National Agricultural Education Day Lecture IARI
New Delhi, November 13, 2014

Agricultural Education in India: Imaging Possibilities to Meet Challenges in the Changing World

Anupam Varma
Adjunct Professor, Indian Agricultural Research Institute, New Delhi

Honourable Chief Guest Shri B. N. Navalawala, Madam Director Dr. Mrs. Ravinder Kaur, Dean Dr. Rakesh Jain, Joint Director Dr. Vinod Prabhu, distinguished staff, faculty and students of IARI, distinguished guests, ladies and gentlemen, I feel greatly honoured to be invited to deliver the prestigious National Agricultural Education Day Lecture, and pay tribute to a great son of India, Dr. Maulana Azad, who laid the foundation of school and higher education in the country as the First Minister of Education of independent India.

Source: Indian Council of Cultural Relations

Maulana Abdul Kalam Muhiyuddin Ahmed, popularly known by his pen-name Maulana Azad, was born in Mecca on November 11, 1888. He was a man of many facets — scholar, poet, journalist, a natural leader and linguist shown by the ability to communicate in Arabic, English, Urdu, Hindi, Persian and Bengali. He was a devout nationalist. His philosophy and thoughts can be best summed up in his own words, "It was India's historic destiny that many human races and cultures

should flow to her, finding a home in her hospitable soil, and that many a caravan should find rest here…. Our languages, our poetry, our literature, our culture, our art, our dress, our manners and customs… everything bears the stamp of our joint endeavour…. we have now become an Indian nation, united and indivisible. No fantasy or artificial scheming to separate and divide can break this unity". (Presidential Address, Indian National Congress, Ramgarh, 1940). He was one of the key founders of the first Indian Institute of Technology (IIT), Kharagpur, in 1951, and the University Grants Commission, New Delhi, in 1953. Let us join hands to pay tribute to this great leader of ideas and ideals, who laid foundation for multi-level education in the country.

Growth of Indian Agriculture

Over five thousand tears of agricultural development helped India in developing a strong base for traditional farming systems, such as the cereal-legume rotation system for maintaining sustainability of land and stability in production. But, organized agricultural research systems in India was initiated with the establishment of a camel and ox-breeding farm at Karnal in 1829, the agricultural college and research station at Coimbatore in 1868, a bacteriological research laboratory for veterinary science in Poona in 1889 and the Imperial Agricultural Research Institute (IARI) in 1905 at Pusa. IARI started building trained human resource, but the overall organized effort in capacity building for agricultural research, education and extension (AGREE) received limited attention during the pre-independence period. AGREE received a much greater attention during the post- independence period, which helped in ushering the famous 'Green Revolution', turning the country from a state of acute food shortage to that of a food surplus state. It is considered to be the greatest achievement of mankind since the advent of agriculture.

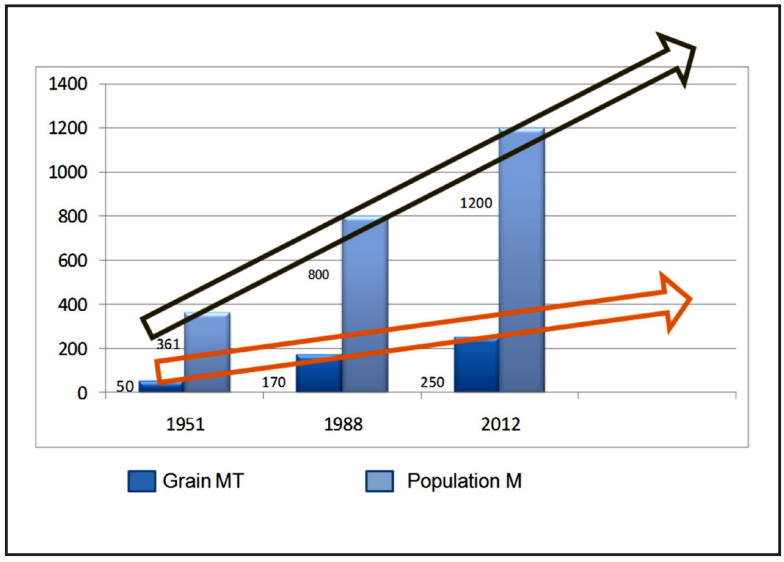

Fig. 1: Growth in grain production and population

The major contributing factor in achieving the phenomenal increase in agricultural production was the research input in providing improved technologies. The increased food production has helped the country in meeting the demands of the swelling population which increased from 361 million in 1951 to nearly 1200 million in 2012 (Fig. 1). However, high levels of poverty, food insecurity and malnutrition pose a serious concern and challenge. Current population is estimated to be 1.27 billion, which is expected to cross 1.5 billion mark by 2030, making India the most populous country.

In 2013, India ranked 136th out of 186 countries in the UNDP Human Development Index and 94th out of 119 countries in the Global Hunger Index. The National Food Security Act (NFSA) passed in 2013 is expected to correct the imbalance. It is an enormous challenge, as the demand for food will grow not only to meet the requirements of NFSA, but also due to increase in consumption with increasing incomes.

Indian agriculture has registered impressive growth rate in recent years. Year 2012 has been a landmark, when India exported $20 billion worth more than the imports of agricultural commodities and India became the largest exporter of rice (exporting 10.5 million tons), and buffalo-beef, and became one of the largest producer of poultry, eggs and milk. India has shown the path of integrating milk and crop production, which has helped in improving the income of a large number of marginal farmers. Ownership of a few cows also means a supply of manure for improving soil health. The national agricultural research, education and extension system (NAREES) , played a key role in this remarkable development. However, the challenges ahead are enormous. NAREES has to play a much greater role to keep pace with the ever growing demand for food, in the backdrop of emerging challenges in the changing world. This requires imaging possibilities for NAREES to develop human resource equipped to find practical solutions to the emerging challenges of Indian agriculture.

Major Challenges

Declining Land Productivity

Soil degradation is a major concern. Loss of soil from erosion, soil degradation due to mismanagement and conversion of agricultural land to non-agricultural uses, adversely impact agricultural production, but do not get the required attention. Available estimates reveal that nearly 120.72 million ha of land in thecountry is degraded due to soil erosion and about 8.4 million ha is affected by salinity and water-logging. Besides, huge quantities of nutrients are lost during crop production cycle. Improvement in soil health is essential to maintain the desired growth rate in agriculture. Country also needs to increase the area under irrigation to bridge the gap in crop productivity (Table 1).

Table 1 Productivity (tones/ha) of paddy and wheat in selected countries in 2012

Crop	World	India	China	Indonesia	USA
Paddy	4.39	3.59	6.74	5.14	-
Wheat	3.12	3.17	5.00	-	3.11

Source: FAO, ROAP, Bangkok

Global Warming Associated Changes

Projections that by the end of this century, global earth temperature is likely to increase by 1.8o to 4.0°C is a matter of great concern, requiring urgent action to check the factors leading to global warming, which will adversely affect crop yields in most of the tropical and sub-tropical regions due to decreased water availability, and increase in pests and diseases. Increase in green-house gases (GHG) is expected to affect crops differently in different regions. In the Indian sub-continent it is expected to considerably reduce crop yields. India appears to be one of the major contributors of GHG emissions from agriculture (Fig 2). It needs to be checked.

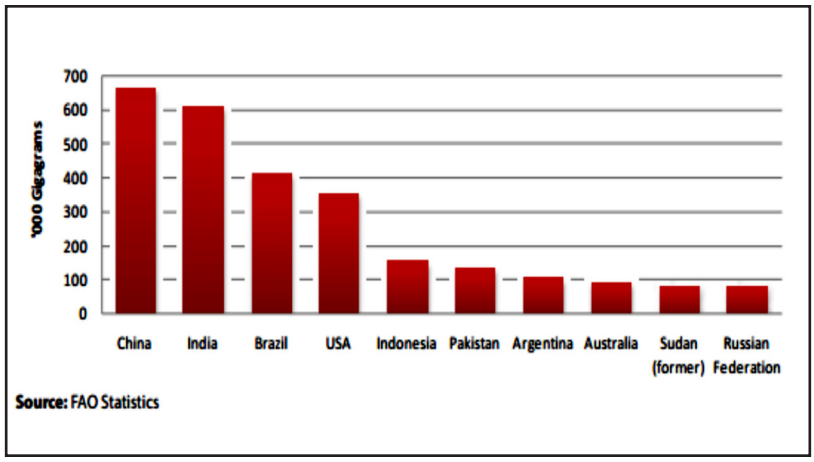

Fig. 2: GHG Emissions from Agriculture Sector in major countries in 2010

Evolution of Agricultural Education in India

Agriculture has evolved in India over thousands of years, and early agricultural practices are well documented *Upanishads* and *Vedas.* However, there was no formal system for agricultural education until 1877, when the first Agricultural College was established at Saidapet, which later shifted to Coimbatore. In some other parts of the country agricultural education started as a part of engineering colleges like the Bengal Engineering College (then known as Civil Engineering College), Shivpur which started agricultural education as the formal curriculum in 1898. It was only in the beginning of the 20th Century, the need of formal agricultural research and education on a larger scale was realized with the establishment Imperial Agricultural Research Institute (IARI) at Pusa, in 1905, where the agricultural education programme of the Civil Engineering College, Shivpur, had shifted a year earlier. Pusa, situated in the heart of Indo-Gangetic plains in North Bihar, was selected as it is one of the richest agro-ecological regions of the world. Establishment of IARI in 1905, was followed by the establishment of colleges at Kanpur, Nagpur, Lyallpur and Coimbatore in 1906, Pune in 1907 and Sabour in 1908.

Right from its inception, IARI has been developing trained manpower for the country, and training officers of the Departments of Agriculture. High demand for such trainings led to the start of formal training courses leading to two years Diploma of Associateship of IARI from 1923 to 1957. The Associteship of IARI was recognized as equivalent to the M.Sc. degree of Indian Universities by the Ministry of Education in 1949. The Associates of IARI became the backbone of the National Agricultural Research System (NARS). The Institute shifted to its present location in New Delhi in 1936, and it was renamed as Indian Agricultural Research Institute (IARI) in 1947.

Immediately, after the independence in 1947, the Government of India formed the University Education Commission under the Chairmanship of Dr. S. Radhakrishnan, who identified agricultural education as a major issue, and recommended establishment of 'Rural Universities' (S. Radhakrishanan, 1949). Located in rural settings, the Rural Universities were to consist of a ring of small residential undergraduate colleges with specialized main University, for post-graduate education at the Centre. The Rural Universities were proposed to be autonomous and free to develop their own programmes, syllabuses, curricula, and regulations to teach all subjects, including literature, history, philosophy, psychology, social sciences, mathematics and the natural sciences. The concept of rural University was very similar to the Land Grant Colleges. Subsequently, two joint Indo-American Teams of

Agricultural Research Education (1954-55 and 1959-60) also endorsed the recommendation of the University Education Commission and suggested establishment of Agricultural Universities in various States of the Country on the pattern of the Land Grant Colleges of the USA.

In 1958, the University Grants Commission accorded the status of a Deemed to be University to IARI, to impart post graduate education leading to M.Sc. and Ph.D. degrees. This was the beginning of reorganization and modernization of higher agricultural education in the country. The newly established Post Graduate School of IARI, developed regulations with the objectives of (a) integrating teaching, research and extension, (b) promoting multi-disciplinary team work, (c) introducing flexible course credit system with continuous internal evaluation, (d) promoting organizational and operational autonomy, and (e) working towards the philosophy of service to society by solving social and economic problems, particularly of rural India.

The first State Agricultural University (SAU) was established in 1960 at Pantnagar, as UP was the only State which developed a blue-print to establish an SAU on 16000 acre Government farm (the Tarai State Farm). Government agreed to the setting up of the Agricultural University at Pantnagar only as an experimental measure. Soon, new SAUs were established at Bhubaneshwar (1962) and Ludhiana (1962), Hyderabad (1964), Jabalpur (1964), Bangalore (1065), and others. Today there are 66 universities/institutions imparting agricultural education in the country (Fig 3).

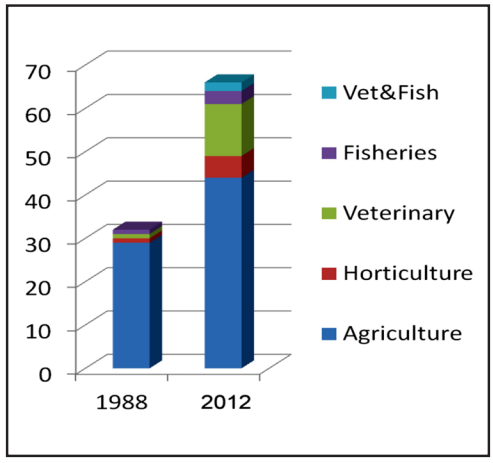

Fig. 3: Agricultural Universities in India: Changing pattern; in 1988 the country had 32 agricultural universities (SAU – 26; Deemed to be University – 03; Central University with Agril. faculty – 03), the number swelled to 65 in 2012 (CAU- 01; SAU – 55; Deemed to be University – 05; Central University with Agril. faculty – 04)

The salient features of the SAUs are: (a) integration of teaching, research and extension functions at all levels, (b) course-credit pattern of education with continuous internal evaluation, (c) teaching through constituent colleges with no provision for affiliated colleges, (d) organizational and operational autonomy, and other features related to overall improvement in social and economic conditions of rural areas. Later the Education Commission (1964-66) recommended establishment of at least one Agricultural University in each State. The Indian Council of Agricultural Research developed a Model in 1966 which could be adopted with such changes as were deemed necessary by the newly developed Agricultural University.

Evolution of Land-Grant Univiersities (LGUs) in the USA followed a similar trend. Some universities/colleges existed for over a century, for example Rutgers University (1766) and University of Georgia (1784), before the Morrill Act (1862) was passed to establish LGUs. Each State was

granted 30,000 acres (12,140 ha) federal land, which were sold and proceeds used to establish one or more schools to teach 'agriculture and mechanic art' to build scientifically trained technicians and agriculturists. In contrast to the growing 'specialized' SAUs, almost all the LGUs are multi-faculty universities. For example, University of California, Davis, besides college of agriculture, has a college of biological sciences, college of engineering, college of medicine, college of veterinary medicine, college of social sciences and humanities, school of business management and a law school. However, college of agriculture is pre-eminent. It has three divisions – agricultural sciences, environmental sciences and human sciences, and each division is supported by disciplinary departments (Khush, 2014).

There is no system in place, which could judge the performance of SAUs. In 2014, TNAU was the best SAU at 74 position followed by IARI at 138 position and HAU at 254 position amongst the Indian Universities in the Web Ranking, whereas NTU Ranking of world Universities, among the top 300 universities only IARI was represented at 210 position based on quality of publications and their citations (Table 2). ICAR has instituted a prestigious award to encourage one SAU/DU every year, to encourage agricultural education. It is good to see that IARI has found a place in World Ranking. We need a larger representation of Agricultural Universities in World Ranking.

Table 2. Top Eleven Agricultural Universities in India 2014

Institute/University	Rank Indian University Web Ranking*	Rank National University#
Tamil Nadu Agricultural University	74	
Indian Agricultural Research Institute	138	210
CS Haryana Agricultural University	254	
Assam Agricultural University	260	
University of Agricultural Sciences, Dharwad	268	
Kerala Veterinary and Animal Sciences University	278	
Orisa University of Agriculture and Technology	293	
YS Parmar University of Horticulture and Forestry	294	
Rajasthan Agricultural University, Bikaner	301	
Veterinary and Animal Sciences University, Ludhiana	303	
Indian Veterinary Institute	304	

*: Indian Universities ranking, based on teaching, research, knowledge transfer and international outlook; #: World University ranking based on publications

Students' Perception of Teaching in SAUs

Several concerns have been expressed for declining quality of agricultural graduates. Major concern are depleted faculty strength, lack of manpower in frontier areas, inadequate hands-on skills and lack of research experience (Kumar *et al.*, 2014). The SAUs also have a serious problem of inbreeding as nearly 51% of faculty members have their all degrees from the same university in which they are teaching (Ayyappan and Arunachalam, 2014). In 2013, I did an in-house exercise of seeking the opinion of IARI students, about quality of teaching in the SAUs at graduation and post graduation

level (Fig 4). The trend needs to be reversed. The students also frankly expressed their views about the improvements they would like make in the curricula and teaching.

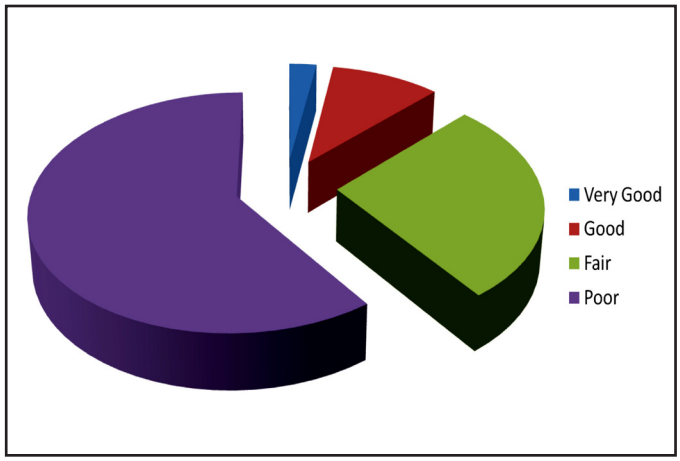

Fig. 4: Evaluation of overall teaching quality at the undergraduate level by a selected group of students from 14 SAUs

Graduate Courses

- Curriculum needs complete change
- Basic sciences – Physics, Chemistry & Biology should be compulsory
- Introduce 'case studies'
- Introduce internship
- Teachers should have exclusive responsibility to teach, and no research
- Principles courses should be taught by senior faculty
- Greater emphasis to concepts
- Must provide background reading materials
- Teachers Must update their knowledge
- Periodic external assessment Some disciplines better than the others
- Periodic external assessment
- Improve teaching skills
- Inadequate use of black board
- Introduce feed back after each class, to judge the knowledge gained
- Teaching should be interactive, and allow discussion
- Emphasis on learning and understanding, not on memorization
- Elective courses
  - Should be re-introduced
- Infrastructure
  - Improve library facilities

Practical Classes

- Neglected in most of the SAUs
- Should be taken by experts
- Provide illustrated compendia
- Create interest in practical through creative exercises, like preparation of models
- Practical classes should be held in proper laboratories and fields.
- Perform field experiments in actual farmer's fields
- In examinations students should be tested for understanding the basic concepts behind experiments
- Field visits
- Attention should be given to each student
- Need more time for lab work and field experience
- Inadequate facilities
- Need for at least one molecular biology lab

Extension

- Limited farm visits and interaction with the farmers
- Greater emphasis should be given on field demonstrations with the participation of students
- Mostly a part of RAWE (Rural Agriculture Work Experience) programme
- RAWE programmes should begin with the cropping season
- The time of RAWE should be at least 6 months
  - RAWE should not be only in the last semester as at that time students have to devote more time to course work
- Extension teachers should have contacts with a large number of farmers, so that one student is assigned interaction with one farmer.
- Attach the students to a village
- Provide one acre of arable land to each student, to grow crops.

Post-graduate courses

- ***Faculty***
  - Need to update regularly; many teachers refer to very few books
  - Should be strong in basic and practical knowledge
  - Advanced topics should not be skipped
- ***Pedagogy***
  - Provide in depth knowledge
  - Discourage power point based teaching
  - Power-point may be used judiciously, as a support to black board teaching
  - Encourage black-board teaching
  - Teachers should desist from providing notes downloaded from the internet without any change

- ***Practicals***
  - Generally neglected.
  - Teachers should be motivated to take interest in practical classes.
  - Develop practical exercises directed at solving problems; taking local problems.
  - Enough time should be provided so that results of experiments are seen.
  - Connect practical classes with research problems to make them more interesting.
  - Need to introduce field experience.
  - Introduce survey for learning practical problems.
  - Basic and advanced techniques, through hands-on experience, and not mere demonstration.
  - Organize excursions.
- ***Research***
  - The guides should be able to guide.
  - Course load should be reduced, to allow more time for research.
  - Insufficient time for research in MSc, it should be integrated with PhD programme.
  - It should be on a well directed novel problem, rather than simple routine research.
  - Improve facilities.
  - The problem should be field oriented.
  - The labs should be adequately equipped.
  - Introduce credit hours.

Imaging Agricultural Education

The views expressed by the students are sufficient to make a change. ICAR has taken several initiatives to address to concerns expressed by the students. However India is changing and so should the agricultural education. New India does not want to be trapped in the past. Today we need skills, not just degrees, with the ability to assimilate, adapt, apply and develop new technologies. Today we need high quality agricultural graduates equipped with problem solving and creative skills and ability to think and improve productivity of agricultural sector. Apart from the technical and generic skills, our graduates need leadership and entrepreneurial skills to build leading teams, and put innovations into practice and respond to competitive environments. I am happy that recently the country is giving priority to improve agricultural education.

The theme of the XI Agricultural Science Congress of the National Academy of Agricultural Sciences in Bhubaneswar, 7-9 February, 2013 was Transforming Agricultural Education for Reshaping India's Future. The Congress emphasized the need for creation of a world-class agricultural system (Singh, 2014). The ICAR Vision 2030, also emphasized the need to strengthen and streamline higher agricultural education system to enhance quality of human resource in agri-supply chain to meet the future challenges through cutting-edge science and technology.

I am sure we can make a change. We need to reimage the possibilities. Twenty five years ago, when I analyzed the 'human resource development and its utilization in the country' (Varma, 1989), the number of sanctioned posts of scientists in the ICAR system was same as now, and it appears to have come down in the SAUs (Table 3), while the number of ICAR institutions and SAUs has more

Table 3: Sanctioned posts in ICAR and SAUs

Organisation	Sanctioned posts	
	1988	2012
Scientists (ICAR)	6,458	6,470
Scientists (SAUs)	19,646	16,000*
Technical (ICAR)	7,362	6,635
Administrative (ICAR)	5,233	4,886

*: IASRI Database

than doubled during the same period. Obviously, we are short of faculty in the SAUs. Can we reverse the multiplication of SAUs and re-merge, an fulfill the need to build world-class SAUs. It is doable. For example, during the second half of the last century agricultural research institutes proliferated in the Netherlands, with overlapping mandates and activities. A bold step was taken 1997 to merge various institutions and establish 3rd Generation world class Wageningen University and Research Centre (WUR). It was established on a participatory model of "knowledge creation, replacing the traditional ... system", with a mission "to explore the potential of nature and improve the quality of life". WUR maintains high quality through a system of internationally peer reviewed graduate schools, which guaranties the quality of Ph.D. research and teaching, and also faculty performance. (Rudy Rabbinge, 2014).

The country has experimented with semester and trimester system. Generally it is agreed that the trimester system is better than the semester system. Several years ago I suggested 'modular system' of teaching (Varma, 1989), and also experimented that in a couple disciplines at IARI. Recently it was also introduced for the first batch of M.Sc. Agronomy students of the Afghan National Agricultural Sciences and Technology University (ANASTU) at IARI, with the help of Dr. R.K. Jain, Dr. K.S. Rana and other colleagues. It was a very satisfying and successful experience. The Modular System of Teaching helps in improving learning through hands-on experience. It is based on the concept of one credit for one week of teaching; the students are attached to the teacher for full time. The response from the students was very good. The only requirement is the total commitment of time of the teachers!! This system will resolve most of the issues raised by the students.

There is a need to build Centres of Excellence for agricultural education and research. The country needs at least four more IARIs, located in the east, south, west and central India, by by restructuring some of the major ICAR Institutes to cater the need of developing human resource for cutting-edge research. For example, IIHR, Bangalore can be re-designated as IARI, Bangalore. It should then start post-graduate teaching in all disciplines of agriculture. I understand there are plans to establish *de-novo* IARI-like institutions. It needs reconsideration.

There is an urgent need to provide practical field experience to our graduates. This can be best achieved by making provision in the curriculum for internship of about one year during graduation. The internship could be in the form of attachment to private companies and/or allocating time to practice agriculture in villages. This will help the students in gaining maturity. The villages which are being adopted by the Members of Parliament across the country could provide a good opportunity for students, if a formal system of attachment is put in place, to not only apply the latest technologies in field situations but also to learn the practical difficulties for which they could find solutions.

At the post-graduate level international exposure of 4 to 6 months will provide valuable experience of working in advanced laboratories and developing long-term interactions. This will also help in developing leadership to be able to lead changes and build capacity to address the emerging challenges.

These are just some thoughts to make a change. The path for rejuvenation is obvious. Let us hope for a more vibrant agricultural education system in the coming years.

I warmly thank Dr. (Mrs.) Ravinder Kaur for giving me this opportunity to share some thoughts with our dear colleagues and students on this auspicious occasion. At the end, let me quote Gandhi ji:

"Be the change you want to see in the world"