Emerging challenges in agriculture:

Need for restructuring agronomy education

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Agriculture has been facing frequent challenges since the inception of its practice by human beings. Ever-changing climate coupled with decreasing resource-use efficiencies and new-emerging biotic as well as abiotic stresses are posing enormous challenges in present-day agriculture. Combating all of these and making agriculture sustainable, agronomy research and education have immense importance. It is high time to restructure the present agronomy education considering all the emerging challenges in agriculture. Modern-day agronomy education should be reshaped keeping in mind the demand of climate-resilient as well as smart-agriculture, nano-technology, artificial intelligence in agriculture, system modeling, etc. Overall, the agronomy education should be constructed in such a way to make an agronomist confident enough in the innovation of cutting-edge technologies combating the current and emerging challenges in agriculture.

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AGRONOMY education, the backbone of agricultural education system, has got its immense importance since the inception of agricultural education. Looking back at the glorious past, it is evidenced that the agriculture especially the field management or agronomy was included in the curricula as one of the eighteen arts in the famous Nalanda and Takshila Universities. *Krishi Parashar'* written by sage Parashar also explained the importance of agronomy knowledge in agricultural education. Traditional knowledge in agriculture in India as well as practices were noteworthy and recommended by many eminent agricultural scientists and extension specialists. 'An Agricultural Testament', a notable literary work of the British botanist, Sir Albert Howard, father of organic farming, on his works on traditional agriculture at Pusa, Bengal (now in Samastipur, Bihar) during 1905–1924, has flaunted superiority of traditional Indian farming practices over conventional agriculture science of Europe. Agronomy as a major branch of agricultural education was started since the initiation of two years postgraduate diploma in Imperial Agricultural Research Institute (IARI); Associateship in 1923 from Imperial Agricultural Research Institute, Pusa on the recommendation of Royal Commission on Agriculture; In early 1930s, postgraduate diploma was further extended to M.Sc. and Ph.D; and Degree in Agriculture with specialized subjects. Afterwards, the agronomy education and research got its pace with the establishment of state agricultural universities on the Land Gant Pattern of USA as per the recommendation of Dr. S. Radhakrishnan commission and Indo-American study teams headed by Dr. K.R. Damale (1955) and Dr. N.S. Randhawa (1959). In 1960, the GoI appointed another agricultural university committee headed by Dr. Ralf W. Cummings from USA, prepared the blue-print and guidelines for agricultural universities in the states. With the establishment of universities in the states, the post-graduate studies on agronomy were also started subsequently with defined curriculum which was modified from time to time. The agronomy education also shares more than a quarter of the undergraduate syllabus with practical crop production which happens to be a unique feature of the UG course curriculum.

Emerging challenges in agriculture

Agriculture has been facing numerous challenges since the human being stared crop-cultivation. The challenges are never ending as the crop production is governed by millions of factors. Now-a-days, agriculture research and education is passing through a transitional phase demanding appropriate amalgamation of traditional knowledge with modern concepts to combat the current and future challenges. Some of the emerging challenges are ever-

changing climate, resurgence of biotic as well as abiotic stresses, soil quality with multiple nutrient deficiencies, poor resource-use-efficiencies, production of crop with stringent quality without losing the yield potential, high yield-gap in farmers' fields, etc. For combating these challenges, agronomy education as well as research needs to be reshaped.

Dimension shift in agronomy

Last few decades, the field management has advanced from ploughing the soil with a stone fitted on a tree-branch drawn by a horse to monitoring the entire field with artificial intelligence and drone technology. This clearly depicts widening of the dimension of agronomy during last couple of decades. In 21st century, agriculture in general and agronomy in particular faced lot of challenges like global food crisis and pest outbreaks, climate change which made food security more uncertain. The challenges further got aggravated due to steadily rising population and scarcities of water, land and a productive agricultural systems. Though agronomy today has made remarkable advances right in genetics to the tools for real time cropping system monitoring and things in between, the effectiveness of agronomy science will largely be determined by its continuous linkage with the end user and the dynamic technology surrounding that end user. It should not be surprising that at events today featuring the latest technologies, the greatest interest is on reliable knowledge on how those technologies can best be put to use in adding value to business, whether the business is a farm or an entity supporting farm. Many new tools like biotechnology, nano-technology, machine learning, etc. have got their massive importance in the advancement of agronomy research vis-à-vis education. Recently, climate change is one of the burgeoning issues in the agricultural sector. It is a big challenge to the scientists and the policy makers to develop a climate resilient agronomy under changing climatic scenario. So, current agronomy education must consider this aspect as well. Biotic stresses due to weeds, insect and diseases are highly responsible to reduce the crop yield. Better understanding of the science behind these stresses and development of their management strategies accordingly is also very much needful. Knowledge regarding management of agricultural waste to convert it as wealth is also crucial at this juncture. In the light of advancement, one must not overlook the goal of sustainable agricultural development. Any advancement must be nature and biodiversity conserving.

Agronomy in the quest of sustainability

Both academic and policy circles express concerns over the ability of current agricultural practices to ensure long-time productivity of farming systems and to sustain ecologically and socially sound development. Therefore, national and international policies constantly strive to find appropriate ways to promote the idea and praxis of sustainable agriculture (SA). Nevertheless, such a shift from conventional to alternative modes of agricultural production is knowledge-intensive and requires the opening of new spaces for agricultural knowledge and innovation. Thus, the development of appropriate knowledge co-evolution schemes among key actors emanates as a top priority for both academia and extension services. However, supplying farmers with technical knowledge is not sufficient to support transition towards sustainable farming. Agricultural professionals have to use tailor-made approaches that can help farmers increase their knowledge-generating potential. An agronomist's specialized knowledge and expertise makes them "too skilled" for conventional production systems but not skilled enough to confront with problems related with SA. As an interesting new stream of research has showed, such "hybrid learning configurations" can provide a novel setting for the development of trans-boundary and creative knowledge. This set of studies indicated that, to face the challenges imposed by the quest for sustainability, it is important to reorganize both agronomy education and training in order to provide agronomists with new sets of competencies.

Need of restructuring agronomy education

Relevant applied science, viewed through the filter of local experience, is the source of much of the valued knowledge for converting technology into solution. Science is most valued when it is closely linked to the people and place whose urgent problems need to be solved and who are in need of solutions. Developing and applying science based solutions to problems will keep our roots in reality. With this understanding, agronomy needs to be conditioned with the range of agro-ecological and socio-economical circumstances where farming takes place, for better factor productivity vis-à-vis synergies with ecology, environment and nature conservation to have sustainable and profitable production system. Thus, agronomy needs to be reoriented for future challenges, with changed agriculture scenarios like advent of new technologies of hybrid crops, indiscriminate and imbalance use of agrochemicals, volatile prices, and demand and supply problem of different crops together with ecological balance and nature conservation. Agronomy will also have to be broadening itself and need to be integrated with other disciplines like plant breeding, engineering, microbiology, biotechnology, sociology, economics and physiology to give farmers more profitable options and a higher place in the society.

Agronomists' responsibilities and requirements

Agronomists are scientists who are well-trained in studying, caring for and researching crops. They critically examine crops to determine how to fight diseases, nurture growth and improve quality. They are also intercessors for farmers and agricultural researchers. This means they act as a liaison during discussions about crop development, harvesting and distribution. Agronomists meet with researchers and review the results of agricultural tests and experiments. Then, they

take this information to local farmers and find ways to practically apply the research outputs. Agronomists can specialize in several different areas, including crop management, soil and water conservation, climate change research, sustainable development and research. Before becoming an agronomist, there are a few important requirements one should consider. First, agronomists are required to be formally educated in the field of agriculture. Agronomists must also be physically able to examine farms in a variety of environments and climates. Agronomists should also be skilled in communication, collaboration and critical thinking. An agronomist's specific duties will vary by job title but most can expect to:

- Conduct crop experiments in a lab,
- Meet with farmers to discuss possible farm improvements,
- Collaborate with other researchers to produce ideas for plant development,
- Solve problems related to planting, harvesting, storage and distribution,
- Determine methods for protecting plants from harsh weather or climate,
- Develop ideas for sustainable and environmentally conscious farming practices,
- Engineer methods for conserving and recycling water and other resources,
- Integrate knowledge of other disciplines/science for interactive intensive interdisciplinary research, on-farm assessment, refinement and dissemination of technologies.

Some tactical changes making agronomy education more germane

At this juncture, considering the multifaceted challenges in agriculture, there is a need of some tactical changes in agronomy education system. Some of these crucial tactics are included below:

- At undergraduate level, the fundamental knowledge as well as practical aspects of basic agronomy must be emphasised. Curriculum should be reoriented in this pattern.
- The practical crop production course needs to be redesigned considering innovative cropping system under challenging situation to make the new learners more acquainted with challenges in current agriculture and the dignity of the farmers.
- More experiential learning curriculum like organic farming, precision agriculture, digital farming, smart farming, integrated farming system, etc. should be included.
- At postgraduate level, the learners with basic knowledge on agronomy must be nurtured to make them agronomy innovators, thinkers and professionals. So, the advance knowledge with exposure to cutting-edge technologies must be provided at this level. Curriculum must be reoriented with recent advancements in agronomy in diverse ecologies of globe.
- Learners should be provided with student-exchange programme with advanced laboratories and institutes.
- Post-graduation agronomy education should be focussed on problem solving innovation. The analytical mind of the learners must be cultured by a teaching professional at postgraduate level. Students should be put into challenges concerning agronomy and they should be guided to overcome these challenges. This kind of experiential problem-solving learning during this level will make the learners more confident on subject.
- Assignment based study for higher level such as PhD, should be there for each and every agronomy course. Assignments must be focussed on the recent developments on the particular topic. Students must be encouraged to work as a team and in a multi-disciplinary mode.
- There should be some scope in the agronomy education system of postgraduate level for the students to participate in seminars, symposium, conferences, etc. which will brush up their knowledge.
- Agronomy education should focus on recent problems in agriculture such as sustainability issues under changing climatic scenario, lower resource vis-à-vis input use efficiency, climate change adaptation and mitigation, sustainable intensification, ecosystem services, ecological protection, food and nutritional security issues, etc.
- Agronomy education should be beyond harvest of crops, to post-harvest management.
- Smart agriculture is the need of the hour. Agronomy education should focus on it as well. Along with remote-sensing and geo-informatics, apposite importance should be given for learning some smart agricultural tools such as unmanned aerial vehicle (UAV), chatbot, robotics, sensor based study, artificial-intelligence, machine learning, big-data analysis, etc. in agronomy education.
- Present agronomy education should be re-casted in such a way that a graduate gains enough confidence for being an entrepreneur. The education policy should create some scope to facilitate the start-up for the enthusiastic learners.

SUMMARY

At the advent of numerous challenges in agriculture, it is high time to reshape the agronomy education. The agronomy education must provide enough exposure to the learners combating current and emerging challenges in agriculture. Education system should be restructured keeping the present day demand in agriculture with appropriate amalgamation of basic and applied knowledge. Case-study as well as problem-solving aptitude based curriculum must be given priority in agronomy education. This will make an agronomist confident enough to innovate cutting-edge technologies to combat emerging challenges in agriculture.

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