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REVIEW ARTICLE

Nurturing agripreneurship in India through open and distance learning: A comprehensive study

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Abstract

Agriculture remains a primary source of income and livelihood especially in developing nations amid the rapidly changing global economy. However, traditional educational systems often fail to prepare aspiring agricultural entrepreneurs due to limitations such as geographical barriers, rigid curricula and insufficient access to resources. Open and Distance Learning (ODL) emerges as a transformative solution, offering flexible, accessible, scalable education tailored to diverse learner needs and modern agribusiness demands. This study examined a comprehensive review of 192 publications using academic databases such as Google Scholar, Web of Science, Scopus and Education Resources Information Centre (ERIC). India is the leader in ODL research, United States of America (USA), United Kingdom (UK), Australia and China are other countries contributing to ODL research studies. The analysis identified key benefits, including bridging the education access gap in rural areas, fostering an entrepreneurial ecosystem and promoting lifelong learning. The scalability of ODL facilitates widespread reach, impacting a larger audience than traditional education methods and enhancing individual livelihoods. Furthermore, it fosters community engagement and collaboration, strengthening the resilience of the agricultural sector. This review highlights the significant role of ODL in nurturing a new generation of skilled agripreneurs, contributing to sustainable agricultural development, economic growth and global food security. Future research should explore the potential of ODL courses in metropolitan cities and green entrepreneurship.

Keywords: agribusiness; economic growth; entrepreneurship; lifelong learning; ODL courses

Introduction

Distance education began to take root in the middle of the 19th century and flourished within a century later as a result of its widespread adoption it gained significant traction after World War II (1). Due to environmental obligations, time and distance constraints, or a combination of these, the sources of educational information and identified learners are physically and geographically separated, making open distance learning (ODL) an inevitable phenomenon in the educational landscape of developed and developing nations. For this reason, the idea of open distance education was developed to provide accessible alternatives to students who are unable to attend regular universities (2). The quasi-permanent separation of the teacher and student for the duration of the learning process is a defining feature of distance education (3). It is a crucial tool for increasing education opportunities and outcomes, particularly in remote and underserved areas (4).

Since 1991, India has one of the largest ODL systems in the world, with 15 Open Universities (OUs), over 100 Directorates of Distance Education (DDEs) operating under Dual Mode Universities (DMUs) and over 1.7 million students pursuing higher education through this mode. Periodic system assessment is critical to its growth and maintenance of quality and standards. ODL is a technology-driven system continuously evolving with emerging innovations. As such, it must be routinely assessed to guarantee the system's efficacy and effectiveness (1). In an ODL setting, students can learn more efficiently and with greater confidence when they receive high-quality tutoring (5). Distance education has grown in significance because of technological advancements and the growing significance of the lifelong learning philosophy (6).

Distance learning techniques have gained momentum due to the unpredictability of the pandemic, which has brought about significant changes to the educational system (7). The impact of closing educational institutions was mitigated and the learning process was assisted by accelerating the digitization of education through distance learning (8). As traditional classrooms grew unfeasible, implementing distance learning programs became widely adopted (9). This action was required to reduce the pandemic's severe effects. All educational establishments continued to offer instruction and learning using the Open and Distance Learning (ODL) platforms. Two years after the outbreak, schools began to gradually reopen (10).

ODL has the potential to empower marginalized groups in Indian society, particularly those in remote and hilly areas such as Northeast, by providing a system responsive to post-industrial era demands (1). As we move through the 2020s, the researchers have developed increasingly sophisticated methods to enhance how students learn online. Students at each stage of education have different needs in distance learning and researchers are working to understand how to support their success at every level (11).

It is evident that the future of agripreneurship in India will increasingly depend on ODL approach to empower the agricultural sector. This paper, therefore, critically examines agripreneurial courses delivered through the ODL framework.

Agribusiness offer significant potential for rural population by creating livelihood opportunities and boosting local economies (12). Agripreneurship contributes to the overall economy by enhancing export competitiveness and increasing the global recognition of the "Made in India" brand (13). Additionally, governments often support these ventures with subsidies due to their potential to improve productivity and foster sustainable food systems, especially in developing countries. These enterprises are vital for income generation among marginalized communities and for strengthening food security.

Agripreneurship drives innovation through the integration of value chains, environmentally friendly practices and technology-enabled solutions (14). It plays a pivotal role in raising farmers' incomes, addressing ecological challenges and stimulating economic development (15). Agripreneurship can accelerate economic growth by encouraging innovation, market expansion, change and wealth creation through the development of new goods, concepts and solutions. Agritech companies are bringing new ideas to market linkage, precision farming and supply chain management. These innovations contribute to increased productivity, cost efficiency and overall agricultural profitability (16).

ODL has become crucial in today's fast-paced world, where continuous learning and skill development are essential for professional growth. Distance education also significantly reduces costs associated with physical infrastructure and commuting, making quality education more affordable and accessible to a broader population. Moreover, it promotes digital literacy and self-discipline, preparing learners for an increasingly technology-driven workplace while allowing them to maintain a better work-life balance.

The main aim of this study is to explore the role of ODL in empowering agripreneurship and to identify research gaps through content analysis, thereby addressing a previously underexplored area. This study aims to examine the potentials of ODL-based entrepreneurial courses in different agricultural sectors, review existing studies on the role of ODL in agripreneurship development, evaluate the effectiveness of ODL in delivering culturally adapted entrepreneurial education to remote farming communities.

Methodology

The comprehensive literature review is used in this process. It employs a structured content analysis approach to examine research on ODL in the context of agripreneurship.

2.1. Selection of literature

The literature review was carried out with an integrated, multidisciplinary approach. It encompasses peer-reviewed journal articles, conference proceedings, government reports and policy documents focused on agricultural entrepreneurship and distance education in India among which 2176 pieces of literature were retrieved for study. Primary searches were conducted in academic databases including Consortium for e-Resources in Agriculture (CeRA), Scopus, Web of Science, ERIC and Google Scholar using relevant search terms. The keywords which were utilized for the literature searches from the database are given in Table 1.

After applying inclusion filters to focus on relevant subject areas, 540 documents were manually screened to extract key thematic elements related to ODL and agripreneurship.

2.2. Content analysis process

The methodology employs a three-stage content analysis approach as mentioned in Table 1. In the first stage, documents are screened for relevance based on title, abstract and keywords. During this step, 348 duplicate entries were identified and removed. The second stage involves in-depth reading and

Table 1. Three-stage content analysis approach used to evaluate the role of ODL in agri-entrepreneurship development

Stage	Process	Key action
Stage 1: Screening for relevance	Identifying and filtering relevant literature	Search databases: Google Scholar, ResearchGate, Scopus, Web of Science Keywords used: "Agripreneurship + ODL + India", "Agribusiness Training + Distance Education", "Distance learning + Agribusiness". (The keywords are searched according to each database criteria) Inclusion: Studies on ODL in agrientrepreneurship, policy reports, government initiatives (IGNOU, MANAGE, MOOCs, etc) Exclusion: Irrelevant, outdated, inappropriate studies, articles less than time span of 2015 Filtering based on title, abstract and keywords
Stage 2: In-depth reading & categorization	Categorizing studies into predefined themes	The content analysis is structured around the key themes: •Role of ODL in Agri Entrepreneurship Development •Educational technologies and delivery methods •Barriers in ODL-based entrepreneurship development •Also included Success Stories and Case Studies and Policy Recommendations
Stage 3: Synthesis & pattern identification	Analyzing patterns and drawing insights	Extract insights on technology, skill gaps and ODL effectiveness Limitations: limited practical exposure, digital literacy, connectivity and cost issues Highlight effective case studies, mobile and blended learning in Agri entrepreneurship

categorization of selected materials according to predefined themes therefore 192 studies were assessed for eligibility. The final stage focuses on synthesizing findings and identifying patterns across the literature.

2.3. Thematic framework

The content analysis is structured around the key themes:

- Role of ODL in Agri Entrepreneurship Development.
- Educational technologies and delivery methods.
- Barriers in ODL-based entrepreneurship development.

2.4. Quality assessment

In this step inclusion of relevant studies and structured quality assessment was done. Eligibility criteria were based on several factors, including peer-review status, methodological strength such as clarity of research design, sample size, data analysis techniques and relevance to the objectives. Studies were also evaluated for the recency of publication, clarity of findings and consistency with established theories or frameworks. Articles that did not meet these standards such as non-peer-reviewed publications, studies with unclear methodologies and those tangential to the topic were excluded. Through this process, 164 well researched publications were chosen, while 28 articles were removed as they failed to meet the quality assessment criteria from the PRISMA flow diagram (Fig. 1). The findings, conclusions and general characteristics of the 58 literature studies were systematically extracted and the synthesized data were presented using graphs and tables.

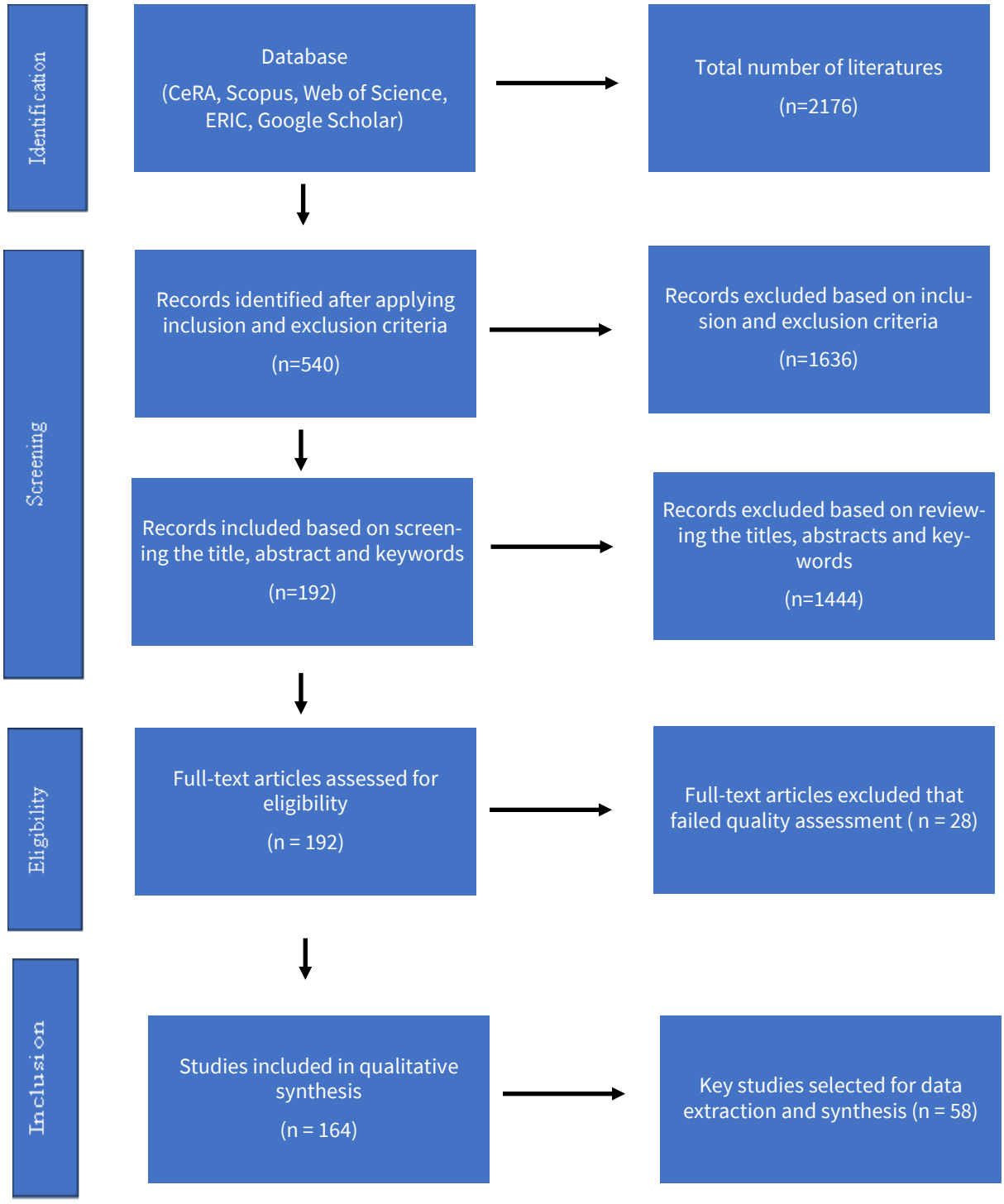

Fig. 1. PRISMA flowchart.

Result and Discussion

3.1. ODL in agripreneurship development

Higher education institutions increasingly recognize the importance of equipping graduates with entrepreneurial knowledge and skills. Realizing the critical role entrepreneurship plays in contributing to national economic growth and job creation, the Ministry of Education in several countries has proposed entrepreneurship as a course in higher education institutions in the hopes of nurturing local entrepreneurs among graduates through ODL approach (17). The online and distance learning environments overcome time and distance constraints when compared to face-to-face or traditional learning environments (18). Numerous digital platforms now support entrepreneurial development by providing interactive forums, workshops, video lectures, hands-on exercises and globally collaborative learning environments (19).

Universities with proper infrastructure can offer distance learning aligned with global standards. They play a key role in promoting education, entrepreneurship and economic growth by producing skilled professionals (2). Agri-entrepreneurship courses aim to instill entrepreneurial values and practical skills through fieldwork, preparing students to pass on this knowledge (20).

The compiled study from various sources explains the distribution of enrollments across various agripreneurship sectors, as mentioned in Fig. 2, highlighting key areas of interest. Organic farming and dairy & livestock attract the highest enrollments, reflecting a strong focus on sustainable agriculture and animal husbandry. Food processing has the lowest enrollment levels suggesting either limited awareness or fewer specialized programs in this domain. The profound study of authors such as Haribalaji et al. (22), Singh et al. (26), Guiné et al. (31), Manoj et al. (35), Jraisat (40) and others have identified the positive impacts of nurturing agripreneurship through ODL courses in various business settings in India. These insights are added in the following section.

Sericulture

Sericulture, the practice of breeding silkworms for silk, combines technical skills with cognitive, psychomotor and affective development. It has become a popular income source for agripreneurs across India and with ongoing government support, it holds strong potential as a profitable farming enterprise (21). Distance learning offers high-quality training, enabling the instruction of multiple students simultaneously (22). It is especially suitable for small-scale farmers, business owners and marginalized communities due to its low initial investment and potential for high returns (23). It emerged that the ODL sericulture certificate programme, which Tamil Nadu Agricultural University (TNAU) provides virtually, significantly influenced the students toward entrepreneurship. The programme delivered over a 6-month period, includes 4 modules with online lectures, interactive sessions and field-based virtual demonstrations. Over 78 % of enrolled participants reported increased confidence in pursuing sericulture-based ventures after completion (22).

Beekeeping

Beekeeping is an important and growing industry for several reasons (24). ODL plays a key role in developing competency-based curricula and multimedia training modules for beekeeping. Most male learners in beekeeping programs are younger (15 to 30 years), have lower levels of education and are school dropouts. Over 50 % of them have agricultural backgrounds, mainly as marginal, small, or landless farmers (25). ODL's widespread network of study centers and counsellors can support the testing and certification of short-term, skill-based training programs. With features like open access and flexible pedagogy, ODL is well-suited to design and implement qualification frameworks in beekeeping education.

Mushroom cultivation

Mushroom cultivation presents a high-potential agribusiness, especially for improving livelihoods among rural poor communities (26). Techniques such as cultivating *Pleurotus*

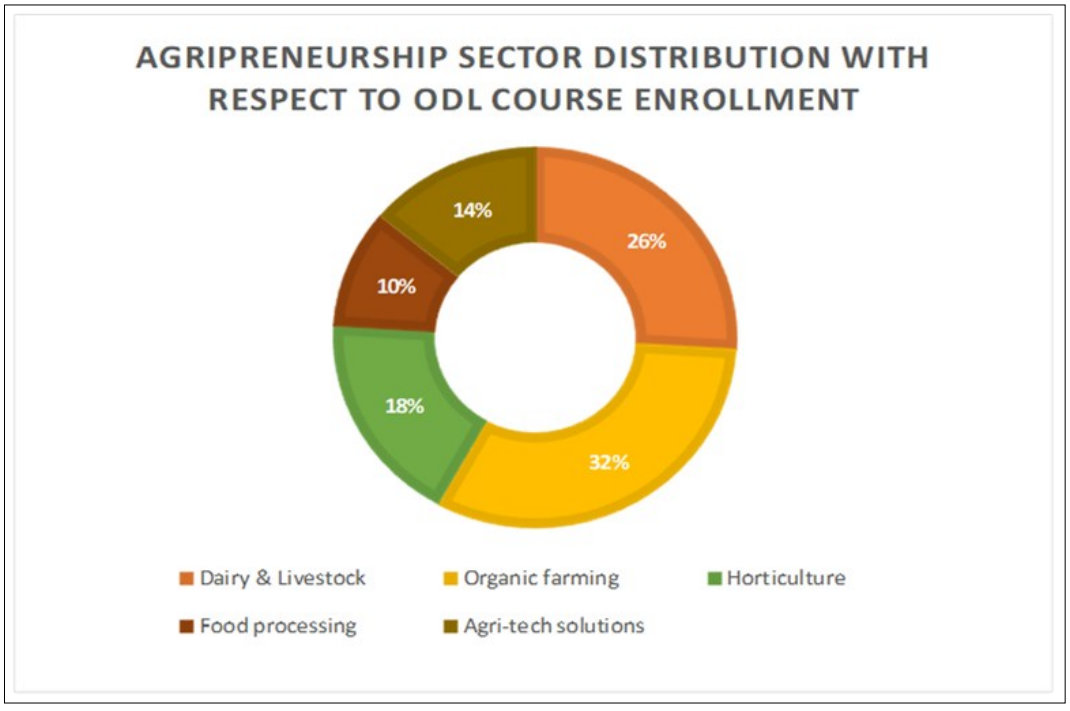

Fig. 2. Distribution of agripreneurship sectors based on enrollment in ODL courses across various domains.

mushrooms using agro-industrial waste are economically viable and environmentally sustainable. ODL courses guide small-scale growers through these processes, offering affordable and accessible training options. This sector offers significant employment opportunities for unemployed youth and rural women, making it an inclusive development pathway (27). To expand outreach, Interactive Voice Response (IVR) systems have been deployed as a part of ODL-based extension programs, demonstrating effective use of ICT tools in agricultural education (28). The study conducted on effectiveness of skill oriented ODL programmes revealed that majority of responders to the mushroom cultivation course said it was very effective (29).

Organic farming

The rising popularity of organic agriculture presents opportunities to use digital tools in distance education for delivering up-to-date information. Mobile-based learning programs in organic farming can support rural development by effectively addressing learners' needs and preferences (30). Findings show that people of all ages, especially those with limited education and farming experience, are turning to distance learning for agricultural education. Learners from weaker sections also benefit from its flexible format to enhance their skills. However, female participation remains low, highlighting the need for inclusive efforts (27). Guiné et al. (31) revealed that enrollment in the organic farming ODL course was shaped by four key factors: The teaching-learning process was crucial, highlighting the importance of effective instructional methods and active learner engagement. Academic aspects, such as the quality of the curriculum and the credibility of certification, played a significant role in attracting students. Additionally, attractive elements like flexibility, affordability and ease of digital access made the course more appealing, especially to rural learners. Other influencing factors included better job opportunities, encouragement from peers and the availability of nearby support centers. Together, these dimensions strongly influenced learners' decisions to enroll in the program.

Terrace gardening

Terrace gardening is an increasingly popular urban agripreneurship practice that offers both nutritional and economic benefits. Feedback from participants of the terrace gardening ODL course was mixed. While most found the course useful, only a portion rated it as highly effective, with some expressing dissatisfaction due to limited opportunities for practical skill enhancement (27). Several learners already had prior experience in terrace gardening and expected more advanced content, suggesting a mismatch between learner expectations and course level. Despite these concerns, the majority expressed satisfaction with the syllabus structure, content quality, print materials, personal contact programs (PCPs) and administrative support (32).

Fodder management

According to Krishnaveni et al. (33), distance learning in fodder management has well-structured planning and reliable communication systems. This becomes particularly important when addressing agronomic practices aimed at enhancing the yield and nutritional quality of livestock feed (34). Manoj et al. (35) studies further stresses the importance of faculty training and building a sense of community partnership in distance education that are relevant in fodder management courses. It also highlights that ODL empowers local farmers through flexible, accessible training that builds both technical competence and leadership skills in managing fodder resources effectively.

Handicrafts

The students believed that their knowledge and comprehension of designs, as well as their inventive use of color and stitching, had improved. Nearly all of them stated that the training course had assisted them in learning about bank loans, entrepreneurship, different government programs and using technology in their businesses (36). For household assistants, the ODL training in handicrafts offered several benefits: it helped them make productive use of their free time, build on existing skills, gain new competencies and explore income-generating opportunities. The knowledge and abilities gained through the course also contributed to their personal development and improved job performance (37).

Value addition

Value addition and food processing are vital for improving food utilization, extending shelf life and preserving nutritional value. These processes also empower farmers and farm women to start their own ventures (38). The ODL program focuses on building skills in producing value-added products such as pickles, jams, squashes, dehydrated fruits and spice powders. It also trains learners in post-harvest management of fruits and vegetables. The program aims to develop entrepreneurial and technical capabilities, particularly among rural youth and marginalized communities, to enhance employment and self-employment opportunities (39).

Dairy farming

Distance education is becoming a viable means of imparting knowledge and skills, as well as fostering entrepreneurial spirit among livestock producers, due to its ability to accommodate a larger student body than traditional educational settings. Due to this, the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) began providing two correspondence courses in 1996: one on goat farming and the other on dairy farming (40). The first step in the dairy development initiative was to guarantee a fair price for milk by using Community Based Organizations (CBOs) to oversee Village milk procurement centers and Bulk Milk Cooling Units (BMCUs). In the southern states, 31 % of entrepreneurs who own microbusiness are literate and hold post-secondary education credentials. For them, the dairy farming entrepreneurial training provided by ODL is useful (41).

Vermicomposting

The farming community has embraced the technology of vermicomposting very well and extensively. It improves the financial situation of small and marginal farmers who are low on resources and it gives young people options for self-employment (42). According to Sourabh et al. (43), distance learning on vermicomposting resulted in high adoption rates and observable economic benefits. Individuals between the ages of 35 and 55 years are often deeply committed to their families and highly motivated to improve their socioeconomic status through ODL learning. Most participants reported

satisfaction with all aspects of the course. Learners gained practical skills in compost production, quality assessment and local marketing strategies (32).

Tea cultivation technology

Tea production and management require precision and attention to detail. Agricultural information delivered through ODL offers unique advantages such as timely access to expert knowledge, flexible learning schedules and practical guidance, which are valuable regardless of the economic strategies adopted by tea farmers (44). The ODL Certificate Course on Tea Cultivation Technology, offered by the Directorate of Open and Distance Learning (DODL) at Tamil Nadu Agricultural University (TNAU), identified several key factors influencing learner enrollment. These included situational considerations, course convenience, career aspirations and positive attitudes toward both ODL and entrepreneurship. Most students indicated that a moderate combination of these factors guided their decision to pursue this distance learning credential (3). Table 2 represents a list of ODL entrepreneurial courses offered in various universities in India and their impact on the enrollers to improve entrepreneurial skills.

3.2. Educational technology and delivery methods

Educational technology has shown significant promise in fostering entrepreneurial skills, especially in areas like initiative, motivation, problem-solving and financial literacy (45). In India, several digital platforms have been successfully integrated into online and hybrid entrepreneurship education. Prominent among them are SWAYAM, NPTEL and eSkill India, which offer Massive Open Online Courses (MOOCs) tailored to diverse learner needs. These platforms provide flexibility in content access, allowing learners to progress at their own pace and convenience. Social media applications such as WhatsApp, Telegram and YouTube have been increasingly used to support collaborative learning and peer interaction (46). For example, TNAU's ODL programs often utilize WhatsApp groups for doubt clearance and peer discussion (28). Additionally, simulation tools and serious games, such as FarmSimulator and agri-business strategy games, have enhanced engagement and provided learners with practical, decision-making experience in a risk-free environment.

Successful integration of these technologies in distance learning environments requires clear learning outcomes, sound instructional strategies and high-quality digital content (47). Platforms like DIKSHA (Digital Infrastructure for Knowledge Sharing) and AgMOOCs by ICRISAT are further examples that cater specifically to agricultural education, promoting skill development through interactive and bilingual content. Experiential learning through case studies, fieldwork simulations and virtual internships has been shown to strongly influence entrepreneurial intentions among learners (48). Studies show that over 70 % of learners enrolled in online agripreneurship courses cited flexibility of access and location independence as top motivators. Other influential factors included cost-effectiveness, relevance of content, digital tool accessibility and exposure to mentorship and industry networks as shown in Fig 3.

Moreover, course design in ODL entrepreneurship education must address fundamental instructional elements such as "who the learners are, what content is being taught, how it is being delivered and which outcomes are targeted" (49). The literature suggests that ODL institutions should prioritize the development of short-term certificate programs in agripreneurship, embed entrepreneurship modules across all faculties and adopt hands-on experiential approaches that reflect real-world entrepreneurial challenges (50).

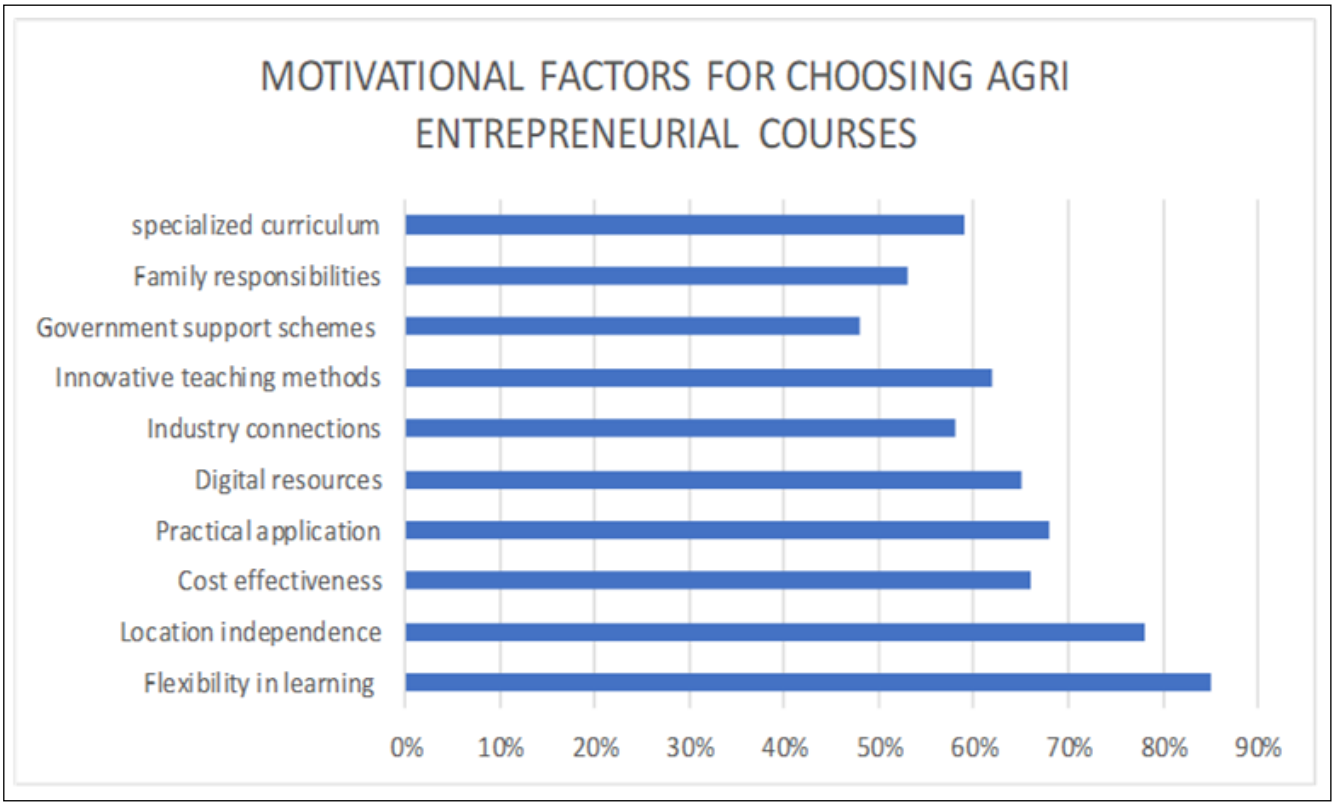

Fig. 3. Major motivational factors influencing the enrollment in agri-entrepreneurial courses through ODL platforms.

Table 2. ODL entrepreneurial courses offered by various institutes in India and their role in fostering entrepreneurship in the agricultural sector

S.No.	Entrepreneurial course	Institutions offering courses	Role of ODL	Impact & Outcomes	Reference
1	Sericulture	Tamil Nadu Agricultural University (TNAU), Indira Gandhi National Open University (IGNOU), University of Agricultural Sciences (UAS).	Distance learning in sericulture provides essential training and has significantly boosted rural income and entrepreneurial enthusiasm, particularly among marginalized farmers.	Over 1,500 trained via IGNOU (2019-2023); 65 % reported 20-30 % income growth.	(21-23)
2	Bee keeping	Tamil Nadu Agricultural University (TNAU), Acharya N.G. Ranga Agricultural University (ANGRAU), Dr. YSR Horticultural University.	ODL effectively enhances beekeeping skills and knowledge, especially among young, less-educated farmers, through competency-based curricula and multimedia training modules	70 % of 2,300 learners started micro-enterprises; greater uptake by youth in Andhra and Tamil Nadu.	(25)
3	Mushroom cultivation	Acharya N.G. Ranga Agricultural University (ANGRAU), Tamil Nadu Agricultural University (TNAU), Indira Gandhi Krishi Vishwavidyalaya (IGKVY)	Mushroom cultivation, supported by ODL initiatives and ICT tools like IVR systems, offers promising agribusiness opportunities, particularly benefiting unemployed youth and rural women	40 % of learners set up micro units; 58 % women participation; increased seasonal income among youth.	(29)
4	Organic farming	Tamil Nadu Agricultural University (TNAU), Acharya N.G. Ranga Agricultural University (ANGRAU), Indira Gandhi National Open University (IGNOU).	Distance education in organic farming, particularly utilizing mobile learning, supports rural development by addressing learners' needs, with potential for wider participation, especially among underprivileged groups	75 % of IGNOU learners accessed better markets; strong community adoption seen in Kerala and MP.	(31)
5	Terrace gardening and landscaping	Tamil Nadu Agricultural University (TNAU), Acharya N.G. Ranga Agricultural University (ANGRAU), Yashwantrao Chavan Maharashtra Open University(YCMOU)	ODL terrace gardening courses received mixed reviews, with participants finding them useful but expressing a need for more comprehensive skill improvement opportunities.	85 % urban learners; 60 % women; many used knowledge for urban kitchen gardening and landscaping startups.	(32)
6	Fodder management	Tamil Nadu Agricultural University (TNAU), Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), UAS-Dharwad	Efficient communication and faculty preparation are crucial for successful distance learning in fodder management, necessitating locally relevant ODL materials and community involvement to support dairy farmers' educational needs.	48 % of trainees saw improved livestock productivity; key support tool for dairy self-help groups.	(35)
7	Handicrafts	National Institute of Open Schooling (NIOS), IGNOU	Handicraft training through ODL significantly enhances household assistants' skills, entrepreneurial knowledge and financial prospects, garnering high satisfaction rates among trainees for program quality and overall conduct	62 % of enrollers became self-employed; 80 % women trainees; high program satisfaction and confidence boost.	(37)
8	Value addition	PGRI Banyuwangi University, Indira Gandhi National Open University (IGNOU), Yashwantrao Chavan Maharashtra Open University (YCMOU), Madhya Pradesh Bhoj Open University (MPBOU)	ODL programs in value addition and food processing empower farmers, especially from rural and marginalized backgrounds, with entrepreneurial and technical skills to enhance employment and self-employment opportunities in food-related businesses	55 % of enrollers started agri-processing ventures; high entrepreneurial activity reported among rural youth and women.	(39)
9	Dairy farming	Tamil Nadu Veterinary and Animal Sciences University (TANUVAS),IGNOU, National Dairy Research Institute (NDRI).	Improving dairy cattle breeding sustainability and competitiveness is crucial for food security, with distance education emerging as a key tool for training livestock producers	67 % of learners improved milk yield and herd practices; many joined local cooperatives post-training.	(41)
10	Vermicomposting	Tamil Nadu Agricultural University (TNAU), Acharya N.G. Ranga Agricultural University (ANGRAU).	Vermicomposting technology, embraced by the farming community, notably benefits small farmers financially and offers avenues for youth self-employment, with middle-aged individuals particularly motivated to enhance socioeconomic status through ODL training programs	45 % started commercial composting units; 30 % saw more than 15 % income increase; especially popular among mid-aged farmers.	(32)
11	Tea cultivation technology	Tamil Nadu Agricultural University (TNAU)	The ODL Certificate course on Tea Cultivation Technology at TNAU attracted learners due to factors like situational considerations, course convenience, career goals and attitudes toward ODL and entrepreneurship	50 % of attendees took up tea-based micro-ventures or found work in tea estates; strong rural interest noted.	(3)

3.3. Barriers in ODL-based entrepreneurship development

While ODL offers numerous benefits, several challenges hinder its effectiveness in entrepreneurship education (51). Program-related barriers are common, especially among adult learners, including poor internet connectivity, distractions and difficulty grasping complex content like technical or computing topics (52). One potential solution is the development of offline-accessible learning modules and downloadable content that learners can access without real-time internet. Technological inequality further limits access, as many learners lack high-performance devices or fast internet, deepening the digital divide (53). Community digital hubs or study centers equipped with shared ICT infrastructure can help bridge this gap in under-resourced areas.

Printed materials still play a role but cannot match the interactivity of digital platforms, especially in remote regions (54). Blended learning models combining printed content with mobile-based engagement tools can enhance learning outcomes in such contexts. Educators also face time constraints when developing and delivering online content, making preparation burdensome (55). Providing ready-to-use teaching templates and training in digital pedagogy can significantly reduce this load.

Some learners found existing training durations insufficient, while others noted low enrollment in vocational ODL courses delivered at physical centers (56). To address this, modular course formats with flexible pacing and mobile-based learning can boost participation. Although immersive technologies like AR/VR show promise for enhancing online learning, their implementation is limited due to infrastructure constraints (57). Investment in low-cost simulation tools or virtual field trips using basic devices could make such experiences more accessible (58).

Conclusion

Promoting agripreneurship through ODL presents a strategic approach to reducing educational disparities in rural areas. By offering flexible, affordable and need-based training, ODL equips aspiring agripreneurs with the knowledge and skills to innovate and succeed in the agricultural sector. These programs are critical in transforming traditional farming into sustainable entrepreneurial ventures, contributing to rural economic growth and resilience. Future research should focus on developing region-specific ODL models, assessing the long-term impact on enterprise sustainability and integrating emerging technologies such as mobile learning and AI to enhance the delivery of practical agri-business education.

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Authors' contributions

ARNA carried out the survey, analysed the data and formulated the manuscript. VR assisted in data collection and analysis as part of the research study. RK contributed by developing ideas, reviewing the manuscript and assisting with procuring research grants. NDM helped in summarizing and revising the manuscript. PK provided additional support and contributions to the research study.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

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