HUMAN RESOURCE REQUIREMENT IN AGRICULTURE

Indian Council of Agricultural Research (ICAR)

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Acknowledgement

1. Introduction

Indian agriculture has made remarkable progress on production enhancement leading to food security Competent human resources have been the fulcrum of the progress. Indian Council of Agricultural Research (ICAR) has played a key role in enabling and capacitating these human resources. In the wake of evolving geopolitical scenario, dynamic supply–demand forces and steep technology disruptions globally as well as nationally, identifying and developing quality human resources at various levels in agriculture and allied sector has become more relevant.

Looking at the intended outcomes of National Agricultural Higher Education Project (NAHEP-An ICAR- World Bank funded project), a need was felt to undertake an assessment study of Human Resource (HR) requirements in Agriculture and allied sector under the ambit of ICAR. This study was aimed to further aid in the ongoing implementation efforts of NAHEP through possible alignment of project activities meeting human resource (HR) demand potentials of sub-sectors, related project advisories & orienting impact assessment study and bringing more directional efforts in overall implementation of NAHEP, leading to achievement of key project outcomes such as improved student placement rates & entrepreneurship, enhanced industry sponsored projects in cutting edge areas etc. The study aimed to provide a strategic input to the ICAR education system while critically analyzing the demand and supply of human resources in the Agricultural education – employment ecosystem.

This policy note captures the key outputs and findings of this study in the form of a roadmap which will help in bringing more directional efforts in

implementation of ongoing agri education initiatives of country through right assessment of HR supply - demand estimations and forecasts. It will also support ICAR in better aligning and achieving its future visions and strategies in long run.

Previous Studies[1]

ICAR has been cognizant of the future human capital requirements in agriculture and allied sectors in country so as to put development of agricultural human capacity development on a rational footing. The most recent study was completed in 2011 with a report named "Assessment of Future Human Capital Requirements in Agriculture and Allied Sectors" under ICAR-NAIP project. According to the report, the forecast for 2020 was estimated that there will be 53,630 students' supply whereas in the actual scenario the number of graduates supplied are 70,410 which shows 31% deviation from the forecasted value.

At the Undergraduate (UG) level, the deviation is around 25% with a forecasted value of 40,188 and an actual value of 50,375. At the Postgraduate (PG) level, the deviation is around 41% from the forecasted value of 10,638 to the actual value of 14,981. Whereas, at the Doctorate (PhD) level, 80% deviation is found with a huge variation between the forecasted value of 2,805 and the actual value of 5,054. The overall number of constituent (aided) Agri colleges expanded from 360 to 617 over the previous decade, while the number of private (affiliated/non-aided/semi-aided) institutions increased from 168 to 398 at present.

2. Agriculture Scenario

The agriculture sector provides livelihoods for large populations in developing countries and helps sustain economic growth in developed economies. By 2050, the world's population is expected to reach 10 billion, which makes it crucial to find solutions to fulfil future requirements of food, feed, fuel and industry[2]. Globally, food demand is expected to increase in the range of 59-98% by 2050.

To meet this demand, agricultural produce in 2050 will need to increase by 50% as compared to that in in 2012. In the near future, regions with high population growth will have most of the additional demand for food, particularly India, the Middle East, North Africa and Sub-Saharan Africa. While India's population is projected to grow at the compounded annual growth rate of 2%, demand for key food grains is expected to grow at a compound annual growth rate (CAGR) of 3%[3].

With growing demand for food, it is necessary to increase resource use efficiency. The 2018 Global Agricultural Productivity Index™ (GAP Index™)[4] reveals that for the fifth straight year, Global agricultural productivity growth is not accelerating sufficiently to sustainably meet the food, feed, fiber and fuel needs of nearly 10 billion people in 2050.

[2] The future of Food and agriculture – Trends and Challenges, FAO 2017
[3] World Fisheries and Aquaculture, FAO 2020, UN's department of Economic and social affairs (UN – DESA), 2018
[4] Sowing the Policy seeds of a flourishing agriculture sector, PwC 2019

Relevance of Agriculture in Global landscape and emerging trends

The agriculture sector not only contributes towards securing livelihoods of large populations in developing countries but also helps in sustaining economic growth in developed economies. Employees of Global food systems account for 29%[5] of the world's employed and utilize 38%[6] of the total available land to produce food. Out of the total 570 million farms available worldwide, 500 million[7] are smallholders who produce 80% of the world's food crops.

In future, we would need to feed 10 billion[8] people worldwide, provide them adequate nutritional security and ensure sustainable agriculture practices despite the shrinking land and natural resources.

In India, Agriculture and allied sectors grew at a rate of 3% in 2021-22, whereas it performed better than the services and industry sectors during the pandemic year- 2020. This performance may be majorly attributed to a comparatively fair monsoon and enabling government policies such as direct benefit transfer, agri infrastructure development, better market support etc. During the last decade, the share of the service industry has been comparatively higher (~60%) followed by industry (~23%) and then Agri and Allied sector with 16%.

Within Agri and allied sector, Horticulture production has already surpassed the Food grain production in 2012-13, accounting for around 35% of total value of crop output in total Agri and allied sector. The allied sector has grown in prominence over the previous decade, owing to rapid expansion of animal husbandry and fisheries sectors.

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[5] https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS

[6] https://www.fao.org/3/i6583e/i6583e.pdf

[7] https://www.fao.org/family-farming/themes/small-family-farmers/en/

[8] https://www.weforum.org/reports/innovation-with-a-purpose-the-role-of-technology-innovation-in-accelerating-food-systems-transformation

Figure 1 Sectoral share and performance of agri and allied sectors in India

Figure 1 Sectoral share and performance of agri and allied sectors in India
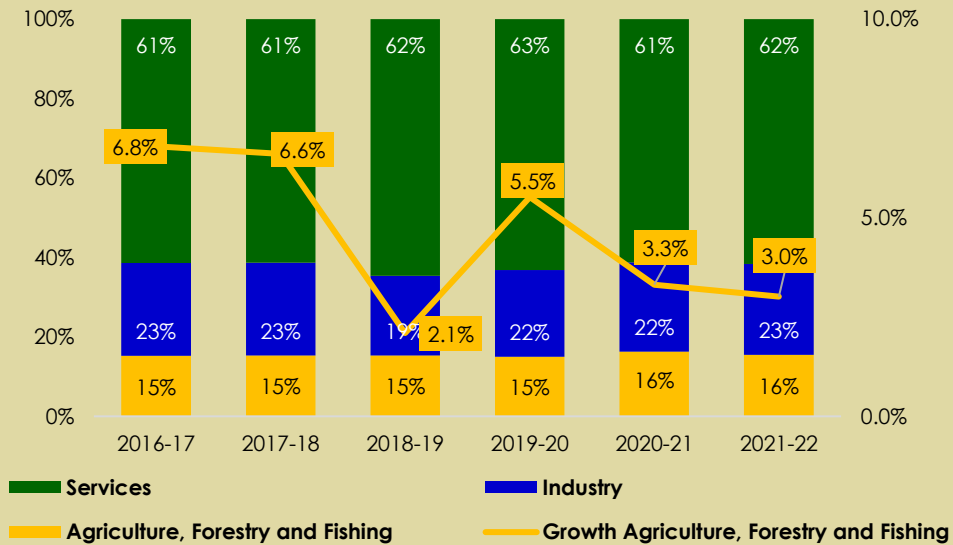
During the recent decade (2010-19), the Indian livestock sector has record CAGR growth of 6.6%[9], with India becoming as a leading producer of milk, eggs, and meat in the globe. With the extent of operational land holdings constantly decreasing, livestock is developing as a major source of steady income for not just small and marginal farmers, but also landless laborers.

Employment Scenario

Globally, Millions of people have gone through changes which have greatly transformed their lives within and beyond work, their wellbeing, and the efficiency. Millions of people have lost their jobs around the world, and millions more are at risk as a result of the Global crisis, economic structural change, and increased automation.

In the last decade, the advent of ground-breaking & emerging technologies has led to the onset of Fourth Industrial Revolution (Industry 4.0). In order to suitably capture the prospects generated by these technologies, many private sector organizations have reoriented their strategic priorities including Human Resource management and engagements. As per PwC[10] analysis on Workforce of the Future- The

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[10] PricewaterhouseCoopers

Competing forces shaping 2030, the major forces that are reshaping the current world of job globally are: Technology breakthroughs / advancements, demographic shifts, rapid urbanization, changes in Global economic power and climate change[11].

Figure 2 Forces reshaping the world of work globally

Technological breakthroughs
Rapid advances in technological innovation

Demographic shifts
The changing size, distribution and age profile of the world's population

Rapid urbanisation
Significant increase in the world's population moving to live in cities

Shifts in global economic power
Power shifting between developed and developing countries

Resource scarcity and climate change
Depleted fossil fuels, extreme weather, rising sea levels and water shortages

World Economic Forum estimates that by 2025 around 85 million jobs might get displaced by a change in the division of labour between humans and machines, while 97 million new roles may emerge in the new division of labour between humans, machines, and algorithms. To prepare for the new age roles, companies are looking to reskill and upskill the majority of their workforce to reduce skill gaps. As per the CII[12] report, in 2020, there were about 900 million people (67% of the total population) in the working age group of 15-64 in India, which is expected to increase by another 100 million by 2030, despite a declining trend in the fertility rate. This implies that a whopping 24.3% of the incremental Global workforce over the next decade will come from India.

Till early 21st century, globally agriculture was the primary source of the overall employment globally. However, the number of people engaged in agriculture and allied sector has reduced by 17% between 2000 and 2020, reaching 874 million in 2020. Agricultural employment in Asia has fallen from nearly 800 million to approximately 590 million, implying that more than one out of every four agricultural employees in the area has left the industry for another career choice outside agriculture.

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[11] World Food and Agriculture – Statistical Yearbook 2021 FAO
[12] Confederation of Indian Industry

Between 2000 and 2020, the worldwide share of employment in agriculture, forestry, and fisheries fell by nearly 13 percentage points to 27.4 percent. Nonetheless, agriculture is the world's second greatest source of employment, after only the services industry. A decrease in the percentage of the agricultural sector is typically associated with rising income levels, which explains the decrease in the share of agricultural employment across all regions and almost all nations.

Overall working population in India has been growing significantly since last couple of years, whereas labour force participation has exhibited comparatively lower pace and unemployment has increased during the same period.

Indian labour force market

- Between 2011- 12 and 2019-20 the labour force grew ~63 million at CAGR of 1.4% whereas unemployment grew at CAGR of 10.7% reaching 26 million from 10 million form 2011-20.
- Rate of growth of population among those aged 25 years or above was around 2.5% per year (CAGR), but the rate of employment growth (on a much lower base) was around 1.5 to 2 %. For rural women, it was negative.
- Unemployment increases at higher education level.

Based on multiple analyses, it emerges that the key factors behind high unemployment of doctoral and (post-graduate) students include inadequate numbers of industry and academia jobs, challenges in the faculty recruitment process indicated by vacant faculty positions while doctoral students apply for low-skill jobs in other sectors, and inadequate quality of doctoral programs. It has also been observed that at times there is inadequate quality assurance of doctoral programs, and the volume and quality of research produced are low. These factors contribute to low employability and lack of preparedness of doctoral students as future faculty.

Working age population and female participation[13]

Growth of working age population in India stood at ~2% in 2020, has constantly been declining and is expected to reach 0.3% by 2033. Comparing with other emerging markets and BRICS nations between 2020 - 24, India has an opportunity to grow with 5%+ rate due to better working age population growth.

- Indian working age population is declining, and the growth rate is expected to turn negative by 2050
- Female labour participation is less in India compared to China and countries with similar income levels
- There's an opportunity for better GDP growth (5%+) post 2030 through improved female workforce participation

As per India Skill Report 2023[14], the overall employability in India in 2017 stood at 40.44%, which has increased to 50.3% in 2023. In 2022, the employability rate for male graduates in India was 47.28% while the employability rate for female graduates was comparatively higher i.e., 53.28%. The significant growth in female employability is a testament of India's achievement in providing better access to education including higher education, creating employment opportunities and improving female labour force participation rate (movement from unorganized to organized sectors).

- Employability by program where four-year professional course graduates and MBA graduates were found to be the most employable talents across all domains.

Employability in B. Com and B. Arts have also been catching up since last couple of years, possibly due to increased demand for non-technical employability skills.

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[13] World Bank stats: https://data.worldbank.org/indicator/SL.TLF.INTM.FE.Z

[14] Skill India Report, CII-2023
https://www.cii.in/PublicationDetail.aspx?enc=XF2FtOKR1TnDFQ/BVpAZp2KoWPo5sapXv7+q7UwuUFs=

Figure 3 Employability in India

Employability in India

	2016	2022
	38%	46%

Employability by Gender (%)

■ Male ■ Female

	2019	2022
Male	34	46
Female	46	51

Employability by Domain (%) ■ 2019 ■ 2022

Domain	2019	2022
4 years professional course	57%	55%
MBA	36%	55%
B. Arts	29%	44%
B. Com	30%	43%
B.Sc.	47%	38%
MCA	43%	29%
Polytechnic	18%	21%
B. Pharma	36%	45%
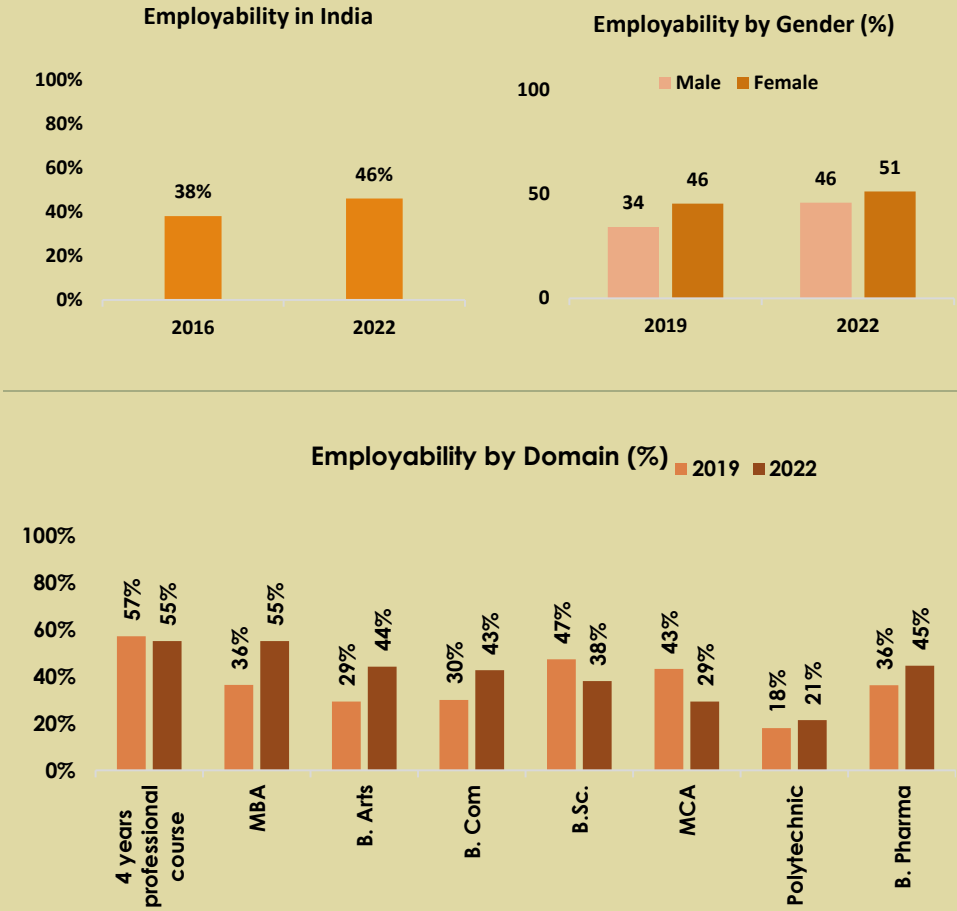
At overall level, the previous sections of this document have presented an insight on overall Global as well as domestic level scenarios of the labour market. When it comes specific to agriculture, it has also been observed that the rise of technology solutions such as artificial intelligence (AI), machine learning, internet of things (IoTs), automation, etc. along with the increase in smartphones and internet penetration at rural level, etc. present a great opportunity to increase labor productivity and improve employment opportunities in the agriculture sector.

3. Agricultural Higher Education in India

ICAR supports and regulates Agricultural Education in India, which is primarily delivered through ICAR AU System, it comprises of State Agricultural Universities (66), a few Deemed to be Universities (4), Central Agricultural Universities (3), and Central Universities with Agriculture Faculty (4) under the ambit of Agricultural Education Division (AED). The division is involved in strengthening and streamlining of higher agricultural education system to enhance the quality of human resources in Agri-supply chain to meet future challenges faced by agriculture sector in the country[15]. In India, there are 1,259 ICAR constituent and private (affiliated[16]) Agriculture and allied colleges, up from 626 in 2010. The student admission capacity has expanded from fewer than 5,000 in 1960 to 70,410 in 2020.

Table 1 Education level-wise distribution of colleges and student's intake in agricultural higher education

Education Level	Colleges	Distribution by student intake
UG	703	50,375
PG	339	14,981
PhD	217	5,054
Total	**1259**	**70,410**

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[15] Landscape of Higher Agricultural Education in India, July 2020

[16] Definition of affiliated (private): Considered semi-aided colleges, private non-aided colleges are not part of this data. Semi-aided colleges follow the ICAR accredited courses only.

Currently, there are ~19% Affiliated (private) colleges in India which offer Agricultural Higher Education to students. Majorly, private colleges offer UG-level education programs.

Landscape of Higher Agricultural Education in India

There are 13 major disciplines offered under Agricultural Higher Education in India. Based on the intake capacity and attractiveness of the sector, Agriculture stands at the top (~45%) followed by Veterinary, Horticulture, Engineering etc.

Figure 4 Discipline wise number of intakes over last 10 years[17]
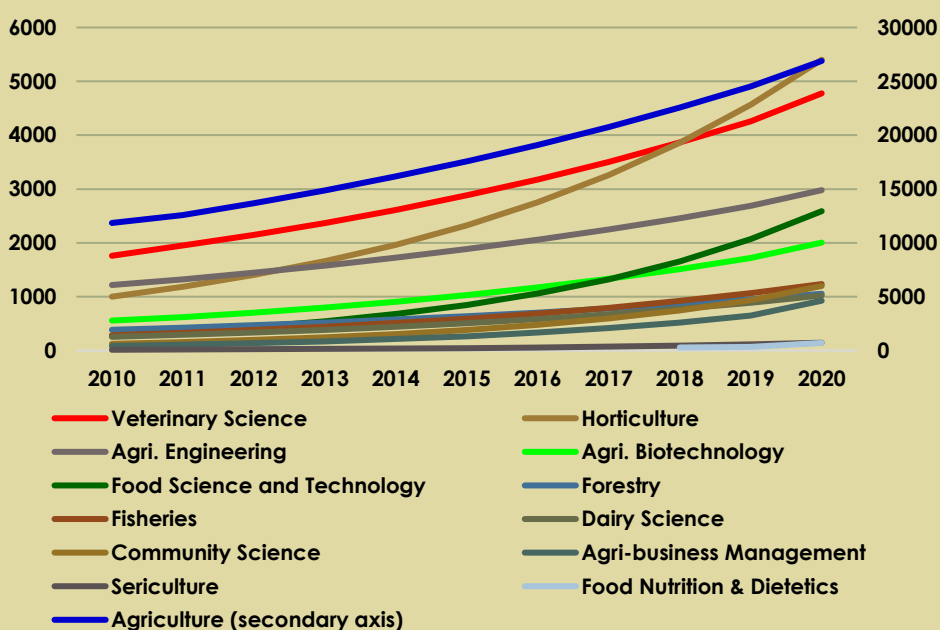
Over the last decade, ICAR- AED has made significant efforts for both students and faculty to further strengthen the overall AU system and improve quality and relevance through various initiatives and programs such as Student READY, Experiential Learning Program (ELP), offering National Talent Scholarships to various groups of students, attracting foreign talent through International Fellowships, and so on.

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[17] Data received from AED and PwC Analysis- data for UG-constituted colleges only

NAHEP has provided not only a significant push to these initiatives (not limited), but also has created an enabling ecosystem for better quality & more relevant agri higher education in country.

Moreover, a few additional initiatives undertaken by ICAR- AED under NEP implementation strategies such as 'Making Multi-disciplinary Agricultural Universities,' focusing on developing a 'Single Window System for International Students,' adoption of 'Institutional Development Plans' by each AU, focusing on maintaining a 'Minimum 3000 Student Strength by each AU,' planning 'Research Support System through National Research Foundation' to strengthen the research capabilities at AU level, promoting 'Online & Digital Education are also worth mentioning and adding to uplift the agricultural higher education in India.

With a plan to promote and coordinate agricultural higher education in the country, 77 AUs of ICAR-AU-System had a cumulative budget of INR 15,735 Crores in 2021-22. Out of this, ~90% budget goes to SAUs, whereas rest is allocated to CAUs and Deemed AUs.

Figure 5 Budget contribution of ICAR-AU System[18]

Overall budget (INR Crores)

■ State ■ Central ■ Others

	2019-20 INR 14,288	2020-21 INR 13,431	2021-22 INR 15,735
Others	13%	14%	12%
Central	25%	20%	23%
State	63%	65%	63%

Budget distribution of ICAR AU-System

■ SAUs ■ CAU/Deemed

	SAUs	CAU/Deemed
2021-22	88%	12%
2020-21	90%	10%
2019-20	88%	12%
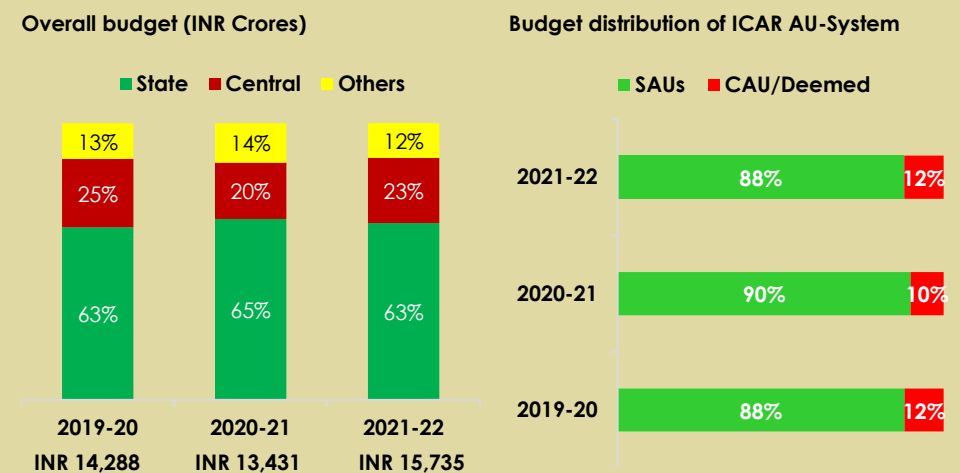
Interestingly, the average budget has marked >INR 200 crores in recent years and there are 29 SAUs which have crossed INR 200 Crores mark in 2021-22 compared to 17 in 2019-20. As per available data, presently there are 37% vacancies in total for faculties in ICAR AU System.

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[18] Agricultural Universities Ranking System (AURS) & PwC Analysis

Budget distribution by type of university

Legend: ■ State ■ Central ■ Others

SAUs

	2019-20	2020-21	2021-22
Others	14%	15%	14%
Central	15%	13%	14%
State	71%	71%	71%

Deemed/CAUs

	2019-20	2020-21	2021-22
Others	3%	7%	4%
Central	94%	82%	91%
State	3%	11%	4%
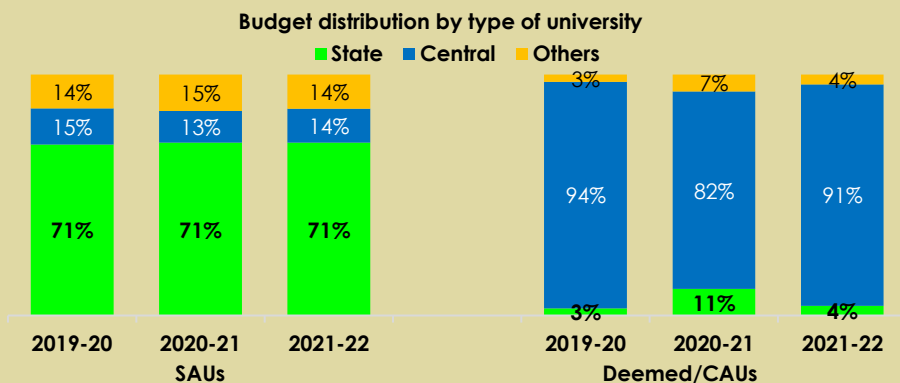
Figure 6 Distribution landscape of faculty staffs in ICAR – AU system

In position and vacant positions for faculty staffs at AUs

		In-Position	Vacancies	Sanctioned
SAUs	2019-20	62%	38%	29,903
	2020-21	63%	37%	29,877
	2021-22	61%	39%	31,171
CAUs	2019-20	58%	42%	1,168
	2020-21	58%	42%	1,029
	2021-22	63%	37%	1,125
Deemed	2019-20	82%	18%	1,159
	2020-21	75%	25%	1,704
	2021-22	80%	20%	1,175
Total	2019-20	63%	37%	32,230
	2020-21	63%	37%	32,610
	2021-22	62%	38%	33,471

Legend: ■ In-Position ■ Vacancies
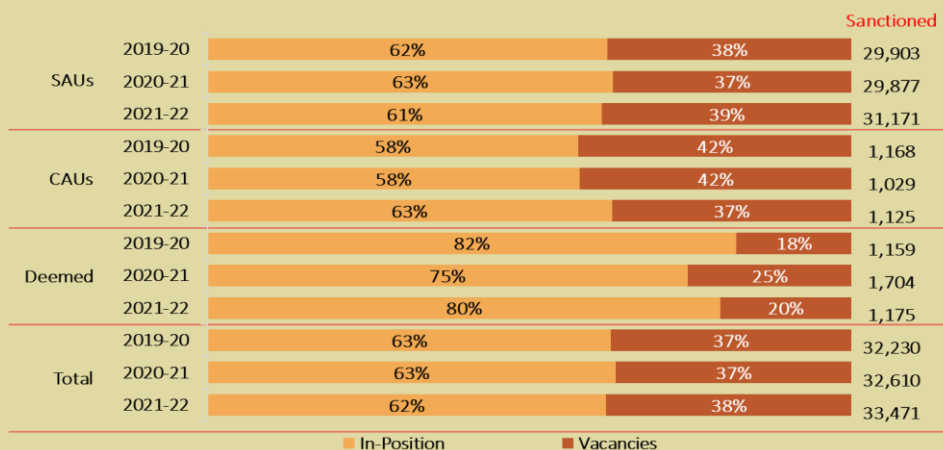
Purpose based categorization of faculty staffs

		College	Research	AICRP	KVK
SAUs	2019-20	62%	13%	12%	13%
	2020-21	62%	14%	12%	13%
	2021-22	63%	13%	11%	14%
CAUs	2019-20	70%	4%	14%	12%
	2020-21	72%	4%	15%	9%
	2021-22	73%	5%	3%	19%
Deemed	2019-20	93%			7%
	2020-21	86%		7%	4%
	2021-22	92%			7% 0%
Total	2019-20	63%	13%	11%	12%
	2020-21	64%	13%	11%	12%
	2021-22	64%	12%	10%	13%

Legend: ■ College ■ Research ■ AICRP ■ KVK
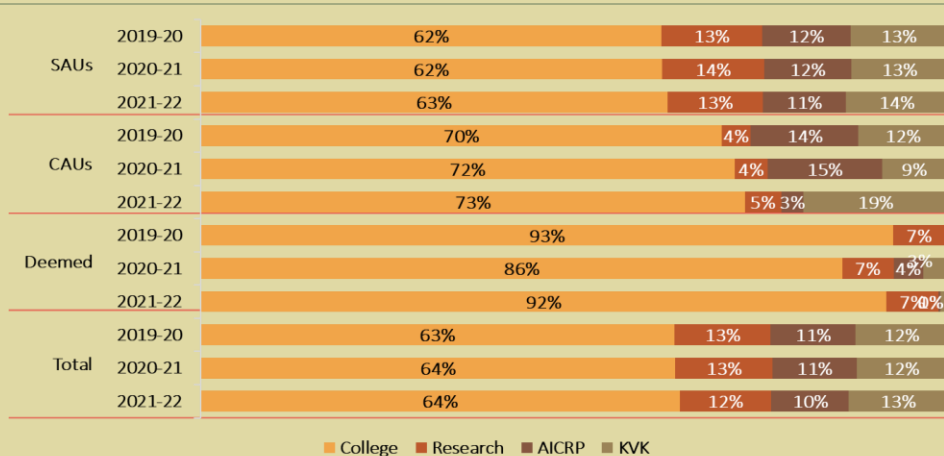
Enrollment of Agri & Allied graduates in India

Agricultural Higher Education (which contributes only 1% in overall enrollments) in the country is currently offered by 1259 colleges in the country and around 70,410 students are pursuing their career in the field and this student intake has grown with 11% CAGR in last decade. Amongst the program perceived, UG contributes 80% share. Interestingly, the female participation has recently marked 44% and has been more than 50% in 11 states of the country. When the state scenarios for all Agri higher education level enrollments are examined, it can be observed that the top 5 states contribute more than 50% of overall enrollments. Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, and Rajasthan dominated the top five. This involves participation from both public and private (affiliated) universities. The number of colleges and their availability are likewise linked to the state Agri GSDP.

Figure 7 Female student share in total enrollments by state
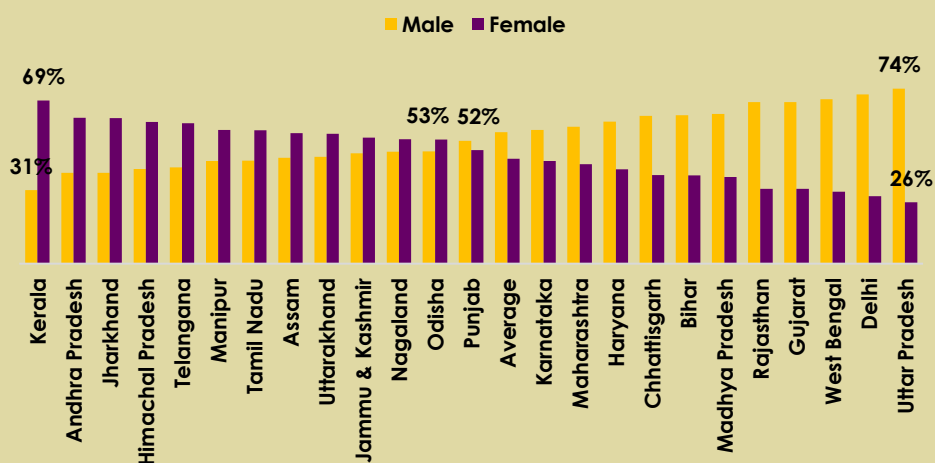
It has been found that the top 15 states contribute more than 90% of the Agri colleges (Constituent+ private affiliated) existing in the country are also contributing 88% of the GSVA[19] of agriculture and allied. Maharashtra has the most colleges and contributes 8% of Agri GSVA, followed by Uttar Pradesh, which contributes 11% of Agri GSVA. While AP, MP, and UP have larger Agri GSVA contributions than Maharashtra, they have a far lower number of Agri and related institutions.

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[19] GSVA- gross-state-value-added

Figure 8 State GSVA vs No. of Colleges

Figure 8 State GSVA vs No. of Colleges

Axis labels: GSVA Current Price (2019-20) (in lakh rupees) vs Number of colleges

Data points: Uttar Pradesh, 113; Madhya Pradesh, 51; Andhra Pradesh, 53; Maharashtra, 260; West Bengal, 33; Rajasthan, 80; Gujarat, 74; Tamil Nadu, 86; Karnataka, 82; Punjab, 39; Haryana, 40; Bihar, 33; Kerala, 4; Chhattisgarh, 67; Jammu & Kashmir, 33

Figure 9 State GSVA vs No. of AIEEA (UG) Applicants

Figure 9 State GSVA vs No. of AIEEA (UG) Applicants

Axis labels: GSVA Current Price (2019-20) (in lakh rupees) vs Number of colleges

Data points: Uttar Pradesh, 13965; Madhya Pradesh, 11651; Andhra Pradesh, 12213; Maharashtra, 3438; West Bengal, 14357; Rajasthan, 29025; Karnataka, 6522; Tamil Nadu, 16895; Telangana, 12238; Haryana, 7203; Odisha, 11104; Chhattisgarh, 4961; Jharkhand, 4547; Bihar, 33948; Kerala, 38651

A similar trend is also observed in AIEEA[20] (UG) applicants from a specific state and its GSVA of agriculture and allied. The top 15 states account for 93% of all applications and account for 84% of total GSVA. In terms of applications for AIEEA UG seats, Kerala, Bihar, and Rajasthan are the top three states. This is a significant untapped potential to increase the number of Agro and related institutions in at least Kerala and Bihar in order to fulfil significant in-house state demand and, eventually, contribute to state agriculture GSVA.

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[20] AIEEA: All India Entrance Examination for Admission

4. Potential of employment needs and preferences

This study covered the views of >6500 students[21], >1086 alumni[22] & >1300 faculties[23] and also involved one to one interactions with 20 policymaking institutions and 5 FGDs (with minimum 40 participants in each FGD meeting) with employers / private players / industry representatives across agriculture and allied value chain to collect and validate views on future skill needs in broader agriculture sector, adequacy of current skill sets, supply of human resource by career streams (mapping of current supply to the employment) and at experience level, demand forecast by sub-sectors, disciplines etc., views on policy considerations influencing future opportunities of employment in sub- sectors, key trends & challenges emerging in the sub-sector etc.

With the exhaustive methodology followed for this study, feedback has been collected from all stakeholders of the ecosystem and have observed various trends around potential employment needs and preferences of the students towards it, factors influencing on decision of career paths, opinion on current education delivery and its relevance to the current market trends etc.

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[21] N=6,505 (female responses: 47%), Education level sample: UG-75%, PG-13%, PhD-7%,
[22] N=1086, (female: 25%), Category level sample: Equal across education level i.e. 33%.
[23] N=1,326, (female: 31%), Category level sample: Professor: 83%, Dean, Director, Scientist: 17%

Summary of key findings from different stakeholders

1. Student:

1. Awareness and perception of students on agri higher education

- ~30% of total surveyed students or responses were self-aware / through social media about agri higher education, ~25% got awareness through seniors, fellow friends and relatives
- Students got awareness through school noticeboards and newspaper advertisements are very low (Only 10%)

Reasons to consider agri as higher education option

- ~50% feels agri is interesting subject for them and an essential professional degree required to get job in the sector, whereas ~25% find agriculture as useful to prepare for other competitive exams.
- 10% respondents have also mentioned that fellow friends have suggested them to pursue Agri higher education considering better career opportunities in sector.

Information sources of higher education (%)

Source	%
School noticeboards	8
Seniors	28
Seminars organized on carrer opportunities	21
Relatives	25
Fellow Friends	25
Social Media	30
Newspaper Advertisement	18
Self-aware	34
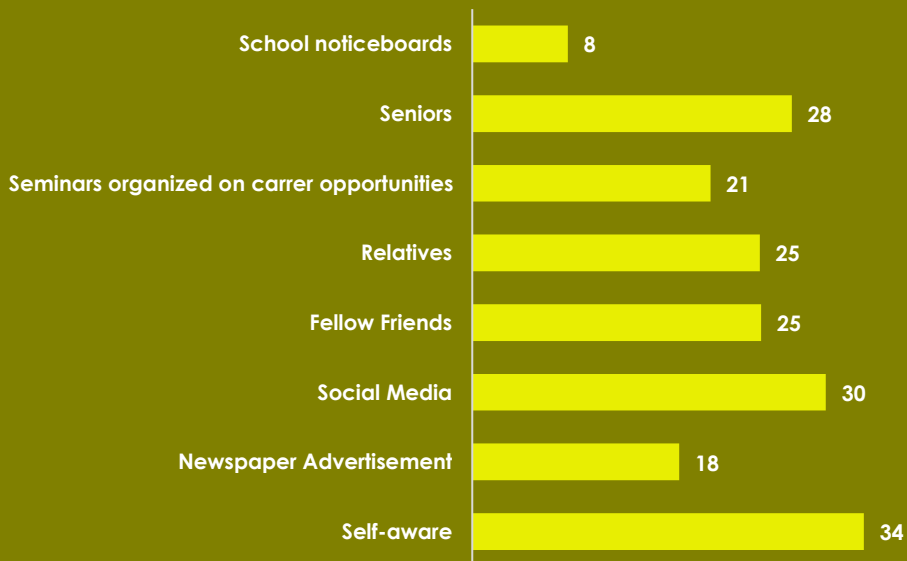
Reasons to consider Agricultural Higher Education option to pursue your future career(%)

Reason	%
My fellow friends suggested to pursue considering better career avenues	13
Does not require any entrance exam for admission	2
I find this subject more easy than other higher studies	9
Essential professional degree for most of the jobs in Agri- sector	45
Useful for other competitive exams	27
Interest subject for me	49
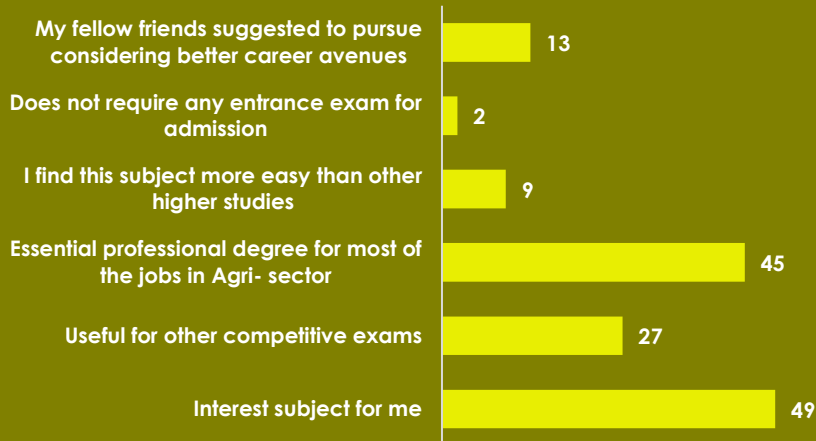
2. Skills acquired and its relevancy in existing curriculum

Factors influencing decisions to choose job in agri and allied

- Subject interest, better return on investment (ROI) in education, suitable job opportunities as per skills acquired, better career prospects are some of the key factors mentioned by 60-70% students.
- 50% PG and PhD students also mentioned that better remuneration is one of the key factors.

Skills acquired through existing curriculum

- ~50% of the respondents mentioned that personality development, core subject knowledge, communication, research and coordination, industry etiquettes and behavior are the key skills acquired through agri higher education.
- While only 30% perceives computer and IT, entrepreneurial, business analytics and digital marketing skills are acquired through existing curriculum
- It is also observed that UG students have comparatively acquired lesser number of market-oriented skills than PG and PhD. (Role of NAHEP in developing market-oriented courses will play an important role herein)

Factors influencing the decision to choose any particular job profile to pursue a career (%)

Factor	%
Suitable job as per my skill sets	65
Subject interest	76
Location	37
Ease of Working	38
Better Return on Investment in Education	46
Better Remuneration	40
Better Career Prospect (For e.g...	61

Skill sets acquired during current educational program/studies (%)

Skill set	%
Research and Coordination Skills	45
Personality development skills	51
Knowledge on subject area	51
Industry etiquettes and behavior	40
Entrepreneurial Skills	39
Digital Marketing Skill	34
Communication or Negotiation skills	45
Business ethics and morals	39
Business Analytics	33
Acquired desired computer and IT skills	33

3. Relevancy and career preferences to pursue in future

Career preferences to pursue based on existing skills acquired

- 50% respondents mentioned that agriculture / allied officer in government department, preparation for competitive exams and pursuing higher studies are key the career preferences / preferred trajectories for them.
    - >80% PhD students mentioned to evolve as academician and >60% preferred to join as an agri officer in departments,
    - 50% PG students mentioned to prefer preparation for competitive exams

- • 50% UG students mentioned to prefer higher studies and preparation for competitive exams,
- Out of total respondents, 25% would like to prefer self-employment based on available skill sets

2. Faculty

1. Employment trends in future

Current employment trend
- 50% of respondents mentioned that students should pursue higher studies, pursue jobs in government departments and 30% mentioned that students prefer academic jobs, sales and marketing profile, officers in banks, pursue competitive exams etc.
- Only 20% faculties mentioned that students are eager to start their own enterprise or consider project management role (intrapreneurship) in private firms

Likely employment trend in future
- Out of total faculties, 50% mentioned that opportunities have significantly increased in private sector, employers focusing more on other skills than academic results while recruiting (non-technical employability skills),
- Only 10% would like to prefer entrepreneurship over other interest areas

Skill sets required to perform their responsibilities after joining
- 75% respondents mentioned that communication skills, IT skills, business analytics, personality development, subject knowledge are some of the key skill sets required
- 50% director level faculties perceive that requirement of subject knowledge is comparatively low than other skill sets (personality development skills)

Current employment trend (%)

Category	Value
Veterinary Doctor	39
Self- Employment/ Enterpreneurship	19
Sales and Marketing Manager	32
Quality manager in dairy/food	26
Pursue Higher Studies	45
Pursue Competitive exams	38
Others	19
Field Assistant	21
Credit Manager in NBFC or Private Banks	16
Buyer, Commodity Trader, Category/…	18
Agronomist/ Horticulturist	34
Agricultural Officer in State department	41
Agricultural Officer in Banks	34
Agri - Consulting or Project Manager	19
Academician	34

Skill sets desirable for students to perform their responsibilities after joining the organization (%)

Category	Value
Subject knowledge	77
Personality development skills	76
Ethics and morals	71
Computer and IT skills	69
Communication skills	74
Business and analytical skills	64
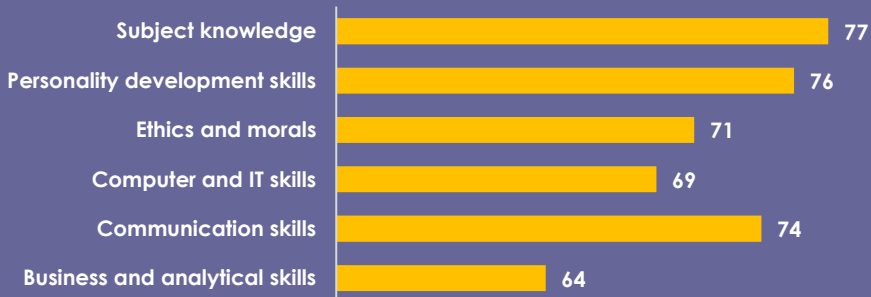
2. Relevancy of existing curricula and requirement for revision

Existing competency level of faculties

- 75% respondents mentioned that faculties are good with only teaching theoretical and/or practical subjects whereas
- 50% mentioned that faculties are also better with orienting students on communication skills

- Only 30% respondents mentioned that faculties are better with orienting students on business acumen, orienting on personality development skills

Additional efforts to be made for improving student competency
- Training to the students on communication skills and exposure visits to industry are the most common efforts to be made perceived
- 75% also mentioned that organizing guest lecture through industry experts, personality development trainings, introducing market-oriented pilot courses etc. are need of the hour.
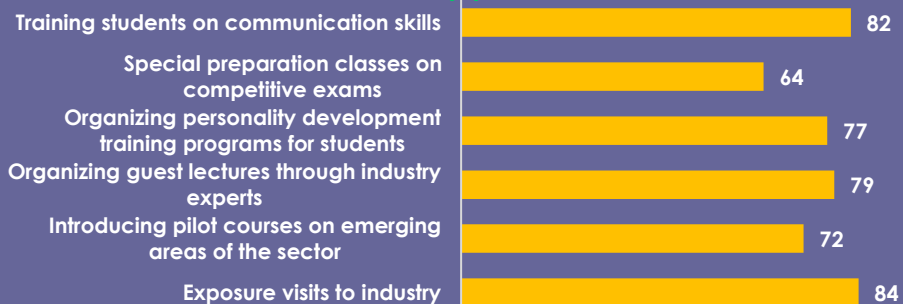- Additional efforts to be made for improving faculty competency
- ~80% respondents mentioned that availability of digital teaching aids, regular faculty upgradation programs, establishing linkages with industry, exchanging learnings from reputed institutes, orientation by Global experts are some of the efforts to be made for improving faculty competency
- All director level faculty mentioned that faculty upgradation program and exchanging learnings from reputed institutes are immediate actions required.

Competency level of faculties(%)

Category	Value
Theoretical subjects	74
Practical subjects	65
Orienting students on personality development skills	46
Orienting students on business acumen	40
Communication skills	58

Efforts to be made on improving student competency by the university (%)

Category	Value
Training students on communication skills	82
Special preparation classes on competitive exams	64
Organizing personality development training programs for students	77
Organizing guest lectures through industry experts	79
Introducing pilot courses on emerging areas of the sector	72
Exposure visits to industry	84

NEP acknowledges that despite the initiatives taken so far to improve academic careers, overall faculty motivation in terms of teaching, research, and service is low. It discusses several challenges in faculty selection and promotion, quality of research and quality standards including limited teacher and institutional autonomy, inadequate mechanisms for merit-based career management and progression of faculty, low emphasis on research and ineffective quality assurance.

3. Alumni

1. Placement scenario and academic facilities supported in better placement

Placement in job market
- Only 20% mentioned that they got placed immediately after pass-out whereas 10% mentioned they got placed after 1 to 5 years of gap
- 50% Graduates from Agri, Biotech, Food tech, nutrition and dietetics, sericulture and veterinary have mentioned they got placed through their own without institute support immediately after academics

Role of institute's placement cell in securing job
- Half of alumni mentioned that they got placed without support of placement cell, whereas 25% mentioned that colleges does not have placement cell available during their academic period – Role of NAHEP will be very imminent in changing this scenario.
- Placement cell supported only half of the UG alumni in getting placed in the job market

Time to get a job after completing the academics(%)

Category	Percentage
Immediately through Lateral	41
Immediately through Campus Placement	23
After one year gap	17
After more than 5 years gap	5
After 2 to 5 years gap	14
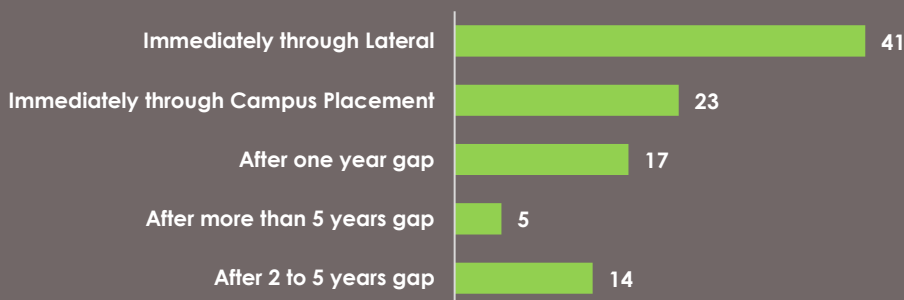
Did placement cell support in securing employment post-completion of studies (%)

Category	Value
Yes	32
No	45
NA, as college did not have an empanelled placement cell	24
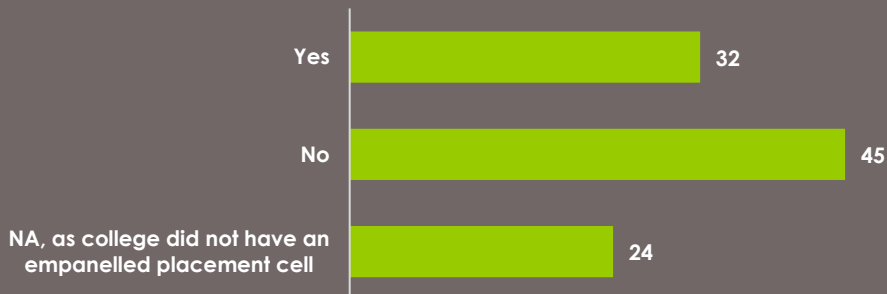
2. Skills sets supported in better placement and required changes in existing

Challenges alumni faced after joining the industry in skills

- 20% alumni mentioned that they have faced computer and IT related skills, communication and negotiation skills, personality development skills, business analytics and managerial skills related challenges etc. after joining the industry
- Whereas 25% alumni with only UG background mentioned that they have faced business analytics, problem solving and communication skills related challenges after joining the industry

Skills supported in getting better placement

- 50% mentioned that experiential learning programs (successful initiative of ICAR- AED), practical knowledge, trainings on communication skills, exposure visits to industry etc. have helped them in getting better placed in job market
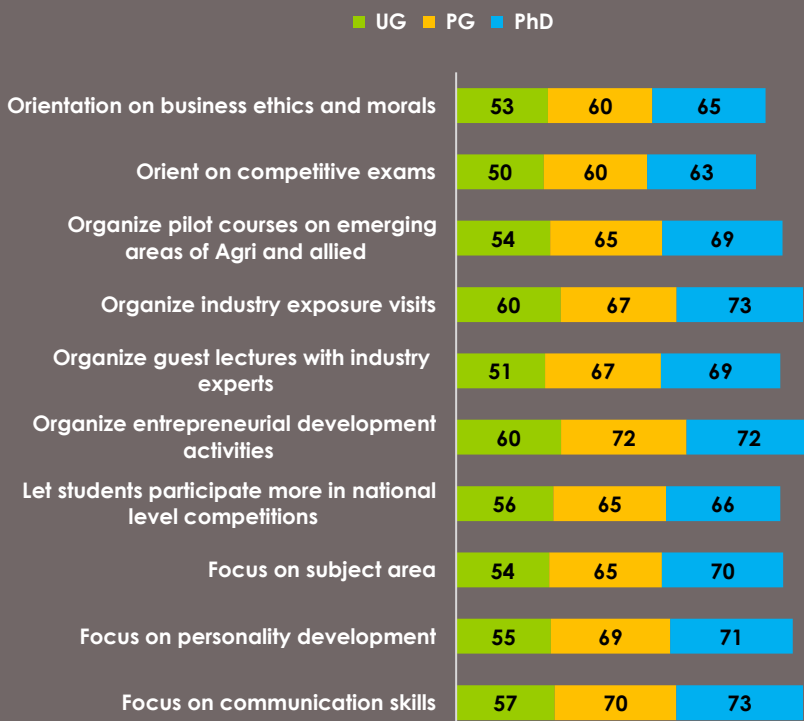
Improvement need in existing curricula

- More than 65% PG background alumni suggested to focus on organizing entrepreneurial development activities, organize industry exposure visits, focus on communication and skill development.

Skills-related challenges faced after joining the industry (%)

Challenge	Value
Subject Knowledge	17
Research and Coordination	23
Problem solving skills	21
Personality development skills	22
Marketing Skill	28
Industry etiquettes and behavior	21
Computer and IT skills	20
Communication / Negotiation Skills	20
Business ethics and morals	22
Business Analytics	25

Improvement required in existing curriculum to better prepare students for jobs (%)

■ UG ■ PG ■ PhD

Improvement	UG	PG	PhD
Orientation on business ethics and morals	53	60	65
Orient on competitive exams	50	60	63
Organize pilot courses on emerging areas of Agri and allied	54	65	69
Organize industry exposure visits	60	67	73
Organize guest lectures with industry experts	51	67	69
Organize entrepreneurial development activities	60	72	72
Let students participate more in national level competitions	56	65	66
Focus on subject area	54	65	70
Focus on personality development	55	69	71
Focus on communication skills	57	70	73

5. Human Resource requirements in Agriculture and allied sectors

The forecast of the human resource requirements in agri and allied sector were estimated through robust integrated forecasting model. Basis of the data availability through primary and secondary sources, there are multiple sets of data and information were analyzed to understand the human resource requirement forecast over a period of next 20 years. Estimations consists of

- Employment stock in different sectors
- Projection of future stock- Supply forecast
- Required occupational structure- Demand forecast
- Required educational structure- Demand forecast
- Current stock and flow from supply- Supply forecast
- Estimation of Replacement Needs and so on

To support and strengthen this model and basis of detailed literature review, we have also considered exhaustive list of variables and assumptions for both supply and demand estimations. These variables and assumptions were finalized in consultations with domain experts, policy makers and concerned authorities from AED and NAHEP.

A detailed assessment of the career for each of the discipline and their employment avenues was carried out. Basis of this, current and forecasted period estimations for these graduates are done.

Supply stock projections

Supply projections has been estimated at Supply Flow Projection, Outturn Flow Projections and Stock Flow Projections[24]. While estimating the projections, various factors were considered across the types of variables and assumptions such as historical growth rate, increase/decrease in number of seats for each discipline (with/without policy implications), delay in graduation, placement rates/consideration for higher educations, replacement needs, adjusted stock etc.

Disciplines	Supply stock- 2025	Supply stock- 2030		Supply stock- 2035	Supply stock- 2040	
	Supply stock	Supply stock	CAGR from 2020	Supply stock	Supply stock	CAGR from 2020
Agriculture	354,862	447,027	4.0%	561,660	702,444	4.3%
Veterinary Science	84,771	124,224	7.2%	177,252	241,110	7.0%
Horticulture	50,170	77,109	8.4%	114,619	163,477	8.1%
Agri. Engineering	37,795	48,733	4.3%	63,535	83,228	4.9%
Fisheries	16,176	24,670	8.6%	35,701	48,515	7.8%
Forestry	14,530	19,744	6.3%	26,008	33,154	5.8%
Agri. Biotechnology	14,264	20,285	7.1%	27,698	35,848	6.5%
Dairy Science	13,350	20,246	8.0%	30,431	43,723	8.0%
Food Science and Technology	14,504	24,086	12.4%	35,749	49,012	**9.9%**
Agri-business Management	14,208	28,589	18.9%	48,344	72,874	**14.3%**
Community Science	9,051	14,566	11.4%	21,182	28,657	9.2%
Sericulture	1,072	1,858	13.9%	2,831	3,973	10.9%
Food Nutrition & Dietetics	623	1,276	23.1%	2,037	2,871	15.5%
Grand Total	625,378	852,414	5.7%	1,147,047	1,508,885	5.8%

Supply stock is predicted to grow from 4,88,882 to 15,08,885 in next 20 years. Courses like agriculture, agri engineering is likely to degrow whereas streams like agri business management, food science & technology will be growing at higher pace compared to veterinary science, horticulture and fisheries. The share of UG among total available stock will increase from 70% to 76%, whilst PG share will reduce from 22% to 17% and PhD share remains the same in 2040.

[24] Stock Flow Projections= Outturn Flow Projections+ Adjusted stock for 34 years
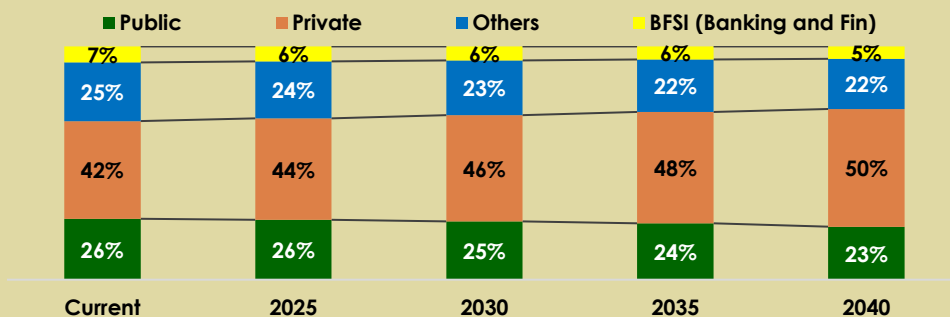
Demand projections

To arrive at the demand projections[25], various factors have been considered such as historical growth of the respective sector, attrition rate, vacancies, and participation of non-agri background graduates in respective sector, contractual employment, new job roles, job loss due to automation, digital interventions, integration of sectors in future etc.

Disciplines	Demand - 2025 Actual Demand	Demand - 2030 Actual Demand	CAGR from 2020	Demand - 2035 Actual Demand	Demand - 2040 Actual Demand	CAGR from 2020
Agriculture	4,70,387	5,39,722	2.7%	628,845	7,60,515	3.1%
Veterinary Science	1,76,694	2,01,610	2.8%	234,495	2,84,292	3.1%
Horticulture	1,33,989	1,51,664	2.4%	174,155	2,06,693	2.8%
Agri. Engineering	61,818	73,464	3.4%	88,936	1,12,504	3.9%
Agri-business Management	32,717	57,400	3.3%	69,538	88,369	3.9%
Dairy Science	37,502	44,543	2.4%	47,201	61,159	2.8%
Forestry	32,767	42,013	2.1%	44,492	55,220	2.4%
Fisheries	28,774	37,834	2.8%	51,041	54,811	3.3%
Food Science & Technology	48,395	38,955	3.4%	38,056	60,089	3.9%
Agri. Biotechnology	39,411	32,778	2.5%	46,982	46,145	3.0%
Community Science	21,066	23,863	2.4%	27,506	33,171	2.9%
Sericulture	5,043	5,819	2.7%	6,851	8,351	3.2%
Food Nutrition & Dietetics	2,491	2,905	3.0%	3,448	4,293	3.5%
Grand Total	10,91,054	12,52,570	2.7%	14,61,545	17,75,612	3.1%

Demand is expected to grow at 3.1% CAGR from 9.5 lakhs to 17.7 lakhs from 2020-40. ~80% of total demand is for the top 5 streams (Agriculture, Veterinary, Horticulture, Agriculture Engineering & Agriculture Business Management (ABM)). Agriculture Engineering, ABM and Food-technology disciplines are expected to grow at higher rate of 3.9% whereas Forestry shown lowest growth rate of 2.4%. Whereas at the education level, UG has the maximum share in total demand of about 72% followed by PG & PhD.

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[25] Demand Flow Projections= Current demand * (1+ sectoral growth rate ^(t)+attrition, vacancies+ other variables*weighted average)

Figure 10 Human resource requirements at sector level till 2040

	Public	Private	Others	BFSI (Banking and Fin)
Current	26%	42%	25%	7%
2025	26%	44%	24%	6%
2030	25%	46%	23%	6%
2035	24%	48%	22%	6%
2040	23%	50%	22%	5%

Supply-demand gap estimation

Looking at the supply demand gap for current year, the total demand for agriculture and allied graduates is 9,58,777 whereas the total available stock during the year is 4,88,882. It may be observed that there is a 49% gap in demand and supply of overall agriculture and allied graduates. Based on various factors of job market demand and likely policy adoption in the higher education in future, it is observed that this gap has been reducing, but with lower pace over next two decades. The gap for 2025 stands at 43%, for 2030 it is 32% and for 2035 it is 22% whereas in 2040 it will significantly drop to 15%.

Figure 11 Supply and demand gap estimations (figures in lakhs)

	2020	2025	2030	2035	2040
Supply	4.9	6.3	8.5	11.5	15.1
Demand	9.6	10.9	12.5	14.6	17.8
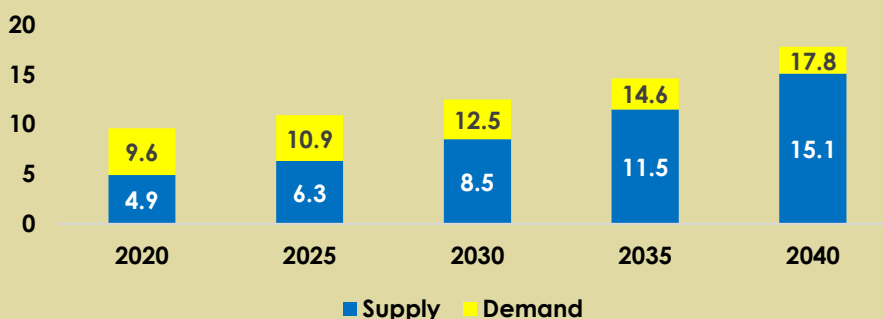
Though, study recommend that estimation of demand and supply for 2035 and 2040 would require revisit and necessary deliberations at ICAR level involving key stakeholders in 2030 based on various scenarios likely to emerge in industry as well as agricultural higher education level.

6. Recommendations

Based on the current and futuristics trends in the industry, job market and estimations of human resource requirement in the sector, study observed few critical areas which needs immediate and long-term strategic roadmap for effective human resources planning. This section highlights such critical areas and provide the indicative plan to the ICAR-AED.

Short-term plan

1. Improving the attractiveness of Agri Higher Education:

Study observed that only 10% of the students those who have chosen Agri Higher Education as their career preference mentioned that they got awareness on the program through school notice boards and news paper advertisements and 30% were self-aware. Looking at this scenario, there is an immediate action plan required at ICAR level to promote the Agri-Higher Education at school level.

2. Orientation towards market-oriented curriculum and skill sets:

Study indicates that there has been significant opportunities and influx of private sector jobs for AU students. But based on current students responses, students still prefer

government department jobs over private sector opportunities with an aspiration of better job security. Lesser orientation towards market oriented course curriculum is also one of the key concern for employers. Bipronged strategies can be considered for improving the faculty competancy and introducing market oriented courses in mainstream. Consideration for timely revision of the course curriculum (rather than long gestation period of Dean's committee approval) while introducing market oriented courses for each program twice / thrice in every five year.

3. Requirement of additional colleges imparting agri higher education:

Estimated that an additional 552 institutions across disciplines providing agriculture higher education in the country will be required to accommodate this demand.

Streams	Total colleges required in 2040	Total colleges available in 2020	New colleges required
Agriculture	559	434	125
Veterinary Science	220	155	65
Horticulture	284	153	131
Agri. Engineering	111	100	11
Agri. Biotechnology	80	56	24
Food Science and Technology	97	65	32
Forestry	54	54	-
Fisheries	95	64	31
Dairy Science	123	47	76
Community Science	60	60	-
Agri-business Management	112	60	52
Sericulture	10	8	2
Food Nutrition & Dietetics	5	3	2
Total	**1,811**	**1,259**	**552**

4.

4. Leveraging EdTech in the future delivery of Agri Higher Education:

According to World Bank research on the impact of Covid-19 on higher education, South Asia may lose up to USD 400 billion in the near future due to school closures. The majority of agricultural institutions are located in rural India, where internet access is quite poor, it is anticipated that 6 lakh villages would be served by a fibre network by 2025. This creates an urgent necessity to prioritise the deployment of EdTech in Agriculture Higher Education Institutes (HEIs). One of the primary demands in agri-higher education would be to provide the necessary digital infrastructure for content development in order to capacitate professors. Leveraging Ed and Tech domain experts for RAES (Resilient Agricultural Education System) augmentation will be the key success factor for this strategy.

5. Transforming existing AUs with Multidiciplinary model:

With the existing narrow discipline education delivery model, specialized Agri AUs have limited number of batches and seats avaialble for students. In addition, faculties and other administrative staffs are equaully engaged in research, education and extension services. In addition, high faculty vacancy rates (~37%) at AU level eventually led to lot of burden on limited resources. Transforming existing education delivery mechanism to Multidiciplinary Education and Research Universities (MERU) would create space for more students, diversify their learnings, provides exposure while solving regional problems with holistic perspective. This would not only improve the problem based learnings of students but also help them to improve their soft skills while collaborating/ working/ learning in multidiciplinary environment.

Medium and long term plan

1. Top 20 AUs in Top 100 QS ranking by 2030:

As of today, only GBPUAT, Pantnagar is an AU that holds a spot in the QS ranking 2021. Preparing AU for QS rating will not only attract worldwide attention but will also prepare AU for self-sufficiency. ICAR-AED may consider developing a Strategic Action Plan to prepare 20 AUs as model AUs of the ICAR-AU-System in order to rank among the top 100 QS universities by 2030. This can be initiated by promoting the internationalisation of Indian Agri higher Education through various measures like student and faculty exchange programs, research collaborations, curriculum integrations, online learning and virtual exchanges, etc.

2. Enhance the employability of AU students:

AUs must develop methods to include the skills into the course curriculum in order to fulfil employer demands, increase the overall employability of Agri students, and successfully reduce supply-demand gaps. To prepare students for the job market, it is vital to develop both transferable and non-cognitive abilities within the curriculum to the greatest degree feasible. Extracurricular activities, which signal students' employability to employers, are just as significant as subject knowledge in the curriculum. One key yardstick is career tracking surveys/graduate income surveys, which monitor the success of labour market outcomes of newly graduated students. NAHEP has already launched a similar project, which ICAR could expand upon. Provide career counselling services and help students establish their profiles, write CVs, prepare for interviews, and hunt for employment. Effective career advising may assist AU students in reaching their full potential and is essential for smooth transitions from HEIs to and within the labour market.

Notes

National Agricultural Higher Education Project (NAHEP) was launched in 2017 by the Indian Council of Agricultural Research (ICAR) with financial assistance from World Bank, intending to improve the quality and provide more relevant agricultural higher education in the country. Under NAHEP, the ICAR is in the process of bringing a fundamental change in its approach and control, financial sustainability, accountability, autonomy, and transparency to improve the quality and relevance of agricultural higher education in India. The project is also a multi-Global Practice collaboration (Agriculture and Education) and is expected to support activities and results directly related to cross-cutting strategic areas of climate change, jobs and gender.

High impetus has been laid upon undertaking this 'Assessment of Human Resource Requirement in Agri and allied sector for next 20 years' study under the ambit of ICAR NAHEP which is aimed to further aid the overall implementation of NAHEP and leading to the achievement of key project outcomes such as improved student placement rates & entrepreneurship, enhanced industry sponsored projects in cutting edge areas etc.

This policy document highlighted the key results emanated through Assessment of Human Resource Requirement in Agri and allied sector for next 20 years. The output of this document will not only help in bringing more directional efforts in overall implementation of NAHEP through right assessment of human resource supply - demand estimations and forecasts but also it will help ICAR in better aligning it with the evolving needs of the sector and for effectively planning the initiatives under National Education Policy 2020. The valuable insights of this document would certainly help shape the future of agricultural higher education in our country by improving job outcomes in higher agriculture education, thereby enhancing the quality and relevance of higher education in India.