ISSN (Print): 2788-8320 ISSN (Online): 2788-8339

JOURNAL OF SOCIAL RESEARCH DEVELOPMENT
www.jsrd.org.pk editor@jsd.org.pk

TRANSFORMING HIGHER EDUCATION: AN INCLUSIVE REVIEW, RESEARCH-DRIVEN ROADMAP TO FINANCIAL SUSTAINABILITY IN PAKISTANI UNIVERSITIES

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KEYWORDS

Transformation, Systematic Review, Higher Education, Financial Sustainability

ARTICLE HISTORY

Date of Submission: 16-01-2025
Date of Acceptance: 20-02-2025
Date of Publication: 23-02-2025

ABSTRACT

Higher education in Pakistan faces significant financial challenges, due to an overreliance on tuition fees, which limits ability of universities to focus on research and innovation. This study proposes research-driven roadmap for achieving financial sustainability in Pakistani universities by adopting best global practices in research commercialization. The research results identify fundamental obstacles, like insufficient research facilities, weak academic-industry connections, and a lack of faculty member training in commercialization methods. The Pakistani universities currently operate at only 3.5% of their capacity. The targeted improvement areas are centered on developing industrial relationships, creating specific ORIC structures, providing research and commercialization training for faculty members. The proposed financial sustainability plan presents step-by-step strategy to achieve its goals over three essential investments in research facilities, faculty development, and applied research activities by 2028. This study shows that following international norms alongside local barrier solutions creates opportunities for the Pakistani universities to become innovation-based learning centers that drive economic development & technological progress for society.

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DOI https://doi.org/10.53664/JSRD/06-01-2025-05-50-65

INTRODUCTION

The sustainability of higher education functions as the fundamental pillar for economic progression and societal development; however, Pakistan's developing nation confronts the major obstacles in keeping it sustainable (Wu, 2024). The use of tuition fees as main revenue source has transformed universities into financially dependent institutions, making them unable to pursue the meaningful

research or innovation. Educational institutions must achieve financial sustainability to transform rigid learning environments into active centers that produce knowledge, innovation, and social advancement (Mowery, Nelson & Sampat, 2015; Shattock, 2009). This paper delivers an extensive review and strategic plan that shows how to achieve financial sustainability in higher education based on the research outcomes. This makes universities vulnerable to funding cuts disbursements, deflation long-term planning. Universities worldwide have proven that research commercialization develops financial independence for the institutions. The United States universities such as Stanford University and the Massachusetts Institute of Technology (MIT), produce billions annually through the patent sales, industrial collaboration, and technological advancement activities (AUTM, 2022; Shane, 2004).

According to HEPI (2022), both Oxford and Cambridge Universities have generated the significant financial revenues in United Kingdom through research spin-offs and licensing agreements. The Chinese institution Tsinghua University has made substantial economic contributions to innovative technology change, driving national economic growth (Wang, Li & Chen, 2023; Zhou, Zhang & Sun, 2016). Academic output transitions into commercial items & patented solutions under research commercialization to link academic knowledge to practical challenges (Mowery et al., 2015). The Google PageRank algorithm signifies how commercialized research at Stanford led to significantly transformative outcomes (AUTM, 2022). Academic institutions have transformed into technological drivers of economic growth and societal advancement over innovative solutions (Kumar, Sharma & Mehta, 2020). Universities throughout Pakistan have not yet achieved full potential for research-based financial resilience. According to Higher Education Commission (HEC, 2022), only 3.5% of public universities generate revenue in research commercialization, reflects systemic barriers such as scarce infrastructure, weak industry-academia linkages, and lack of commercialization training (HEC, 2021).

Few universities have established dedicated offices of research, innovation and commercialization, limiting their volume to render research into revenue-generating outputs (HEC, 2022). The absence of structured pathways for research commercialization hinders universities from contributing to national economic growth and addressing societal challenges in the country. For example, applied agriculture, health, and technology research have immense potential to drive the national progress (Pingali, 2012; Frazer, 2006). In agriculture, high-yield crop varieties developed through university research can improve food security, whereas health novelties can address public health challenges (Frazer, 2006; Zhou et al., 2016). Still, a lack of funding, infrastructure, and incentives for researchers hinders such outcomes in Pakistan (Gasper, 2007; Bhattacharya, 2017). Moreover, social sciences drive evidence-based policy making and community development. The universities must highlight applied social science research to address societal challenges, such as poverty, education, and social justice (Teferra, 2014; Gasper, 2007). The social science research from the University of Sussex has informed poverty alleviation policies, indicating transformative likely of research-driven solutions (Gasper, 2007).

Research-based fiscal sustainability planning requires an organization-wide method that conforms to global benchmarks but also addresses specific local obstacles. Universities worldwide have built

highly developed innovation systems that aid industrial partnerships, technology movement amid the academic and commercial sectors, and startup creation initiatives (Zhou et al., 2016; Shattock, 2009). The Indian Institutes of Technology (IITs) created a restrained framework for turning their applied research into income, has brought noteworthy social and economic advancements (Kumar et al., 2020). Tsinghua and Peking universities in the China have realized their innovation programs over government-sponsored incentive programs to develop technology-based innovation centers (Wang et al., 2023). Research commercialization in Pakistani universities requires implementation of guidelines that establish priorities for such initiatives to succeed. HEC Vision 2025 specifies that research-based solutions are essential for building socioeconomic growth (HEC, 2021). Research commercialization offices at universities should be established with industry-academia alliance platforms and compensation systems to inspire faculty to develop practical and impactful research (Bhattacharya, 2017).

The main barriers to research commercialization are inadequate training and insufficient awareness among faculty members and researchers. Statistics from HEC reveal that IP management combined with patent registration and industrial partnership abilities are absent in over three-quarters of the university teaching staff (HEC, 2021). Bridging these skill deficiencies requires systematic training, capacity enhancement programs and beset awareness initiatives to establish research leadership in universities (Mowery et al. 2015). Universities' research capabilities need to be improved because their existing infrastructure does not support advanced activities. Most institutions operate without sufficient research facilities or funding to apply highly credible scientific knowledge (Teferra, 2014; Kumar et al., 2020). To become competitive on a global scale and attract industry collaborations, universities must arrange strategic investments in research laboratories, technology transfer offices, and innovation centers (HEPI, 2022). The roadmap declares financial sustainability over research output-based revenues, cover 25% of expenses. According to international standards, universities in developed economies obtain research commercialization revenues amid 25% & 40% (HEPI, 2022; Zhou et al., 2016).

This objective requires a strategic sequence of the capacity development, policy advancement, and surveillance systems to achieve its goals (HEC, 2022; Shattock, 2009). Thus, national development depends heavily on converting the higher education into a research-centered financial model that guarantees its financial stability. The Pakistani universities can transform from tuition-dependent institutions to innovation hubs by adopting the international benchmarks and tailoring solutions to local conditions. Through this shift, universities will drive economic growth, societal development, and technological advancement to fulfill their purpose as engines of national progress (HEC, 2021; AUTM, 2022). In Pakistan's development context, higher education requires urgent improvement. Tuition fee skepticism among universities creates a collapsing financial structure that reduces their capacity to conduct quality research and develop innovations while making social contributions. Successful functioning models based on this operational approach exist in the United States, United Kingdom, China, and other parts of the world. The framework operates within the established norms and parameters of the Higher Education Commission of Pakistan to achieve economic, academic, and societal growth.

Objectives of Study

1. To analyze global best practices and successful models of research commercialization in the universities, particularly in the developed nations (US, UK, China, and India), and assess their applicability in the context of Pakistani higher education.
2. To identify systemic barriers hindering research commercialization in Pakistani universities, including infrastructure gaps, industry-academia disconnection & lack of commercialization training, and to propose actionable solutions to address these challenges.
3. To develop a structured, research-driven roadmap to achieve the financial sustainability in Pakistani universities by ensuring that at least 25% of university spending is generated over applied research, patents and industry partnerships by 2028.

LITERATURE REVIEW

The research commercialization has been widely adopted globally to drive university innovation, sustainability, and social impact. Stanford University generated over USD 1.9 billion in 2021 from patents and licensing agreements, including Google PageRank algorithm (AUTM, 2022). The MIT's collaborations with industries produce technologies that contribute USD 33 billion annually to the U.S. economy (Shane, 2004). Harvard University earns over USD 200 million annually over research and industry connections (Mowery et al., 2015). University of Oxford's Innovation Arm generates over GBP 30 million annually through spin-offs and patents (HEPI, 2022). Cambridge University collaborates with industries over its Science Parks, causative GBP 50 billion to economy annually (Shattock, 2009). Tsinghua University's innovation ecosystem earns CNY 10 billion annually over technological advancements and start-ups (Wang et al., 2023). Chinese government incentivizes research commercialization over grants and policies, resulting in over 20% of university revenue originating from applied research (Zhou et al., 2016). Indian Institutes of Technology (IITs) actively partner with industries, easing over USD 2 billion in societal and economic contributions annually (Kumar et al., 2020).

IIT Bombay launched over 50 spin-offs in the technology sector to improve the national innovation capability (Bhattacharya, 2017). Research on high-yield crop varieties in agriculture has increased global food security (Pingali, 2012). In health, the university research has led to the development of vaccines such as HPV vaccine developed at University of Queensland (Frazer, 2006). In technology, university collaborations have resulted in innovations, like Bluetooth technology (Ericsson, 1994). Only 3.5% of public universities in Pakistan generate revenue through patents as well as industry collaborations (HEC, 2022). African universities, like University of Cape Town, have implemented research-driven funding models, achieving 12% of their revenue over commercialization (Teferra, 2014). India's success with IITs highlights the potential of structured university-industry linkages in developing economies (Kumar et al., 2020). In this linking, social sciences are critical for evidence-based policymaking and societal progress, and The University of Sussex conducts research to drive public policy on the poverty alleviation (Gasper, 2007). Universally, the higher-education systems are pivotal to economic development, technological advancement, as well as societal development (Mowery et al., 2015).

Universities impart knowledge and serve as innovation hubs through research commercialization and industry collaborations. In developed economies, such as United States, the United Kingdom, and China financial sustainability of universities relies significantly on research commercialization, technology transfer, and patent revenues (AUTM, 2022; Zhou et al., 2016). Nevertheless, higher education institutions in developing nations, such as Pakistan, remain tuition-dependent because of systemic barriers, underdeveloped infrastructure & limited industry-academia collaboration (HEC, 2022; Teferra, 2014). This literature review synthesizes the global and local evidence to highlight successful research commercialization models, challenges, and potential applicability to Pakistani universities, mainly focusing on social science research, education, and teacher training. Research commercialization involves transforming academic outputs into marketable innovations, products, or patents, enabling universities to make sustainable revenue (Shane, 2004; Mowery et al., 2015). In this connection, different countries such as the United States, the United Kingdom, China, and India exemplify the successful and leading integration of applied research and commercialization into their financial models.

For example, in the United States, universities such as Stanford and MIT generate billions of dollars annually through patents and spinoffs (AUTM, 2022). Similarly, in United Kingdom, the University of Oxford's research commercialization arm earns GBP 30 million annually (HEPI, 2022), whereas Cambridge University's collaborations contribute GBP 50 billion to the economy (Shattock, 2009). In China, universities such as Tsinghua University have established robust ecosystems for research commercialization, earning over CNY 10 billion annually (Wang et al., 2023). Applied agriculture, healthcare, and technology research address the real-world challenges and drive societal progress (Pingali, 2012; Frazer, 2006). However, social sciences, particularly education and teacher training, are correspondingly critical for fostering the human capital development, promoting social justice, and informing evidence-based policies (Teferra, 2014; Gasper, 2007). The social sciences play a transformative role in the societal progress by addressing poverty, inequality, and education gaps (Gasper, 2007; Teferra, 2014). For example, the research conducted at the University of Sussex on the poverty alleviation has directly informed evidence-based policy-making to economic growth (Gasper, 2007).

Universities contribute to improving teaching quality and learning outcomes over quality research in pedagogy, curriculum development, and teacher training (Bhattacharya, 2017). Teacher training programs help bridge the skills gap in developing countries, ensuring that teachers are equipped with modern methodologies to meet students' needs effectively (Kumar et al., 2020). In Pakistan, teacher training remains underdeveloped despite the potential of the sector and it has been focused (Pirzada et al., 2021; Saif et al., 2021)This training aims to address systemic educational issues and challenges (HEC, 2022). Further research shows that poorly trained teachers and their quality are significant barriers to achieving national educational goals (Gasper, 2007). By arranging research in teacher training universities, teacher education curricula, classroom practices, student outcomes can be improved. The teacher-training centers and departments are the key drivers of educational improvement. Globally, universities have highlighted standing of research in teacher preparation and policy design. For example, research-driven teacher education programs in United States have

improved classroom practices and reduced learning gaps in deprived communities (Shane, 2004; AUTM, 2022).

The universities have created and commercialized new teacher preparation models that combine contemporary teaching strategies, inclusive teaching approaches, and subject-based pedagogical methods that are spread across different regions (Kumar et al., 2020; HEPI, 2022). The results from these cases offer the essential lessons for Pakistan, whose universities have not started capitalizing on financial rewards of commercializing teacher education research. Indian Institutes of Technology (IITs) demonstrate over their evidence that formal university-industry partnerships foster advanced approaches in the teacher education and technology-based educational methods, as technology integration is being focused on teaching and learning (Jamil, Aslam, & Shahzad, 2024; Tariq et al., 2019; Waqar et al., 2024). In this linking, the thriving commercial activities of IIT Bombay include digital teacher-training platforms that drive educational reforms & financial gains (Bhattacharya, 2017; Kumar et al., 2020). The research field in this study area has not been sufficiently developed for commercial applications. According to data from Higher Education Commission (HEC, 2022), almost all the universities in Pakistan (96.5%) do not earn revenue through the patents or industry leading collaborations.

Potential advances in teacher education research encounter resistance due to insufficient funding, maintenance problems, and poor connections between education ministries and private institutions (HEC, 2021; Teferra, 2014). The successful marketing of educational research approaches between interactive learning methods together with evidence-based teacher certification plans with digital classroom tools can be applied to the domestic and international markets, as in other regions (HEPI, 2022; Mowery et al., 2015). Evidence-based policymaking confirms the essential nature of teacher-training research for social advancement. Social science research at the University of Sussex has enabled essential educational policy changes to fight poverty and strengthen teachers' capacity (Gasper, 2007). The strategic financial investment directed at teacher training research allows for adaptable training solutions that include modern curricula, contemporary pedagogical resources, and technology-enabled educational instruments that suit the Pakistani education system (HEC, 2022; Zhou et al., 2016). Under the vision of HEC 2025, the commercialization of teacher education and research supports the foremost goal of developing research and socio-economic development. (Bhattacharya, 2017).

The results indicate that teachers across Pakistan need advanced professional skill training for the quality education (Abbas, Tariq & Jamil, 2021; Hussain et al., 2021; Naveed, 2022). This training creates academic market for new researchers to turn their findings into certified teacher-education programmes (Kumar et al., 2020; Teferra, 2014). The complete achievement of potential depends on Pakistan teacher training departments, including minimal commercialization, faculty empathetic, inadequate infrastructure, and shortage of industry relationships (HEC, 2022; Gasper, 2007). The university research marketing effectiveness is bolstered through investments to train researchers in intellectual property management, technology transfer procedures, as well as industry partnership building (Shane, 2004; Mowery et al., 2015). The strategic financial support directed at teacher education research will help Pakistani universities build new educational tools that lead to market

competition and sustainable profit generation. In the Pakistani context, sustainability in education has been emphasized for its importance (Jamil, Kamran, & Taj, 2024; Jamil, Nosheen, & Saleem, 2024; Saqib et al., 2020). Pakistani teacher-training departments should use international best practices to meet local requirements, as they play a central role in advancing educational finance and education system.

RESEARCH METHODOLOGY

This study uses an extensive method to merge and assess secondary data to generate the financial sustainability strategies for the Pakistani educational institutions. This study undertakes systematic literature review with a comparative analysis as its basis, using document and policy analysis to examine financial sustainability in Pakistani higher education. A research methodology with the defined steps guides the investigation of secondary data on worldwide research commercialization models, financial sustainability frameworks, and local and international higher education systems. This methodology bases its conclusions on proven practices that provide relevant solutions to the challenges faced by the Pakistani universities. This systematic review constituted the primary data collection and synthesis approach of the study. Thus, according to the methodology provided by Kitchenham and Charters (2007), this study undertakes a thorough research to find the academic literature. It reports case studies that analyze research commercialization, innovation ecosystems, and financial sustainability in higher education. An open and trackable selection method was used to choose and analyze the literature, which incorporated only the most trustworthy and existing academic documents.

Search Strategy

The research used several search databases, including the Scopus, JSTOR, Springer, Wiley, Google Scholar, and official publications from international and national organizations. In this linking, the specific keywords and search phrases included the following like Research commercialization in universities, higher education financial sustainability, university-industry partnerships, the case studies of research-driven revenue generation, HEC policies on commercialization, challenges in higher education funding in Pakistan, and teacher training and education commercialization in the diverse circumstances.

Inclusion and Exclusion Criteria

To ensure relevance and rigor, following specific inclusion & exclusion criteria were applied. Peer-reviewed articles, government reports, policy documents, and institutional case studies published between 2004 & 2023 were examined. This research encompasses national and international studies. The non-peer-reviewed sources, non-English literature, & studies lacking substantial evidence or data were excluded.

Data Sources

Secondary data were collected from diverse sources, including reports from the HEC of Pakistan, annual reviews and the Vision 2025 framework. Financial reports and case studies from global universities (Stanford, MIT, Tsinghua, IIT Bombay, Oxford, and Cambridge) served as benchmarks. The international organization policy documents include the Association of University Technology

Managers (AUTM, 2022), the Higher Education Policy Institute (HEPI, 2022), and UNESCO. Peer-reviewed journals include Journal of Higher Education Policy, Asian Journal of Innovation Policy, and Research Policy.

Data Extraction

Data from identified sources were extracted and categorized into themes that aligned with study objectives. The best practices in research commercialization and innovation ecosystems in global universities. Challenges and barriers to financial sustainability in higher education, particularly in developing countries. Policy gaps, infrastructure needs & faculty training requirements are specific to Pakistani universities.

Document Analysis and Policy Evaluation

This study incorporates a detailed document analysis to examine HEC policies, university financial reports, and innovation performance metrics. The various HEC documents, including annual reports from 2015 to 2022 and the Vision 2025 policy framework, offer statistical and descriptive insights into the commercialization of research and financial activities at Pakistani universities. Research on worldwide higher-education funding strategies focused on analyzing commercialization activities at MIT, Oxford, and Tsinghua University over reports by Shattock (2009), Wang et al. (2023), and Zhou et al. (2016). This study assessed these strategies in terms of local institutional characteristics and socioeconomic elements. Thus, the comparative analysis helps evaluate Pakistani policies using international best suitable practices to detect their strengths and weaknesses as well as potential opportunities and gaps.

DATA ANALYSIS

A combination of qualitative and quantitative data analysis methods was applied to achieve a complete comprehension of the research goals. The thematic analysis was used to group the findings according to vital themes, including infrastructure requirements, industry-university relationships, teacher skill development, and commercialization techniques (Kumar et al., 2015; Kumar et al., 2020). The literature presents recurring challenges and patterns that led to the identification of the practical solutions that should be executed in Pakistani universities. The performance assessment of Pakistani universities compared their standings to world-class institutions using the benchmarking methods. The research output commercialization alongside revenue percentages from patents and innovation office establishments was measured at the Stanford, MIT, and IIT Bombay (AUTM, 2022; Bhattacharya, 2017).

SWOT Analysis

A SWOT (Strengths, Weaknesses, Opportunities & Threats) analysis evaluated Pakistan's potential for delivering the research commercialization frameworks. This evaluation method sheds light on university strengths, including an academic workforce, and weaknesses related towards inadequate commercialization structures, while uncovering opportunities stemming from the rise of business interests and the threats of reluctant policy changes. Secondary data from peer-reviewed and credible reports ensured reliability and validity while reducing the potential bias. The researcher implemented triangulation by verifying data points across HEC reports, universal case examples,

and published academic research. This approach ensured the consistency, accuracy, and depth of findings. A systematic literature review and data categorization enhanced the study's transparency and replicability.

Thematic Analysis

Thematic analysis was used to identify and organize the findings into core themes aligned with the study objectives.

1. Global Best Practices of Research Commercialization
2. Systemic Barriers in Pakistani Universities
3. Key Opportunities for Research-Driven Financial Sustainability
4. Role of Social Sciences and Teacher Training

For each theme, we included the following:

1. Narrative Description (supported by evidence and references).
2. Comparative Tables to highlight the differences between the global and Pakistani systems.
3. Graphs/charts of quantitative trends and findings.

Higher education in Pakistan plays a pivotal role in national socioeconomic development; however, financial sustainability remains challenging since of its heavy reliance on tuition fees. Compared to global models where 25-40% of revenues stem from commercialization, universities generate mere 3.5% (HEC, 2022).

This analysis focused on the following aspects.

1. Identifying the best global practices in research commercialization.
2. Highlighting systemic barriers in higher education in Pakistan.
3. A structured research-driven roadmap for financial sustainability is proposed.

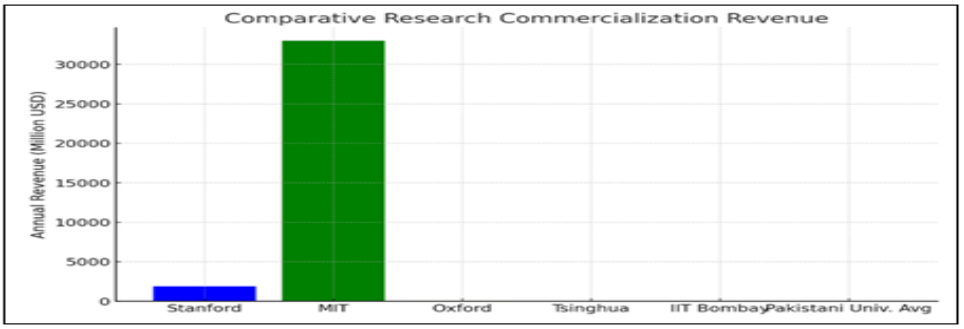
Theme 1 Global Best Practices of Research Commercialization

Table 1 Key Strategies from International Case Studies

University	Annual Revenue (USD)	Key Strategies
Stanford University (USA)	$1.9 billion	Patents, Google's PageRank, spin-offs
MIT (USA)	$33 billion	Industry partnerships, tech innovations
University of Oxford (UK)	$30 million	Licensing agreements, spin-offs
Tsinghua University (China)	$10 billion (CNY)	Innovation ecosystem, start-ups
IIT Bombay (India)	$2 billion	Industry collaborations, EdTech tools

Global universities such as Stanford, MIT, Oxford, Tsinghua, and IIT Bombay have demonstrated successful models of research commercialization through patents, industry collaboration, together with innovation ecosystems. In this linking, these institutions generate 25-40% of their revenue through commercialization, compared to 3.5% in the Pakistani universities (HEC, 2022). This bar graph highlights the revenue disparity between global and Pakistani universities. Therefore, global universities leverage patents, spinoffs, and industry partnerships to generate sustainable revenue. The Pakistani universities lag behind due to the inadequate infrastructure together with the weak innovation ecosystems.

Graph 1 Bar Graph: Comparative Research Commercialization Revenue



Theme 2 Systemic Barriers in Pakistani Universities

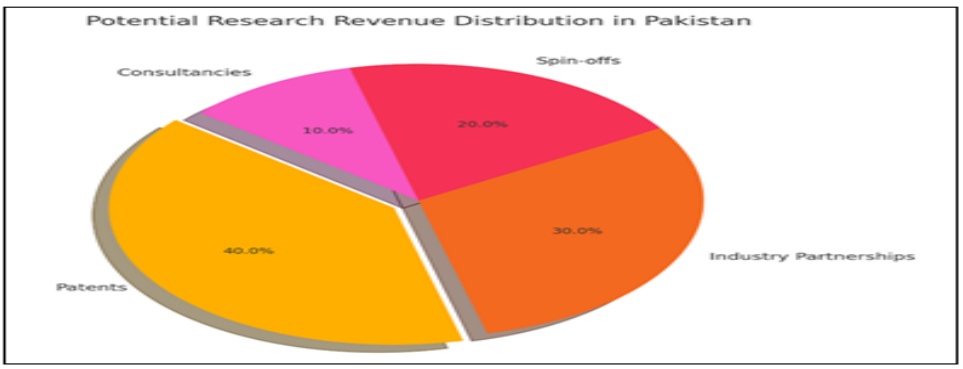
Systemic Barrier	Impact (% Universities Affected)	Source
Lack of research infrastructure	85%	HEC, 2022
Faculty unaware of commercialization	75%	HEC Surveys, 2021
Limited industry collaborations	10%	HEC Reports, 2022
Low patent output	3.5%	HEC, 2022

Findings from HEC Reports and Surveys reveal that HEC reports and faculty surveys indicate that systemic challenges hinder research commercialization in Pakistani universities. These include the inadequate infrastructure, poor commercialization awareness, and weak industry collaboration in institutions & Industry.

Theme 3 Key Opportunities for Financial Sustainability HEC Vision 2025

Target: Ensure that 25% of the expenditures are covered by research commercialization revenue by 2028, Focus Areas: Industry collaborations, ORIC offices, the teacher training research, and applied sciences. HEC Vision 2025 outlines clear targets for increasing the research commercialization in Pakistan. The universities are encouraged to generate at least 25% of their expenditures through the research commercialization revenues by 2028. This includes: Strengthening ORIC offices for the industry-academia linkages, encouraging the patent development and applied research funding are also important.

Graph 1 Pie Chart: Revenue Potential Distribution



Theme 4 Role of Social Sciences and Teacher Training Global Benchmarks

Focus Area	Global Example	Applicability for Pakistan
Teacher Certification	Cambridge & Stanford FRW	Develop marketable certification modules
EdTech Tools	IIT Bombay digital tools	Create, market digital teaching platforms
Policy-Driven Research	University of Sussex (poverty)	Policymaking for education gaps

Research in social sciences and teacher training is critical for societal development and generating revenue. The global benchmarks reveal how education research can be commercialized to address policy gaps, teacher shortages, and reforms, strength: Pakistan's untapped potential for the teacher-education research.

Comparative Analysis

The comparative analysis evaluates the performance of global and Pakistani universities in terms of commercialization revenue, infrastructure, and industry linkages that are critical for development of educational system.

Table 2 Comparative Performance Between Global & Pakistani Universities

Aspect	Global Universities	Pakistani Universities
Research Commercialization Revenue	25-40% of total income	3.5% of total income
Infrastructure for Applied Research	Robust labs, innovation hubs	Limited infrastructure
Industry-Academia Collaboration	Strong, structured partnerships	Weak linkages,
Commercialization Policies	Global & national frameworks	Policies with poor execution

Pakistani universities underperform on key indicators compared to global benchmarks. Strategic reforms are required to align with global best practices, radar chart evaluates Pakistani universities based on global benchmarks.

Diagram 3 Comparative Radar Chart

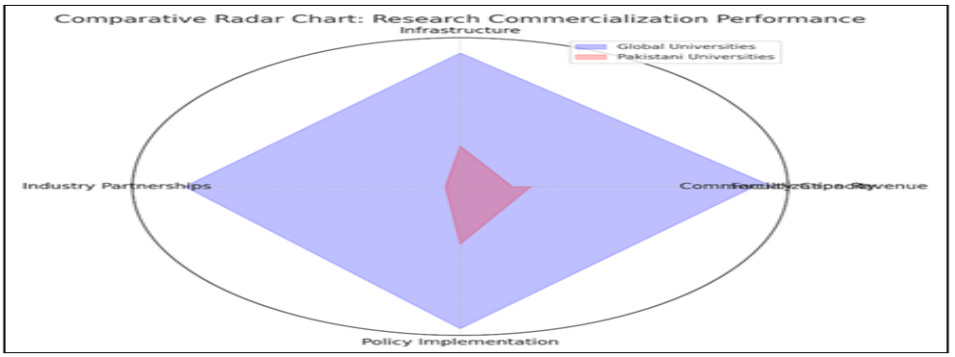


Table 3 Policy Gaps and Solutions

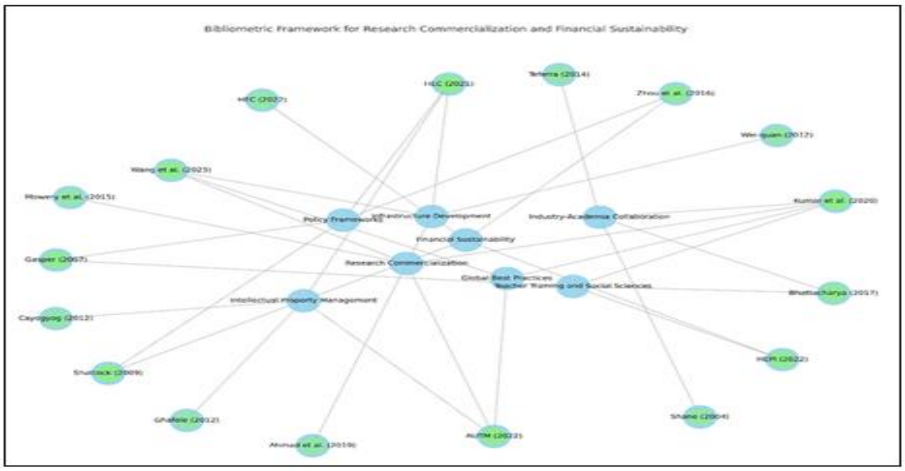
Identified Policy Gap	Proposed Solution
Insufficient research infrastructure	Establish innovation labs and ORIC offices.
Lack of faculty commercialization skills	Capacity-building workshops on IP and patents.
Weak industry partnerships	Government incentives for industry-academia linkages.

Proposed Framework for Research Commercialization

Roadmap for 2024–2028:

1. Phase 1 (2024–2025):
    - Capacity-building programmes for faculty members
    - Establish ORIC offices in all public universities.
2. Phase 2 (2026–2027):
    - Facilitating industry-university collaborations.
    - Increase in Applied Research Funding.
3. Phase 3 (2028):
    - Achieve a 25% research commercialization revenue target.

Diagram 4 Conceptual Framework for Research Commercialization



DISCUSSION

The results of this study, which emphasize the critical role of research commercialization in ensuring financial sustainability for Pakistani universities, align closely with findings from global contexts while reflecting unique regional challenges. Peralta (2008) and Cayogyog (2012) underscore that intellectual property rights and research utilization key drivers of economic sustainability; still, most research outputs remain underutilized. In case of Pakistani universities, meager contribution of 3.5% of total revenue from research commercialization aligns with similar findings in developing regions such as Region XI in the Philippines, where research contributes only 14.6% to university finances despite ample innovations (Cayogyog, 2012). These parallels highlight the typical global pattern in which the research culture remains underdeveloped and commercialization is not fully integrated into institutional practices. While universities in United States and the United Kingdom, such as MIT and Oxford, generate billions of dollars annually over patents, licensing, and industry collaborations (AUTM, 2022; HEPI, 2022), this study echoes concerns dyed by Miroshnikova and Taskaeva (2021). They argue that the developing nations often lack models to measure financial stability in public institutions, which are traditionally designed for the service delivery rather than revenue generation.

Infrastructural shortages and deficiencies in commercialization offices present significant structural challenges for Pakistani universities, which share this problem with other institutions. The absence of research commercialization integration in institutional strategies matches Malaysian public universities' operational strategies. The efforts of Malaysian universities to find additional revenue streams besides grants and tuition fees mirror the conditions in Pakistani education sector, where tuition fee revenue remains insufficient, according to Ahmad et al. (2019). This study recommends implementing the resource optimization strategy for the Malaysian universities by enhancing the capacity of these Offices of Research Innovation and Commercialization (ORICs). The proposed frameworks fill the gap between academic research and industry by implementing networked technology transfer offices, which Ghafele (2012) labels as the "Third Way." This study reveals the same problem as Bessant and Robinson (2019), demonstrating that Pakistani faculty have limited awareness of commercialization efforts. According to both studies, research and commercialization goals clash with institutional incentives, making it difficult for faculty members to conduct applied research in the industry.

According to Cayogyog (2011), this problem is compounded by the lack of standardized intellectual property and technology transfer training programs in universities. Therefore, he recommended the creation of distinct research utilization offices for formal commercialization infrastructure. Research ~driven innovation ecosystems benefit from government incentives, as demonstrated by Tsinghua University, IIT Bombay, and other globally recognized institutions (Kumar et al., 2020; Wang et al., 2023). Role~based policy funding from China generates 20% of the university's income, whereas Pakistan produces minimal revenue (Zhou et al., 2016). Structured industry~academia alliances in India led to significant economic growth, supported by spin~offs and EdTech tools (Bhattacharya, 2017). These effective models prove that financial sustainability comes from encouraging applied research, faculty development, and strong government~industry connections. This research analyzes systemic obstacles in Pakistani universities; however, the results confirm the challenges faced by developing nations globally, as observed in multiple countries. The recurring challenges of limited commercialization awareness, weak infrastructure, as well as insufficient industry linkages affect universities across Malaysia, Philippines, and Africa. Implementing global innovation frameworks alongside technology transfer systems will turn Pakistani universities into the research~focused, sustainable institutions.

CONCLUSION

The findings related to research commercialization barriers in Pakistani universities need attention alongside new commercialization opportunities revealed by this study, which will serve as a base for attractive future financial sustainability. Multiple strategic directions arise from these findings to help Pakistani higher~education institutions follow international best practices for developing active centers of research and socioeconomic development over innovation. Pakistani universities' future direction should focus on the infrastructure development, faculty capacity building, industry partnerships, policy reforms and commercialization of teacher training innovations. These strategies, coupled with government support and targeted incentives, will enable the universities to overcome

systemic barriers, align with global best practices, fostering financial sustainability and national socioeconomic progress.

Recommendations

1. There should be a focus on developing the research infrastructure at an acceptable level for applied purposes.
2. Future policies in Pakistan should focus on significant investments in infrastructure progress, especially in the public universities, to support research ecosystems conducive to patents, prototypes and spinoffs.
3. Universities should establish the robust industry–academia collaborations to bridge the gap between academic output and market needs.
4. The Pakistani universities should incentivize private sector investment through tax benefits, research grants, and funding for joint innovation projects.
5. Universities can collaborate with global technology-transfer experts to equip researchers with the skills to effectively navigate commercialization pathways.

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