Educating Future Agricultural Scientists and Academicians in India*

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I. Abstract

In addition to meeting the food demand of India and its increasingly affluent population, agriculture in India must also address many of today's major challenges such as climate change, water pollution and scarcity, dwindling biodiversity, degrading soils and increasing energy demand, urbanization and brick making, use of traditional biofuels, and sanitation. As an enterprise, agriculture must provide raw materials for agribusiness and industry and address regulatory issues while raising the profile of the agricultural profession. Thus, agricultural curricula should be flexible, cross-disciplinary, demand-driven, provide skills through hands-on training and promote entrepreneurship. Rather than exam-centric, the curricula must be learning-centric, with emphasis on self-study, group studies, assignments and case studies. Similar to the land grant institutions (LGIs) of the USA, state agricultural universities (SAUs) must also have a strong linkage between research, education and extension. The complementary research program must be characterized by originality, objectivity, accuracy, conservatism, reductionism, moral-neutrality, accountability, relevance, output/productivity-based and team-building approach. The private sector must play an important role in research and development and in the curricula development. Basic principles of LGIs (e.g., openness, accessibility, competitiveness, productivity-based, evaluation of teachers' performance and service to people) are extremely pertinent to SAUs. Nonetheless, the LGI system must be appropriately adapted to the Indian conditions and to the specific needs of a highly diverse society.

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II. State-of-the Agriculture in India

India has a total area of 329 million hectare (Mha) and land area of 297 Mha, or 2.4% of the world's land area. India's population of 1.22 billion (17.4% of the world's population) lives in 5,100 towns and 380 urban agglomerations. The population growth rate is 1.4% per annum, and 31% of the population is under 14. Agricultural production has increased drastically, especially since the 1960s, with the onset of the Green Revolution. Food grain production increased from ~50 million tons (Mt) in 1950-51 to 257 Mt in 2011-2012 (Table 1) by a factor of 5.14 (Ahmed and Haseen, 2012; FAO, 2011). Therefore, the per capita food production increased by 56% over a period of six decades, a commendable achievement. However, there is no cause for complacency, because even greater challenges lie ahead.

Food production may have to be increased drastically because the population may be 1.69-1.8 billion by 2050 and 1.85 to 2.18 billion by 2100. The problem is severe because of: (i) change in dietary preferences towards more animal-based food, (ii) decline in arable land because of conversion to non-agricultural uses such as urbanization, infrastructure (i.e., highways, airports, industry, shopping malls), (iii) reduction in agronomic production because of abrupt climate change, extreme events, and soil degradation, and (iv) diversion of land and/or grains to biofuels. Despite the increasing trends in productivity of crops between 1970 and 2011, great yields of major crops in India are lower than the attainable potential, and considerably below the maximum yields obtained in other countries (Table 2). Thus, agriculture in India has a long road ahead to realize its full potential. Therefore, these and other challenges warrant creation of a world class agricultural research, extension and education program based on strong links among these three components. Education plays a specific role in addressing these challenges. Therefore, the objective of this article is to discuss the importance and need for an improved, relevant, demand-driven, and mission-oriented agricultural education system in India.

III. Attributes of a High Impact Agricultural University

A university is an institution of scholars and facilities organized for developing new knowledge, teaching and outreach. A university must challenge faculty and students to be original, creative and innovative. It is the standard of undergraduate and graduate education which makes the difference between a mediocre and a first rate university. Inter- or a cross-disciplinary program is an important attribute of a first rate university. A scientist who has rarely been outside his/her field of specialization is not prepared to assess the importance of an isolated observation of great significance. Thus, learning mathematics, physics, chemistry, biology, genetics, sociology, economics, theology and other basic sciences is essential to research and education in agriculture. Students must be taught the importance of both basic and applied research. The former is a reservoir of knowledge to be drawn later, and the latter is the information to be made use of immediately. A university must also prepare its students to differentiate between knowledge and wisdom. Knowledge is accumulated through lectures, laboratories, research experiments, brain storming sessions, etc. Wisdom is the common sense to apply that knowledge appropriately. Wisdom involves reasoning out the answers from known facts. Teaching wisdom is a big challenge. Students must understand the difference between “a test” and “an experiment”. A test ends when the hypothesis is verified; an experiment ends when new truth comes forth. Access to good library facilities is essential to synthesize the knowns, identify known unknowns and hypothesize unknowns. In an era of rapid advances, as much as 90% of the scientific literature available today may not have existed even a decade ago. Therefore, graduate students must be trained in reviewing the literature, in synthesizing the knowledge, and in identifying researchable issues.

In the context of South Asia in general, and India in particular, agricultural science and technology must alleviate drudgery and the risks from farming operations, introduce labor saving devices, develop appropriate tools for women farmers, and elevate the status of farming.

Despite the commendable achievements of the “Green Revolution”, students must be taught that the new revolution begins with each class. If we are not sure whether to plow or not, puddle and flood the rice or not, grow crops with the BT gene or not, use dung for cooking or as a soil amendment or not, design tools exclusively suited for women farmers or not, the revolution has not yet begun.

Yet, agricultural science, like any other, must not become arrogant and all-knowing. It must be environment-friendly and ingrained in high morals and ethical standards.

Students must be taught that agricultural scientists will always be humble with the vast unknown waiting to be discovered, including the readings of theology, philosophy and spiritualism which must be intricately linked with the scientific knowledge. Above all, agricultural scientists must not be detached from the society that pays them. They must care for the well-being of the community and strengthen warmth in human relationships. Indeed, agricultural scientists must also work with the popular press and create headlines, and even flirt with sensationalism, up to a limit. Agricultural scientists must go back to nature for a reality check because agriculture must be compatible with nature and ecosystem health. While being creative thinkers, agricultural scientists must be incredulous, inquiring and inquisitive about ecosystems and the environment.

Most state agricultural universities (SAUs) are focused on applied agricultural research and testing programs (varietal testing, dates and rate studies). It is understood that many site-specific problems of practical nature need a rapid response. However, agriculture is a science, industry and also an important business. Thus, it must be profitable to practitioners, the ecosystem in which it is practiced and the planet Earth. Thus, SAUs must participate more fully in both fundamental and basic research. Some of the applied problems in agriculture in India await answering by laws of basic science. Thus, there is a need to develop a good a balance between the two.

IV. Recognition and Respectability of Agricultural Profession

Public image of agricultural scientists and professionals must be improved. At present, SAUs are not the first choice of the best and the brightest students, nor is farming the choice of young and aspiring entrepreneurs. This trend must be rectified.

Respectability and recognition of agricultural science by SAUs and other Indian Council of Agricultural Research (ICAR) institutions can be enhanced by following ten tenets:

1. **Originality** in thinking and problem identification is needed to become a scientist rather than a follower. It is always important to use brains especially when budgets are low. Thus, researchers must be thinkers rather than equipment users,
2. **Objectivity** is necessary to being impersonal, impartial and detached in interpreting the results and looking at data without wearing tinted glasses,

3. **<u>Accuracy</u>** in making observations is essential by being a skeptic in supporting evidence and facts, and avoiding speculations,
4. **<u>Conservatism</u>** in implications and scaling up pays dividends,
5. **<u>Reductionism</u>** by minimizing generalizations from site specific testing is important,
6. **<u>Moral neutrality</u>** by not involving questions of right and wrong is an essential pre-requisite,
7. **<u>Accountability</u>** is critical because agricultural educators and researchers must never forget that no one is indispensable, everyone is answerable to the public, and pay back to the farming community that supports them is essential. To be accountable, a faculty member cannot do what he/she wants with little or no obligation,
8. **<u>Relevance</u>** to the needs of the society, developing a demand-driven research and academic program, and regarding farmer as the boss are crucial,
9. **<u>Output-based,</u>** mission-oriented and problem-solving approach is indispensable, and
10. **<u>Team building</u>** and collegiality are required through cooperation of many minds because no scientist is an island.

Integrity in scientific research and academic institutions is crucial to originality and objectivity. It includes research misconduct such as plagiarism and faking data (Kaiser, 2002). Integrity must be imbedded in the curriculum. In search of excellence in teaching, evaluation of teaching by students is another important aspect of improving agricultural education in India. A system which takes student achievements into account in various ways comprises a different way of doing the business.

Similar to other sciences, agricultural science is not merely an intellectual conviction, it is a **way of life**. Thus, agricultural curricula must prepare students to feel it, deeply believe in it, and experience it even during their dreams. The way of life is not confined to strict office hours, it is experienced with every breath inhaled and exhaled. Researcher and teachers must be taught work ethics and be prepared for dedication towards responsibility and commitment. Their job neither has an 8 to 5 punch clock nor a 5-day work week. Similar to riding a bicycle, to avoid a serious fall or rust out, agricultural scientists must be continuously pedaling. Walking at the same speed as others perpetuates stagnation and mediocrity. One must run to get ahead, and maintain the tempo in perpetuity.

V. Agricultural Education in India

India has been a land of knowledge and wisdom for millennia. However, access to knowledge was limited to a select strata of society. Being a secular state and its constitution guaranteeing access to education for all, the challenge lies in meeting the needs of the vast diversity of its citizens. India is comprised of more than 2,000 ethnic groups, which speak 22 official languages (with scripts) and 200 overall languages and some 2,600 dialects. Towards an earnest effort to making education accessible to all its citizens, India has created a vast and a modern education system, which is the largest education system in the world. It is comprised of 378 universities, 864 colleges, 0.5 million faculty, and 14 million enrollment. Agricultural colleges and universities are an important component of this vast education system.

Formal agricultural education began with the establishment of an agricultural school in 1877 at Saidapet in the then Madras province (now Tamil Nadu). Organized agricultural education was started during the first decade of the 20th century through the establishment of four colleges in 1905 (Kanpur, Lyallpur, Coimbatore and Nagpur) and two in 1907 (Pune and Sabour-Bihar). The degree program started in early 1920s, and had a total of 17 agricultural colleges at the time of independence in 1947. At present, there are 71 agricultural colleges with 5,452 candidates enrolled in each university annually (ICAR, 2007). The University Education Commission, established in 1949 and chaired by Dr. S. Radhakrishnan, recommended the establishment of rural universities on the patterns of the land grant institutions (LGIs) in the USA. (See also Section X).

VI. Factors Affecting Quality of Agricultural Education in India

The education system of SAUs has vast potential for improvement. The system has numerous constraints including decreasing funds, declining number of faculty and proliferation and bifurcation for political rather than scientific/technical reasons. The system is plagued by in-breeding and lack of reward system and incentivization.

Even more serious problems than those listed above are:

i.) **Unaccountability**,

ii.) **Irrelevant curricula** to changing realities (e.g., globalization, intellectual property rights, linkages with industry),

iii.) **Insensitivity** to market-oriented demands and needs of private investors,

iv.) **Inflexibility** in choice of courses,

v.) **Obsolete** teaching methods,

vi.) **Lack of competition** among peers for public and private funds,

vii.) **No peer or student evaluation** of teaching, and

viii.) **Inbreeding** with little faculty and students recruitment from outside the state.

The teaching methods are **exam-centric** rather than **learning-centric**. The emphasis is on teacher completing the syllabus rather than students learning the concepts and skills. In a learning-centric approach, the focus is on self-study, group-study, assignment, case-studies, and hands-on projects.

In addition, there are problems with motivation, low morale and lack of incentives. The system is held back because of:

- **Poor reward systems,** which are based on seniority rather than on performance and productivity,
- **Low social acceptance** and lack of professional recognition,
- **Ineffective** and **poor governance**,
- **Political interference**,
- **Lack of transparency**,
- **Provincialism**, and
- **Favoritism**.

VII. The Land Grant System in the USA

A land grant college or university is an institution that has been designated by its state legislature or U.S. Congress to receive the benefits of the Morrill Act. A series of acts were enacted to create LGIs (Table 3). The Morrill Act, signed by President

Abraham Lincoln on July 2, 1862, funded educational institutions by granting federally controlled land to the states for them to develop or sell to raise funds to establish and endow “land grant colleges.” The mission of the LGIs has been “to teach agriculture science, military tactics and mechanical arts as well as classical studies so members of working classes could obtain a liberal practical education that had a direct relevance to their daily lives, as a response to the industrial revolution and changing social class, and to engage youth in experimental learning though 4-H program.” Iowa was the first state to accept the law on September 11, 1862 and start the State Agricultural College (now Iowa State University). The Hatch Act of 1887 appropriated federal grant funds to each state for establishing an Agricultural Experiment Station in connection with the LGI in the state. However, federal funds must be matched by the state. The Smith-Lever Act of 1914 created a “Cooperative Extension Service” associated with each LGI to disseminate information gleaned from the Agricultural Experiment Station. The Act also authorized federal support for the Extension Service, but similar to the Hatch Act, it also required states to provide matching funds.

The Morrill Act of 1890 was signed to extend access to higher education by providing additional endowments for all LGIs, but prohibiting distribution of money to states that made a distinction of race in admissions. A total of 70 colleges and universities evolved under this Act and are known as the 1890 LGIs.

States that provided a separate LGI for blacks in each of the then segregated states were eligible to receive the funds. Rather than Hatch or Smith-Lever Funds, 1890 LGIs receive support through the Evans-Allens program. The Fulbright Act of 1946 (Public Law 584) was aimed at enabling Americans to study and teach abroad.

Similar to 1890 LGIs, the 1994 LGIs created 29 American tribal colleges. These colleges provide access to education for all native tribes in the USA. Along the patterns of LGIs, other initiatives include the Sea-Grant colleges (1980), Space-Grant colleges (1988), and Urban/Sun-Grant colleges (2003).

The United States Department of Agriculture (USDA) has played a crucial role in LGIs. It administers federal grant funds, and coordinates land grant activities at the national level. The Extension Service of USDA administers the Smith-Lever funding in liaison with the Cooperative Extension Service.

Most LGIs have been transformed into large public universities that today offer a full spectrum of educational opportunities. Consequently, millions of students, both domestic and international, are able to study every academic discipline and explore fields of inquiry beyond the scope envisioned in the original mission of LGIs.

Among major strengths of LGIs are: openness, accessibility, competitiveness, review-based grant funding, teaching evaluation by student and peer and service to people.

The system believes that a college degree is not a sign that its holder is a finished product but an indication that a person is prepared for life. The LGI system is strengthened by a healthy competition for grant funds. Competition is a painful process but essential to achieving excellence. It promotes wisdom in knowing what to do next, and accentuates virtue in doing it. Evaluation of teaching by peers and students is another important component of LGIs. Student achievements and job placements of alumni are also pertinent to improving education standards of LGIs.

VIII. Alleviating Constraints of Agricultural Education in India

Common recommendations of improving the education system at SAUs include:

- **Developing** a mechanism to upgrade the curricula on a regular basis through periodic (3-5 year) reviews,
- **Strengthening** the link between teaching, research and extension,
- **Reducing** the time lapse between research, education and extension,
- **Enhancing** entrepreneurship through developing linkages with agro-business, international trade, etc.,
- **Making** curricula rural-realistic and farmer-centric, and
- **Incorporating** both basic sciences and human dimensions in the curricula.

The drastic increase in global agricultural production since the 1970s has occurred because of strong investments in research and extension, including those from the private sector (Piesse and Thirtle, 2012). Funding basic agricultural research is a major challenge, even in the U.S. and other developed countries (Danforth, 2006). Yet, basic research (e.g., in biology, pedology, hydrology, biogeochemistry, genetics, climatology, pest management, post harvest technology) is essential to increasing land productivity and to preserving natural resources. Globally, private investments in food and agricultural research increased from US $14 billion in 1994 to about $19 billion in 2007 (Fuglie et al., 2012).

In India, however, there has been a decline in crop yield in some regions or slowdown in the rate of growth of total production since about the mid-1990s. Global challenges of the 21st century require a strong and symbiotic combination of science and innovation, thus, variable and diverse funding sources are important to improve science (Elder, 2012). There exists a strong need for strengthening linkages between SAUs and the private sector to promote investment in research and development. Developing linkages with industry must be duly incorporated in the curricula.

IX. Towards Improving the Curricula: "STREAM-Lining ICAR"

The agricultural enterprise of the 21st century, and especially in the era of globalization, is a complex undertaking. It is affecting, and is affected by, a multitude of interacting factors (Fig. 1). As a business, the agricultural enterprise is influenced by complex interaction among a series of stakeholders ranging from farmers and scientists to retailers, grocers and risk managers. In turn, the enterprise must be so managed to be restorative, eco-ethical and knowledge-based so that it is conscious of its impact on the environment and C/H_2O/N/energy footprint and the related regulatory issues. Both research and education must play a pivotal role in promoting this crucial enterprise. The research must be innovative (I), cutting edge (C), anticipatory (A), and rewarding (R) – ICAR. Research and education funds must be provided on a competitive grant basis. Healthy competition among peers is essential to developing a high-class program. Similarly, education must be strategic (S), transferring skills (T), resource (human) enhancing (R), effective in teaching (E), agricultural-profile raising (A) and managerial-skill promoting (M) – STREAM. Thus, agricultural curricula must be developed on the principle of "STREAM-Lining ICAR".

The education systems at SAUs must be broad-based, flexible and accessible to all. It must teach knowledge, skills and entrepreneurship. The competency development in agricultural education (Ghadei et al., 2011) is important to prepare graduates for the complexities outlined in Fig. 1. This is especially important because agriculture is a cause and solution towards major global challenges of the 21st century

(NAS, 2011). Thus, demand-oriented curriculum to improve relevance of SAUs requires reforms, investments in staff training (including overseas training) and educational infrastructures and increase in the quality and diversity (beyond the state borders) of staff and faculty (Maguire, 2012). Rather than partitioning and proliferating (i.e., separating veterinary and animal sciences from agriculture), it is important to promote and strengthen inter-disciplinarity. Agricultural research and education must be a cross-disciplinary program based on concepts and methods taken from diverse disciplines (Vale et al., 2012). The importance of post harvest technology cannot be over-emphasized in view of the several million tons of wheat rotting when stored outside every year (Parsai, 2012), while millions are starving (Bhardwaj, 2012, a, b, c; Das, 2012). People begging for food in front of a rotting pyramid of wheat is an indication of a system gone wrong but no one seems to care.

X. Adapting the Land Grant System into SAUs

Development of an education program in India started in 1877, but was accelerated after independence (Table 4). In 1949, Dr. S. Radhakrishnan, Chair of the University Education Commission, recommended the creation of rural universities on the patterns of LGIs. Thus, the first joint Indo-American Team chaired by Dr. K.R. Damle was established in 1955 on the advice of Dr. Frank Parker and Dr. I.H.W. Hannah. The second joint Indo-American Team was chaired by Dr. M.S. Randhawa in 1959, and the Agricultural University Committee was chaired by Dr. Ralph W. Cummings, Sr. in 1960. The second committee chaired by Dr. M. S. Randhawa recommended that each agricultural university must:

(i) be autonomous,
(ii) have agriculture, veterinary, animal husbandry, home science, technological and science colleges located on the same campus,
(iii) offer composite courses, and
(iv) integrate education, research and extension.

These recommendations are precisely along the principles of LGIs. Therefore several LGIs were involved in establishing SAUs in India (Table 5).

India is endowed with an abundance of natural resources. With a wide range of soils, waters and climates, India should be a breadbasket of the world. Properly managed (biophysically, socially, ethically and politically) soil and water resources of the Indo-Gangetic Plains (from Amritsar to Calcutta) can surpass the productivity of the Cerrados of Brazil, Corn Belt of the U.S., and the HHH Plains of China. Herein lies the challenge of SAUs and ICAR, because a scarcity of all basic needs persists in every walk of life. For example, Mawsynram, near Cherrapunji in the northwestern region, receives the world's highest rainfall (~1.25m/yr). However, it also frequently suffers from a shortage of water during the non-rainy season every year. The country as a whole faces the problem of flood-drought syndrome. The great rivers of India (Ganges and Brahmaputra) have contributed through flood- drought syndrome, to the miseries of their worshippers. There is no justification why the population of resource-rich river systems must be perpetually subject to poverty and misery year after year. Sustainable management of natural resources must be a key course taught at all SAUs within the ICAR system.

Indian agriculture is at a crossroads, and is challenged by a serious trilemma (Table 6). The challenging trilemma is driven by the increase in population at the rate of 30/minute, which will make India the most populous country of the world by 2020. Escalating demands of increasing and growingly affluent population are adversely impacting natural resources. Accelerated soil erosion is estimated at 38-152g/soil/ha/minute, water withdrawal for irrigation depleting the aquifers is 1.5 million m^3/minute. There are 8.25 new vehicles produced every minute, and CO_2-C emission is estimated at 1075 t/minute. Despite impressive and revolutionary gains in agricultural production, the death from hunger in India is estimated at 5/minute.

The world is familiar with Gandhi's seven sins of humanity:

- Wealth without work,
- Pleasure without conscience,
- Knowledge without character,
- Commerce without morality,
- Politics without principle,
- Religion without sacrifice, and
- Science without humanity.

If Gandhi were alive today and faced with the trilemma outlined in Table 6, along with millions of tons of grain rotting annually while 236 million are starving, he may have expanded the list of sins by including the followings:

- Technology without wisdom,
- Humanity without conscience, and
- Education without relevance.

Above all, integrity, as an ethical issue (refer to Section IV), must go beyond a casual discussion. Integrity programs must be part of the standard for accreditation.

In view of the vast importance of agriculture, this subject occupies an astonishingly marginal place in the thinking of growing middle class and the elite segment of the Indian population. In addition to mentoring graduate students in becoming excellent researchers, efforts must also be given to mentoring them as future educators. Faculty discussions on curricula are often limited to who teaches/covers what, rather than to planning what students must know prior to entering the job market (Goldsmith, 2002).

There are seven I's of improving the curricula at SAUs:

1. Institutions,
2. Infrastructure,
3. Incentives,
4. Innovations,
5. Information technology,
6. Inputs, and
7. Indigenization.

While adoption of the basic principles of LGIs is pertinent, it is important that the LGI system is adapted to the specific needs of a highly diverse society, complex physiography, and a broad range of biomes and ecosystems. The importance of indigenization through adaptation is highlighted by the dialogue between an Indian Chief and Benjamin Franklin:

> "But you, who are wise, must know that different nations have different conceptions of things; and you will not therefore take amiss, if our ideas

> of this kind of education happen not to be the same with yours. We have had some experiences of it; several of our young people were formerly brought up at the colleges of the northern provinces; they were instructed in all your sciences; but when they came back to us they were bad runners, ignorant of every means of living in the woods, unable to bear either cold or hunger, knew neither how to build a cabin, take a deer, nor kill an enemy, spoke our language imperfectly, were therefore neither fit for hunters, warriors, nor counselors; they were totally good for nothing" (CIC 1968)

X. Conclusions

There is a strong need to improve research, extension and education in SAUs and other agricultural institutions in India. The system must be relevant, competitive, peer-reviewed, demand-driven and world class based on originality, innovativeness, and integrity. Adoption of the basic concepts of LGIs (openness, accessibility, competitive, subject to review and service to people) is appropriate, but must be fine-tuned to the specific needs of India. Funding must be based on competitive grant proposals. Faculty (in research, education, and extension) must be rewarded on the basis of merit and productivity rather than seniority. In addition to support from public funds, research and education must also be supported by private investments. Thus, there must be close linkages with industry and agro-business. Entrepreneurship and managerial skills must be integral to agricultural curricula.

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TABLES

Table 1. Trends of food grain production in India over 60 years (Das, 2012; Ahmed and Haseen, 2012; FAO, 2011).

Year	Production (10^6Mg/yr)
1950-51	50.8
1960-61	82.0
1970-71	108.4
1980-81	129.6
1990-91	176.4
2000-2001	196.8
2011-2012	257
Potential	550

Table 2. Trends in grain yields in India over 40 years and comparison with World's Highest Yields (http://en.wikipedia.org/wiki/Agriculture_in_India)

	Grain Yield (kg/ha)			World High Yield	
Crop	**1970-71**	**1990-91**	**2010-11**	**kg/ha**	**Country**
Rice	1,123	1,740	2,240	10,800	Australia
Wheat	1,307	2,281	2,938	8,900	Holland
Pulses	524	578	689	2,800	China
Oilseeds	579	771	1,325	-	
Sugarcane	48,322	65,395	68,596	125,000	Peru
Tea	1,182	1,652	1,669	-	
Cotton	106	225	510 (1,600)	4,600	Israel

Table 3. Evolution of the Land Grant System in USA

Year	Act	Initiated by
1862	Morrill Act	Rep. Justin Smith Morrill (VT)
1887	Hatch Act	Sen. William Hatch (MO)
1890	Second Morrill Act	Evans-Allen Act (1977)
1914	Smith-Lever Act	Sen. Hoke Smith (GA)
		Rep. A.F. Lever (SC)
1946	Fulbright Act	Sen. J. William Fulbright
1994	Tribal Colleges Endowment Fund	Congress authorized support to certain Native American colleges as LGIs

Table 4. Historical Evolution of Agricultural Education in India

Year	Established	Leaders
1877	Saidapet, Madras	
1905	Kanpur, Lyallpur, Coimbatore, Nagpur	
1907	Pune, Sabour (Bihar)	
1920s	Degree program started at 6 colleges	
1947	17 agricultural colleges	
1949	Established “rural universities”	Dr. S. Radhakrishnan
1955-56	1st Joint Indo-American Team	Dr. K. R. Damle (Chair)
1959	2nd Joint Indo-American Team	Dr. M.S. Randhawa (Chair)
1960	Agricultural University Committee	Dr. Ralph W. Cummings, Sr.
2007	71 agricultural colleges	

Table 5. Indo-U.S. collaboration in establishment of SAUs with support from LGIs (Read, 1974).

U.S. University	SAU	Year
1. University of Illinois	G.B. Pant University of Agriculture & Technology, Pant Nagar, Uttar Pradesh	1960
2. The Ohio State University	Punjab Agricultural University, Ludhiana (Haryana & Himachal Pradesh), Punjab, Rajasthan	1962
3. University of Missouri	Orissa University of Agriculture & Technology, Bhubaneswar, Odisha	1962
4. Kansas State University	Andhra Pradesh Agricultural University, Hyderabad, Andhra Pradesh	1964
5. Tennessee	University of Agricultural Sciences, Bangalore, Karnataka	1964
6. Penn State	Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra	1968

Table 6. Trilemma of India - Dynamics per Minute

Dynamic	Per Minute
Population increase	30
Environmental impact	
Soil erosion	38-152g soil/ha
Water withdrawal	1.5 million m^3
Net virtual water import	0.07 million m^3
Vehicles produced	8.25
CO_2-C emission	1075 t
NPK consumption	32
Tons of wheat grain rotting	40
Brick making from top soil	0.08-0.10 ha
Food Insecurity	
Death from hunger	5
Female deaths	3.8

FIGURES

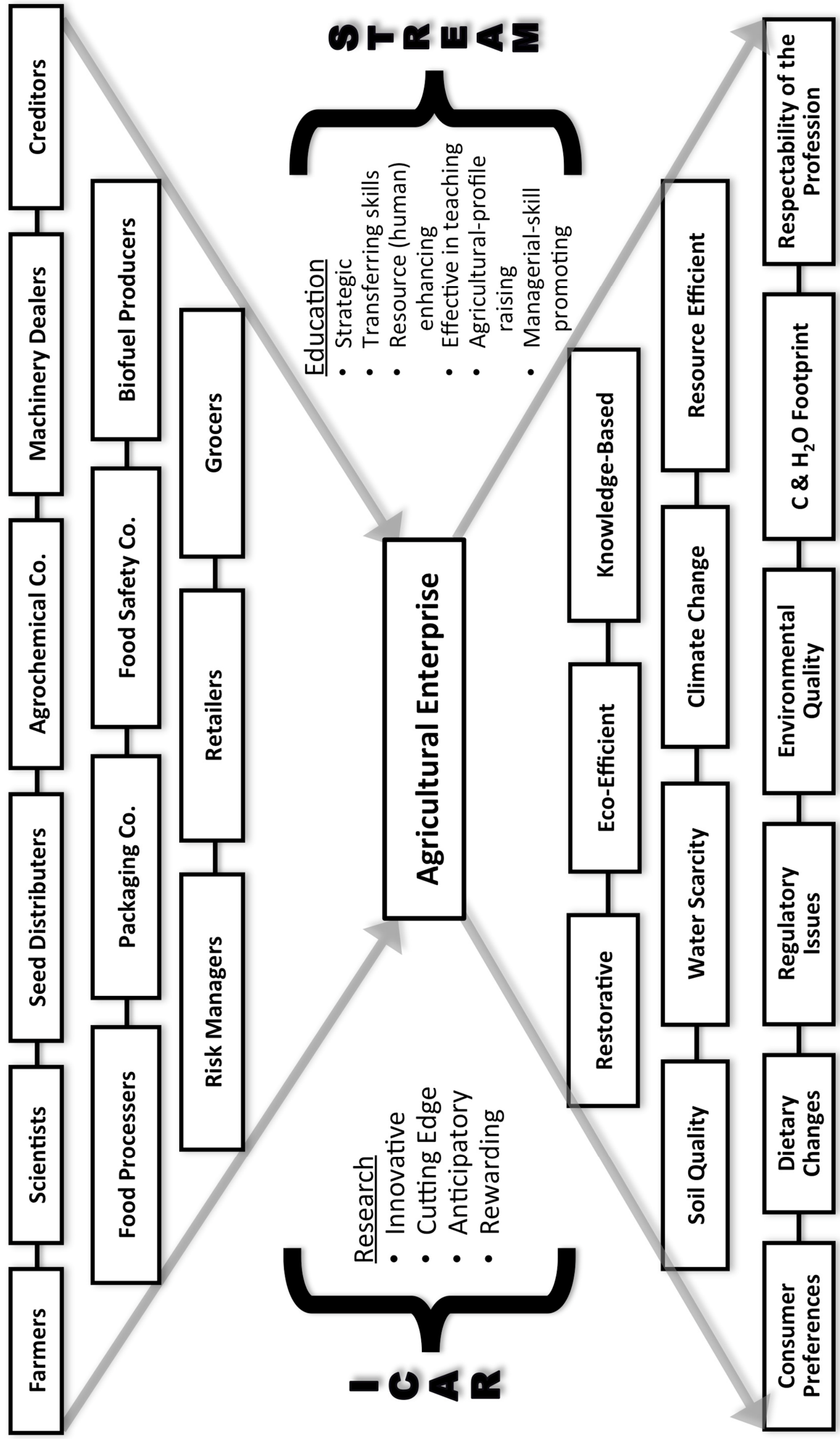

Figure 1: Complex realities of agricultural enterprise require innovations in research and education.