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A Few Strategies for Twenty 20 in Agriculture: Dream or Reality for its Long Term Sustainability

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SUMMARY

Agriculture is the backbone of Indian economy. Many efforts have been made since long last to increase productivity and quality of the staple food crop especially cereals to feed the mass population ever increasing at an alarming rate. Along with the agricultural growth, environmental sustainability is one of the prime concerns of the modern agriculture. So, to augment productivity to eliminate starvation of a remarkable section of people worldwide, scientific interventions should include (i) Strategy 1: 20:20 Cereals: Increasing cereal productivity to yield twenty tons per hectare in 20 years (T20) cumulating from increased one tone per hectare per year consistently through enhancing crop potential, plant protection for yield loss, determining soil resources interactions, using systems approaches to crop improvement; Strategy 2: Tapping Carbon as one of the mitigation processes for environmental sustainability and agricultural productivity; Strategy 3: Designing and synthesizing seeds for improving qualitative aspects of seeds, and Strategy 4: Delivering sustainable systems for productivity, agro-ecology, and sound environment around the globe.

INTRODUCTION

The world is facing shrinkage of all resources viz., food, energy, water and cultivable land for living being since the anthropogenic intervention of the nature as a whole in the last few decades. There is geometric progression in global population, and is expected to reach an unimaginable growth of about 10 billion by the end of the next there decades. The ramifications of global climate change have been contributing to build up of dangerous climatic catastrophic situations around the world, ultimately on the abundance of the essential commodities for survival of the humanity from place to place. Therefore, we have to concentrate our efforts to produce sufficient value added feed staff along with the keeping abreast of the sustainable all sorts of pollution free and clean environment of the mother earth. In this context, the world organizations i.e FAO has been deeply concerned to alleviate the starvation and undernourishment of millions of people by increasing food over 40% by 2030 to 70% by 2050. We have been also experiencing the volatile increments in costs of production, transport and distribution of food items due to input costs and scarcity of energy resources used in agriculture sector. So, low input Agriculture with high productivity without further damage to the environment becomes a prime concern to the farming community.

As the world population enhances at an alarming rate, and if the availability of resources diminishes simultaneously, the endeavor for efficient and quality food production is becoming of utmost important. Now-a-days, in Agriculture high yielding genotypes are preferred but these require high inputs of the all resources including fertilizer nutrition. Crop breeding has a paramount role in this aspect for developing high performance varieties. However, high-input systems become less sustainable, and may not be realistic in the future because of so many social and economic issues (e.g. poverty, illiteracy, disease, politics and policies) around the world that influence the productivity of crops in a region followed by post harvest processing of foods for feeding the burgeoning population. We are fortunate enough that we have developed biological tools and technologies required to bridge the gaps in knowledge to meet these challenges. The art of phenomics and genomics renders the revolutionary approaches to develop crops with nutrient and water use efficiency, plant protection, nutritional value and soil health sustainability. Global efforts have been pressed to impart of investigations in the new priority research areas with collaboration from many other academic and research institutes in a country and beyond. However, these strategies will not be covering for many upcoming years considerably, while there will be reflections of the new demands and priorities. So, it requires priority for redesigning to enable us to deliver the scientific comprehension and innovation to produce and feed an ever increasing, a segment of starving world population.

In fact, many institutions have visions and strategies on wide perception that encompasses the whole plant system, and a cautious balance of approaches. This comprises of biotechnology but also take account of areas of science such as Crop physiology, Soil Science, Crop Husbandry so that we can understand how existing and new knowledge can be implemented in agricultural productivity.

Strategies

The challenges and strategies which are to be channeled through as much as alert program in consistence with the agricultural sciences as follows:

Strategy 1:

20:20 Cereals: Increasing cereal productivity to yield twenty tons per hectare in 20 years (T20) cumulating from increased one tone per hectare per year consistently. We require enhancing the rate of increase in the world cereal yields remarkably to more than the present variable yield potential rates based on location, region specific or globally. In this instance, the UK wheat research provides us a glaring example that there had been a quantum jump of wheat productivity from single digit to double digit numbers and likely to achieve the desired target T20 in wheat yield in due course of the early the current decade. Concurrently, our aim has to provide the knowledge base and tools to increase cereal yield potential within the next 20 years in a phased manner. To achieve this target the challenges might be

(i) Enhancing crop potential :

With the requirement for innovative ideas to boost yield, we ought to focus on augmenting total crop biomass and grain yield through improved photosynthetic efficiency, altered crop canopy and root system architecture, modified seed development and enhanced nutrient (N) utilization efficiency (NUE), which is believed to be one of the important physiological traits, because in cereals we generally achieve at best 33% NUE, where the rest of the applied nutrient is lost by both leaching with natural surface rainwater especially in tropics and subtropics, and vanished by ammonia volatilization or bacterial competition. It's estimated that 1% increase in NUE, will recover about $1.1 Billion annually against the incurring losses. This can be introduced to some extent either by following real time and fixed time nutrient management practices at farmers' level or by utilizing breeding materials based on plant phenotyping, exploiting novel germplasm, transgenesis and other forms of genome remodeling at the institutional end. The potential of these approaches to offer substantial increases in yield is exemplified by the difference between C3 and C4 crops, where for a given volume of water, photosynthetic efficiencies can be 50% higher in a C4 crop because of the suppression of photorespiration.

(ii) Plant protection for yield loss*:* Pest and diseases reduce the cereal yields elsewhere at the maximum level. Healthy solutions to these anomalies could contribute a substantial increase of about 5-10% in average yield of cereal crops.

(iii) Determining soil resources interactions: Efficient water uptake and its proper use efficiency for sound photosynthesis are important, where cereal crops can be very sensitive to drought or submergence where water potential plays a very crucial role cellular growth and development and finally on crop yield,

(iv) Using systems approaches to crop improvement: Development of crop models supported by physiological and environmental parameters, exploring gene-environment interactions, dissecting complex yield trait into its component traits (e.g. QTL analysis for panicle characters for rice yield against resource use efficiency), and explore performance of cereal ideotypes under climate change situations.

Strategy 2:

Tapping Carbon:

(i) Optimizing carbon harvest by grassland and energy crops, such as Willow, Miscanthus, Canola, Witch grass, Sugarcane, cultivation of bamboo and micro algae, Azolla species have paved the ways for the country's transition to a low carbon economy. Ambitious projects renewable and sustainable alternatives for fossil fuel-based products may translate these into technologies, and practices that can be used by agencies, agribusinesses and energy companies to help in transition to low carbon economy and contribute to future energy security. Along with the carbon sequestration in soils using the analyses of plant biomarkers and radio isotopes, mass spectrometry, will help in understanding the contribution of roots to sub-soil carbon stocks and the underlying biogeochemical processes for carbon deposition in deep soils, may enlighten strategies for enhanced carbon retention capacity.

Strategy 3:

Designing and synthesizing seeds: Zinc and iron are the two most important micro nutrients vital for sound health especially for overcoming ailments (e.g. anemic for iron deficiency). So, harnessing our expertise in seed physiology and biochemistry may contribute to rectify and cure the immune deficiency diseases in human being. Determination of genetic variation in content, form, location and bioavailability of the minerals in seeds, and identification of the mechanisms and genes, too, describe these differences. Genetic engineering enhances the contents and bioavailability of the minerals in the produces. Metabolic engineering of energy crops increasing poly unsaturated fatty acids, typical to those found in oily fish i.e. EPA and DHA explores the feasibility of dilatory intervention. Control of lipid catabolism by oxidation of fatty acids, especially lipolysis and peroxisomal β-oxidation in seed, is essential for an oil seed plant becoming established, prior to becoming photoautotrophic. Apart from these, synthetic seeds comprising of encapsulated somatic embryo, shoot buds, cell aggregates or any other tissue that can be used for sowing as a seed that possess the ability to convert into a plant under vitro or ex-vitro conditions and retain potential after storage, offers tremendous opportunity in micro propagation and germplasm conservation.

Strategy 4:

Delivering sustainable Systems:

It requires designing and redesigning sustainable agricultural systems that increase productivity. Along with the sustainable crop protection strategies for pest and diseases, optimization of nutrients in soil-plant-systems explores possibilities for using system biology techniques to understand soil ecosystem function, nutrients and pollutants in air, soil and water, and evaluate soil parameters that are important to sustainability and fundamental drivers of nutrient cycling in soils. After all, developing numerical tools becomes potential for quantifying sustainability of agro ecosystems.

CONCLUSION

At the heart of these strategies, there is a consumer focus with a requirement to make available the environmentally user friendly technologies, manufacturers and most importantly the farming community who are integral to delivering sustainable food security in years to come.

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