JUST AGRICULTURE
multidisciplinary e-Newsletter

Achieving sustainability by infusing agriculture into STE(A)M.

Ikkurti Gopinath[1],BK Namriboi[2] and Kranthi Kumar[1]
[1]ICAR- Indian Agricultural Research Institute, New Delhi.
[2]GBPUA & T, Pantnagar

ARTICLE ID: 01

Defining STEM with the long enthralled societal perspective is very easy as they are considered Science, Technology, Engineering and Mathematics, which play(ed) pivotal role in wholesome development of human resources and civilization. We should understand that these are the umbrella terms in the context of education system, which in-turn tendentiously promote certain technical disciplines only, for instance medicine in science; robotics, artificial intelligence and astrodynamics in technology and engineering; algebra and combinatorics in mathematics. Despite many associated advantages, agriculture has always been subverted as pivotal in academic andcareer options, livelihood, and societal advancement. Indian economy is also called an agrarian economy. The significant role of agriculture sector in Indian economy can be summarized as below. Firstly, agriculture forms an important sector of Indian economy. The gross value added (GVA) of agriculture was 19% in 2021-22, while it dropped to 18.3% in 2022-23. The fiscal year 2023 is predicted to exhibit rise above the previous year, the discussion of which forms a different facet.The two major agriculture and allied sectors displayed massive share to this GVA: 55.33% by crop sector and 30.8% by livestock sector. The Indian agriculture sector has been growing at an average of 4.6% during last 6 years. Additionally, with the engagement of 55% country's population, Indian agriculture sector employs largest workforce in India. Agriculture is the constant supplier of industrial raw material. Therefore, agriculture sector plays immense role in development of any country. Further, the importance of agriculture in countries like India can be identified from these simple statistics. With 2.3% of total world's land, and 4% of world renewable water resources, every year Indian agriculture achieves tremendous feat of feeding and sustaining nearly 18% of world's population. Moreover, India has 5 times morepressure on land as compared to the world and the regions like Indo-Gangetic plains have even more population pressure and mouths to feed. In the face of all this, agriculture

JUST AGRICULTURE
multidisciplinary e-Newsletter

sector contributes nearly US$ 50.2 billion worth to net exports and basmati rice variety Pusa Basmati-1121 itself has provided Rs. 18000 crores of revenue to the Government of India in the year 2020-21. Therefore, agriculture is backbone of our country.

Our country has overcome hunger and famine that loomed for few decades after independence and we have achieved two important things, food sufficiency and a linked outcome, 'life expectancy'. India has achieved 6 times more food grain production, 10 times more of milk, vegetables, fruits and meat, 15 time of fish production and 50 times of egg production. Despite all this, we have 800 million people under public distribution system in India, those considered earning less than Rs. 1 lakh per annum. This amounts to Rs. 2.43 lakh crores being spent on PDS system as per the economic survey 2021. Further to mention, huge percentage of people are below poverty line and several are undernourished with mass hidden hunger. Moreover, India has meagre 0.3% research intensity as compared to 6-9% in developed countries. We should not forget the pressure and engagement in agriculture. During the period of intense waves of Covid-19, agriculture sector has shown positive result growth. Congratulations to the farmers, scientists and seed producers! Therefore, the emphasis should be to provide wholesome food security. This emphasis is possible firstly by introduction of agriculture education in school curriculum and actively incorporating discussions on agriculture as important as any discipline so that agriculture is included in STEM as STE(A)M.

On a lighter note, mere stem is of no purpose without the roots, leaves and people to use. India needed revamping of education system which was brought on by National Education Policy (NEP) in 2020. In terms of introduction of agriculture and its importance to primary education, exposure to secondary education and scientific understanding of sense of agriculture is currently in a dawdle state when we ponder on the immense role played by agriculture in diverse Indian economic sectors.While talking about NEP, our prime minister also emphasized on taking agriculture education in school level. According to Prime Minister Narendra Modi said that this would benefit firstly, by enhance the knowledge of agriculture in a scientific manner and further provides timely information to villagers.Never under look the role played by agriculture in achieving green revolution. It is a study of farm, field crops, machines and soil.In India there are currently 74state and central government funded agricultural universities including three universities under Department of Agriculture,

JUST AGRICULTURE
multidisciplinary e-Newsletter

Research and Education (MoA & FW). In Indian outlook, Indian Council of Agricultural Research (ICAR) is entrusted with upholding the quality of agriculture education besides its major mandate to "plan, undertake, coordinate and promote research and technology development for sustainable agriculture" among others. Each year thousands of students graduate from these universities after obtaining high quality education with specific reference to Indian agricultural and allied sector scenario. However, inculcating the importance of agriculture from school programs would significantly impact in understanding the community and environment in the original pristine ways in addition to acknowledging the economical footprints of the sector. There are other unforeseen benefits that could be acquired by such interventions: responsible consumption enhanced physical activity in the digital era, nutritional knowledge and even the survival skills too. The core benefit to arise would be, enhanced career choices revolving around farming sector, which should be cherished upon as we could less depend on projects like "Attracting and Retaining Youth in Agriculture" through KVKs, initiated by ICAR. The current revamp also demands that school teachers be well versed with basic concepts and minimum of scientific background of the respective agriculture and allied sectors. The three major e-learning portals: 'e-Krishi Shiksha', 'e-Granth' and 'CBP e-books' can provide impressive benefits for enthusiastic teachers.It is time to put agriculture into the STEM mix ensuring that it sits in school curriculum through mainstreaming of agriculture under NEP 2020.

In addition to educating students in schools, discussing agriculture in scientific community is an uncultivated necessity. Because, everything else can wait but not agriculture. The field is growing and has been quite extraordinarily outstanding relatively to other scientific fields. Impressive feats were achieved by agricultural science in India and the world. From a famine struck country, which once was ready to skip a meal a week only to feed all the hungry mouths of its inhabitants, India has risen to be a global leader in several sectors of agriculture. The genetically improved varieties developed by well collaborated and fool proof agricultural research system in India are the examples. Meeting the diverse 15 agro-climatic regions of India with well adapted consumer specific high yielding varieties in all the majorly consumed food grains is another noteworthy feat. Our scientific community has well utilized the rich germplasm and developed crop varieties worth celebrating. Biofortified varieties have been developed to sustainably alleviate malnutrition and 'hidden

JUST AGRICULTURE
multidisciplinary e-Newsletter

hunger' looming in the human-kind. In 2020, 17 biofortified varieties, rich in essential amino acids, micro nutrients and containing richer nutritional profile, of 8 crops were dedicated to the nation by the Prime Minister Shri Narendra Modi. Further, heat tolerant wheat variety HD-3385 is a perfect example arraying the heights of agricultural research of India. Already mentioned, Indian basmati is highly demanded throughout the world and the economic impact is highly pronounced. A promising strategy to combat weed associated yield loss was provided to rice farmers of India by developing varieties Pusa Basmati-1979 and Pusa Basmati-1985 containing mutated gene of acetohydroxy acid synthase, therefore conferring tolerance to spray of imidazolinone based broad spectrum herbicides. India is currently leading in developing triple biofortified maize varieties. These varieties are among thehighly efficacious and cost-effective approaches to meet UNs Sustainable Development Goals. The worldwide achievements of genetically improved varieties are the master feats of agricultural sciences. Pre-breeding approaches have well provided improved varieties with characteristically specific traits. The noteworthy examples are utilization of *SUB1* in rice for submergence tolerance, *Pstol1* and *Pup1* genes imparting better performance in rice through tolerance to phosphorus deficient conditions like acidic soils, and several disease resistant genes obtained into wheat through inter-specific crosses.

The transgenic approaches carry immeasurable scope and benefits to humans in developing crops for diverse needs. Recent improvements in the fate of genetically engineered crops in India express ambitious future for genetically modified crops. The genome edited alterations with the help of site directed nucleases are to be excluded from transgenic listings, unless a foreign DNA element template modification is reported in the modification. Therefore, the progressive developments in the regulations of SDN1 and SDN2 have paved bright future for our transgenic crops with specific consideration for inclusion of CRISPR/Cas9 based genome edited crops for the enhanced trait improvements in shorter spans. As our country ambitiously waits for the first commercial genetically modified crop, hopefully DMH-11, there are multipronged approaches to develop crops for diverse trait improvements in the pipeline. This provides hope that the regulatory discriminations would be put to end, and more emphasis would be paid towards the gene's function and effect, rather than the source and host, thereby anticipating for probable further developments in regulations placed on transgenics. The principal transgenic crops developed in soybean,

JUST AGRICULTURE
multidisciplinary e-Newsletter

cotton, maize and mustard are grown on over 120Mha of land worldwide. They have played very key roles in dimensions of economic, environmental and social sustainable developments in their respective growing countries.

Our very name "*Homo sapiens*" is derived from word 'humus', the decomposed organic matter in soil. Several cultural aspects are very associated with the conscious of good soil and its protection. Dr. Rattan Lal once quoted "if the health of soil goes down, the health of everything else goes down with it". The entry point to the end of human misery is soil health.The restoration of soil fertility and maintenance of healthy soil is more than ever important with the present population pressure on earth that demands for healthy food. Moreover,with adoption of better agricultural practices, soil has potential to sink thousands of giga tonnes of atmospheric carbon dioxide. These further emphases the need for quality agricultural education in schools itself and strong inclusion of agriculture in scientific discussions. Understanding of the basic concepts of soil and agronomy in countries like India with maximum of farmers involved in marginal farming, cultivated by marginal inputs can boost the marginal status of our farmers and make the development indeed sustainable. The genetically improved varieties are supported by the scientific approaches of agronomy and soil chemistry, to make them yield to their potential.

The importance of agriculture mechanization is not to be overlook on. Countries like India were able to have green revolution majorly because of high yielding varieties, better agronomic practices and revolutionary agriculture mechanization. Farm mechanization improved quality of products, removes farm drudgery, improves farmer livelihood and improves irrigation facilities.

Conclusion

The agriculture innovation network, Consultative Group for International Agricultural Research, is the largest groups of research organization aiming for betterment of humankind and food security. However, the world's agenda 2030 for all the sustainable goals are currently out of track. The goals of achieving zero hunger, ending poverty, mitigating climate change and obtaining land degradation neutrality by 2030 seem to be off track. They are off track due to ignorance of soil health, due to ignorance of incorporation of sense of food nutritional importance since childhood and due to negligence of agriculture policy interventions. Therefore, what we currently need is a serious commencement of application

JUST AGRICULTURE
multidisciplinary e-Newsletter

of scientific knowledge of "lab to farm and farm to food" approach through recognition of importance of agriculture and inclusion of the same into STEM, making it STEAM.