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COMMENTARY

Revisiting the science of agronomy: crop production versus crop management

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Addressing the emerging challenges of agriculture demands reorienting the agricultural education in general and agronomy education in particular. Crop husbandry has been evolving constantly, although academically and, for different operational purposes, agronomy science and academia have remained far more static than they should have been. This note emphasizes that the science of agronomy must include all the important aspects of crop management so that agronomists/students can attain better comprehension in wider perspective so that the goal of agronomy can be realized in the current context of changing crop husbandry.

Indian agriculture contributes to about 8% of the global agricultural gross domestic product (GDP) to support 18% of the world's population on only 11.3% of arable land and 2.3% of geographical area. Attainment of food security has been the major objective of Indian agriculturists since independence. India successfully achieved this goal by adopting green revolution technologies (GRTs). The country has attained more than a fivefold increase (50–265 million tonnes (Mt)) in food grain production, against a three and a half-fold rise in human population (360–1250 million) with per capita availability of food grains from 395 g/day in 1950 to 450 g/day in 2012. The gross irrigated area also increased from 22.5 to 91.5 million hectares during this period. Likewise, fertilizer consumption has increased several-fold since independence.

Consequently, India emerged as the second largest producer of food grains in world and has the potential to become the world leader, if the emerging challenges of agriculture are addressed through the reorientation of agricultural education in general and agronomy education in particular. On-farm crop husbandry has also experienced dynamic evolution, but academically the science and academics of agronomy have remained largely unadapted. Therefore, here we argue for revisiting the academic and functional parlance of agronomy in the context of the functional repercussions of modern agricultural technologies.

Challenges of modern agriculture

Though GRTs helped India become food secure, they are also blamed for severely damaging farm production resources. The degradation of natural resources like land and water has now become the key constraint in augmenting agricultural production. The yield plateaus and new-generation problems of soils are considered the silent ill-effects of overexploiting the resources. The soil has become sick for sustaining food production and the environment has turned unsafe for human health. The widely emerging problems in agriculture have been empirically documented and discussed at several forums. Some of the more notable ones are listed below for a better understanding and to help us realign our mindset to achieve the future goals.

- The soil quality is poor with multiple nutrient deficiencies and low organic carbon content due to intensive cultivation and use of indiscriminate amounts of fertilizers.
- The water table is critical in most irrigated lands, and water quality is also deteriorating due to the leaching of salts and pollutants.
- The overexploitation of irrigation water has lowered the depth of the water table.
- The indiscriminate use of insecticides has caused a resurgence with no satisfactory control of pests; for instance, *Helicoverpa armigera* on cotton and pigeon pea, and tolerance to the chemical toxicity of the herbicide isoproturon on the wheat weed *Phalaris minor* and butachlor on wrinkle grass in rice.
- Chemical residues in food have increased the incidence of several diseases/disorders among farmers in particular and consumers in general.

Apart from the above, there is growing concern about the consequences of climate change for food security, as projections indicate that the demand for food grains will increase to 345 Mt by 2030, for which food grain production has to be increased at a rate of 5.5 Mt annually. There are several other examples also which challenge the modern technology and demands a change as well as an upgrade of human intelligence for searching the alternate options while keeping all the issues in mind. In view of the above, there is a need for re-inventing agronomy education, as this prime discipline is known for its contributions to the cause of science and society. There is a need to redefine agronomy, which reflects the discipline as a whole and may help develop competent resource persons to foster the next generation of leaders and professionals required to address these challenges.

Defining agronomy: existing trends

The word 'agronomy' is derived from two Greek words, 'agros' meaning 'field' and 'nomos' meaning 'to manage'. Literally, agronomy is the 'art of managing a field'. Whereas technically, it is the 'science and economics of crop production by management of farm land'. Scientists have defined agronomy as that branch of agricultural science dealing with the principles and practices of crop production and field management. 'Agronomy is the science and technology of producing and using plants for food, fuel, fibre and land reclamation. Agronomy has come to encompass work in the areas of plant genetics, plant physiology, meteorology and soil science. It applies a combination of sciences like biology, chemistry, economics, ecology, earth science and genetics.'[1] Agronomy is also defined as 'a branch of agriculture dealing with field-crop production and soil management'[2]. According to Norman[3], agronomy is 'The science of manipulating the crop environment complex with dual aims of improving agricultural productivity and gaining a degree of understanding of the process involved.' Jain[4] has defined agronomy as 'Sustainable management of natural resources and increased efficiency of production inputs'.

Shifting the paradigm: from 'crop production' to 'crop management'

Considering the above emerging issues arising in modern agriculture in the last few decades, Tripathi[5] defined agronomy as the 'branch of agricultural science which deals with the principles and practices of crop production for obtaining maximum economic production from a particular field in one agriculture year without impairing the fertility of soil'. Jain[4] further suggested that agronomy is not only a science of 'crop production' but also a science of 'crop management'. However, his above proposal lacked discussion of various possible academic dimensions of crop maagement[4]. As building theory or definition of any subject mainly has the antecedents of dynamism of related events documenting their records and establishing the empirical relations among them, therefore, in the context of the above-delineated facts of modern agriculture, the definition of agronomy as the 'science of crop production' may be restructured as 'Agronomy is that branch of agricultural science which deals with the principles and practices of crop management for obtaining maximum economic production from a particular field in one agriculture year without impairing the fertility of the soil and adversely affecting the eco-system.'

This modern definition of agronomy will fulfil the holistic aim of any agronomist in the present changing scenario. Principles of agronomy deal with scientific facts in relation to the environment in which the crops are grown. Knowledge of such basic principles helps in modifying the controllable environmental factors of crop production for realizing the production potential of crops. Sound knowledge of agronomic principles and practices aids agronomists in realizing maximum yields at minimum cost in one agriculture year without degrading soil fertility and the environment.

Conclusion

Among all the branches of agriculture, agronomy occupies a pivotal position and is regarded as the mother or primary branch. It is an integrated and applied aspect of different disciplines of pure sciences. Agronomy has three clear branches, namely (i) crop science, (ii) soil science and (iii) environmental science that deal only with applied aspects, i.e. soil–crop–environmental relationship. Sound knowledge of agronomic principles and ways to perform farm operations skillfully help agricultural scientists realize maximum yields at relatively low cost without deteriorating soil fertility and endangering the environment. The modern definition of agronomy includes all the important aspects of crop management, through which agronomists and students could attain better comprehension from a wider perspective so that the goal of agronomy may be achieved in a real sense in the current context.

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