

A comprehensive analysis of India's talent landscape for the smart protein sector





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Executive summary

As [India's smart protein sector](#) evolves, a well-equipped workforce will be essential to drive innovation and scale production. With the announcement and implementation of the [Biotechnology for Economy, Environment, and Employment \(BioE3\) policy](#), the Government of India envisions the acceleration of bioeconomic growth by establishing biomanufacturing facilities, fostering innovation, and creating a highly skilled workforce. The distinctive recognition and inclusion of 'functional foods and smart proteins' as a thematic area under the policy, with dedicated funding efforts for cutting-edge research in the field, serves as a testament to the promise and [growth of the smart protein sector](#).

With the technology behind smart protein rapidly advancing, the diversity of jobs and skills required in the industry continues to evolve. GFI's [Career Pathways tool](#) expertly provides insights into the changing job archetypes, technical skills, and educational backgrounds required for succeeding in the global alternative protein sector. With current and future talent potential in mind, the need for graduates with [industry-relevant](#) skills tailored to emerging areas of biomanufacturing has become more critical than ever. While India produces a large number of graduates in [disciplines relevant to the sector](#)—such as biotechnology, food science, and bioprocess engineering—there is a dearth of [specialised, hands-on skills](#) required for smart protein research and manufacturing.

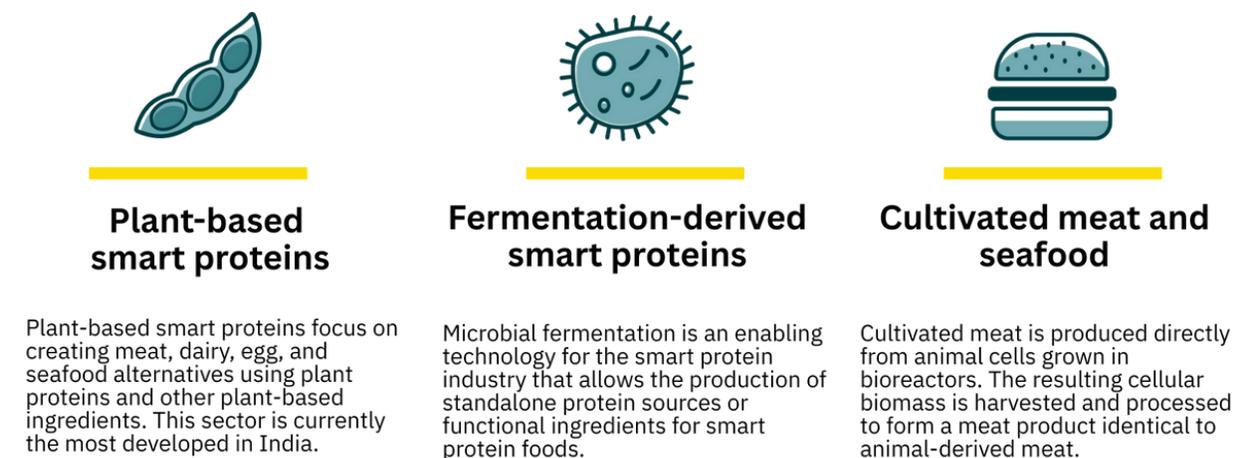
This study aims to address these gaps by systematically researching current job roles in the Indian smart protein sector and assessing the alignment between academic curricula and industry needs. By engaging with experts from industry, academia, and policy-education bodies, and analysing academic programmes, structured recommendations for upskilling programmes have been formulated. Policy bodies, industry players, and academic institutions can use this report as a comprehensive roadmap to incorporate smart protein training into university curricula and professional development programmes.



Section I: The Indian smart protein sector

[Smart proteins](#), globally known as alternative proteins, include meat, seafood, eggs, and dairy made from plants or produced through microbial fermentation, as well as cultivated meat grown directly from animal cells using advanced technologies (Figure 1).

Figure 1. Plant-based and fermentation-derived smart proteins, and cultivated meat and seafood. Dig into the science of smart protein [here](#).



The global alternative protein market is expected to grow at a compound annual growth rate (CAGR) of 14.1% from its anticipated [USD 21.5 billion in 2025 to USD 80.4 billion by 2035](#). Between 2021 and 2022, the Indian smart protein startups secured USD 17 million worth of investment, as reported in GFI India's [State of the Industry Report \(2023\)](#).

Government support for smart proteins

In August 2024, the Indian Union Cabinet approved the [Biotechnology for Economy, Environment, and Employment \(BioE3\) policy](#), with smart protein identified as one of six thematic subsectors for fostering high-performance biomanufacturing. This is a clear signal of the government's intent to position the smart protein sector as one of the key pillars for achieving a \$300 billion bioeconomy by 2030. The BioE3 policy focuses on increased research and innovation in the sector while underscoring the need for industry-academia collaboration and technocommercialisation. Through this policy, the Union Cabinet also approved the [Biotechnology Research Innovation and Entrepreneurship Development \(Bio-RIDE\) Scheme](#) with a total outlay of INR 9,194 crore (through 2021-2026), for promoting Indian



biomanufacturing and biofoundry establishment (under which smart proteins have also been identified as a key sector). In March 2025, DBT, jointly with BIRAC, announced a [call for proposals](#) to address smart protein R&D and commercialisation challenges, inviting Indian academia and industry participation. In addition to all the recent funding activities in the sector, the BIRAC's [Biotechnology Ignition Grant \(BIG\)](#) scheme has supported multiple smart protein startups since 2021 with early-stage grants of up to INR 50 lakhs for proof-of-concept development.

The Food Safety and Standards Authority of India (FSSAI) has been undertaking efforts to evaluate the needs of the emerging smart protein categories (cultivated meat and precision fermentation-derived products) under the [Non-Specified Food and Food Ingredients \(NSF\) regulations](#). In 2020, the FSSAI formed a working group on cultivated meat (called the [Working Group on Cultured Meat](#)) with regulatory and scientific experts to understand the possible regulatory pathways for cultivated meat in India. At the 2025 Global Food Regulators Summit (GFRS), organised by the Ministry of Health and Family Welfare and the FSSAI in New Delhi, the FSSAI [emphasised food safety regulations for novel smart protein foods](#) as a priority focus area. They announced their intention to introduce a regulatory sandbox approach to make necessary amendments in the current NSF regulations, thereby charting a regulatory roadmap for establishing the food safety of novel smart protein foods. Notably, the FSSAI has already approved a non-animal, precision fermentation-derived whey protein (manufactured by Perfect Day) under the NSF Regulations.

Ecosystem development

India's smart protein research and entrepreneurial ecosystem have expanded significantly in the past five years. GFI's flagship programmes, like the [Research Grants Program](#), [Alt Protein Project](#) (APP), and [India Smart Protein Innovation Challenge](#) (ISPIC), have propelled this growth. The Alternative Protein Project, also known in India as the [Smart Protein Project](#) (SPP), is a student-led movement of over 70 active chapters globally, including six at leading Indian universities and technical institutes. The SPP encourages students to promote community-building, education, research, and entrepreneurship in their university ecosystems. In 2024, GFI India launched the [Smart Protein Advanced Research & Knowledge \(SPARK\)](#) Fellowship to grow the smart protein research landscape and encourage students to carry out more translational research under the mentorship of experts from premier Indian institutions.

The smart protein [industry ecosystem](#) has more than 113 startups active across plant-based, fermentation-derived, and cultivated meat technologies. Several accelerators and incubators continue to support the growth of smart protein companies, particularly through the Bioincubators Nurturing Entrepreneurship for Scaling Technologies (BioNEST) scheme (from



BIRAC) and the Atal Innovation Mission (AIM), a flagship initiative of the NITI Aayog. In 2024, two dedicated smart protein centres, namely the [Centre for Smart Protein and Sustainable Material Innovation](#), launched by IKP Knowledge Park and the [Alternative Protein Innovation Centre](#) (APIC), were established in Bengaluru, with support from GFI India. The University of Hyderabad's ASPIRE BioNEST incubator, along with Cytiva, also launched a new [Centre for Alternate Protein Research](#) in 2025. These facilities provide incubation support, access to state-of-the-art equipment, and expert mentorship to startups focusing on smart protein ingredients and products.

With the ecosystem developing at a steady pace, supported by key stakeholders capable of shaping the sector's trajectory, India is well-positioned to emerge as a global hub for smart protein innovation and biomanufacturing. Talent development and workforce readiness to keep up with emerging breakthroughs in smart protein are critical to the ecosystem's growth. In this study, the gaps in India's teaching system that impact graduating students' preparedness to work in various technical jobs in the smart protein industry have been thoroughly assessed. The following section outlines the methodology and tools used to identify and assess the skills gaps and opportunities within the current workforce.

Section II: Study tools and methodology

Methodology

A predominantly qualitative research approach (Figure 2) was used for the study based on insights from one-on-one interactions with Indian stakeholders active in the development of plant-based meat, dairy, and ingredients; biomass and precision fermentation-derived ingredients; and cultivated meat. The questions for surveys, interviews, and focus groups were modelled on [GFI's Alternative Protein Career Pathways](#) tool. The Career Pathways tool helped lay the foundation for understanding various job archetypes, desired educational backgrounds, and relevant technical skills for smart protein job roles across the different value chains of plant-based, fermentation-derived, and cultivated meat domains (Figures 3a, 3b, and 3c). Publicly available information was used in secondary research, data interpretation, and validation.



Figure 2: Tools and validation framework for smart protein talent landscape study

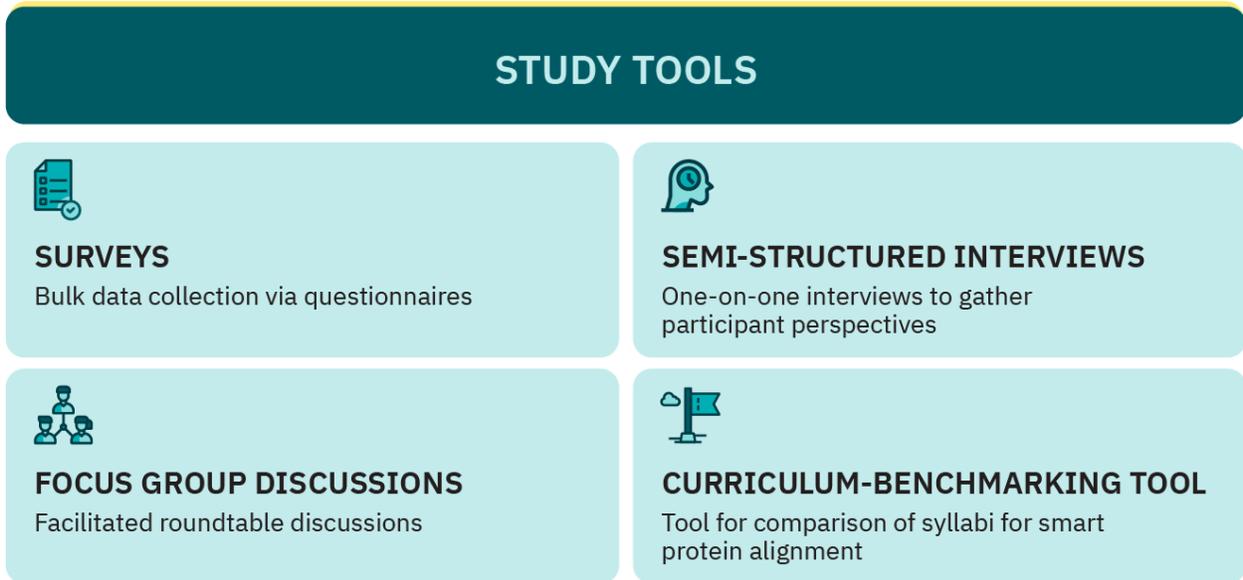


Figure 3a: Value chain map for plant-based meat

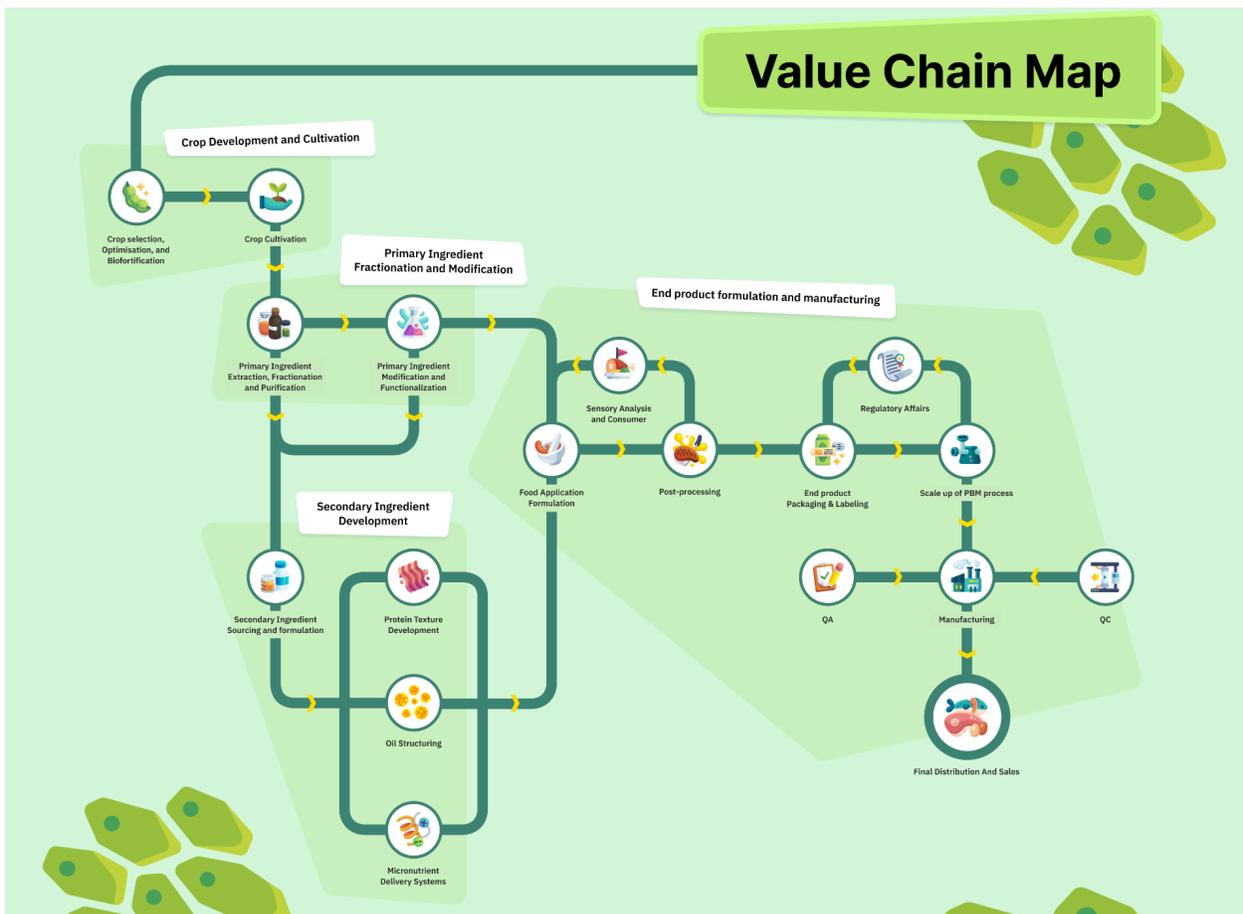




Figure 3b: Value chain map for fermentation-derived smart proteins

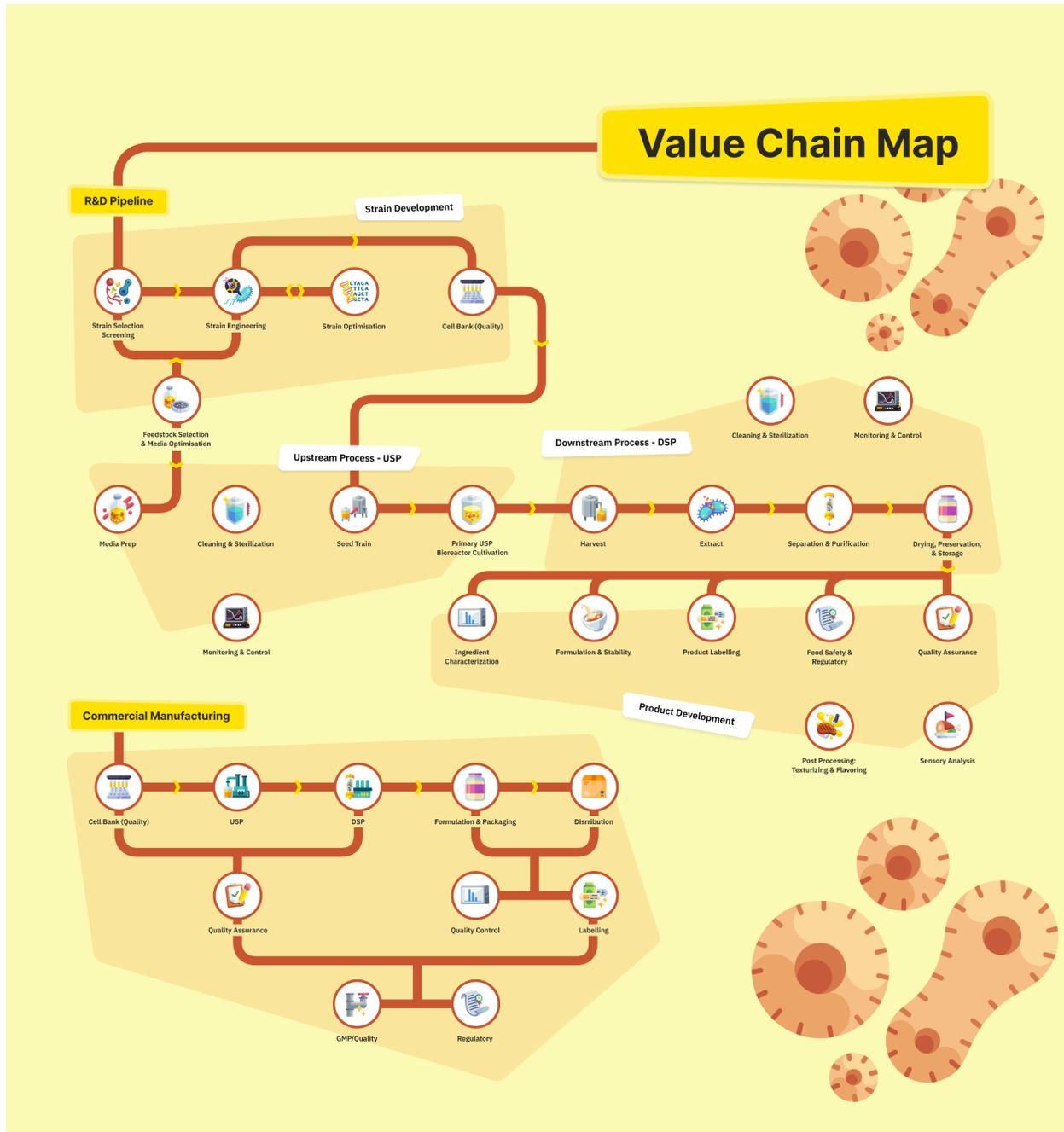
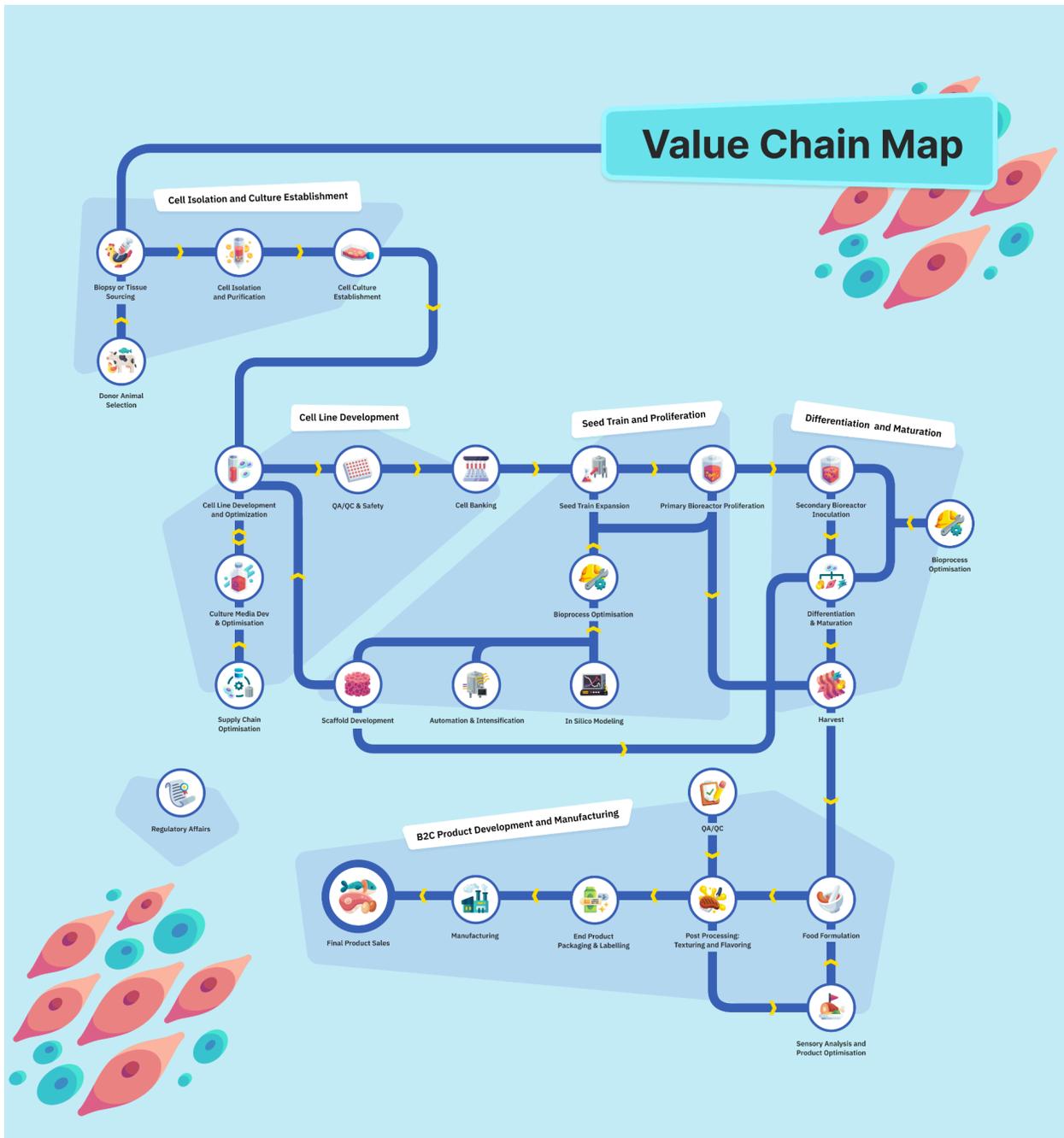




Figure 3c: Value chain map for cultivated meat



Industry skill mapping and talent gaps

Based on their availability, surveys or one-on-one interviews were conducted with active Indian smart protein companies (ingredient manufacturing, end-product development, production, and commercialisation) to gain in-depth qualitative insights. The survey and interview questions were aimed at understanding:



- current hiring patterns
- ideal candidate profiles for various smart protein job archetypes
- skill requirements
- future projections of critical skills and job archetypes
- training preferences

The industry cohort includes responses (n=20) from startups (pilot to commercial scale) and larger corporates, with at least five representatives from each smart protein vertical.

Academic curriculum mapping and talent estimation

To understand the level of smart protein inclusion within existing academic and vocational curricula, the course content of key scientific disciplines (such as Food Science, Biotechnology, Fermentation Technology, Microbiology, and Chemical Engineering) taught in major public and private Indian universities, as well as educational and research institutes, was analysed on a modular level. First, surveys and semi-structured interviews were conducted with a representative cohort (n = 19) of academic leaders and administrators across Indian universities and educational and research institutes to assess curriculum implementation practices and evaluate institutional readiness for curriculum reform. Next, a benchmarking framework was developed to analyse curricula and evaluate their alignment with the competency requirements of the smart protein industry. The framework used 10 broad topics related to smart protein and allied scientific areas, which were further divided into 46 sub-topics (practical and theoretical).

Aside from assessing the teaching tools, secondary research was conducted to collect data on annual graduate output across all analysed programmes, stratified by educational level [undergraduate (UG), postgraduate (PG), and doctoral (PhD)] to establish baseline talent output in smart protein-related disciplines. The above methodologies informed our evidence-based recommendations for curriculum integration of smart proteins to bridge the skills gap at the university or vocational education level.

National sector skill development bodies and training initiatives

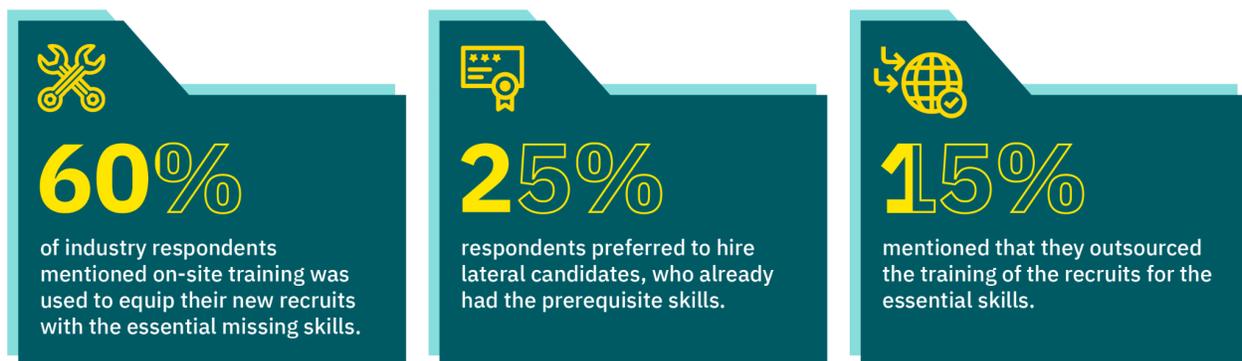
Policymakers and government-skilling bodies ensure that the topics and critical skills prioritised in public policies are taught via certified courses and training programmes throughout the country. One-on-one interviews were conducted with prominent experts from the food industry and technical skill development councils for perspectives on smart protein-relevant technical training. Following this, two multi-stakeholder focus group



discussions (FGDs), engaging a total of 16 key stakeholders representing academia, industry, and policy bodies, were organised to identify barriers and opportunities for smart protein curriculum development and implementation. This approach ensured that the studies' findings were grounded in the diverse perspectives and expertise of the broader smart protein ecosystem, providing a space for experts across various domains to interact and propose collaborative measures to bridge the skills gap.

Section III: Industry perspectives on critical skill requirements

The [All India Survey on Higher Education \(AISHE\) 2021-22](#) indicates that 249,879 graduates across UG, PG, and PhD degrees at public and private universities, colleges, and standalone institutions are from smart protein-relevant disciplines. In spite of this, the findings from initial surveys and interviews conducted with active industry stakeholders indicated that most graduates appeared to lack essential smart protein-relevant practical skills (Table 1). The primary reason for this is that current theoretical and practical training from most UG academic degrees in Food Technology, Agricultural Sciences, Biotechnology, Chemical Engineering, Microbiology (or similar core scientific degrees of All India Council for Technical Education (AICTE) and University Grants Commission (UGC)-certified B.Sc./B.E./B. Tech programmes) do not teach such skills.



Emerging smart protein technology startups converged on the need for stronger hands-on training in biotechnology skills such as animal cell culture and molecular biology, as well as in operating high-moisture extruders (HME), bioreactors, analytical instruments, 3D food printers, and emerging food sensory analytical instruments such as E-nose and E-tongue.

Aside from scientific skills training, another critical challenge highlighted by industry representatives was the lack of courses for food safety training dedicated to the 'novel foods' category, i.e., cultivated meat and fermentation-derived smart proteins. Most existing food safety certificate courses, like the [FSSAI's Food Safety Training & Certification \(FoSTaC\) programme](#), focus on general quality control and Hazard Analysis and Critical Control Points



techniques for evaluating conventional food value chains from a hazard detection and prevention angle.

Table 1: Technical skill gaps among new graduates gathered from industry surveys, interviews, and secondary research

Technical skill gaps among new graduates	
Plant-based	<ul style="list-style-type: none"> • Plant protein extraction and functionalisation • High-moisture extrusion
Fermentation and cultivated meat	<ul style="list-style-type: none"> • Basic animal cell culture techniques, molecular biology, metabolic engineering • Bioreactor handling, bioprocess optimisation, and scale-up for fermentation and cultivated meat
Experimentation and analytical work	<ul style="list-style-type: none"> • Food sensory studies with newer technologies (E-nose, E-tongue) • Experimental design and analytical protocols for high-throughput screening using HPLC, GC-MS • New product formulation using novel smart protein ingredients
Regulatory affairs	<ul style="list-style-type: none"> • Awareness of regulatory pathways for novel smart protein foods

Industry stakeholders agreed that expertise in AI-driven data analytics, life cycle assessment or techno-economic analysis, environmental, social, and governance (ESG) frameworks, and novel smart protein-related legal/regulatory affairs will become crucial as the sector matures over the next five years. Therefore, the implementation of robust theoretical and practical curricula as standalone or stackable certificate courses (with transferable credits to UG/PG programmes) needs to be given priority.



We prepare students for regulatory and compliance roles, integrating both theory and applied learning. Employers value adaptability and interdisciplinary skills over specialisations.

**-Dr. Gurmeet Singh,
Dean (Research & Outreach), University of Trans-Disciplinary Health
Sciences and Technology**



Training preferences and pathways: a multi-stakeholder initiative

For theory-based learning on the science behind alternative proteins, there are globally accessible online courses like [GFI's The Protein Transition course](#). International institutions such as Imperial College London, the National University of Singapore, and Tufts University also offer alternative protein research and training programmes, including an [undergraduate minor in cellular agriculture](#). In India, there are very few existing hands-on training programmes for smart protein-focused knowledge-building. [Foresight Biotech's Industrial Training Program](#), conducted in collaboration with Birla Institute of Technology, is one of the few hands-on programmes available for upskilling in cell and molecular biology, microbiology, synthetic biology, and food technology. Similar to these, recruiters pointed out that it would be ideal if smart protein-tailored certified upskilling courses (theoretical, practical, and regulatory) were run by Indian academic institutions or skill-development bodies such as the National Skill Development Corporation (NSDC), International Training Center Food Safety & Applied Nutrition (ITCFSAN), and FSSAI. New hires could then complete these certification courses before joining the company, making on-site induction more seamless and saving company resources required to train them on fundamental techniques.



In the Indian context, the policies of the Ministry of Food Processing Industries and the Ministry of Agriculture reflect the growing focus on plant-based and smart protein sectors. This shift brings to light critical skill gaps and the need for targeted training. There is considerable potential for well-crafted initiatives in this domain.

**-Mr. Rishikesh Patankar,
Vice President, Government Programs, Industry & Academia
Collaboration, National Skills Development Corporation (NSDC)**

One such external training workshop is a multi-stakeholder collaborative programme led by the Food Industry Capacity & Skill Initiative (FICSI) meant to introduce graduates and early career professionals to real-world applications of their theoretical knowledge. The case study below outlines the approach taken to design this nationally recognised training programme.



Case study: FICSI-TDU-GFI India's Training of Trainers (ToT) programme on plant-based proteins

Background

The Food Industry Capacity and Skill Initiative (FICSI), the University of Trans-Disciplinary Health Sciences and Technology (TDU), Bengaluru, and GFI India came together to create India's first Training of Trainers (ToT) [course on plant-based proteins](#) with a [custom-designed model curriculum](#). This initiative aims to address the growing need for skilled professionals in the smart protein sector. The programme is linked to the Government of India's Skill India mission and follows [FICSI's NSQF Level 5 Qualification Pack](#) for Food Technologist – Plant-Based Proteins (QP Code: FIC/Q9303).

Course design and vision

The ToT course for Food Technologists – Plant-Based Proteins aims to build national capacity by training certified instructors who can teach India's first Plant-Based Food Technologist course. The curriculum includes essential concepts in plant protein processing and texturisation, with modules covering:

- Selection of raw materials and vendors
- Texturisation by extrusion
- Optimisation of texture, flavour, and nutrition
- Quality assurance, safety, and packaging
- Food safety at the workplace
- Employability skills

Graduates of the course will be equipped to operate equipment like twin-screw extruders, perform sensory and physicochemical analyses, and design plant-based products for commercial scaling. Trainers who complete the ToT will receive authorisation from FICSI to deliver certified programmes nationwide. This initiative is designed to help address India's skill gap in alternative proteins.



Evolution and implementation journey for the ToT course

2021-2023

Through collaboration between GFI India, FICSI, and TDU, the ToT programme was conceptualised, and a curriculum was designed.

October 2024

The Participant Handbook was finalised and launched at the Smart Protein Forum in October 2024, with the aim of conducting the first batch of the ToT programme in early 2025.

December 2024

As new FICSI officials and coordinators took charge, the programme's rollout was paused.

January 2025

GFI India organised a roundtable between national and international stakeholders from industry and academia to plan for the programme launch.

- Academic institutions conveyed their willingness to design and deliver customised hands-on upskilling training programmes.

- Unanimous recommendation to the industry to offer their pilot plant facilities for such practical training and internships.

May 2025

GFI India, FICSI, and TDU continued deliberations on the programme launch and identified that one bottleneck was the dearth of high-moisture extruders (HME) across training centres.

The course is intended to be launched in 2026, with FICSI serving as the certification partner and active involvement from GFI India and TDU. In addition, companies currently equipped with HMEs have expressed an interest in joining the training programme as collaborators and resource personnel. On the academia side, a number of universities and research institutes have procured HMEs for their pilot facilities, and select faculty may opt to qualify themselves as trainers through the proposed ToT programme.



These positive developments establish proof of continued sectoral interest, with the promise of further disseminating the course among scientists and industry professionals from smart protein and allied areas.

Recommended reading: [Bridging workforce gaps in India's plant-based protein sector](#)

Section IV: Academic perspectives on curriculum readiness

With the context of skill gaps from industry interactions, detailed surveys and interviews were conducted with academic and research faculty from various institutes across India. In primary surveys with academic stakeholders, encouraging trends emerged where most (84.2%) teaching faculty demonstrated very high awareness about the smart protein sector. However, only 47.4% of the respondents reported adequate coverage of smart protein topics in their existing (theoretical and practical) curriculum. Nevertheless, it was encouraging to see that a notable majority of 89.5% expressed openness to incorporating new modules on smart protein in their courses.



India's food and nutrition ecosystem is going through a transformative shift. The challenge is in terms of academic preparedness and industry-academic collaborations within smart proteins. Despite producing a lot of graduates in allied disciplines, there is a dearth of specialised hands-on skills tailored to the smart protein industry. We need to align academic curriculum with industry requirements.

**-Mr. Arun Om Lal,
Industry Chair Professor, National Institute of Food Technology
Entrepreneurship and Management, Kundli (NIFTEM-K)**

Research and teaching staff agreed that, instead of standalone degrees for smart proteins, modular options could be created within existing programmes in Food Technology, Biotechnology, and other relevant UG/PG programmes. This would allow for quick scaling of courses across multiple institutes while maintaining relevance to the core degree programme. For instance, a module on bioprocess design for cultivated meat and fermentation-derived smart proteins could be covered within a core subject on bioprocess engineering in a Biotechnology degree programme. Plant protein extraction, functionalisation, and plant-based



meat texturisation topics could be covered within a food chemistry core subject of a Food Technology degree programme.

GFI affiliates, in collaboration with faculty across global educational institutions, have developed open-access resources for designing smart protein subject modules. These can be accessed through GFI's open-access [curriculum repository](#) or GFI's online course, [The Protein Transition](#).

Navigating challenges and opportunities in smart protein curriculum integration

Given the openness of academia to integrate smart protein learning, a tool was developed to identify specific points in the existing curriculum where module integration is necessary. The curriculum benchmarking framework was designed to systematically compare existing academic curricula (i.e., Biotechnology, Food Technology, Agricultural Sciences, and various engineering disciplines of UG/PG programmes) against a detailed set of smart protein topics and subtopic areas (see Annexure), indicating which smart protein topics can be accommodated within a curriculum.

The syllabi from two undergraduate programmes—B.Tech Biotechnology and B.Tech Food Technology offered at different universities in India were reviewed using the curriculum benchmarking framework to assess how well core and elective courses cover relevant smart protein subtopics and to identify opportunities for curriculum integration (Table 2). The analysis revealed that core syllabi covered broader scientific principles like protein chemistry, food processing, biochemistry, cell and molecular biology, and new product development. While such topics are crucial for understanding the foundational science of smart protein, smart protein-specific references in the teaching materials or focused modules were not seen in the core courses. Wherever references existed, they were available only as partially covered topics under electives or as optional projects that students could undertake as final-year thesis projects.

Table 2: Example of the curriculum benchmarking template comparison with B.Tech Biotechnology and B.Tech Food Technology curricula (across cores, electives, and practicals). Note: For brevity, this example only displays four major topic areas out of the total 10 topics.

'Yes' denotes full coverage of the sub-topic within the curriculum; **'Partial'** denotes partial coverage of the sub-topic in the curriculum; **'No'** indicates the sub-topic is not covered in the curriculum within core or elective courses. The **asterisk (*)** indicates course elements that require practical (lab-based) training, in addition to theoretical lectures.



Smart protein topic	Smart protein sub-topic	B.Tech Biotechnology curriculum	B.Tech Food Technology curriculum
Introduction to smart proteins	Science of smart proteins	No	No
	Value chain overview of smart proteins	Partial	Partial
	Global and Indian smart protein landscape	No	No
	Market trends and consumer behaviour	Partial	Partial
Protein chemistry & biochemistry	Protein structure–function relationships: gelation, emulsification, foaming, water/oil binding	Partial	Yes
	Protein folding, denaturation, and aggregation	Yes	Yes
	Protein extraction, purification, and quantification methods*	Yes	Yes
	Protein digestibility, amino acid scoring, and bioavailability	Partial	Yes
Food science and processing	Heat and mass transfer in food processing*	N/A	Yes
	Operations: mixing, extrusion, drying, texturisation*	N/A	Yes
	Shelf-life and preservation techniques, food safety*	N/A	Yes
	Food formulation and ingredient interactions*	N/A	Yes
	Food rheology and texture analysis*	N/A	Yes
Microbiology & synthetic biology	Basics of fermentation technology	Yes	Yes
	Strain selection and optimisation*	Yes	Yes
	Bioreactors and bioprocess scale-up*	Yes	Yes
	Fermentation product recovery and downstream processing*	Yes	Partial

Upon understanding the current gaps in graduate teaching/training programme structures, academic and policy landscapes were then evaluated to ideate efficient methods of introducing curriculum updates or creating smart protein electives.



Students lack scale-up knowledge and have minimal industry exposure. Major universities need to include specific courses on smart proteins or augment existing courses.

-Dr. P.S. Rao,
Professor, Indian Institute of Technology (IIT) Kharagpur



Leveraging policy-driven initiatives to advance emerging technologies

In July 2020, the National Education Policy (NEP) was introduced by the Government of India, recognising the flaws of rigid, static curricula that were inefficient in meeting evolving talent needs. The new policy advocates for a learner-centric, multidisciplinary approach designed to enable educational institutions to periodically review and revise their curricula. Regular curriculum updates enable gathering feedback from faculty, students, and industry for capturing recent trends and advancements. The following inclusions provide institutes with the flexibility and space to integrate emerging domains of learning, fostering experiential learning and critical thinking.

1. **A Choice-Based Credit System (CBCS)** allows students to pick the following:
 - a. Core courses (based on the major course of study)
 - b. Elective courses (cross-disciplinary options)
 - c. Minor courses (in-depth studies within complementary disciplines)
 - d. Skill-based/skill enhancement courses (vocational and practical learning)
2. **Academic Bank of Credits (ABC)**, where credits obtained from diverse learning sources (listed below) can be transferred and accumulated:
 - a. Traditional coursework across institutions
 - b. Online courses (e.g., MOOCs, SWAYAM, DIKSHA platforms)
 - c. Industry certifications and skill-based training
 - d. Project-based or experiential learning



We should focus on categories that have already emerged, like plant-based smart proteins, and build training and curriculum around these.

**-Mr. Sunil Marwah,
CEO, Sector Skill Council for Food Processing (FICSI)**

Given the NEP 2020's forward-thinking curriculum inclusion guidelines, interviews with scientists and professors from Indian teaching institutions delved into the protocols generally followed to enable regular syllabus revamps. Experts agreed that certain bottlenecks prevent the swift implementation of new programmes, especially hands-on modules relevant for 'novel' domains like smart proteins. For example, a number of faculty members raised that they had limited or no access to advanced equipment and infrastructure required to holistically train students in theoretical and practical aspects of the emerging smart protein sector. Furthermore, the procurement of such facilities would be a very resource-intensive and time-consuming process for the teaching staff.

Larger institutions such as the Indian Institutes of Technology (IITs), AICTE- and UGC-accredited universities and colleges, the Academy of Scientific and Innovative Research



(AcSIR), and colleges or state agricultural institutes under ICAR draw on NEP 2020 guidelines to stay aligned with emerging technologies. These institutions use a multi-pronged strategy to revise, design, and introduce updates to their syllabi every few years (Table 3). Because these processes vary across institutions, the time required to implement new programmes can differ as well.

Table 3: Syllabus design and accreditation process for Indian higher-education institutions

Type of Institution	Syllabus Design Framework	Accreditation Board	Governing Ministry
Indian Institutes of Technology (IITs)	Syllabus design and revamps ensure alignment with industry requirements and benchmarks against global standards. For emerging topics, online learning platforms like SWAYAM, which features NPTEL courses, provide faster access to educational materials.	The Senate of each IIT (chaired by the Director) gives final approval for syllabus design and changes. No National Accreditation Council yet.	Ministry of Education
AcSIR, Council of Scientific & Industrial Research (CSIR)	The AcSIRs were established under the AcSIR Act of Parliament, 2011. AcSIR designs and updates its curriculum tailored to advanced technologies in line with CSIR's overall strategic vision.	The Director General, CSIR, gives final approval. No National Accreditation Council is involved, as AcSIR has academic autonomy.	Ministry of Science and Technology
Indian Council of Agricultural Research (ICAR)	ICAR colleges and state agricultural institutes frame syllabi, and any revamps based on emerging technologies and industry demands.	National Agricultural Education Accreditation Board (NAEAB) standards	Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers' Welfare
Indian public universities and private universities or colleges	Both public (central and state) and private universities retain autonomy in designing and updating their curricula (based on NEP 2020); however, their academic programmes must conform to the standards and guidelines issued by national regulatory bodies.	UGC (overall academic standards) AICTE (technical programmes)	Ministry of Education, Respective State Governments



To unify smart protein curriculum efforts across India's higher education and training system, academic experts who participated in the FGDs suggested forming a consortium to appeal to the relevant authorities on the importance of smart protein courses. Such a bottom-up approach may help gain broader system recognition and accelerate the process of bringing smart protein modules and elective courses to curricula. Following approval and implementation, student and faculty interest (and demand) could drive future curriculum revisions that incorporate smart protein topics as core elements of degree programmes.

Another preferred mode of training—separate from formal UG, PG, or PhD programmes and highlighted by both industry and academic respondents—involves stackable short courses and boot camps delivered jointly by academic and industry experts. Similar to FSSAI's FoSTaC certification programmes, these offerings could provide flexible, modular skill development. The faculty participants emphasised the need for formal recognition of these courses within the AICTE, UGC, or NSDC frameworks to ensure credibility and scalability.



A six-month government-certified course in smart protein with expert facilities and hands-on training will build incredible skilled manpower.

**-Dr. Vidyashankar Srivatsan,
Senior Scientist, CSIR-Institute of Himalayan Bioresource Technology**

Academia-industry collaborations for workforce development

Academic interactions revealed that theoretical learning often outweighed practical training, with a ratio of over 70:30. The teaching faculty admitted that this left the graduates knowledgeable but hesitant in real-world applications. Industry stakeholders reiterated this need to create tailored hands-on training courses for early-career professionals and graduates to make them more industry-ready and ensure a seamless on-site company induction process. The interviewed academicians noted that, in areas where university infrastructure was lacking, they actively sought industry partnerships to provide students with practical exposure. The NEP 2020 also encourages greater industry involvement through guest lectures, industry-led courses, and other experiential components, which institutions can leverage to bring practical perspectives into theoretical learning.

Many universities possess funding to conduct hands-on workshops and training programmes, presenting further opportunities for collaboration. Industry recruiters likewise expressed strong interest in collaborating with academic institutions on joint programmes to help students become more industry-ready at the time of placement. There are also active external programmes like GFI India's SPARK Fellowship, which uses the industry-academia collaboration model to provide research opportunities (via six-month capstone projects for UG



students and one-year research fellowships for UG/PG graduates) for hands-on skill development in smart proteins.

Despite ongoing industry-academia partnerships in smart protein, some company recruiters highlighted having limited systematic feedback channels to inform teaching faculty and syllabus development boards on emerging skill gaps among UG and PG passouts. A continuous feedback loop system between industry-academia-talent councils would ensure that university curricula are aligned with real, evolving workforce needs, closing the skill gap and producing job-ready graduates. Improving academia and industry harmony is essential for building sustained partnerships, leading to a more responsive education ecosystem for graduates to thrive in a rapidly evolving talent landscape.



There is a disconnect between academic offerings and practical training. Industry-academia interactions have progressed, but there is more to be done.

**-Mr. Nilesh Lele,
President, Chamber for Advancement of Small and Medium Businesses
(CASMB)**

The case study below indicates an example of a well-structured curriculum revamp process conducted by a premier Indian educational institution, with the involvement of industry experts to brainstorm and validate the new curriculum inclusions.

Case study: Collaborative curriculum development at Amity University

In 2025, GFI India attended an [Industry-Academia Brainstorming session](#), conducted by the Corporate Resource Centre (CRC) of Amity University, Noida, featuring prominent members from industry, academia and heads of the institution to revamp the B.Tech and M.Tech Biotechnology curriculum. The goal of the session was to ideate pathways for upskilling to improve the employability of students, aligned with the Ministry of Science and Technology, Government of India's [BioE3 Policy](#) thematic areas, [Viksit Bharat 2047 Vision](#) and [ABLE-BIRAC India Bioeconomy Report 2024](#). Aside from core and elective programmes, the session also focused on building emerging technology and value-added courses, which are included under the NEP 2020.



At the conclusion of the session, next steps were planned to revamp the curriculum for implementation throughout Amity Institutes of Biotechnology globally. Amity University, one of the largest private Indian groups of institutions (with multiple campuses in India and abroad), taking a proactive approach for curriculum revisions serves as a yardstick for the ecosystem. The timely intervention and inclusion of emerging sector knowledge into academic and training programmes creates a global standard for the future of Indian workforce training. If more institutions take up this proactive approach, the incorporation of advanced training modules into existing core courses or the creation of specialised electives can be streamlined.



Our university places a huge emphasis on the employability of our students. We appreciate your inputs so as to enrich our syllabus with the latest and upcoming trends in the biotech industry.

**-Prof. Chanderdeep Tandon
Additional Pro-VC, Dean - Faculty of Biosciences and Biotechnology,
Amity University Uttar Pradesh (AUUP), Noida**

Section V: Conclusion

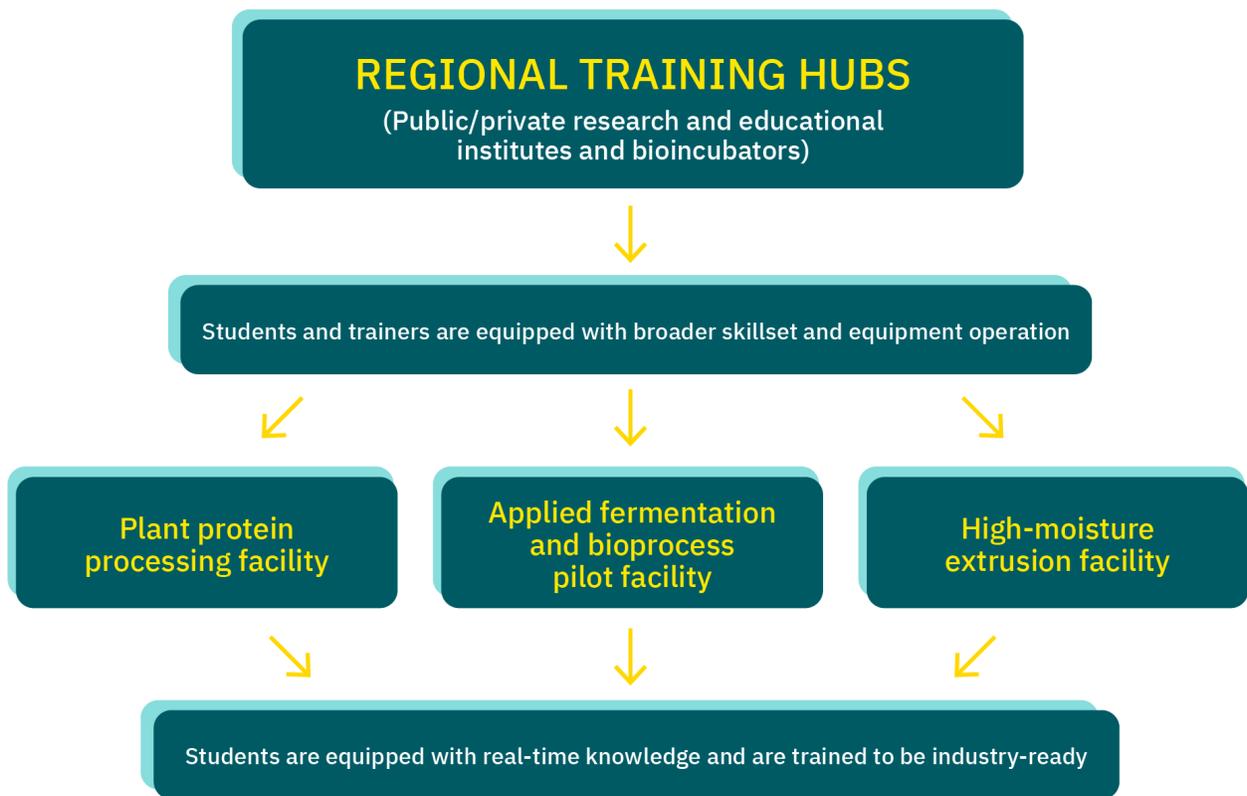
Smart protein technological development and scale-up are growing exponentially in India. The country's strong base of agri-food processing and manufacturing industries has catalysed innovative R&D and increased production of plant-based and fermentation-derived smart protein foods. Simultaneously, India's booming biotechnology sector has enabled breakthroughs in the emerging fields of precision fermentation and cultivated meat, which will benefit the global food biomanufacturing industry. The rapid technological and industrial progress has spurred national policy attention and created new employment opportunities requiring niche technical and interdisciplinary skillsets. Fortunately, India does not need to build its smart protein-specific talent pipelines from the ground up. The country's higher education systems are already globally recognised for imparting strong foundational training in disciplines like Agricultural Sciences, Food Technology, Biotechnology, and Chemical Engineering that align with the smart protein sector. However, several gaps in foresight, awareness, and coordination to recognise new fields and act swiftly to incorporate them into training systems continue to persist.

A frequently discussed barrier to upskilling is the limited availability of trainers and training infrastructure. Several larger establishments, such as the IITs, NIFTs, CSIR laboratories, and ICAR institutes, are well-equipped with cutting-edge equipment, such as extruders,



bioreactors, 3D printers, and analytical instrumentation labs, but this capacity remains concentrated in some major learning or research centres. Establishing these institutes and their associated bioincubators as designated regional training hubs (Figure 4) would allow students, faculty, and trainers from multiple surrounding institutes access to comprehensive hands-on learning environments. Complementing this model with industry-provided pilot facilities—accessible through internships, placements, or capstone project-based learning—would further expose students to real-world manufacturing environments (Figure 4). Together, these models could form a cohesive national training ecosystem capable of expanding over time with supportive policy frameworks.

Figure 4: Regional training hubs model with industry pilot facilities for hands-on training



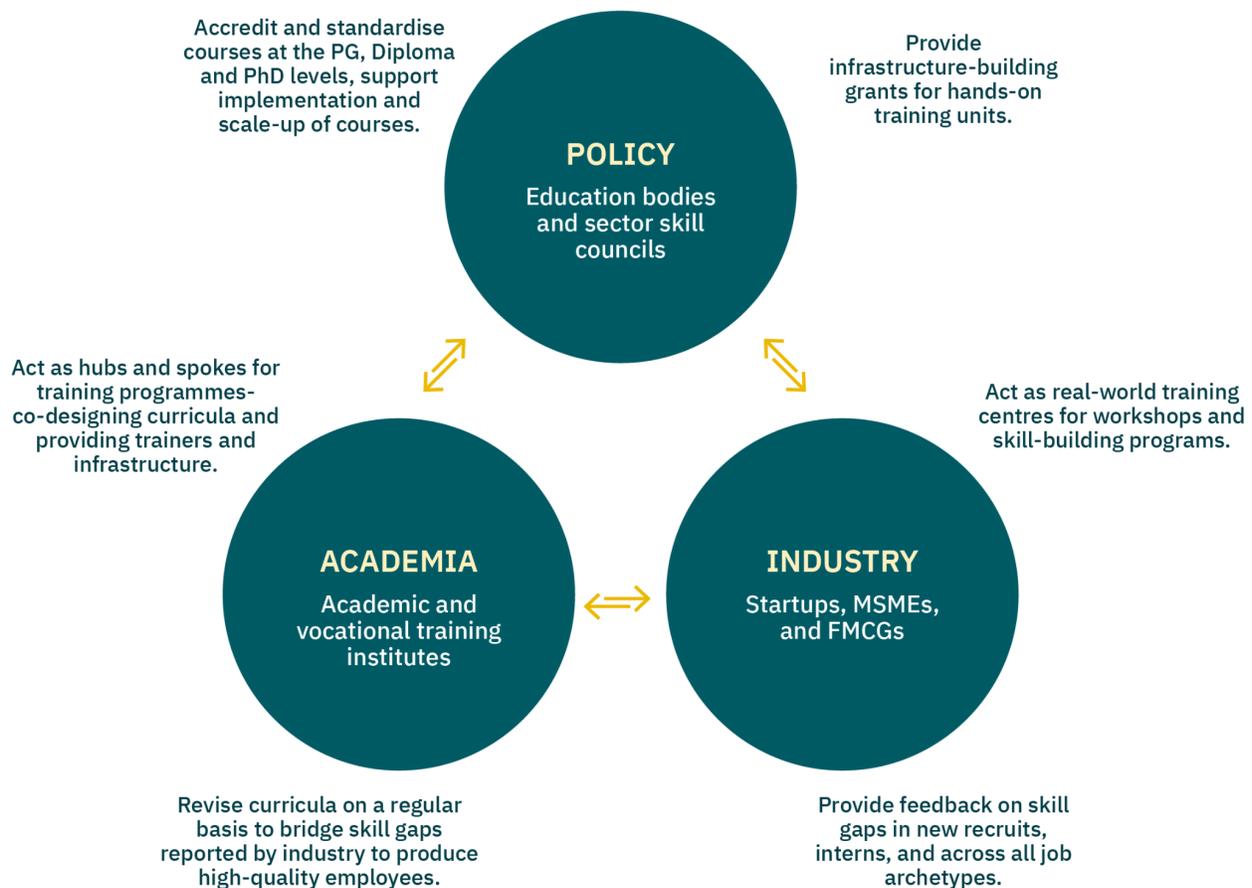
Establishing Centres for Smart and Sustainable Proteins to promote advanced, scalable research on plant proteins is essential. These centres will serve as hubs for research, training, and incubation, addressing protein deficiency, which affects one-third of India’s population, through academic innovation and sustained awareness efforts.

-Rajni Chopra,
Professor and Head of the Department of Food Science and Technology,
National Institute of Food Technology Entrepreneurship and
Management (NIFTEM-K)



For regional training hubs to remain effective, they must be embedded within broader educational and skilling systems. Active participation from policymakers (education and skilling bodies) and regulatory bodies is essential to establishing recognised standards—such as certified workshops, short-term courses, and micro-credentials—which ensure nationwide alignment and quality of critical skilling initiatives. The [BIRAC Bio-enabler Biomanufacturing Hubs](#)’ public-private partnership (PPP) model is an example of co-developing integrated infrastructure (biofoundries) to create scale-up facilities for access by start-ups and research communities. Biofoundries provide skilling opportunities for hands-on training and workshops under key biotechnology focus areas relevant to smart protein (such as animal cell culture, advanced analytical techniques, bioreactor handling, and process optimisation). These multi-stakeholder models (Figure 5) encourage the integration of industry needs into academic and training frameworks, ensuring that students gain competence aligned with emerging smart protein technologies. These models would also ensure the curriculum builders remain informed on the industry’s emerging trends, which can be incorporated in educational courses and certification courses in a timely fashion.

Figure 5: Multi-stakeholder model for upskilling and training the smart protein workforce





As national and global demand for smart proteins continues to accelerate, specialised upskilling in this domain will play a critical role in equipping India’s future-ready workforce. Building on the country’s strong higher education base, it will be essential to equip stakeholders, from curriculum developers and trainers to industry players, with the tools they need. This includes monitoring emerging trends and integrating them into accredited and nationally recognised courses, workshops, and hands-on training programmes. This report provides a structured view of current gaps and stakeholder insights to outline pathways to build a resilient skilling ecosystem for the smart protein sector.



Annexure

Academic survey questions: <https://forms.gle/6fzTqpYiUgmVBprYA>

Industry survey questions: [+](#) Industry surveys- Annexure

2021-22 graduate estimation data: [x](#) Annual Graduate output (AISHE).xlsx

Curriculum benchmarking tool: [+](#) Curriculum Benchmarking Framework-Annexure

Focus Group Discussion and one-on-one interview prompts: [≡](#) FGD and interview prompts

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Consultants

[Idobro Impact Solutions](#)

Contributions: Data collection, stakeholder outreach, admin support, and curriculum benchmarking framework development

About GFI India:

GFI India is the central expert organisation, thought leader, and convening body in the Indian alternative protein or smart protein sector. As part of an international network of organisations with partners in the U.S., Brazil, Europe, Israel, Asia Pacific, and Japan, GFI India is on a mission to build a secure, sustainable, and just global food future. With unique insights across science, business, and policy, we are using the power of food innovation and markets to accelerate the transition of our food system toward smart proteins. In building the sector from the ground up in India, we're aiming to establish a model for its growth in the developing world.