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Climate Smart Extension for Soil and Water Conservation by Kvk Nizamabad

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ABSTRACT

Soil degradation has become a serious problem in both rainfed and irrigated areas of India. In India, 147 million hectares of land suffer from various kinds of degradation. Widespread land degradation caused by inappropriate agricultural practices has a direct and adverse impact on the environment, food, and livelihood security of farmers. For ensuring food and nutritional security on one hand conserving natural resources and ensuring environmental security in the other hand, there is an urgent need to employ and adopt conservation effective best practices in various aspects of agriculture. Adverse weather conditions impacting water and soil ecosystem resulting in farmers distress has become a major challenge in Nizamabad district. Therefore, an attempt has been made to help farmers to overcome the challenge disseminating climate resilient technologies with climate smart extension. This paper describes a few locations of specific technologies and practices demonstrated by Krishi Vigyan Kendra, Nizamabad, Telangana state under a technology demonstration component in a farmer's field for a climate-smart farming in rice, maize, and turmeric as major crops in the district to withstand the adverse climatic shocks. Conducting demonstrations on Aerobic rice and Organizing field days and exposure visits on farmer's own innovation with three different seed rates viz, 12,15 and 18 kgs per acre in aerobic rice and realization of good crop performance in 18 kgs per acre helped to change the perception of other farmers to adopt the technology. The on-farm testings on raised bed planting in maize, turmeric, and cluster front line demonstration on broad bed furrow planting in soybean saved the crops from failure with good yields in comparison to the flatbed method of sowings while conserving soil and water during excess rainfall events, water logging, and prolonged dry spell conditions.

Keywords: *Therefore, an attempt has been made to help farmers to overcome the challenge disseminating climate resilient technologies with climate smart extension.*

INTRODUCTION

Soil degradation has become a serious problem in both rain-fed and irrigated areas of India. In India, 147 million hectares of land suffers from various kinds of degradation such as 94 million hectares from water erosion, 16 million hectares from acidification, 14 million hectares from floods, 9 million hectares from wind erosion, 6 million hectares from salinity and 8 million hectares from a combination of factors. Widespread land degradation caused by inappropriate agricultural practices has a direct and adverse impact on the environment, food and livelihood security of farmers. For ensuring food and nutritional security in the one hand conserving natural resources and ensuring environmental security in the other hand, there is urgent need to employ and adopt conservation effective best practices in various aspects of agriculture. National Initiative on Climate Resilient Agriculture (NICRA) is being implemented by ICAR to address the impact of climate variability and climate change in agriculture and develop appropriate technologies for bringing resilience to the agricultural production systems.

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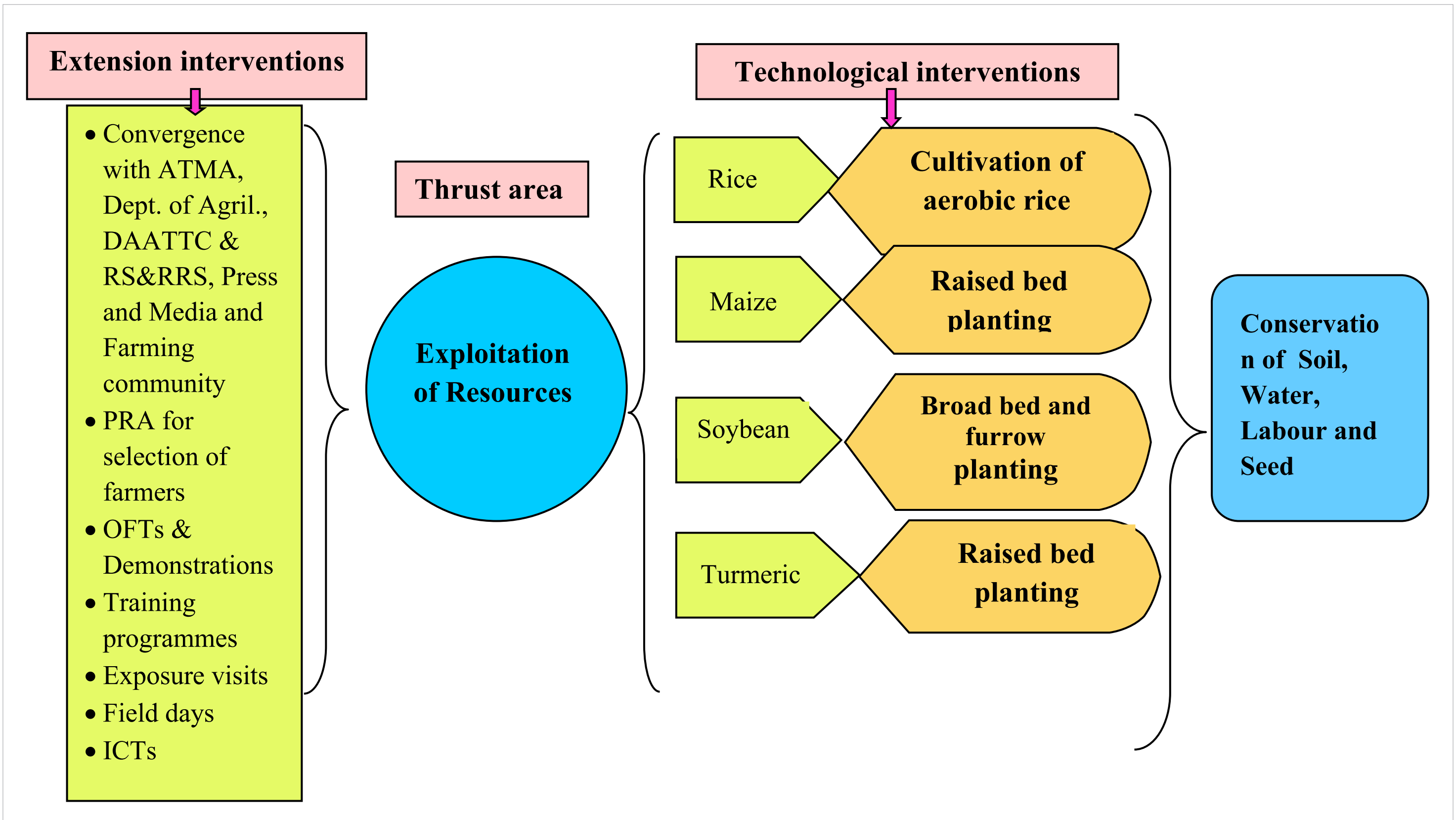
A good number of location-specific technologies and practices have been identified and demonstrated under the technology demonstration component in farmers' field for aclimate climate-smart farming.

Rice, maize, soybean and turmeric are major crops in Nizamabad district, Telangana state grown in 98000, 16800, 60000 and 14,046 hectares respectively in kharif season along with other crops. The total annual rainfall in the district is 998.3 mm. However the crops suffer with uneven and untimely distribution of rainfall during different crop growth stages resulting crop failure most often. The prevailing soils in the district are black and chalk with 52 percent and 48 percent respectively.

METHODOLOGY

In convergence with ATMA, Department of Agriculture officials, Scientists of District Agriculture Advisory and Transfer of Technology and Regional Sugarcane and Rice Research Station (RS&RRS) of PJTSAU, farming community; press and media Krishi Vigyan Kendra Nizamabad conducted demonstrations, field days, Exposure visits in the farmers' fields in Nacharam village, Bodhan Mandal for the promotion of aerobic rice cultivation. On-farm testings in 6 micro locations (0.1 ha each) for the assessment performance of raised bed planting in maize under the component of technology demonstration in Hanmajipet village, Banswada mandal, Kamareddy district; cluster front line demonstrations in 50 ha (0.4 ha each) for popularization of broad bed furrow planting in soybean under National Mission on Oil seeds and Oil palm NMOOP in Suddulam village, Kotagiri mandal were conducted.

Fig: A conceptual model



DAATTC: District Agricultural Advosory and Transfer of Technology Center, Nizamabad, PJTSAU
RS&RRS: Regional Sugarcane and Rice Research Station, PJTSAU
PRA: Participatory Rural Appraisal
OFT: On-farm Test

Climate vulnerability

The crops were subjected to climate vulnerability like excess rainfall events, prolonged and continuous dry spells, and water logging at different crop growth stages resulting in crop failure in the district. Rainfall distribution in the district from 2014-15 to 2017-18 was as follows

Year	Normal Rain fall(mm)	Actual Rainfall (mm)	Deviation %
2015-16	998.3	484.8	(-) 51.43
2016-17	998.3	1270.8	(+) 27.29
2017-18	998.3	717.6	(-) 28.11
2018-19	998.3	931.8	(-) 14.00

Farmers existing practices

Generally, the farmers of the Nizamabad district cultivate rice under anaerobic conditions with assured irrigation and maize, turmeric, and soybean with local country plow and seed drill on flatbeds which is time and labor-intensive subjecting to waterlogging conditions during excess rainfall.

Climate-smart extension interventions in aerobic rice

1. Conducting demonstrations on aerobic rice and organizing field days and exposure visits on farmer's own innovation with three different seed rates viz, 12,15 and 18 kgs per acre and realization of good crop performance in 18 kgs per acre.

Rice is a semi-aquatic plant and it grows well under lowland flooded anaerobic conditions in Nizamabad district. The increasing scarcity of water during drought has threatened the sustainability of the irrigated rice production system and hence the food security and livelihood of rice farmers. It is fundamentally a different approach of rice cultivation where a high yielding rice is grown in non-puddled and non-saturated fields with supplementary irrigation and high 118 Water management of aerobic rice external inputs[1]. With the looming problem of water scarcity, KVK, Nizamabad introduced Aerobic Rice cultivation (Var. Ganga Kaveri), an alternate to reduce water use in rice production without compromising yield in the farmer field by name P. Raghu Ram Prasad in 6 acres during kharif 2018. The crop was grown in non-puddled, non-flooded soil with the use of external inputs such as supplementary irrigation and fertilizer with the aim of obtaining high yield. The savings in labor input has further changed the perceptions of people toward adopting aerobic rice. Its adoption was facilitated by the availability of efficient herbicides for weed control with the timely conduct of a training program and suitable rice varieties for aerobic conditions. The average yield obtained with aerobic cultivation in rice from 6 hectares was 30 quintals per hectare which was on par with puddled and flooded rice. To improve aerobic rice yield, the focus was on combining the drought-tolerance characteristics of upland varieties with the high yield of lowland varieties and growth-limiting factors such as increased availability of N, P, Zn, and Fe; efficient weed control measures; and tolerance of root-knot nematodes. A field day and exposure visits to anaerobic rice farmers were organized to spread this climate-smart farming practice in rice.

Table:1. Observations on aerobic rice with different seed rates

Parameters	Seed rate /acre	Seed rate /acre	Seed rate /acre
Seed rate	12 kg/acre	15 kg/acre	18 kg/acre
Spacing (plant – plant)	6 cm	6 cm	5 cm
Plant height (in cm)	103 cm	100 cm	105 cm
No. of rows (5 x 5 m^2)	21	22	22
No. of plants (5 x 5 m^2)	37023	23408	41976
No. of tillers / hill (5 x 5 m^2)	41	28	36
No. of hills (5 x 5 m^2)	903	836	1166
Height of panicle	25 cm	26 cm	25 cm
No. of grains in one panicle	225	180	265
Wet weight of grain	15.800 gm.	18.100 gm.	20.100 gm.
Dry weight of grain	14.820 gm.	16.800 gm.	18.800 gm.
Total yield / acre	**23.712 q.**	**26.886 q.**	**30.08 q.**
Total yield / ha.	**59.28 q.**	**67.215 q.**	**75.2 q.**

With his own creativity to identify the exact seed rate, Sri Raghu Ram Prasad, experimented with three different seed rates as shown in the above table, and proved that the seed rate 18 kgs per acre resulted in good crop performance. The data was recorded in 5x5 m^2

Seedbed preparation: Minimum tillage was ensured for aerobic rice cultivation by well harrowing and leveling. Field preparation was done with a disc plough, cultivator, and rotavator.

Seed rate and sowing method: Seed was sown directly with seed drill using three different seed rates as shown in the above table with the Ganga Kaveri variety.

Weed control: Pre-emergence herbicide pendimethalin was applied followed by manual weeding

Irrigation: Light irrigation (30 mm) was given just enough to bring the soil water content in root zone up to field capacity (FC).

Details of cost of cultivation of aerobic and anaerobic rice

Parameters	Aerobic Rice (Rs.)	Anaerobic rice (Rs.)
Primary & secondary ploughing	3300/-	3500/-
Seed rate & cost	Less seed rate 18 kg (Rs.630/-)	More seed rate 20 kg. (Rs.700/-)
Labour charges for transplanting	0/-	4500/- (Labour charges)
Weedicide sprays	1050/-	500/-
Fertilizers	2850/-	4900/-
Pesticide sprays	4000/-	8000 -10000/-
Labour charges for weeding	2500/-	2250/-
Harvesting	1800/-	2500 - 2750/-
Total cost per acre	**16,130.00**	**29,100.00**

Impact: In comparison to anaerobic rice

- Less water requirement. Water saving by 50%
- Less labor cost and total cost of cultivation by 55%
- Less pest and disease incidence
- Less laborious
- Easy crop management
- On par yield with anaerobic rice

2. Performance assessment of raised bed planting in maize through on-farm test

Maize (*Zea mays)* is one of the important cereal crops in the Nizamabad district grown as a rainfed *kharif* crop after paddy as the soils and climate are most conducive to the crop. But most often the crop is affected with excess rains resulting low yields. To overcome the problem and get high yield, KVK, Nizamabad conducted On Farm Testing (OFT) on "Performance Assessment of Raised Bed Planter in Maize" during *Kharif*, 2017. The farm level performance of bed planter was tested for wheat, maize, mungbean, and other crop cultivation in different areas of Dinajpur and Rajshahi districts. On-farm research results revealed that this system saved 20-34% irrigation water, 16-69% planting cost, and ensured higher crop yield compared to the conventional system[2] Raised bed technology could successfully reduce the amount of various production inputs like irrigation water, seed, fertilizer, and labor.

These observations were also similar to the observations made by Lauren et al. (2008).

The farmer's practice of sowing the seed on flatbeds which got affected with rains received during August and September 2017 (173.4 and 282.3 mm, respectively) resulted in low yield, whereas the raised beds prepared by raised bed planter helped in preventing water logging allowing the soils to drain excess water with the maintenance of good aeration, ultimately yielding good.

Climate-smart extension intervention

On-farm test on mechanized raised bed planter with two trapezoidal raised beds prepared at a time performed seeding operations along with fertilizer application.

Width of bed : 120 cm

Furrow width : 45 cm

No. of plant rows on bed : 2

Row to row spacing : 60 cm

Plant to plant spacing : 15 cm

Particulars	Raised bed	Farmers practice of Flatbed method
Seed rate kg/acre	6.00	8.00
Yield q/acre	33.58	29.00
Gross income (Rs/acre)	47856	41491
Net income (Rs/acre)	33756	25875
B:C Ratio	3.40:1	2.66:1

Impact

- Management of irrigation water is easy and more efficient. On average above 30% less irrigation water was required compared to the flatbed method.
- Better crop production was possible under wet spells because of proper drainage.
- Reduced lodging adds a significant positive effect on yield as many farmers do not irrigate precisely.
- Herbicide dependence was reduced and hand weeding was possible.
- The compaction of soils was limited only to the furrows.

3. Performance assessment of raised bed planting in Turmeric through on-farm test

Turmeric (Curcuma longa) an important crop, is extensively cultivated worldwide though native to Southeast Asia[4]. Turmeric is a traditional spice crop in Nizamabad district used as dye, drug, and cosmetic in addition to its use in religious ceremonies. It earns the first position in the country with 26% share of total turmeric production. Though turmeric crop occupies nearly 50% area under horticultural crops in the district, farmers follow manual sowing on flat beds where the crop is affected by water logging conditions during heavy rains in different stages of crop growth resulting in pest and disease incidence, poor yields, less dry rhizome recovery,poor processing quality fetching low market prices. To overcome this, KVK, Nizamabad conducted On Farm Testing (OFT) on "Performance Assessment of Raised Bed Planter in Turmeric" during *Kharif*, 2017. This method results in an increased incidence of rhizome rot which increases the cost of cultivation, and decreases yield and economic returns. Planting method influences the growth and yield of turmeric[5&6].

Climate-smart extension intervention

On farm test on mechanized raised bed planter with two trapezoidal raised beds prepared at a time performed seeding operations along with fertilizer application.

Width of bed : 90 cm

Furrow width : 130cm

No. of plant rows on bed : 2

Row to row spacing : 30 cm

Plant to plant spacing : 20 cm

Particulars	Raised bed	Farmers practice of Flat bed method
Seed rate kg/acre	Low seed rate. 500 kgsl/ac	High seed rate.800 kgs/ac
Yield q/acre	38. 00 tonnes/ha	33.75 tonnes/ha
Labour requirement	4 can complete 2 to 2.5 acre	8-10 per acre
Depth of sowing	Uniform depth of sowing	Depth of sowing varies
Rhizome health	Good drainage facility through furrows protects rhizome health	Water stagnation during heavy rains damaging rhizomes causing rhizome rot and rhizonme fly incidence.
Spacing	Wider spacing reduces competition among rhizomes giving good rhizome weight and more tillers	Closure spacing increases competition among rhizomes giving poor rhizome development and weight.
Weed management	Weed management was a problem	Weed management was easy.
B:C Ratio	1:87	1:67

Impact

- Management of irrigation water is easy and more efficient. On average above 30% less irrigation water was required compared to the flatbed method.
- Better crop production was possible under wet spells because of proper drainage.
- Reduced lodging adds a significant positive effect on yield as many farmers do not irrigate precisely.
- Herbicide dependence was reduced and hand weeding was possible.
- The compaction of soils was limited only to the furrows.

4. Promotion of broad bed furrow planting in soybean through cluster front line demonstration.

Soybean is one of the important oil seed crops grown in 60000 ha. in Nizamabad district after paddy crop as the soils and climate are most conducive to the crop. The farmers of the district mostly use the flatbed sowing method with seed drills for soybean cultivation as a rainfed crop during Kharif. Soybean crop is prone to water logging during heavy rains during different crop stages resulting in low yields. Broad bed furrow planter (BBF seed drill) was developed basically to cope with the problem of excess rainwater in the fields. For this purpose, Krishi Vigyan Kendra, Nizamabad demonstrated broad bed furrow technology in soybeans during kharif, 2017.

It is also observed the performance of the broad bed and furrow system was consistently superior to the traditional system in reducing annual run-off, soil loss, and peak run-off rate. They remarked when rainfall was very low and moisture conservation was crucial, the broad bed and furrow system conserved most of the annual rainfall[3]

Climate Smart Extension Intervention

Sowing of soybean with broad bed furrow planter.
No. of furrows : 2
Width of bed : 180 cm
No. of plant rows in bed : 4
Row to row spacing : 45 cm

Advantage

Furrows helped in draining excess water during heavy rains simultaneously conserving the soil moisture that was used by the crop during subsequent crop periods with following observations.

Particulars	Flat bed method of sowing	Broad bed furrow method of sowing
Seed rate (kg/ha)	80	60
Plant population (No. of plants/ m2)	55	30
No. of nodules/plant	Less	More
No. of pods/plant	55	75
Seed yield (kg/ha)	22500	26500
Cost of cultivation (Rs/ha)	34250	32780
Gross income (Rs/ha)	63000	74200
Net income (Rs/ha)	37540	51850
B:C ratio	1.83	2.26

Impact

- Increase in water use efficiency
- Increase in crop productivity (5-10%)
- Less moisture stress during non-rainy days
- Time saving (25-30%) in irrigation
- Requires 20-25% lower seed rate
- Water saving up to 25-30%
- Better weed management
- Reduces crop lodging

CONCLUSION

In aerobic rice on par yield i.e., 30 q/ha. in comparison to anaerobic rice was observed with less labor requirement, less cost of cultivation, less water requirement, and less pest and disease incidence. In maize the farmer's practice of sowing the seed on flatbeds which got affected by rains received during August and September 2017 (173.4 and 282.3 mm, respectively) resulted in low yield, whereas the raised beds prepared by raised bed planter helped in preventing water logging allowing the soils to drain excess water with the maintenance of good aeration, ultimately yielding good. In soybean good vegetative growth due to proper drainage of excess rainfall through furrows and wider and uniform spacing in the broad bed furrow method over the flatbed method resulted in good crop canopy with a greater number of root nodules and pods per plant. Fifteen-point zero nine (15.09) percent more yield was observed in the broad bed furrow method over the flatbed method of sowing.

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