, Kadapa, Chittoor, and Prakasam districts. About 70% of rural population lives in dry farming areas and their livelihood depend on success or failure of the crops. Dryland Agriculture plays a distinct role in Indian Agriculture occupying 60% of cultivated area and supports 40% of human population and 60 % livestock population. The contribution (production) of rainfed agriculture in India is about 42 per cent of the total food grain, 75 per cent of oilseeds, 90 per cent of pulses and about 70 per cent of cotton. By the end of the 21st century the contribution of drylands will have to be 60 per cent if India is to provide adequate food to 1000 million people. Hence tremendous efforts both in the development and research fronts are essential to achieve this target. In order to achieve these goals and

to overcome the problems in dryland agriculture Acharya N.G.Ranga Agricultural University (ANGRAU), Andhra Pradesh has taken many initiatives and produced proven technologies which are contributing in raising the farm production and income to the farmers.

Proven technologies of ANGRAU to double the farmers' income:

1) Cost reduction technologies in dryland crops: Dryland farming is vulnerable to many uncertainties like early or late onset of rainfall, cessation of rainfall, failure of rainfall, floods etc. which causes huge losses to the farmers. Hence farmer should be cautious enough in investment in dryland agriculture. To overcome these uncertainties ANGRAU has developed many cost reduction technologies to safeguard the farmers towards climate uncertainties and enhance the net income of the farmers. These cost reduction technologies are as follows.

- Seed treatment
- Herbicide application
- Soil Test Based Fertilizer Application (STBFA)
- Integrated Crop Management(ICM)
- Mechanization

Seed Treatment: In dryland agriculture seed treatment using pesticides, fungicides, bio pesticides and bio fertilizers are very much important to protect the crop form pests and diseases during initial stages of the crop (20-30 days). Demonstrations conducted in groundnut crop have shown good results.

Treatments	Pod yield (Kg/ha)	% Increase	Haulm yield (kg/ha)	Collar rot incidence percentage	Additional cost on seed treatment chemicals	Additional returns (Rs/ha)	C:B ratio
Groundnut							
T1(Imidacloprid+Tebuconazole)	643	12.2 %	982	13 %	828	2800	1: 3.4
T2 (Imidacloprid+Mancozeb)	616	7.5 %	819	18 %	742	1720	1: 2.3
FP (Mancozeb)	573	-	790	20 %	-	-	-

Herbicide application: In dryland agriculture manual weeding leads to high cost of cultivation and hence herbicide application (pre and post emergence) is a proven cost reduction measure in various crops indicted in the following table obtained by various research findings.

Treatments	Labour involved/ha	Cost/ha (Rs.)	Amount saved (Rs/ha)
Groundnut, Bengalgram			
Herbicide (Pendimethalin)	2.5 lit	1000	1250
Manual weeding	15	2250	-

STBFA: Soil tests measure the relative nutrient status of soils and are used as a basis for profitable and environmentally responsible fertilizer application in dryland agriculture proven by various studies mentioned below.

Treatments	Pod yield (kg/ha)		Increase in yield	Additional amount	
	Demo	Control		Saved (Rs/ha)	Returns (Rs/ha)
STBF in groundnut					
STBF (When P is low)	590	563	5%	194	1080
STBF (When P is medium)	603	560	8 %	1144	1720
Popularization of 'P' fertilizer savings in groundnut					
75 % P is applied	627	502	25%	665/-	5000/-
50 % is applied	540	502	8%	1144/-	1520/-
Popularization of micronutrient (Zinc) spray in Groundnut under					
Demo - Zinc (800 gm/spray)	592	516	13%	-	1873

ICM: It iss a system of crop production which conserves and enhances natural resources while producing food on an economically viable and sustainable foundation. It is based on a good understanding of the interactions between biology, environment and land management systems. ICM is particularly appropriate for small farmers because it aims to minimize dependence on purchased inputs and to make the fullest possible use of indigenous technical knowledge and land use practices.

Treatments	**Pod yield (Kg/ha)**	**% Increase**	***Spodoptera/ Helicoverpa/ Semilooper* incidence (%)**	**Leaf miner incidence (%)**	**Cost of cultivation (Rs/ha)**	**Gross returns (Rs/ha)**	**B:C ratio**
Groundnut							
T1 (ICM practices)	697	15 %	13	12	21222	27880	1.31
T2 (Farmers practice) Indiscriminate use of fertilizers & pesticides	604	-	15	26	22875	24160	1.06
Redgram							
T1 (IPM practices)	338	31	12	-	10480	13520	1.30
T2 (Farmers practice)	258	-	19	-	10130	10320	1.02
Castor							
Neem oil	752	9.9%	12%	-	18069	24032	1.33
Farmer practice	683	-	20%	-	18841	21856	1.16
Bengalgram							
T1 (IPM practices)	741	14	7	-	16418	22230	1.35
T2 (Farmers practice)	649	-	16	-	17100	19470	1.13

Mechanization: Mechanised agriculture is the process of using agricultural machinery to mechanise the work of agriculture, greatly increasing farm worker productivity. Besides improving production efficiency, mechanisation encourages large scale production and sometimes can improve the quality of farm produce. Especially mechanization is more important in dryland agriculture where labour shortage coupled with high cost of cultivation problems exists. Mechanization is used as cost reduction and time saving measure. For this purpose tractor drawn implements like seed drill, ferti cum seed drill, aqua seed drill, weeders, sprayers and multi crop harvesters were developed, tested and proved as cost reduction technology measures (K.Madhusudhana Reddy *et al.*(2013), Prasad babu *et al.*(2016)).

Treatments	**Pod yield (kg/ha)**	**Increase in yield**	**Plant population/m2 (Final)**	**Amount saved (Rs/ha)**	**B:C ratio**
Groundnut					
Anantha seed drill (Rs.1000/-ha)	647	15 %	26	500	1.15:1
Farmers gorru practice (Rs.1500/-ha)	563	-	20	-	1:1
Seed saved @ 25 kg/ha, Time taken is only 2 hrs/ha					
Redgram					
Treatments	**Labour involved/ha**	**Cost/ha (Rs.)**		**Amount saved (Rs/ha)**	
Mechanical harvesting in Redgram with multicrop thresher	Machine	4000	-	3000	-
Farmers practice (Manual harvesting)	5	7500	-	-	-
Bengalgram					
Mechanical harvesting in Redgram with multicrop thresher	Machine	4000	-	3000	-
Farmers practice (Manual harvesting)	5	7500	-	-	-

2) Promotion of Integrated Farming System (IFS) - It refers to agricultural systems that integrate livestock and crop production or integrate fish and livestock and may sometimes be known as integrated biosystems. IFS is judicious mix of one or more enterprises along with cropping systems having complimentary effect through effective recycling of wastes and crop residues and encompasses additional source of income to the farmer. In agriculture, crop production is the main activity. The income obtained

from crops may hardly be sufficient to sustain the farm family throughout the year. Assured regular cash flow is possible when the crop is combined with other enterprises. Judicious combination of enterprises, keeping in view of the environmental conditions of a locality will pay greater dividends. At the same time, it will also promote effective recycling of residues/wastes. With this concept IFS with three enterprises like crop+livestock+poultry were introduced and assessed their performance in terms of risk, gross income, net income, B: C ratio at field level with small and marginal farmers.

Type of IFS system	Net returns (Rs./ha.)
Groundnut alone	23,000
Groundnut + 10 rams	54,250
Groundnut + 10 rams + 20 poultry brids	60,000
Groundnut + Reggram (15:1) + 1 milch Murrah buffalo	95,977
Bengalgram + 10 rams	55,258
Korra + Bengalgram + 1 milch Murrah buffalo	96753

3) Entrepreneurship development through value addition: In dryland agriculture the economic status of the farmers is low and there is no source of income during off season and also most of the youth are school dropouts. So, training the women, rural unemployed youth, farm men and women on self-employment activities in the village is very useful for improving economic status of the people which helps in generating income during the off season.

The extension wings of ANGRAU are conducting training programmes on value addition to millets, fruits and vegetable to farm women, school dropouts & the women from SHG's and encouraging entrepreneur development in millet products. In this process they are not only given technical backup but also executing hand holding exercises till they establish successful ventures to get self employment. Due to this initiative majority of the women are getting Rs.10,000 to 25,000 monthly incomes out of value addition to millets (Multigrain malt, biscuits, cakes etc.), fruits, vegetables, mushroom production, tailoring, handicraft etc. (R.Sireesha Kumari *et al*. 2017)

4) Crop diversification/Multiple cropping systems: In dryland agriculture dependency on single crop is not economical to the farmers. For example in Anantapur district out of 28 years 14 years have experienced below normal rainfall and under such circumstances farmers have obtained very poor yields with crop losses. To overcome this kind of problems farmers need to adopt next best remunerative crops which gives almost same returns even during low rainfall periods with low cost of cultivation. In this direction research has been conducted in dryland agriculture with the following crops to find suitable next best remunerative crops. Among all the crops redgram, castor, korra, jowar, bajra have some extent found to be next best remunerative crops in dryland agriculture to traditionally growing groundnut crops.

yields and returns	Average of last 6 years									
	Groundnut	Jowar	Cowpea	Castor	Redgram	Field bean	Cluster bean	Greengram	Korra	Bajra
Yield (Kg./Ha.)	877	1099	556	1040	1292	1454	268	430	608	1682
Net Returns (Rs./Ha.)	28,850	15,020	10,350	21,130	23,460	12,400	8,640	11,111	12,540	14,560

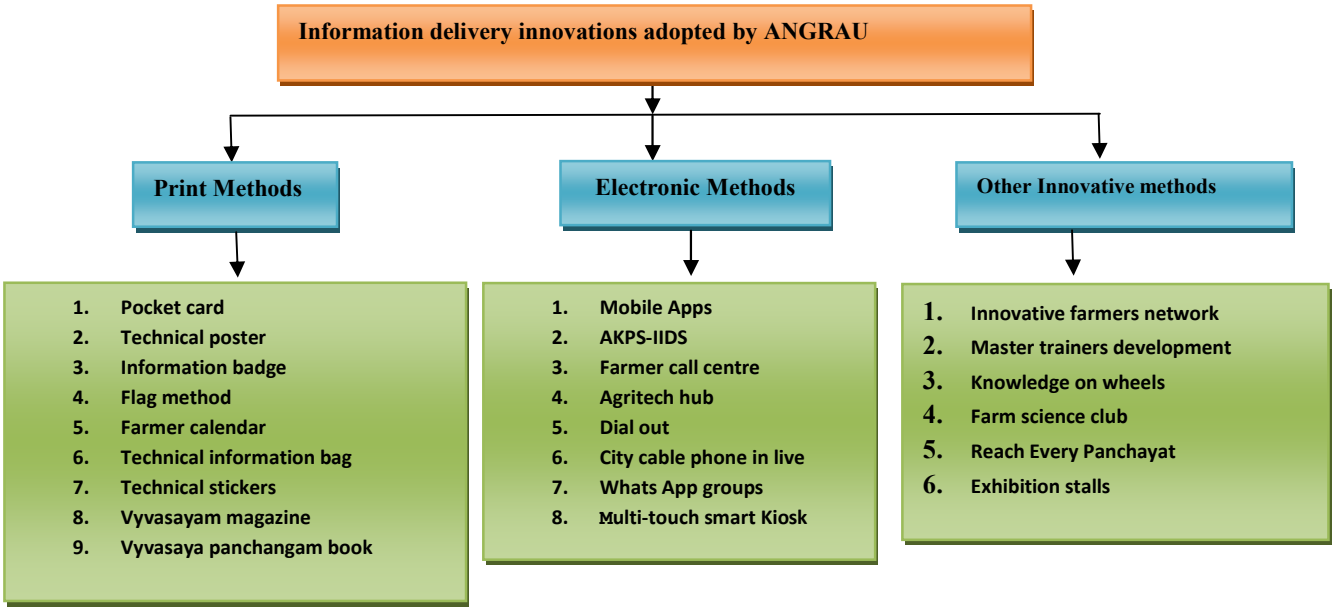
6) Demonstration of dryland technologies: In dryland major challenges are water conservation and efficient use of available water, high cost of cultivation, unforeseen weather conditions, low depth and poor fertility of soils, labour shortage etc. In order to overcome these problems ANGRAU has developed many technologies and solutions which are as fallows.

- ✓ Summer deep ploughings
- ✓ Sowing of crops in right time
- ✓ Growing of suitable crops to dryland agriculture
- ✓ Selection of suitable varieties of various dryland crops
- ✓ Practicing of intercropping
- ✓ Use of organic fertilizers
- ✓ Soil test based fertilizer application
- ✓ Rain water harvesting and management
- ✓ Practicing of Integrated Farming System (IFS), mixed farming
- ✓ Mechanization in dryland agriculture
- ✓ Keep track of weather related information

7) **Promotion of Farmers Producers organizations (FPOs):** Strength lies in unity. Majority of the farmers engaged in agriculture sector are unorganized and hence they are being exploited easily by middlemen, commission agents traders etc. To overcome this problem ANGRAU in liaison with various line departments of government, NGOs, VOs and other like minded agencies actively engaged to develop cooperative societies, Farmers Producers Organization and Farmer Producers Companies etc. to improve their bargaining power, marketing, returns from investment and to achieve self sufficiency.

8) Use of ICT & innovative extension methods: The basic mandates of all the State Agricultural Universities (SAUs) in National Agricultural Research System (NARS) of India are teaching, research and extension. Among them extension is the one which meets the needs of the farming community on real time basis through various extension wings of the University like Krishi Vigyan Kendras (KVKs), Agricultural Technology Information Centre (ATIC), District Agricultural Advisory and Transfer of Technology Centre (DAATTC- Unique extension system of Andhra Pradesh), Agricultural Information Communication Centre (AICC), electronic media wings, community radio, extension specialists etc. In this direction Acharya N.G.Ranga Agricultural University (ANGRAU) of Andhra Pradesh has taken lead role to find and implement innovative, need based and relevant information delivery methods mentioned below to meet majority of the needy farmers in the state and to reach unreached.

9) Promotion of contingency crop planning: From village level to national level every department need to have contingency plans to meet unforeseen events arises due to various factors. ANGRAU in collaboration with CRIDA (Central Research Institute for Dryland Agriculture) has prepared district wise contingency crop plans (ARS Aanntapur Annual report, 2016) to the state of Andhra Pradesh to meet unexpected climatic changes like failure of monsoon, droughts, dry spells, floods etc. in agriculture as well and prepared crop suitability for rainfed red soils and rainfed black soils separately which are as follows.



Contingency crop planning for rainfed red soils:

Crop	June	July	August	September	October
Groundnut	√	√	X	X	X
Redgram	√	√	√	Ist week	X
Castor	√	√	√	X	X
Jowar	√	√	√	√	Fodder
Bajra	√	√	√	√	X
Cowpea	√	√	√	√	√
Greengram	X	√	√	√	√
Guargum	X	√	√	√	√
Horsegram	X	X	15th Aug.	√	√
Korra	√	√	√	X	X
Field bean	√	√	√	√	X

X - Cannot be sown √ - Can be sown

Contingency crop planning for rainfed black soils:

Crop	June	July	August	September	October
Cotton	√	√	√	X	X
Redgram	√	√	√	1st week	X
Castor	√	√	X	X	X
Sunflower	√	√	√	√	√
Jowar	X	X	X	√	√
Korra	√	√	√	√	√
Tobacco	X	X	Nursery	√	√
Maize	√	√	Ist week	X	X
Korra	√	√	√	X	X
Field bean	√	√	√	√	√

X - Cannot be sown √ - Can be sown

By adopting this location specific farming system plan, farmers could successfully overcome climatic vagaries without scarifying their income.

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