



Skills Every Agriculture Graduate Must Develop Before Graduation: A Comprehensive Guide to Becoming Industry-Ready, Research-Ready, and Employment-Ready in the Era of Agriculture 4.0

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The agricultural landscape in India is undergoing a profound transformation. Gone are the days when a degree in agriculture merely opened doors to government extension jobs or teaching positions at universities. Today, the sector demands professionals who are digitally fluent, scientifically grounded, entrepreneurially minded, and globally aware.

The Indian Council of Agricultural Research (ICAR), through initiatives like the National Agricultural Higher Education Project (NAHEP), has been actively reshaping agricultural education to meet these evolving demands. Launched in 2017–18 with a total investment of Rs. 1,100 crores (funded jointly by the Government of India and the World Bank on a 50:50 basis), NAHEP has already facilitated international exposure for over 2,000 students and 900 faculty members, signed more than 650 industry MOUs, and established 16 Centres for Advanced Agricultural Science and Technology across partner universities. These efforts reflect a clear mandate: agricultural graduates must be prepared for Agriculture 4.0—a paradigm where artificial intelligence, precision farming, drones, Internet of Things (IoT), and big data analytics converge with traditional agronomic knowledge.

Yet, many students remain unaware of the full spectrum of skills they need to cultivate before graduation. This article is designed to bridge that gap. Whether you are a first-year B.Sc. Agriculture student at a State Agricultural University, a master's scholar at an ICAR institute, or a doctoral candidate preparing for a research career, the skills outlined here will serve as your roadmap to success.

Essential Skills Every Agriculture Graduate Must Develop

1. Communication Skills: The Foundation of Impact: If you cannot explain your research to a farmer in simple language, your knowledge remains confined to the laboratory. Communication skills encompass written expression, verbal articulation, and the ability to translate complex scientific concepts into actionable advice. Start by writing articles for your university magazine, participating in debates, and volunteering for extension activities at Krishi Vigyan Kendras (KVKs). The Agricultural Skill Council of India (ASCI) emphasizes communication as a core competency across all National Occupational Standards, recognizing that effective knowledge transfer is as critical as knowledge creation itself.

2. Scientific Writing and Public Speaking: Publishing your work in peer-reviewed journals is no longer reserved for doctoral scholars. Undergraduates who learn to write abstracts, prepare posters, and present at seminars gain a significant edge. Master reference management tools like Mendeley or Zotero early—they will save countless hours during thesis preparation. For public speaking, join your university's literary club or participate in the National Seminar on Agricultural Education organized by ICAR. Remember, a well-delivered 10-minute presentation can open more doors than a hundred unread CVs.

3. Digital Literacy: Beyond Basic Computing: Proficiency in MS Word, Excel, and PowerPoint is the bare minimum. Go further. Learn data analysis using Excel's advanced functions, SPSS, or R programming. The FAO's Digital Agriculture Innovation Bootcamp, co-hosted with Zhejiang University, demonstrates how digital tools are reshaping agrifood systems globally. In India, NAHEP partner universities have established AI labs and IoT-based projects, enabling students to work with agricultural sensors, robotics, and precision agriculture technologies. Familiarize yourself with mobile applications developed for farmers—tools like the Auto Phule Irrigation Scheduler (PIS) developed by MPKV, Rahuri, under NAHEP, which helps farmers estimate precise irrigation requirements using crop growth parameters and soil data.

4. Artificial Intelligence, Drones, and Precision Agriculture: Agriculture 4.0 is not a distant future—it is happening now. Drones are being used for crop health monitoring, pesticide spraying, and yield estimation across Indian farmlands. GIS and remote sensing technologies enable precision mapping of soil nutrients and moisture levels. IoT sensors provide real-time data on weather, soil conditions, and crop growth. Students should seek hands-on training through NAHEP-funded incubation cells, industry-institute interaction cells, or workshops organized by KVKs. The Digital Agriculture Mission of the Government of India further underscores the urgency of building these competencies.

5. Agricultural Extension and Leadership Skills: Extension is the bridge between research and the farmer. Under the Student READY (*Rural Entrepreneurship Awareness Development Yojana*) scheme, ICAR mandates that undergraduate students gain practical field experience before graduation. Use this opportunity to develop leadership qualities—organize farmer meetings, conduct demonstrations, and lead village-level campaigns. Leadership is not about authority; it is about inspiring collective action. Teamwork, similarly, is indispensable. Modern agricultural challenges—climate change, water scarcity, pest resistance—require interdisciplinary collaboration. Participate in group projects, student clubs, and community service initiatives to hone these abilities.

6. Critical Thinking and Problem Solving: Agriculture is inherently problem-solving. A farmer's crop is wilting—Is it a nutrient deficiency, a pathogen, or water stress? A startup's supply chain is breaking—Is it logistics, pricing, or market access? Train yourself to approach problems systematically: define the issue, gather evidence, analyze alternatives, implement solutions, and evaluate outcomes. Case study competitions, hackathons, and research projects are excellent platforms to sharpen these skills. The Atal Innovation Mission supports student-led innovation in agriculture through tinkering labs and startup incubators at universities.

7. Time Management and Professional Ethics: Between coursework, fieldwork, research, internships, and extracurricular activities, agricultural students juggle multiple responsibilities. Master time management through prioritization matrices, digital calendars, and the Pomodoro technique. Equally important is professional ethics—integrity in research, honesty in data reporting, and respect for intellectual property. Plagiarism is a career-ending mistake. Learn to cite properly, acknowledge collaborators, and maintain transparency in all academic and professional dealings.

8. Entrepreneurship and Agri-Startup Awareness: India's agri-startup ecosystem is booming. Under Startup India and various state-level initiatives, young entrepreneurs are building ventures in precision farming, agritech, organic food processing, and farm mechanization. Two students of Junagadh Agricultural University (JAU) established Madhav

Organic Honey during their final year of undergraduate studies, leveraging training programmes conducted under NAHEP. Similarly, Agri-Clinics and Agri-Business Centres (ACABC) schemes, supported by NABARD, provide financial assistance and training for graduates who wish to set up agricultural consultancy services. Before graduation, attend entrepreneurship development programmes, participate in business plan competitions, and intern with agri-startups to understand market dynamics, funding mechanisms, and customer acquisition strategies.

9. Research Methodology and Literature Review: Whether you pursue a Ph.D. or join an R&D division of a seed company, research methodology is non-negotiable. Learn to formulate research questions, design experiments, collect and analyze data, and draw evidence-based conclusions. A thorough literature review—using databases like Google Scholar, Scopus, and Web of Science—ensures your work builds on existing knowledge rather than reinventing the wheel. For master's and doctoral students, NAHEP-CAAST (Centres for Advanced Agricultural Science and Technology) at institutions like IARI, New Delhi, provide platforms for learning cutting-edge OMICs skills through hands-on research and international collaborations.

10. Networking, Internships, and Field Experience: Your network is your net worth. Attend agricultural expos, national seminars, and industry conferences. Connect with alumni working in diverse sectors—some may be agricultural officers, others may be agripreneurs or researchers. LinkedIn is a powerful tool for building professional relationships. Internships, whether at KVKs, seed companies, fertilizer firms, or NGOs, provide invaluable real-world exposure. NAHEP has facilitated over 125 industry MOUs for internships and short-term training programmes. Use these opportunities to test your interests, build your resume, and secure pre-placement offers.

11. Climate-Smart and Sustainable Agriculture: Climate change is the defining challenge of our generation. As future agricultural professionals, you must understand climate-smart agriculture—practices that increase productivity, enhance resilience, and reduce greenhouse gas emissions. Conservation agriculture, integrated pest management, agroforestry, and water-use efficiency technologies are no longer optional knowledge areas. ICAR has established specialized Centres of Excellence in climate-smart agriculture under NAHEP. Familiarize yourself with carbon credit mechanisms, sustainable intensification frameworks, and the National Mission for Sustainable Agriculture (NMSA) guidelines.

12. Continuous Learning and Adaptability: The only constant in agriculture is change. New pests emerge, markets shift, policies evolve, and technologies disrupt traditional practices. Cultivate a mindset of lifelong learning. Subscribe to journals like the Indian Journal of Agricultural Sciences, follow ICAR bulletins, enroll in online courses on platforms like Swayam and Coursera, and participate in webinars. The Agricultural Skill Council of India (ASCI) offers Recognition of Prior Learning (RPL) programmes that acknowledge skills acquired outside formal classrooms, encouraging vertical mobility in the skill ecosystem. Stay curious, stay humble, and never stop learning.

Table 1: Essential Skills vs Why They Matter

Skill	Importance	How Students Can Learn It
Communication Skills	Enables effective knowledge transfer to farmers, stakeholders, and peers; essential for extension work and team collaboration.	Join debate clubs, write for university magazines, volunteer at KVKs, participate in farmer awareness camps.
Scientific Writing	Critical for publishing research, preparing project proposals, and securing funding; builds academic credibility.	Practice writing abstracts and research papers, use Mendeley/Zotero for referencing, attend scientific writing workshops.
Public Speaking	Enhances confidence during seminars, conferences, and farmer meetings; improves career prospects in teaching and extension.	Present at university seminars, join literary clubs, participate in national agricultural conferences.

Digital Literacy (MS Office)	Basic requirement for documentation, data entry, report preparation, and presentations in every professional setting.	Complete certified courses, practice daily use of Word, Excel, and PowerPoint for assignments and projects.
Data Analysis (Excel/SPSS/R)	Enables evidence-based decision making in research, farm management, and policy formulation.	Take online courses on Swayam or Coursera, practice with real datasets, join statistics clubs at university.
Artificial Intelligence in Agriculture	Future-ready skill for precision farming, predictive analytics, and automated decision support systems.	Enroll in AI/ML courses, work on NAHEP-funded AI lab projects, participate in Agri-Inno Challenges.
Precision Agriculture	Optimizes input use, increases yield, reduces environmental footprint; highly valued by agri-tech companies.	Attend KVK demonstrations, intern with precision farming startups, learn about variable rate technology.
Drone Technology	Used for crop monitoring, spraying, and yield estimation; rapidly growing field with high employment potential.	Attend drone training workshops organized by ICAR or private agencies, obtain DGCA certification if possible.
GIS & Remote Sensing	Essential for land use planning, soil mapping, crop health assessment, and climate impact studies.	Learn QGIS or ArcGIS basics, take remote sensing courses, work on spatial data projects.
Internet of Things (IoT)	Enables real-time monitoring of soil moisture, weather, and crop conditions; backbone of smart farming.	Build simple sensor projects, join IoT labs at university, study IoT applications in agriculture.
Agricultural Extension	Bridges the gap between research and practice; critical for technology adoption at farmer level.	Participate in Student READY programmes, intern at KVKs, conduct on-farm trials and demonstrations.
Leadership	Required for managing teams, leading projects, and driving institutional or community-level change.	Lead student clubs, organize events, take up coordinator roles in university activities.
Teamwork	Modern agriculture is interdisciplinary; collaboration across agronomy, engineering, and IT is essential.	Work on group research projects, participate in team-based competitions, join interdisciplinary clubs.
Critical Thinking	Enables objective analysis of problems, evaluation of alternatives, and informed decision making.	Engage in case study competitions, analyze real agricultural problems, question assumptions in research.
Problem Solving	Agriculture is full of unpredictable challenges; systematic problem-solving is a core professional competency.	Participate in hackathons, solve farm-level problems during internships, practice root-cause analysis.
Time Management	Balances academic, research, field, and extracurricular commitments; reduces stress and improves productivity.	Use digital calendars, apply the Pomodoro technique, prioritize tasks using Eisenhower matrix.
Entrepreneurship	Creates self-employment opportunities, drives innovation, and contributes to rural economic development.	Attend EDPs under ACABC/Startup India, develop business plans, intern with agri-startups.
Agri-Startup Awareness	Understanding the startup ecosystem opens pathways to innovation, funding, and scalable ventures.	Follow agri-startup news, attend demo days, network with incubators like a-IDEA (IARI) and Agri-Udaan.
Project Proposal Writing	Essential for securing research grants, government schemes, and startup funding.	Study successful proposals, attend grant writing workshops, practice writing for university competitions.
Research Methodology	Ensures scientific rigor in experiments, surveys, and data collection; foundation of credible research.	Take research methodology courses, assist senior researchers, design and execute independent projects.
Literature Review	Prevents duplication of research, identifies gaps, and positions your work within the broader scientific context.	Use Google Scholar, Scopus, Web of Science; learn systematic review methods, maintain annotated bibliographies.

Scientific Paper Writing	Disseminates research findings to the global community; essential for academic and research careers.	Start with poster presentations, progress to conference papers, then target peer-reviewed journals.
Reference Management (Mendeley/Zotero)	Saves time, ensures accuracy, and maintains consistency in citations across long documents.	Download free versions, import references from databases, practice formatting for different journal styles.
Networking	Opens doors to collaborations, mentorships, job referrals, and industry insights.	Attend conferences, maintain LinkedIn profile, join professional associations like Indian Society of Agricultural Statistics.
Internship & Field Experience	Translates classroom knowledge into practical skills; builds professional credibility and employability.	Apply for NAHEP internships, KVK attachments, industry training programmes, and NGO field projects.
Climate-Smart Agriculture	Addresses the urgent need for resilience against climate change; aligns with national and global sustainability goals.	Study NMSA guidelines, attend climate-smart agriculture workshops, work on carbon sequestration projects.
Sustainable Agriculture	Ensures long-term productivity without degrading natural resources; increasingly demanded by consumers and policymakers.	Learn organic farming, integrated nutrient management, conservation agriculture; visit model organic farms.
Professional Ethics	Maintains integrity in research, respects intellectual property, and builds trust with stakeholders.	Understand plagiarism policies, follow ICMJE guidelines, practice transparent data reporting.
Continuous Learning	Keeps you relevant in a rapidly evolving sector; demonstrates adaptability and commitment to excellence.	Subscribe to journals, enroll in MOOCs, attend webinars, read ICAR annual reports and policy documents.

Essential Skills for Agriculture Graduates: Importance and Learning Pathways

Career Opportunities After Graduation

The career landscape for agriculture graduates in India is remarkably diverse. Beyond the traditional paths of teaching and government service, a world of opportunities awaits those who have built the right skill sets.

Higher Education and Research: Pursue M.Sc. and Ph.D. programmes through ICAR-AIEEA at premier institutions like IARI, NDRI, and CIFE. NAHEP-CAAST fellowships support advanced research in genomics, climate-smart agriculture, and precision farming. For those inclined towards international careers, FAO and CGIAR centres offer research fellowships and consultancy positions.

Government and Public Sector: The Union Public Service Commission (UPSC) and State Public Service Commissions recruit agricultural officers for departments of agriculture, horticulture, and animal husbandry. The Agricultural Scientists Recruitment Board (ASRB) conducts examinations for scientific positions at ICAR institutes. KVKs across the country regularly hire Subject Matter Specialists and Programme Assistants.

Banking and Finance: NABARD, regional rural banks, and commercial banks with agricultural portfolios recruit agriculture graduates as Rural Development Officers, Agricultural Finance Officers, and Credit Analysts. The RBI's focus on priority sector lending has created sustained demand for professionals who understand both agriculture and finance.

Agri-Business and Industry: Seed companies (BASF, Bayer, Syngenta, Indian firms), fertilizer companies (IFFCO, Coromandel), pesticide manufacturers, and food processing industries offer roles in R&D, quality assurance, supply chain management, and technical marketing. The agri-input sector alone employs thousands of agriculture graduates annually.

Agri-Tech and Startups: Companies like DeHaat, Bijak, AgroStar, and Ninjacart are revolutionizing farm-to-market linkages through technology. Roles in data analytics, product management, farm advisory, and business development are growing rapidly. India's agri-tech market is projected to reach \$24 billion by 2025, creating massive employment opportunities.

Entrepreneurship and FPOs: Farmer Producer Organizations (FPOs) are emerging as powerful collective enterprises. Graduates can work as CEO, Manager, or Technical Advisor at FPOs, or establish their own ventures under ACABC, Startup India, and NABARD's Rural Entrepreneurship Development Programmes. Agricultural incubation centres at IARI (a-IDEA), IIM Ahmedabad (Agri-Udaan), and various SAUs provide mentorship, seed funding, and infrastructure support.

NGOs and International Organizations: Organizations like PRADAN, BAIF, ActionAid, and international bodies like FAO, World Bank, IFAD, and CGIAR centres recruit agriculture professionals for development projects, policy research, and programme management roles. These positions often require field experience and cross-cultural communication skills.

The key message is this: your degree is the ticket, but your skills are what get you through the door.

Table 2: Career Skills Roadmap

Year of Study	Skills to Develop	Expected Outcome
First Year (B.Sc. Agriculture)	• Build strong foundation in basic sciences (Botany, Chemistry, Physics, Mathematics) • Develop digital literacy (MS Office, internet research) • Improve English communication and writing • Join student clubs and societies • Understand the agricultural education landscape	• Clear conceptual understanding of core subjects • Basic proficiency in digital tools • Improved communication confidence • Active campus involvement • Awareness of career pathways
Second Year (B.Sc. Agriculture)	• Master data analysis basics (Excel, descriptive statistics) • Learn reference management (Mendeley/Zotero) • Develop public speaking through seminars • Begin scientific writing (lab reports, short articles) • Explore specialization areas (Agronomy, Horticulture, etc.)	• Ability to analyze and present data • Organized research workflow • Comfort with academic presentations • Published short articles or posters • Clarity on specialization interests
Third Year (B.Sc. Agriculture)	• Gain field experience through RAWE/Student READY • Learn research methodology and experimental design • Develop GIS/Remote Sensing basics • Attend national seminars and conferences • Build professional network (LinkedIn, alumni connect) • Explore internship opportunities	• Practical field skills and farmer interaction • Understanding of research protocols • Spatial data literacy • Professional network of 50+ connections • One or more internships completed
Fourth Year (B.Sc. Agriculture)	• Complete major research project/thesis • Write and submit scientific paper or review article • Prepare for competitive exams (ICAR-AIEEA, UPSC, banking) • Develop entrepreneurship skills (business plan, pitch) • Master advanced tools (SPSS, R, Python basics) • Attend placement drives and interviews	• Research publication or thesis submission • Competitive exam readiness • Viable business idea or plan • Proficiency in analytical software • Job offer or admission to higher studies
M.Sc. Agriculture (Year 1)	• Deepen subject expertise • Master advanced statistical methods • Learn AI/ML basics for agriculture • Attend international webinars and workshops • Apply for research fellowships (ICAR-JRF, UGC-NET)	• Subject mastery at advanced level • Complex data analysis capability • Understanding of AI applications • Global academic exposure • Fellowship or scholarship secured
M.Sc. Agriculture (Year 2)	• Complete thesis with publication-quality output • Present at national/international conferences • Build industry connections	• Peer-reviewed publication(s) • Conference presentation experience

	• Prepare for Ph.D. entrance or job applications • Develop teaching and mentoring skills	• Industry references and connections • Clear career trajectory • Teaching portfolio
Ph.D. Scholar (Years 1–3)	• Conduct independent, original research • Publish in high-impact journals (SCI/Scopus) • Develop grant writing skills • Build international collaborations • Mentor junior students • Attend advanced training programmes	• 2–3 quality publications • Research independence • Grant writing competence • International research network • Leadership and mentoring experience
Ph.D. Scholar (Years 4–5)	• Complete dissertation • Defend thesis • Apply for postdoctoral positions or faculty roles • Develop course curriculum design skills • Engage with policy and extension	• Doctoral degree awarded • Postdoc or faculty position secured • Teaching and curriculum expertise • Policy engagement experience • Ready for academic or research leadership

Career Skills Roadmap: A Year-by-Year Guide for Agriculture Students

Quick Tips for Success

- 1. Start Early:** Begin building skills from your first year. Waiting until the final year leaves no room for mastery.
- 2. Balance Theory and Practice:** Classroom knowledge gains value only when applied in the field. Spend time on farms, not just in libraries.
- 3. Build a Digital Portfolio:** Maintain a LinkedIn profile, a personal blog, or a GitHub repository. Showcase your projects, publications, and achievements.
- 4. Seek Mentorship:** Find professors, alumni, or industry professionals who can guide your career. A good mentor accelerates growth exponentially.
- 5. Learn One New Tool Every Semester:** Whether it is a software, a language, or a technique, commit to continuous skill acquisition.
- 6. Participate in Competitions:** Hackathons, business plan competitions, and research poster contests build confidence and visibility.
- 7. Read Widely:** Beyond textbooks, read agricultural magazines, policy documents, and research papers. Awareness of current trends sets you apart.
- 8. Develop Financial Literacy:** Understand basic accounting, budgeting, and financial planning. Essential whether you become an entrepreneur or a manager.
- 9. Stay Physically and Mentally Fit:** Agriculture is demanding. Fieldwork, long hours, and rural postings require stamina and resilience.
- 10. Give Back:** Volunteer for community programmes, mentor juniors, and contribute to rural development. The best professionals are also the most generous.

Figure: Quick Tips for Success — Practical Recommendations for Agriculture Students

Conclusion: Your Future Starts with the Skills You Build Today

The journey from an agriculture student to a successful professional is not defined by the marks on your transcript alone. It is shaped by the skills you deliberately cultivate, the experiences you actively seek, and the networks you thoughtfully build. Agriculture 4.0 has arrived, and it demands graduates who are as comfortable with Python as with a plough, as fluent in data analytics as in farmer dialects, as innovative in business models as in breeding techniques.

The Indian Council of Agricultural Research, through NAHEP, has laid the groundwork. Centres of Excellence in climate-smart agriculture, AI labs, international training programmes, and industry partnerships are now available at your doorstep. The Food and Agriculture Organization's global initiatives, from the Digital Agriculture Innovation Bootcamp to the AgriInno Challenge, connect Indian students with worldwide innovation

ecosystems. NABARD's financial instruments, Startup India's policy support, and ASCI's competency frameworks create an enabling environment for skilled graduates.

But opportunity favors the prepared. Start today. Master one new skill this semester. Complete one certification this year. Publish one article before you graduate. Build one meaningful professional relationship each month. The agriculture sector in India—and globally—needs professionals who combine scientific rigor with digital fluency, entrepreneurial energy with ethical grounding, and local knowledge with global perspective. Your degree is the foundation. Your skills are the structure. Your passion and perseverance are what will make you indispensable. The future of Indian agriculture is being written now, and you have the pen in your hand.

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