

Climate-smart actions in agriculture

for ensuring zero hunger

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Climate change is a serious issue and has garnered much attention and utmost priority especially in agriculture connected to food and nutritional security for ensuring zero hunger. Perhaps, agriculture in India is affected to a larger extent owing to its geographical position and dependency on monsoon which made the sector sensitive to the climate change. India is a home to undernourishment for around 21% of the population and as per the Sustainable Development Goal 2, there should be no hunger across countries by 2030. Indian population is expected to reach 1.7 billion by 2050 and by 2030 it will be the most populous country and hence the food and nutritional security to the burgeoning population has to be addressed with additional food production. The theme of the World Food Day – ‘Our actions are our future: a zero hunger world by 2030 is possible’ – obviously was framed taking into the current scenario. Evidently, the challenge is a daunting task in the present scenario wherein climate change impacts are getting worse coupled with declining productive resources. In the absence of appropriate adaptation and mitigation efforts against climate change, the challenge to feed the burgeoning population will remain a big puzzle.

Key words: Agriculture, Climate, Zero Hunger

AMONG the population dependent on agriculture, it is the rural poor comprising a significant proportion of small and marginal farmers as well as landless labourers face the serious consequence of climate change impacts and end with poverty. In the milieu, increasing the resilience of food production system to climate change and food supply/access in general and to rural poor in particular becomes imperative. Nevertheless, it cannot be done without preparing the agriculture sector to adapt for climate change. Of them, management of dwindling natural resources for climate resilience in Indian agriculture takes the top priority to ensure food and nutritional security to millions.

Understanding the complex challenge in agriculture system

The challenges in crop production

are many in the context of food security and hunger reduction. To cite a few, burgeoning population vis-à-vis increasing demand for food; competition for land, water and energy; increasing cropping intensity particularly in the Indo-Gangetic plains leading to irrational resource use; changing pest complex; degradation of natural resources like land and water; declining total factor productivity; and stagnating yield (Fig. 1). Indian agriculture not only faces the above routine challenges as it gets transformed but their intensity gets magnified in lieu of climate change. Agriculture not only affected by climate change but serve as a panacea as well by playing a major role through green economy. The production challenges are interdependent having the confluence at different magnitudes across regions which finally gets reflected at macro-level with negative impact. Hence,



Fig. 1. Interdependent production challenges in agriculture system

framing adaptation and mitigation strategies for climate change becomes utmost priority in Indian agriculture.

The complexity in addressing the production challenges embraced by the negative impact of climate change as shown in Fig. 1 needs an in-depth understanding of the local situation

for implementing relevant resource management strategies. Further, the implementation strategies to be successful at micro-level, it need the synergy between the local communities and authorities apart from the support from government in policies and investment. Clearly, participatory mode is the need of the hour to tackle the situation in the scenario of climate change.

Climate-smart actions for enhancing food production

Agriculture being the most vulnerable sector, management of resources like land, water, energy and other crucial inputs helps to build synergy in adapting as well as mitigating to the negative impacts of climate change. Strategic management addresses the prime issues and reduce the potential negative trade-offs posed by climate change apart from enhancing the capacity to produce more food on sustainable basis. However, it requires the knowledge on the past, current and future scenario to develop climate-smart strategies for the system resilience. Several options like conservation agriculture, climate-smart villages and smart technologies are available in the current scenario but its implementation requires the local knowledge. This section briefly highlights the options for climate-smart action.

Intervention by conservation agriculture practices

Conservation agriculture (CA) is a bundle of soil management practices which helps to minimize the soil structure disruption, improves soil composition as well as natural biodiversity and thereby plays an important role in reducing the risks associated with the food production. Conservation agriculture is a proven technique to improve the crop yields in an eco-friendly and sustainable manner by operating with three major principles: minimum amount of soil disturbance, permanent cover of the land either with organic matter or crops, and practising crop rotation based on the agro-ecology. Several Conservation agriculture practices exists like zero tillage, laser-land

levelling, crop rotation and residue management which facilitate to increase the soil carbon sequestration and water-holding capacity. The conservation agriculture techniques results in drought resilience as well as reduce the crop damage from floods. It is one of popular techniques gaining momentum in India particularly in the Indo-Gangetic plains. The following are some of the recommended and widely adopted conservation agriculture practices in India.

Zero tillage: This is a method of growing crops without any tillage i.e., no disturbance of soil. Indeed it is the extreme condition of minimum tillage and a central element of the conservation agriculture practice with several benefits as highlighted in Fig. 2.

The idea was first propounded by Edward Faulkner who brought a quantum jump in technology frontier as well as harmonizing agriculture with eco-friendly practices. The conservation agriculture technique helps to improve the property of the soil making it more resilient to climate change. Precisely, to mention, zero tillage facilitates to buffer the terminal heat stress which is one of the major abiotic stress posed by ill-effects of climate change in the north-western plains zone of wheat production in India.

Laser-land leveling: It is a process of leveling the field for a desired degree of slope with the aid of tractor mounted laser beam throughout the field. The laser controlled device

facilitates for a flat surface throughout the field and ensure for equitable reach and distribution of water thereby increasing the crop productivity. Some of the benefits of laser leveling are:

- Leveled and smooth soil surface.
- Less time and water required for irrigation.
- Uniform distribution of water and hence the moisture content.
- Uniform germination and growth of crops.
- Less usage of inputs like seeds, fertilizer, chemicals and fuel.
- Uniform surface for smooth field operations.

However, this conservation agriculture technique has its own limitations as well.

- High cost of the equipment/laser instrument
- Requires a skilled operator to fix the laser for land leveling

Residue management or mulching:

It is a practice of sustaining a protective cover over the soil surface with the help of the previous crop residues or stubbles during the planting operations of subsequent year. Alternatively, the crop residue will be left on the surface of the soil which reduces the next crop tillage operations leaving and turning the soil less at the practised farm. Mulching helps in addition of soil organic matter, which in turn enhances the seedbed quality. Further, the practice also helps in increasing the rate of water infiltration as well as the retention capacity of the soil.

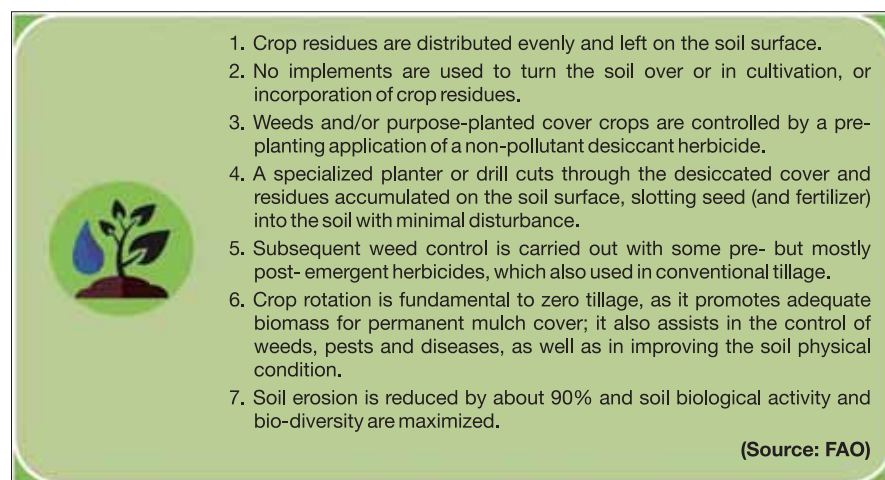


Fig. 2. Features of zero tillage.

Intervention by fostering resource smart farms

Resource smart farms are sites wherein researchers and local communities as well as institutions come together to identify the resource smart agriculture intervention(s) to address the ongoing challenge. The rationale behind fostering resource smart farms is to integrate smart farming practices under participatory approach involving experts and local communities/organizations which will be later incorporated into village development plans. The resource smart farm has a range of adaptation strategies or interventions which entails almost all farm operations (Fig. 3) like land smart practices (zero tillage, rotary tillage, laser land leveling, furrow irrigated raised bed system etc.), water smart practices (aquifer recharge, farm pond, rainwater harvesting, laser land leveling, micro-irrigation, alternate wetting and drying as well as direct seeding in rice etc.), nitrogen smart practices (site specific application, precision dose, legume cropping, green manuring etc.), carbon smart practices (application of organic manures, conservation agriculture, livestock rearing, bio-fertilizer application etc.) and energy smart activities (utilization of biofuels, use of fuel efficient machines, crop residue management, zero tillage etc.) to work in an integrated manner towards building climate resilience. However, if the resource smart practices have to be ranked, it can be based on the scores obtained for contribution to food production, climate risk adaptation and mitigation.

Resource smart farms enable the cultivators to respond smart to the risk and uncertainty posed by climate change. In the long-run, the resource smart farming practices should be prioritized based on the ranks and has to be included in the agriculture development plans for further up scaling at macro-level.

Intervention by climate smart technologies

Climate-smart technologies have evolved in due course of time with

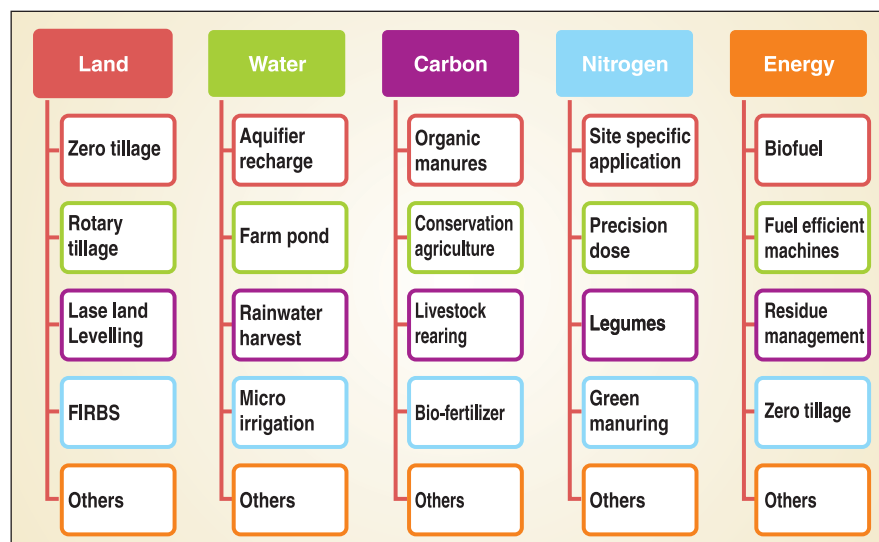


Fig. 3. Smart resource management techniques for climate resilience

the advancement of communication and technology and it helps the farmer to make aware of himself/herself regarding the smart resource management options for climate resilience.

Information and Communication Technology (ICT) services: ICT provides climate services or advisories for smart resource management like season and crop bound voice and text messages in their local language. Further, crop advisories in the form of weather forecasts, new varieties, tips on adaptation strategies are also provided at regular intervals.

Precision nutrient management: Smart nutrient management tools like Nutrient Expert Decision Support, Leaf Colour Chart and Green Seeker sensors are widely used to determine the optimum dose of fertilizers.

- Nutrient expert tool guides for location specific use of appropriate fertilizers. The advantage of this tool is the precision in its prescriptions even in absence soil testing.
- Green Seeker is a sensor-based handheld instrument, which when held above the crop canopy, it calculates the Normalized Difference Vegetation Index and suggests the crop health status and nitrogen (N) requirement. The instrument helps to optimize the nitrogen use thereby reducing the fertilizer footprint on the environment.

- Leaf colour chart is a visual aid traditionally used for comparing the greenness of the leaves to quantify the amount of nitrogen needed for the crop.

Climate resilient wheat varieties

Various biotic and abiotic stresses affect the wheat crop in different growing zones and hence trait specific varieties as listed here are recommended for adoption in farmers' field.

Other Interventions: Apart from the above highlighted options, the following interventions also help to manage the depleting resources at the farm level.

- Crop diversification:** In the context of smart resource management, appropriate crop diversification (for instance, legumes as a part of portfolio will fix nitrogen in the soil) in a piece of land with facilitate for sustainable intensification.
- Agroforestry:** In this intervention, planting trees with the usual crops helps in carbon sequestration of the soil as well as prevent soil erosion.
- Direct seeding:** It is a popular practice in rice cultivation. Direct seeding comprise the process of sowing the rice seeds directly in dry seedbed against the usual transplantation which significantly reduce the crop water requirement and improve the soil physical conditions in the content of

Terminal heat stress tolerant varieties of wheat for normal and late sown

S. No.	Variety name (Wheat)	Year of release	Duration	Yield potential (q/ha)	Recommended region
1	RAJ 4238	2016	114	62.8	CZ
2	HD 3117	2016	146	50.1	Delhi
3	PBW 658	2014	121	60.7	NWPZ
4	WH 1124	2014	121	56.1	NWPZ
5	HD 3118	2015	112	66.4	NEPZ
6	DBW 107	2015	109	68.7	NEPZ
7	MP 3336	2013	107	64.4	CZ
8	DBW 71	2013	119	68.9	NWPZ
9	DBW 90	2014	121	66.6	NWPZ
10	HD 3090	2014	101	63.1	PZ

Moisture stress tolerant varieties of wheat for normal and late sown

1	HS 562	2016	175	62.2	NHZ
2	UAS 347	2015	96	24.6	PZ
3	PBW 660	2016	154	49.3	NWPZ
4	WH 1142	2015	122	36.4	CZ
5	HD 3171	2017	122	51.4	NEPZ
6	DBW 110	2015	124	50.5	CZ
7	HI 1605	2017	105	44.0	PZ
8	DBW 93	2015	122	39.0	PZ
9	MPO 1255	2016	-	34.5	Madhya Pradesh
10	HS 542	2015	192	49.3	NHZ

Yellow rust resistant varieties of wheat for northern states

1	PBW 723	2017	146	63.2	NWPZ
2	HD 4728 (d)	2016	120	75.1	CZ
3	DBW 90	2014	121	66.6	NWPZ
4	PBW 644	2012	153	44.8	NWPZ
5	WH 1080	2011	151	44.4	NWPZ
6	WH 1142	2015	154	62.5	NWPZ
7	DBW 71	2013	119	68.9	NWPZ
8	TL 2942	2006	194	55.4	NHZ
9	TL 2969	2012	165	53.8	NHZ
10	HS 507	2011	165	60.1	NHZ
11	HS 542	2014	192	49.3	NHZ
12	VL 829	2003	151	48.9	NHZ
13	VL 892	2008	143	48.9	NHZ
14	KRL 210	2009	143	49.3	Salinity
15	HD 3171	2017	122	51.4	NEPZ
16	K1317	2017	125	54.2	NEPZ
17	WB 02	2017	128	58.9	NWPZ

CZ: Central Zone, NWPZ:North-Western Plains Zone, NEPZ:North-Eastern Plains Zone, NHZ:Northern-Hills Zone, and PZ:Peninsular Zone

resource management.

- (iv) *Alternate wetting and drying*: This strategy is also practised in rice crop wherein the farm is alternately flooded and drained. The climate smart method reduces the methane emissions to the tune of 48% relative to flooding irrigation. The technique when

combined with precision fertilizer application tools, it further reduces the greenhouse gas emissions significantly. For a farmer, the immediate benefit when adopting this strategy is high reduction in the quantum of irrigation water used in the farm.

- (v) *Community management of*

resources: Local communities shall be involved in managing the depleting resources like water through establishment of community pond apart from building seed and fodder banks for providing quality inputs to the local farmers.

SUMMARY

Alleviating hunger is a top priority for most of the countries, especially developing countries owing to climate change affecting food production. Among sectors, agriculture is the most vulnerable and challenges posed by climate change at the forefront have to be viewed at the grassroots level and it has to be addressed holistically rather than devising or formulating stand alone strategies. To meet the future population food demand, especially by 2030, agriculture has to undergo a rapid transformation which itself will increase the resource damage under the existing agricultural production system. Hence, integrating climate resilience into Indian agriculture and natural resource management gains the focus at the moment. To be effective, the implementation of the initiatives for 'climate smart actions' should be done in participatory approach with the local partners, government authorities and community based organizations viz., self-help groups, village cooperatives and farmer producer organizations. The current situation requires an immediate attention and abrupt local knowledge to design the framework for 'climate-smart actions' at all levels to achieve the target of 'zero hunger' by 2030.

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What can we do to help achieve ZeroHunger?

Wasting less, eating better and adopting a sustainable lifestyle are key to building a world free of hunger. The choices we make today are vital for a secure future of food. Simple actions : • Not Wasting Food; • Producing more, with less; • Adopting more healthy and sustainable diet; and • Advocating for #ZeroHunger will help us make #ZeroHunger way of life, to help re-connect to food and what it stands for.

(Courtesy, FAO)