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"Agricultural Education: New Competencies and Innovations for future"

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Agricultural Education: New Competencies and Innovations for Future

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Introduction

Agriculture is the basis for human existence. Hence, knowing about agriculture is not just meant to be a career path, but it's for the way of life. Creating knowledge and experience and fostering growth and development are two ideas that are ingrained in the definition of education, which is how agricultural education may be defined as the process of educating a person to become a useful and respectable member of society. The design of agricultural education will have to be strengthened toward developing professionals, with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies, and with the consciousness of crucial issues of reducing profitability and/or productivity but expanding. The competence and performance of the actors of the system are the key factors determining the quality of any educational programme. The domain of agricultural education has undergone many changes with the blend of technology and the needs of life. This paradigm shift has significant stress on the professional development of the educational system, to stay relevant to the ever-evolving needs. With the changing forms of expectations of agriculture, a corresponding change in the competencies of agricultural education. The future is looking for

innovative and timely competencies and skills. It is not only just about the skills in field practices but, acquiring the skills for problem-solving, creative thinking and decision-making. Competencies are required more in communities that are becoming more varied and interconnected, and in economies where the effect of new technology necessitates greater levels of ability and human understanding.

Agricultural Education in India: Where is the Gap Existing?

The National Commission on Famers Report (2006) observed that the agricultural education grid of the nation has produced a large number of talented graduates and post-graduates, but over 40 per cent of the farm graduates are unemployed. The mismatch between employment and education may be assumed partly to the following weaknesses in the education system:

- Lack of desired responsiveness to the changing scenario and temporal needs, especially in the Home Science
- Lack of competence, confidence and entrepreneurial ability
- Paucity of required upgradation, competence and skill development opportunities
- Inflexible, mismatch between theory and practice leading to the lack of risk bearing capacity and confidence
- Lack of adequate updating and modernisation of curricula and resources.
- Recalcitrance to broaden the base of education for agriculture.

Skill development is important especially for the knowledge-based precision agriculture

- Strengthening education and skill building need the attention of both the Government as well as the private sector in association with the academia. Isolation of education (even training) from the ground realities is the basic flaw of the Indian system.
- A serious mismatch is observed between the needs of the modern agriculture and the availability of skilled manpower. In spite of surplus graduates in general agriculture, deficits were witnessed in post-harvest management, agro-processing, value addition, packaging, marketing, veterinary care, integrated management of pests and diseases, handling of bio-agents and application of quality standards.
- If Indian agriculture has to grow at around 4 per cent per annum, it will be necessary for the education and training system to produce at least 100,000 technically-skilled people every year.
- Notwithstanding the need for an analytical analysis and estimation of number, quality and discipline-wise requirement of trained and educated agricultural experts and preparing the necessary roadmap to achieve the target.
- As we move up the technology ladder and begin to produce modern products in greater volumes and provide efficient services, particularly in the fast expanding private sector, qualitative growth in skilled manpower is essential.

With the periodical change in agricultural scenario, its needs to assess the challenges and issues in the agricultural education system. This will help to revamp the system. The challenges needs to be assess from various dimensions.

1. Less demand for Agriculture Education and Low Gross Enrolment Ratio (GER)

The number of applications for under-graduate agricultural courses has grown dramatically in recent years, although there were only approximately 85 applicants for each seat at the under-graduate level in 2019-20 — far less than for medical courses, where there are about 50,000 candidates for each seat. Furthermore, the All India Survey on Higher Education (AISHE) report for 2018-19 shows that the gross enrolment ratio for higher education in India is 26.3 percent, but it is just 0.03 percent for agricultural education, showing that there is still a long way to go (All India Survey on Higher Education (AISHE) Report, 2018-19.). Along with that, low priority to agricultural education as a career option and rising unemployment and poor employability of the graduates (43% of undergraduates and 25% of post-graduates) being unemployed. (Umesh, S. 2020). The all India placement status of agriculture graduates during 2011 to 2015 varied between 19.3 to 24.0 %. This shows a low placement of agricultural graduates after completion of their education. (Vijayakumar 2017)

2. Lack of Infrastructure and Workforce

Access to adequate infrastructure can improve quality of education for the students. Inadequate state funding and lack of modern infrastructure for education and research needs prior consideration (Jibran, Shahid & Mufti, Azra. 2019).

The competency strength of the faculty is very well connected with the improvement of agricultural education. But our system suffers reduced faculty strength, and inadequate faculty development programmes (Varma, 2014). Since the faculty is involved in the research, there is poor balance between teaching and research to fill the gap in the teaching quality. The non availability of suitable human recourses became a challenges for the achievement of Sustainable Development Goals. The limited refresher training and faculty improvement affected the competency of emerging areas of the subject.

3. Mushrooming of Private Agriculture Institutions

According to Dr. R.S. Paroda Committee Report (2019), the recent proliferation of private colleges and universities is incompatible with the objectives and purposes established for modern agriculture education. These institutions recruit academically substandard students to enrol in various courses and charge them expensive fees that are disproportional to the infrastructure and quality of education they provide (Landscape of Higher Agricultural Education in India, 2020)

4. Challenges with the Curricula

- Disconnect among agricultural education, employment, and industries' requirements: There exists a skill gap in what recruiters want and what students possess. And that is due to the gap in teaching to make students to improve the entrepreneurial skills
- Uncertainty and unstructured system of Periodic external assessment in different universities
- Lack of elective courses
- Unbalance in the orientation for theory and real time practical exposure
- Lack of connection between practical classes with field and farmer oriented research problems
- Insufficient time for M.Sc. Research programme
- Poor inclusion of basic sciences in agricultural curricula

5. Challenges with the Policy development

- Absence of national policies that regulate trainings and reforms education. The funds kept aside for imparting agricultural trainings.
- Accreditation system of agricultural institutions needs to be consider the quality research and training.
- Low access of rural students, especially to the tribal and socially-deprived communities
- Inadequate and declining investment and financial resources in agricultural universities/ colleges and allocation of private agricultural colleges without proper resources for students. In most of the affiliated private colleges, students lack proper infrastructural facilities

such as, Equipped labs, Libraries and filed for practical orientation

- Indifference to the needs especially women students, scientists and farmers, and increasing irrelevance of home science colleges and curricula
- Separation from global opportunities and inadequate internalization of pertinent global trends and developments.
- There is no inter-departmental coordination between agricultural universities and institutes. The research that happening in the universities and other research institutions of NARS is not well coordinated hence it contributes to wastage of money, manpower and less impact.

Action Plan for Future

The Government had announced the introduction of agricultural education at middle school level in the National Education Policy 2020 (NEP).

The framework of the **National Education Policy 2020 (NEP**) regarding Agricultural Education:

1. Need to revive agricultural education with allied disciplines by rewarding innovative research and market-based extension linked to technology & practice
2. Design of agricultural education to shift towards professionalization including sharpening use of local and traditional knowledge, emerging technologies to solve systemic issues of land productivity, climate change, food sufficiency etc.

3. Universities must offer doctoral and master's programs in emerging core technology areas integrating other promising technologies, such as machine learning, artificial intelligence, virtual and augmented learning.
4. Targeted training must also be offered in "low-expertise" tasks for supporting the Artificial Intelligence value chain.
5. Increased impetus on grants for independent innovation & research
6. Liaising with National Research Fund (NRF) to bolster, reward and award student research efforts.
7. Stress on "holistic and multidisciplinary education" – students would be given the flexibility to choose multidisciplinary subjects with "multiple exit options" and appropriate 'certification' during the course tenure.
8. Credit bank of academic progress would be developed to keep track of the credits earned during the course tenure.
9. Strengthening of Digital Infrastructure across Higher Education Institutes would be done to include e-content, digital library etc to meet the learning needs of students
10. Increase access, equity and inclusion of students through online education and Open Distance Learning (ODL).
11. Focus on setting-up incubation centers, greater industry-academia linkages.
12. UG degree would either be 3 or 4 years long with multiple exit options with appropriate certifications.
13. Two years master's program paired with 3 years UG program; 1 year PG with 4-year UG program; 5 years integrated.

ICAR recommendations regarding the Implementation Strategy for National Education Policy 2020 in Agricultural Education System

University giving emphasis on research with thrust on Post Graduate academic program would be categorized as Research intensive University. Present Agriculture Universities giving greater emphasis to teaching but with significant research program can be categorized as Education and Research Universities or Research Intensive Universities. Institutions/ Universities/ College with main focus on teaching, are to be categorized as Education focussed Institutions. The degree-granting Colleges will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that.

Eliminating "Affiliation system" in the Universities and Colleges:

1. Converting Deemed Universities of ICAR into Multidisciplinary Education and Research Universities
2. Further, the UG programme fulfils the following recommendations of the NEP-2020:
    - Four-year bachelor's degree programme
    - Choice based credit system
    - Integration of entrepreneurship in academic programme
3. Restructure the 4 year degree program as one year certificate course and two year diploma course to be offered in a university
4. The NEP-2020 provides for facilitating easy change of institutions/ credit transfers for those students aspiring to move between institutions within India and abroad

- Need to develop a single window system for international students by each university
- ICAR-NARES makes provision for allowing universities to start Dual degree, integrated and sandwich programmes with national and international universities/organizations.

5. Faculty Development by balancing the teaching time for improving the interaction with students
    - Faculty may be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material, assignments and assessments
6. Curbing Commercialization of Education
    - All Higher Education Institutions - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education
    - It recommends the allotment of students to private institutions through AIEEA conducted by NTA/ICAR on the same lines of allotment to public institutions
7. Market-based extension linked to technologies and practices
    - The institutions offering agricultural education must benefit the local community directly for sustainable progress of agriculture and entrepreneurship development; one approach could be to set up Incubation Centres/Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies
    - Linkage with KVK in technology production

(Source: Implementation Strategy for National Education Policy-2020 in Agricultural Education System. 2021. www.icar.org)

Restructuring of Agricultural Education in India: The Way Forward

1. Developing human resource requirement of the fast transforming, knowledge-intensive agriculture sector

- It requires restructuring of agricultural curriculum by including courses/modules on the latest / cutting-edge technologies like; 5G Internet, Blockchain Technology, Closed Ecological Systems, Cultured/In-Vitro Meat, Digital Twinning, Farm Management Apps, Genetic Modification, Livestock Biometrics, Precision Agriculture Sensors, Rapid Iterative Selective Breeding (RISB), Satellite Imaging, Synthetic Biology, and Unmanned Aerial Vehicles (UAVs). (King *et.al.,* 2019).
- It is important to include teaching, Science, Technology, Engineering, and Mathematics (STEM) in Agricultural education to build professional experts in the sector (King *et.al.,* 2019).
- Using modern IT tools in the educational process and equipping all graduates with competence in using them for information search and exchange, system modelling and optimization, software development for agricultural production, storage and marketing activities.
- Specialisation and student choice courses for preparing the students in expert in any technology/ subject.

2. **Strategies for improving the research in agricultural education**

- There is a need to encourage socially responsible research with meaningful outcomes to suit the changing rural economic landscape, aligning with the Sustainable Development Goals (SDGs). This calls for an enhanced investment on agricultural education and R&D. Repurposing budgetary allocation for agriculture and re-prioritisation of R&D portfolio of the government, to attain the committed level of investing at least 1-2 per cent of agricultural GVA on agricultural R&D. other than that, the CSR funds can be mobilised for research.
- Forging more international collaboration will invite financial support and quality research works. The linkage of research academia with the industry will encourage private investment. And this will promot to do market oriented research and development of need based workforce. University can take actions for supporting Faculty – Student independent research by giving incentives and rewards for further career advancement. Teaching assistant opportunities and payment to the doctoral students can be introduced for additional experience and financial assistance.

3. **Adding Career Development Events in the curriculum**

    - Through Career Development Events (CDEs), agricultural education programs have the potential to prepare students for more than more careers in the science, business, and technology of agriculture. Career Development Events (CDEs) help students develop the abilities to think critically, communicate clearly and perform effectively in a competitive job market. Some

events allow students to compete as individuals, while others allow them to compete in teams (Lundry *et.al* 2015).

4. **Revamp the students into market based work force**
    - The changing labor market and declining importance of government as the primary employer of graduates shows the importance of reorienting students. Emergence of private sector through out the value chain and Self-employment increasingly sought as an option after graduation. Hence, Curriculum should be more focused on productivity issues and principles of market competitiveness
    - Integration of special student-developed projects in the curricula that impart business skills, promote entrepreneurship
    - It needs to add undergraduate internship programe and research program for students: This will help the students to acquire the skills based on the theoretical knowledge they had from the UG classes.
    - It is necessary to redesign the agricultural education system so that the new graduates possess subject competency, self-motivation, a positive outlook, agri-business skills, computer and information technology understanding, and communication abilities.
5. **Emergence of information and communication technologies (ICTs)**

Scientific knowledge is changing rapidly as modern communication technologies facilitate the sharing of information among different stakeholders

- New opportunities to access knowledge and information globally: Hence students needs access towards the all online information platforms. University can make tie up with international organisations to improve the student accessibility.
- There should be equal accessibility for all students to get advantages of existing e-learning platforms such as SWAYAM, DIKSHA and SWAYAMPRABHA
- Making use of ICTs in a cost-effective manner: Adapting ICTs to local conditions and teaching students skills to use ICTs should be made mandatory
- Integration of distance education in agricultural curricula Curriculum based on new teaching methods and approaches that utilize ICTs

6. Towards the Sustainable Development Goals

Sustainability of agricultural and natural resources has become an important developmental goal. The SDG is targeted at increasing literacy to forester substantial information dissemination and knowledge of the most relevant concepts of sustainable development. It focuses on the young and old, without gender bias. And it increased environmental stewardship role of higher educational institutions. (Zamora, 2014; Zamora-Polo, & Sánchez-Martín, . 2022; Georgieva *et.al.*, 2021)

- Need strong revisions existing curricula to fill the gap in sensitizing the students and faculty about the seriousness of the stubbornly high incidences of hunger, under-nutrition, poverty, inequality, fast degrading natural resources and market instabilities

- Curricula need to foster open mindedness innovations and foster participation among different stakeholders of the society
- A holistic/systems approach to economic, social, cultural, ecological and public policy concerns to technological change
- Incorporate new skills such as environmental economics, and impact assessment in the curriculum.

7. Communicating agriculture through writing

Development of communication skills necessary to deal with the general public and audiences in the food, agriculture, and natural resources fields. Hence its important that students need general writing skill.

- Emphasis on writing and on creation of a portfolio including multiple types of written communication is important in agricultural education.
- Promoting multilingualism among the students will improve the communication skills of students and also this will enhance the globalised education opportunities for students.

8. Internationalisation of Education

- Collaboration with the international universities for improving the students internships and student exchange programe
- The focus also should given to make aware the students regarding the preparation of Research Proposals, Statement of Purpose from the UG level.

9. Improving the teachers competency

- To improve the teaching abilities, specialized courses in educational technology should be created.

- A nationwide Teachers Training Institute for Agriculture would be beneficial.
- The faculty should be given plenty of opportunities to attend national and international seminars and workshops
- It is imperative to conduct in-serve training needs assessment for agriculture educators, both. under formal and nonformal settings. It is important to undertake professional development activities for faculty members in agriculture and life sciences to instill competencies related to (a) engaging students in learning; (b) imparting critical thinking; (c) effective lecturing; (d) inquisitive questioning, and (e) effective learning strategies. There is a need to integrate the concepts of sustainability in the agricultural curriculum and strengthen the problem-solving and decision making skills of students, thus making them think critically and creatively by understanding their learning styles and behavioural issues. (Georgieva *et.al,* 2021, Ramesh and Krishnan, 2020, Lundry *et.al.* 2015)

10. Restructuring the system and policy development

- Improving the agricultural institutions on regional basis, providing the physical facilities and forming a proactive relationship with all stakeholders, including planners of public policy, farmers, industrialists involved in agriculture, and leaders of local communities.
- SAUs need to be given freedom and power to decide on important management, academic, student admission, and staff employment and promotion decisions. The SAUs should also be given the right to define clear

criteria for interventions and refrain from political meddling.

- Block funds from the Central Government and ICAR could be offered to SAUs to upgrade their teaching and research infrastructure and to launch new departments. The majority of public institutions lack sufficient funding.

11. Improving the inclusiveness of rural system in agricultural education

- There is a need to provide a curricula reorientation to create an environment sensitive faculty to help bring attitudinal changes among rural communities.
- Steps needed to promote such rural students as urban-based agricultural graduates in rural environment.
- Including regional stakeholders such as farmers, farmer groups, community organisations, agriprenuers, NGOs, Local Self Government system in the course and module planning which will improve the opportunity of students to get real time practical explorations. This will directly connect the students with farmers and fields.

Competencies and Skills: What Evidence Says?

Competency is a subset of competence because competencies are traits of a person, team, or organisation that enable them to achieve a given goal (Mulder, 2001). Personal competencies are a comprehensive collection of performance-oriented talents. These skills comprise knowledge structure clusters such as cognitive, interactive, psychomotor, and emotional abilities, as well as attitudes and values (Lybaert *et.al.,* 2022).

The report "The Future of Jobs Report 2018" released by the World Economic Forum, identified emerging skills for the future and how far the skills need reskilling. Results indicated that Lessthan one month (13 Per cent), 1-3 months (13%), 3-6 months (9%), 6-12 months (9%), over one year (10%) and no reskilling need (46%) (https://www3.weforum.org/).

With the advancement of technology, the orientation towards the skill and competencies for the future workforce has changed. Manual and physical competencies, as well as fundamental cognitive abilities, will be in short supply, while technical, social and emotional, and higher cognitive abilities will be in great demand (McKinsey.com; 2018).

McKinsey Global Institute conducted a vast research study regarding the skills citizens will need in the future world of work with more than 18,000 respondents from 15 countries. They have identified 56 foundational skills in four categories. The study also assessed the influence of education on these competencies and skills.

Cognitive	
Critical Thinking • Structured problem solving • Logical reasoning • Understanding biases • Seeking relevant information	**Planning and Ways of Working** • Work-plan development • Time management and prioritization • Agile thinking
Communication • Storytelling and public speaking • Asking the right	**Mental Flexibility** • Creativity and imagination • Translating knowledge

questions • Synthesizing messages • Active listening	to different contexts • Adopting a different perspective • Adaptability • Ability to learn Cognitive Web

Interpersonal	
Mobilising Systems • Role modelling • Win–win negotiations • Crafting an inspiring vision • Organizational awareness	**Developing Relationships** • Empathy • Inspiring trust • Humility • Sociability
Teamwork Effectiveness • Fostering inclusiveness • Motivating different personalities • Resolving conflicts • Collaboration • Coaching • Empowering Interpersonal	

Self Leadership	
Self-awareness and self-management • Understanding own emotions and triggers • Self-control and regulation	**Entrepreneurship** • Courage and risk-taking • Driving change and innovation • Energy, passion, and

• Understanding own strengths • Integrity • Self-motivation and wellness • Self-confidence	optimism • Breaking orthodoxies
Goals achievement • Ownership and decisiveness • Achievement orientation • Grit and persistence • Coping with uncertainty • Self-development Entrepreneurship	

Digital	
Digital fluency and citizenship • Digital literacy • Digital learning • Digital collaboration • Digital ethics	**Software use and Development** • Programming literacy • Data analysis and statistics • Computational and algorithmic thinking
Understanding digital system • Data literacy • Smart systems • Cybersecurity literacy • Tech translation and enablement	

Global Partnership in Education with World Bank and UNESCO - International Bureau of Education collected data regarding the skills that are relevant to the 21st century.

Communication, creativity, critical thinking, and problem solving were the four most frequently identified skills within national policy documents of the countries. Other skills identified include information technology, social, and entrepreneurship skills—indicating that countries are explicitly identifying a wide range of skills beyond the academic (Care *et.al.,* 2018)

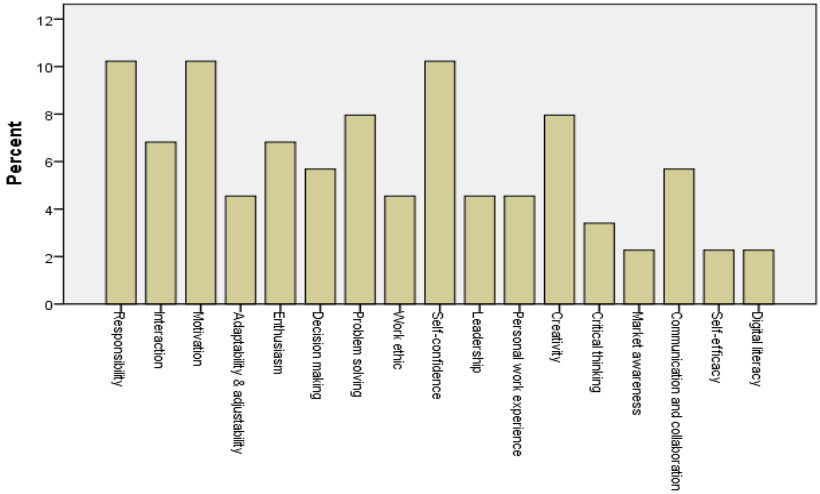
Agricultural Competencies and Skills

Agricultural education system is the major resource in the development of a skilled workforce. Agricultural and natural resource organizations must adapt to global market developments in order to become more competitive. The agricultural education system is critical to accomplishing this aim because it provides a workforce that is equipped to meet the present demands of the global system. Establishing a workforce development infrastructure as one of four solutions to fulfil the requirement for filling the highly skilled worker shortage, emphasising educational institutions' role in "systematically integrating educational resources with business demands"

Employer needs must be considered in university curriculum. Although companies expect college graduates to have transferrable abilities, many graduates have not proved these talents on the job, resulting in a skills gap between employer expectations and employee competence. Easterly III *et.al.,* (2017) reported that, always there is difference in perceiving the competencies of agriculture gradutes by university system and industry professionals. Although professors concentrated on particular academic competencies such as communication and reasoning, they discovered that

industry professionals preferred more broad workplace qualities such as ethics and soft skills.

Ouma (2021) studied on the competency of agricultural students of Kenya, acquired from their educational system. The study identified core competencies that needed for the agricultural students and assessed how much they have been attained in that competencies.



The top learned abilities from the present educational system were responsibility (10%), motivation (10%), and self-confidence (10%). Skills relevant to 21st-century abilities, such as digital literacy and critical thinking, were scored at 2% and 3%, respectively. The results shows the gap in the competency among the students.

Agriculture Competencies: What We Can Do?

With the advancement in agriculture, the agriculture graduates should be innovative enough to take up the sustainable solution at the level of products, processes, and

society in order to meet these challenges. Hence, they should be competent as an innovation advisor. The study conducted by Lybaert *et.al.,* (2022) suggested a competence profile for the Innovation advisors.

A. Basic Disposition and Attitude

Self-awareness	Self-awareness Sense of equity Willing to take a step back when needed Willing to share power and give up control
Personal Drive	Personal drive Passion Dedication Trust in intuition
Sensitivity	Sensitivity Responsiveness Communication skills
Reliability	Reliability Accountability Trustworthiness Ethics Responsibility Professional attitude

B. Content Competence

Understanding the social context	Understanding the broader social environment Connecting to the community Understanding own role in the system

	Being able to identify relevant actors
Understanding the Agriculture knowledge and Innovation System(AKIS)	Understanding political and economic context Basic knowledge about legal matters and the public policy of the region
Content knowledge	Background in agriculture Technical knowledge Ability to understand English

C. Methodological Competence

Understanding the Innovation process	Sensitivity for the process Being able to recognise patterns in an innovation Process knowing how to act in any given situation Possessing and using tools related to innovation processes Problem-solving skills
Energy	Being able to keep energy and enthusiasm in the group Being able to activate and mobilise people Facilitation skills Translation skills
Co-creation	Being able to identify crucial positions Being able to identify missing positions Good insight into human psychology
Mediation	Mediation skills

D. Organisational Competence

Organisational competence	Planning Meeting organisation Keeping track of the network Time management Managing resources Writing project proposals Collecting funds Delegating Digital skills

E. Reflection, Learning and Personal Development

Reflection among peers	Habitually reflecting upon work with peers Sharing a common language
Self-reflection	Habitually self-reflecting
Addressing professional network	Utilizing professional network
Lifelong learning aptitude	Ongoing skill development and learning Knowing how to find new information

Education has been recognised as critical to a sustainable transition. Sørensen *et.al,* (2021) recognised the necessity for higher education to nurture students' abilities for sustainable agriculture, which has initiated conversations about how instructors and students may be competent 'change agents' in the society's sustainable transition. Based on that, he put

forwarded a framework of knowledge, skills and competencies for professionals in the agricultural system.

Sl. No	Knowledge, Skills and Competency framework	Description
1	Systems Perspective	As a broad and holistic perspective of a system, including different stakeholder groups, sectors, and/or disciplines. This include the competency in analysing the situation regarding as the ecosystem and society as a whole. (Hilimire, 2016).
2	Lifelong learning	The skill that encourage autonomous learning and prepare them to deal with uncertainties and complexities in future agricultural practices is essential for their future engagement with new knowledge and self-reflection. Eg: Lifelong learning programmes for agronomists are needed to allow and encourage them to promote farmers' personal and entrepreneurial growth, as well

		as to facilitate the formation of set of actors, such as connecting farmers with other producers, institutes, suppliers, and customers (Charatsari and Lioutas, 2019)
3	Knowledge Integration	The skill to concrete and interpret the localised knowledge of farmers from their practical experience with the theoretical knowledge (Šūmane *et.al*., 2018)
4	Building and Maintaining Networks and Learning Communities	Building networks is the need to build and grow partnerships by linking participants with different power relations in the stakeholder system. Learning communities are identified as improving skills, such as the ability to solve internal conflicts and build knowledge capacities and thinking across institutions, power hierarchies, and markets. (Šūmane *et.al*., 2018; Charatsari and Lioutas, 2019).
5	Technical and Subject-Specific Knowledge and Technology	Expertise in agroecological principles within a broad perspective, including both environmental, economic, and

		social dimensions of managing a farm and system needs to be developed in collaboration with companies, practitioners, and scientists

What Skills the World is Looking For?

According to the **World Economic Forum's Future of Jobs** Report, 50 percent of all employees will need reskilling by 2025, as adoption of technology increases. Critical thinking and problem-solving top the list of skills employers believe will grow in prominence in the next five years. Newly emerging this year are skills in self-management such as active learning, resilience, stress tolerance and flexibility (https://www.weforum.org/.

- Analytical Thinking and Innovation
- Active learning and Learning Strategies
- Complex Problem Solving
- Critical thinking and Analysis
- Creativity, Originality and Initiative
- Leadership and Social Influence
- Technology Use, Monitoring and control
- Technology Design and Programming
- Resilience, Stress Tolerance and Flexibility
- Reasoning, Problem Solving and ideation

1. 21st Century Skills (21CS)

The term "21st century skills" is commonly used to refer "tools that can be universally applied to enhance ways of thinking, learning, working and living in the world. They are specific basic

qualities like as cooperation, digital literacy, critical thinking, and problem-solving that supporters feel institutiosn should teach to help students survive in today's environment (Griffin and Care, 2014; Alpaydın and Demirli, 2022; Weeks et.al., 2020)

- Learning Skills: Also known as the "**four Cs" of 21st Century learning**, these include critical thinking, communication, collaboration, and creativity.
- Life Skills: Flexibility, initiative, social skills, productivity, leadership
- Literacy Skills: Information literacy, media literacy, technology literacy

2. Skill for Green Future

In the era of Green innovations and technologies, there will be a 'Green Transition' for the work framework also. "The transition to a greener economy also requires new skills, both for newly emerging jobs and for existing jobs that are evolving. Without a suitably trained workforce the transition will be impossible." (Making the Green Economy work for Jobs, Income and Growth. OECD. 2020).

United Nations Industrial Development Organisation (UNIDO) identified a Green General Skill Index with five categories of skills (https://www.unido.org/).

- **Engineering and technical skills:** Hard skills encompassing competencies involved with the design, construction and assessment of technology.
- **Science skills:** Essential to innovation activities and high demand in each stage of value chains and in the utility

sector, which provides basic amenities such as water, sewage services and electricity.

- **Operation management skills:** Know-how related to change in organizational structure required to support green activities and an integrated view of the firm through life-cycle management, lean production and cooperation with external actors, including customers.
- **Monitoring skills:** Technical and legal aspects of business activities that are fundamentally different way from the remit of engineering or of science.
- **Soft skills:** Skills related to design thinking, creativity, adaptability, resilience, and empathy

3. Future Skills after the Pandemic

The COVID -19 pandemic was a reminder for the human workforce regarding adaptation and creative thinking. The tectonic change made by the pandemic was visible in different dimensions of job frameworks. It prompted the need for the change the way we make decisions and become more knowledgeable about the future.

The McKinsey Global Organization surveyed the workforce of United States, and the reported that, workers in occupations in the lowest wage quintile, for instance, use basic cognitive skills and physical and manual skills 68 percent of the time, but in the middle quintile, use of these skills occupies 48 percent of time spent. In the highest two quintiles, those skills account for less than 20 percent of time spent (The future of work after COVID-19, 2021. https://www.mckinsey.com/).

Workers will need to learn more social and emotional skills, as well as technological skills, in order to move into occupations in higher wage brackets.

World Economic Forum conducted a study in Italy regarding future skills after the occurrence of the pandemic. The systemic analysis of the impact of COVID-19 in Italy highlights four skills required to face our complex world:

Sl.No.	**Skills identified**	**Description**
1	Futures literacy	This is the skill that allows people to better imagine and make sense of the future. It's important because it is images of the future that drive our expectations, disappointments and willingness to invest or change.
2	Systems thinking	It is a mindset to think, communicate and learn about systems to make the full patterns clearer, improve and share the understanding of problems and see how to face them effectively
3	Anticipation	The anticipation skill requires us to learn how to recognize these possible futures and to use this augmented consciousness to shape our decisions and actions in the present.
4	Strategic foresight	It is a structured and systematic way of using ideas about the future to anticipate and better prepare for change. It is about exploring the

		opportunities and challenges they could present. We then use those ideas to make better decisions and act now.

(https://www.weforum.org/)

4. "Phenomenon-based learning"

It emphasizes skills such as communication, creativity and critical thinking - Occupations will require a higher degree of cognitive abilities — such as creativity, logical reasoning and problem sensitivity — as part of their core skill set (Naik P. & Rajani. 2019)

South Tapiola High School, Finland: ETIS offers a curriculum that seeks to develop skills such as collaboration, entrepreneurship, active citizenship, and social awareness through real-world application. For example, the school has a **Young** Entrepreneurship Program, where students work in groups to design and create their own business and then compete in national competitions against other young entrepreneurs. Or there's the school's European Parliament for Young People Program, which provides a hands-on experience for learning civic duty. Here, students participate in national and regional sessions with students of different backgrounds to discuss current challenges in the European Union. The school also partners with tech companies such as Microsoft and Dell to integrate technology into the curriculum.

5. Digital literacy and computational thinking

Introduction of **SMAC (Social, Mobile, Analytics and Cloud)**

It is the base knowledge and skill of creativity and innovation. The four technologies enhance entrepreneurship processes assisting by reducing time and space dimension in the technology outreach. It is important to introduce this to the students (Rintaningrum *et.al.*, 2021; Egeli and Sağdinç,2021).

- **Social:** Social media platforms such as Twitter, Facebook, Instagram and Snapchat have provided businesses with new ways to reach, interact with and target. It has given rise to new job titles such as social media influencer or digital influencer, new marketing tactics such as viral marketing campaigns, and new data sources such as likes, reposts, hashtags and network connections.
- **Mobile:** Mobile technologies and platforms such as the iPhone and the iPad, have changed the way people communicate and work. The introduction of connected devices and wearable devices, both of which rely on cheap sensors to generate and transmit data, are the basis for new business models and new services offered to customers.
- **Analytics:** Data analytics is also a predictive indicator for future. The open source project Apache Hadoop ushered in a new era of analytics called big data.
- **Cloud:** Cloud computing provides a new way to access technology and the data a business needs to quickly respond to changing markets and solve business problems. It ushered in a new way to build infrastructure, platforms and services. Amazon Web Services was one of the big disruptors in this space.
  (Babu R., 2020; Rahim *et.al.* 2021) ,

6. Technology skills

Even though research students are using SPSS, R and PYTHON for research purposes, the hand on experience and skills are poor among them. Hence, it needs to include basic technological updates in research graduates curriculum for the upskilling. (https://www.indiatoday.in/education-today)

- Knowledge of at least one analytical programming language like R, MATLAB, and Python.
- Advanced Microsoft Excel skills
- Practical use of popular Business intelligence (BI) software and tools

7. Global citizenship skills

Global Citizenship Education (GSE) is crucial and it includes, the knowledge, skills, values and attitudes that learners need to be able to contribute to a more inclusive, just and peaceful world (UNESCO, 2015).

- Cultural Intelligence: Future success and advantage will come from elevating our awareness and understanding of the differences and embracing them so that we can maximize the innovative and competitive advantage that comes from different ways of viewing a process, product, service, problem or situation.
- Sustainability awareness (UNESCO, 2015; Titus, 2020)

A look into Global Innovations in Education

- **Connectedness, collaboration and co-creation**

Learning spaces that enable one-on-one or virtual collaboration on projects for smaller, medium, or large groups will take the role of the traditional classroom.

- **" Flipped" classroom**

It refers to a teaching strategy in which learners do their homework in class and study at home. By reading the chapters and taking notes in class, students have become accustomed to performing their assignments outside of the classroom. The goal of the flipped method is to increase student engagement in the learning process. By including students in in-depth conversations and activities, the goal is to keep them engaged in the classroom. Students may study external websites, consume video-based instructional content, and more anywhere they choose. Yet, in the classroom, the teacher would lead the students and encourage practical learning through experiments, group projects, and other activities (Ozdamli and Asiksoy, 2016).

- **Digital content libraries**

The interactive learning elements in this virtual library keep students interested in the subject matter. A digital content library may have thousands of educational nuggets, providing students with a variety of resources to advance their knowledge. These libraries' instructional resources frequently include interactive and multimedia elements to keep students' attention and aid with information retention.

These digital material repositories may be used by educational institutions to enhance t heir course modules. The curriculum that has been authorised by the university board is often matched to these online resources. The content can be made available in multiple languages as per your region-specific requirements (Perdana and Prasojo, 2020).

- **More bite-sized learning**

According to a study by Microsoft, humans now have an attention span of around eight seconds. In the future, more education will have to be delivered as bite-sized, snackable content. (https://www.forbes.com/)

Hence it needs to include micro learning approaches for education. Microlearning is a way of delivering education in small, bite-sized learning units, typically allowing students to control their own learning, at their own pace. Microlearning gives educators so much freedom in choosing exactly what they want to include within their curriculum and allows them more flexibility when designing their course since they can select only the lessons or assessments they need.

- **Anywhere, anytime learning**

Technology is no longer a motivating factor when it comes to learning – it is a must. It's something that needs to be incorporated in the future of education to ensure students are equipped with the skills to cope in a world dependent on technology. Students can be working on projects in virtual contexts with other students from around the world at any given moment. Technological advances have enabled

interconnectedness of information and people with the touch of a button

- **International internship through Virtual mobility**

With the globalisation of professional world and the internationalisation of higher education, overseas internships are becoming more and more important. These problems can be addressed by virtual mobility, which is described as "a collection of ICT enabled activities that materialise or promote worldwide, collaborative experiences in a context of teaching and/or learning." The Honoris United Universities, UK partnering with the global platform Virtual Internships, an EdTech start-up that was established in 2018. They formed an Honoris 'employability squad' was formalized with the collaboration of leaders across key markets of Morocco, Tunisia, South Africa, and Nigeria. A total of 69 pilot virtual internship placements were made in 2021, each lasting between one and three months.

- **Curricula networking**

The networking of curricula of related subjects could help the students to acquire in depth knowledge in different aspects.

Making the Link between Education and Economic Success

- **Linkages of academia and industry**

This will offers opportunity for enhancement of the career by giving more focused work experience in their interested field by improving their skills and knowledge. The post graduate research can be connected to the industry through

collaborations. This programs will promote the industry to take up the human resource management of the agricultural sector. European project on **industry-academia collaboration**, called **INDUSAC**. The project creating a dynamic community of industry-academia stakeholders, including at least 1000 companies, 3000 students and 300 researchers.

- **Corporate University - Higher Education Institute collaboration**

Corporate universities can partner up with higher education institutions for expanded learning opportunities. Corporate universities are grounds for new thoughts and ideas. Because their structure fosters natural discussion and collaboration among students. Beeline University (Russia), Edcon Academy (South Africa), Groupama University (France) and McDonalds Hamburger University (USA) are example for relevant corporate schools.

- **Ph.D. or Startup? Can do both**

There are many successful stories all over the world, students are turning Ph.D. output into startup project. Duolingo is an American educational technology company which produces learning apps and provides language certification.

It is an output of a Professor and his Ph.D. student research work. Mr.Von Ahn developed Duolingo with Severin Hacker, a doctoral student he advised at Carnegie Mellon University (CMU) (https://www.inc.com/leigh-buchanan/duolingo-700-million-language-learning-startup-pittsburgh-2018-surge-cities.html)

‘**Scientific Venture Program’** started by University of Concordia, an unique postdoctoral program to build business based on your research. The program will receives financial support and services over two years, Keep all the intellectual property (IP) developed during the postdoc, Have access to research facilities and finally give access to incubator programs and mentors.

(https://www.concordia.ca/news/stories/2021/11/22/concordia-helps-bring-innovation-from-lab-to-market-through-the-scientific-venture-program.html)

Conclusion Notes

Learning is a lifelong process and education is the key for it. It is necessary to foster systematic thinking through the use of cutting-edge educational tools through sustainable education and development. Global education and development education are required for this. Instead of giving pupils pre-made answers, it is essential in education for sustainable development to allow students to examine the issue by responding to questions about the "what" and "why" of a particular scenario. Excellent options to start these kinds of learning and competence-building activities are provided by interactive approaches. This will make them to deal with the changing demands of the future markets. With the progress in technology, demography and globalization, the nature of work is changing and accordingly the skills and competencies. Providing facilities for skill updation is as important as providing basic education. It makes the agricultural workforce more competent, reskilled and upskilled in their professional work. Empowering

students with skills has an educational relevance which could open doors to economically and socially rewarding jobs, or help the establishment of entrepreneurship and hence development from individual and community level.

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Brief Biodata of
Dr. Saravanan Raj

Dr. Saravanan Raj is a Director (Agricultural Extension), National Institute of Agricultural Extension Management (MANAGE), an autonomous organization of the Ministry of Agriculture and Farmers Welfare, Government of India, Hyderabad.

Capacity Development of Agricultural Developmental Professionals

Since 2016, 406 national and international training programs, workshops, conferences and webinars were organised and 50,593 participated in the offline and online programs on Agricultural innovation systems, new agricultural extension approaches and innovations, Navigating ICTs, digital and social media for Agricultural extension, Value chain based extension, Agro-tourism, Agri-Starups and Agripreneusrship.

Leading Innovation and Incubation Center

CEO for the MANAGE-Centre for Innovations and Agripreneurship and supporting 330+ early stage startups from across India. Leading a team as Knowledge Partner and Centre of Excellence in Agri-Business Incubation to support partner Agri-Business Incubation centres and Agri-Startups under the Rashtriya Krishi Vikas Yojana - Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR) scheme of the Ministry of Agriculture and Farmers Welfare, Government of India

(https://www.manage.gov.in/managecia/).

International Triangular Cooperation

- Leading a team for establishing an Agribusiness Incubator model in Malawi 'AmayiHub' under India-Germany- Malawi Triangular Cooperation for Women Empowerment in Agriculture and Food Systems. MANAGE, India, GIZ and Access Livelihoods Partnering with SMEDI, Malawi to support and mentoring of rural women entrepreneurs and Startups in Malawi (Since 2022- Ongoing).
- Earlier, he was Director for the Feed the Future India Triangular Training program for the capacity development of 11 African countries and six Asian countries (April- August 2018).

Consultancy Projects

Working on Consultancy project on Rural Women Entrepreneurs Program (WEP) for knowledge assessment and certification (2018-2023).

Assessment and certification of the women Community Resource Persons (CRPs) of Deendayal Antyodaya Yojana – National Rural Livelihood Mission (DAY-NRLM), Ministry of Rural Development, GoI (2018-20)

Leading MANAGE-Agricultural University Alliance

- Co-ordinator for the MANAGE-University alliance for advancing agricultural extension and advisory services with the focus on policy relevant research and market demand based curriculum.
- Pogramme Director for MANAGE Internships programme (2017-2020) and the MANAGE Young Agricultural Extensionist Programme, a community of practice for developing future ready young extensionists in rural India (2017-2018).
- He conducted series of Research scholars' training program on Extension Research Methods and Research priories (2017-

2019) and MANAGE Agricultural Extension webinar Series on "Evening4Learning Webinars" during 2022.

- Director, Centre for Agripreneurship Development and Scheme in-charge for the implementation of Agri-Clinics and Agri-Business Centres (AC & ABC) across India, a flagship programme of the Ministry of the Agriculture and farmers Welfare, GoI to train for self-employment by establishing agricultural consultancy and agri-business ventures among agricultural graduates during 2016-2019.

University Teaching, Research and Extension in North-East India

- Before joining to MANAGE, he worked as a faculty of Agricultural Extension for one and half decade in the Central Agricultural University (CAU- Imphal), Meghalaya and Arunachal Pradesh States of North-East India.
- Having experience of Teaching extension education and communication, Rural Sociology and Forest Tribology related courses for the B.Sc (Horticulture)/ Agriculture/ Forestry students and also a co-ordinated Rural Horticultural Work Experience Program (2002-2009 and 2014-2015).
- Taught course on advanced extension education, diffusion of innovations, research design, communication and e-Extension related courses for the M.Sc and Ph.D in agricultural extension scholars (2009- 2014).
- Guided four M.Sc (Agril.) in Agricultural Extension students for their thesis research as Chairman and also guided two MBA in Agri-Business Management Students for their Project work.
- Implemented four innovative research projects on e-Agriculture, e-Arik, e-Village, e-AgriKiosk and m4agriNEI projects in Arunachal Pradesh and Meghalaya during 2007-2016.
- Facilitated for agricultural advisory services to the 3000 registered marginal and small land holding tribal farmers of 105 villages in four districts of Meghalaya state in North-East

India (2012- 2013) through m4agriNEI project. Combination of advanced ICT tools (Smart phone, web portal, IVRS *etc.*) and conventional extension methods (face-face meetings, awareness meetings, Group discussions, demonstrations, expert field visit, exhibitions *etc*.) were used.

- Implemented ICT based agricultural advisory services project to support 2500 marginal and small land holding tribal farmers of 143 villages through e-Village and e-AgriKiosk projects (2008-12) and 500 registered marginal and small land holding tribal farmers of 12 villages through e-Arik project (2007-09) in Arunachal Pradesh State of North-East India.

World Bank Mission

Participated as an "ICT and Agricultural Extension Specialist" for the World Bank mission on Ghana Solution Assessment for Managing Agricultural Risks during January to February, 2014 to provide solution assessment report and recommendation for improving farmer's access to agricultural extension by using modern Information and Communication Technologies (ICTs) and traditional extension systems in Ghana.

Awards and Fellowship

- Received Netherlands Government Fellowship (NFP/TP-Fellowship) (2006) and participated in the Advanced course on *"Facilitating Multi-Stakeholder Processes and Social learning: – Advanced Course in Up-scaling Participatory Approaches"*, during September, 2006 at Wageningen International, the Netherlands.
- PG and Ph.D research presentations among the SAARC Research Scholars as participants adjudged best research paper presentation awards in PGIA Annual Agricultural Congress, Peradeniya University, Sri Lanka in 2002 and 2003, respectively.

- Received Young Scientist Award (2001) for his research work on Farm communication in the Visva-Bharati University, Shantiniketan, West Bengal, India.
- Recipient of the Indian Council of Agricultural Research (ICAR)-Junior Research Fellowship (JRF) during 1997-99, for the M.Sc (Agril.) in Agricultural Extension.

International Visits

As part of the professional assignments and programs, visited Australia, Argentina**,** China, France, Germany, Ghana, Hong Kong, Jamaica, Kenya, Malawi, Nepal, Netherlands, Philippines, Rwanda, Korea, Sri Lanka, Taiwan and USA.

Specialisation

Specialized in the area of public-private extension, privatisation of agricultural extension, institutional pluralism and innovations in agricultural extension, Information and Communication Technologies (ICTs), digital/social media for agricultural extension, agripreneurship, agri-startups and related policy issues.

Publication of Books

Authored four books on "Agricultural Extension: Worldwide Innovations" (2008) and "ICTs for Agricultural Extension: Global Experiments, Innovations and Experiences" (2010), ICT for Agriculture and Rural Development (2011), Mobile Phone for Agricultural Extension: Worldwide mAgri Innovations and Promise for Future (2014) and co-edited "What works in Rural Advisory Services? Global Good Practice Notes (2018).

Research, Review Articles, Discussion and Working Papers

Contributed 74 research and review papers, 21 book chapters, 27 discussion and working papers.

International and National Conference Participation

Keynote, Invited speaker and panellist for number of international and national conferences.

PG & Ph.D in UAS (B), Bangalore, Karnataka

M. Sc (Agriculture) and Ph.D in Agricultural Extension completed from University of Agricultural Sciences (UAS), GKVK, Bangalore during 1997-2003. During his PG & Ph.D, he focussed Research on Privatisation of Agricultural Extension Services and Institutional Pluralism (Public-Private-NGOs) in Agricultural Extension.

UG in TNAU, AC&RI, Madurai, Tamil Nadu

B.Sc (Agriculture) studied from the Tamil Nadu Agricultural University, College of Agriculture and Research Institute (AC&RI), Madurai from 1992-1996). He was College National Social Service (NSS) secretary during 1993 and College Games Secretary during 1996.

(For more info: www.saravananraj.in)