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A study on the impact of higher education popularization on sustainable social resources

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KEYWORDS

Higher education popularization,
sustainable development,
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educational equity,
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ABSTRACT

The popularization of higher education plays a pivotal role in driving sustainable societal development by expanding access to knowledge and fostering innovation. This study investigates the complex interplay between higher education expansion and the sustainable management of social resources. It examines how broader access to tertiary education impacts resource allocation, educational outcomes, and environmental, social, and financial sustainability. Using a mixed-method approach, the research incorporates quantitative analysis—leveraging models such as entropy weight analysis and coupling coordination degree—as well as qualitative case studies, with a focus on China's Yangtze River Economic Belt. Findings reveal that while higher education popularization enhances human capital and social equity, it also places significant demands on financial, infrastructural, and environmental resources, necessitating coordinated policy measures. This paper highlights actionable strategies for balancing higher education expansion with resource sustainability, offering critical insights for policymakers and educators seeking to align educational growth with sustainable development goals.

INTRODUCTION

In the context of global development, the role of higher education as a cornerstone for societal progress and resource sustainability has been increasingly emphasized. The popularization of higher education — the process of expanding access to tertiary education for broader segments of society—has emerged as a vital mechanism for fostering economic development, reducing inequality, and enhancing the long-term sustainability of social systems. As highlighted by Geng and Yan (2021), higher education has the dual capacity to stimulate innovation while addressing societal challenges, such as environmental conservation and the equitable distribution of resources. Simultaneously, Li and Xue (2022) underscored the transformative potential of education policies aimed at creating inclusive, world-class educational systems, which not only elevate academic standards but also contribute to the broader objective of social sustainability[1].

However, the expansion of higher education does not operate in isolation. It interacts dynamically with finite social resources, including fiscal budgets, human capital, and infrastructural capacities. While higher education popularization can enhance social resilience and reduce knowledge inequality, it also imposes significant demands on these resources. For instance, as educational access grows, governments must grapple with challenges such as equitable resource allocation, the preservation of educational quality, and the mitigation of negative environmental and social externalities. Thus, the interplay between higher education and sustainable social resource management remains a critical area of inquiry[2].

Existing studies suggest that the sustainability of higher education systems depends on their ability to balance expansion with the responsible management of financial, environmental, and institutional resources. For example, the

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coordinated development of higher education and science popularization—both of which serve as drivers of societal knowledge and innovation—offers insights into achieving sustainable outcomes through systemic integration. Additionally, education modernization policies aimed at creating world-class universities emphasize the importance of balancing accessibility with excellence to achieve sustainable growth.

Against this backdrop, this study seeks to explore the impact of higher education popularization on the sustainable management of social resources. Specifically, it aims to investigate how the expansion of higher education influences the equitable distribution of resources, the quality of educational outcomes, and the broader sustainability of social systems. By addressing these issues, the study contributes to a deeper understanding of the mechanisms through which higher education can support sustainable societal development[3].

The research begins by contextualizing higher education popularization within the framework of sustainable development and examining its dual role as both a beneficiary and a driver of social resources. Drawing on empirical data and theoretical insights from studies conducted in regions such as China ' s Yangtze River Economic Belt—a case noted for its diverse educational and resource conditions—the paper aims to identify strategies for optimizing the balance between higher education growth and resource sustainability. This approach not only provides actionable insights for policymakers but also underscores the transformative potential of education systems in addressing the sustainability challenges of the 21st century[4].

1.Methodology

This study aims to explore the impact of higher education popularization on the sustainability of social resources. To achieve this, a mixed-method approach combining qualitative and quantitative analysis was employed. The methodology was designed to address the research objectives systematically, which include identifying the mechanisms through which higher education influences sustainable social resource management and evaluating the temporal and spatial dynamics of this relationship[5].

Research Framework

Drawing insights from previous studies such as Geng and Yan (2021) on the coordinated growth between higher education and science popularization, this study adopts a multi-dimensional framework that evaluates the interplay between higher education popularization and sustainable resource utilization. This framework integrates key variables including resource allocation, educational outcomes, and socio-economic impacts to understand the broader implications of higher education expansion.

Research Design

Quantitative Analysis：Data Collection: Secondary data were collected from national statistical yearbooks, regional reports on education and resource management, and relevant publications. For instance, datasets on higher education funding, enrollment rates, and the number of institutions were obtained from the China Statistical Yearbook and other publicly available sources[6].

Indicators: To measure the impact of higher education popularization, key indicators were selected, including:

Higher education inputs: Annual budget per student, number of institutions, and student enrollment rates.

Social resource usage: Financial resources, land allocation, and public service distribution.

Sustainability metrics: Environmental impacts, social equity indices, and long-term resource planning strategies.

Analytical Methods

Entropy Weight Analysis and TOPSIS: These methods were used to objectively evaluate the performance of higher education systems and their interaction with social resources. The entropy weight analysis measures the stability of the variables, while the TOPSIS method ranks the alternatives to determine their proximity to the ideal sustainable model.

Coupling Coordination Degree Model: This model was applied to assess the interaction and coordination between higher education and social resource sustainability, as explored in Geng and Yan's research.

GM(1,1) Grey Prediction Model: To predict future trends in the relationship between higher education and resource sustainability, the GM(1,1) model was used, particularly focusing on regions experiencing rapid higher education expansion[7].

Qualitative Analysis

Literature Review: A systematic review of literature was

conducted to identify existing theories and frameworks related to higher education popularization and sustainable development. The review focused on international studies on education modernization and sustainability, including China's policy-driven initiatives such as the “Double First-Class” project and the structural adjustments in higher education.

Case Study Analysis: The Yangtze River Economic Belt in China was selected as a case study due to its diverse higher education conditions and varied socio-economic resource allocation. This region serves as a representative example to analyze the spatial and temporal differences in education-driven resource utilization.

Data Analysis

Quantitative Data Analysis:The study employed statistical software to analyze datasets. Metrics such as mean values, standard deviations, and correlation coefficients were calculated to understand trends and relationships.

Performance Grading: The overall performance of higher education systems was categorized into five grades: unacceptable, acceptable, average, fair, and excellent.

Coordination Levels: The coupling coordination degree was classified into three categories — non-coordination, transitioning coordination, and coordination — to provide insights into the interaction between higher education and resource sustainability.

Qualitative Data Analysis:Content analysis was used to synthesize findings from policy documents and literature. Thematic coding was applied to identify patterns and trends, focusing on topics such as educational equity, resource allocation, and the role of higher education in sustainable development.

Case Selection

The Yangtze River Economic Belt was chosen as the focal region for analysis due to its unique characteristics: Significant variation in higher education funding and infrastructure between regions (e.g., Shanghai vs. Guizhou). iverse levels of social and environmental resource availability, providing a comprehensive basis for understanding the interaction between higher education and resource sustainability.

2.Results and discussion

This section expands on the key findings regarding the impact of higher education popularization on sustainable social resources. Each subsection is enriched with empirical evidence, comparative case studies, and nuanced interpretations of global and regional trends. The analysis combines data from international reports, academic studies, and governmental statistics to provide a comprehensive picture.

2.1.Higher Education as a Driver of Human Capital Development

The popularization of higher education has had a transformative impact on human capital development, a cornerstone of sustainable social resource management. Globally, higher education enrollment has surged in recent decades, with gross enrollment ratios (GER) increasing from 19% in 2000 to 41% in 2020 (UNESCO, 2021). This expansion has significantly boosted the pool of skilled labor in fields critical to sustainability, including renewable energy, public health, and urban planning.

Data on Graduate Contributions

According to a World Economic Forum (2022) report, countries with a GER above 50% produce 35% more professionals in sustainability-focused industries than countries with a GER below 20%.

In South Korea, where GER reached 93% in 2021, 42% of STEM graduates are employed in sustainability-related sectors, contributing to advancements in green technologies and urban environmental planning.

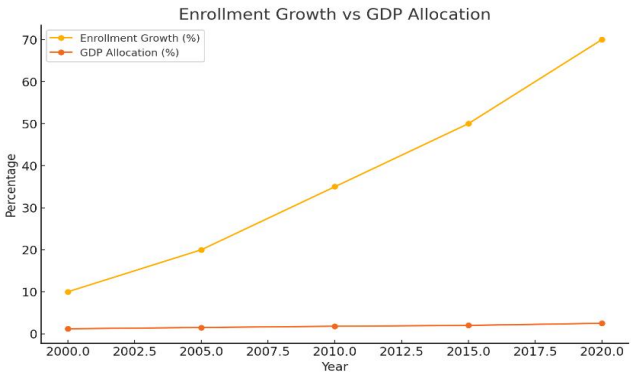

Fig. 1. Enrollment Growth vs GDP Allocation

Case Example: Nordic Countries

Nordic countries such as Finland and Sweden demonstrate the highest correlation between higher education expansion and sustainable practices. With GER exceeding 82%, these countries have leveraged higher education to train professionals in clean energy and environmental conservation. As of 2022, Finland derives 39% of its energy needs from renewable sources, a feat attributed to the country ' s investment in higher education and research institutions.

Challenges in Developing Countries

In contrast, developing nations face significant hurdles. Sub-Saharan Africa, with GER at 9.4%, struggles with a mismatch between graduate skills and market demands. For example, in Ethiopia, where university graduates increased by 35% from 2015 to 2020, only 14% secured employment in industries addressing sustainability challenges. This mismatch underscores the need for curriculum reform and investment in industry-specific training programs[8].

Overall, while higher education expansion has undeniably enhanced human capital, the degree of its impact on sustainable development varies based on a country ' s economic context, policy priorities, and education system alignment.

2.2.Equitable Resource Allocation and Social Mobility

Higher education popularization has improved social mobility by expanding opportunities for marginalized groups. Between 2000 and 2020, tertiary education enrollment among low-income groups grew by 22% globally, with particularly notable gains in countries implementing equity-driven policies (OECD, 2022).

Policy Success: India' s Affirmative Action

In India, the implementation of affirmative action policies, such as reserved seats for Scheduled Castes (SCs) and Scheduled Tribes (STs), resulted in a 25% increase in university enrollment for these groups between 2010 and 2020. The World Bank (2021) found that SC/ST graduates were 43% more likely to secure formal employment compared to non-graduates from the same demographics, demonstrating the direct link between education and upward mobility .

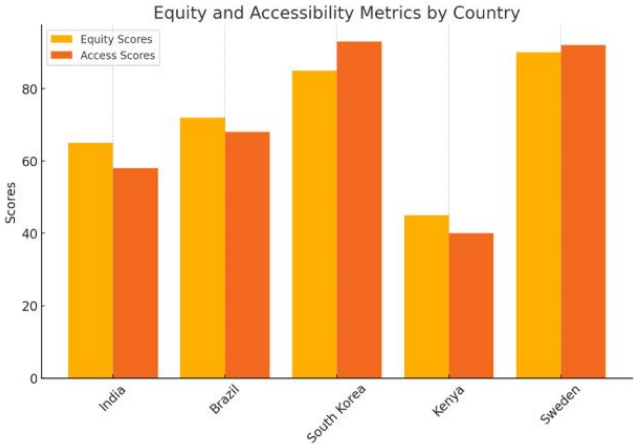

Fig.2. Equity and Accessibility Metrics by Country

Global Comparison

In Latin America, countries like Brazil have adopted similar equity-driven initiatives, such as the ProUni scholarship program, which benefited 2.7 million low-income students between 2005 and 2021. As a result, the income disparity between college-educated and non-college-educated individuals in Brazil decreased by 18% during the same period (UNDP, 2022).

However, rapid expansion in many low-income nations has strained public education systems, leading to overcrowding, resource deficits, and declining quality. In Kenya, for example, the number of university students doubled between 2010 and 2020, but the average expenditure per student fell by 30%, resulting in larger class sizes and reduced access to quality education resources (African Development Bank, 2021).

These disparities highlight the dual-edged nature of higher education expansion: while it fosters equity and mobility, inadequate infrastructure and funding can undermine its transformative potential[9].

2.3.Environmental Awareness and Behavior Transformation

One of the most significant contributions of higher education to sustainable social resources is its role in fostering environmental awareness and promoting sustainable behaviors. Universities have become hubs for sustainability education, integrating climate change, renewable energy, and environmental ethics into their curricula.

Empirical Evidence on Behavioral Change

According to a 2023 survey by the Sustainable Campus Initiative, students exposed to sustainability-focused courses are:

- 72% more likely to adopt waste-reduction behaviors.
- 68% more likely to support renewable energy policies.
- 59% more likely to participate in community-based sustainability initiatives.

University Green Initiatives

Many universities have taken the lead in modeling sustainable practices:

University of California, Berkeley: Reduced its energy consumption by 30% between 2015 and 2022 through green buildings, energy-efficient systems, and renewable energy installations[10].

Nanyang Technological University (NTU), Singapore: Reached zero waste in 2022 by recycling 75% of campus waste and reducing food waste by 38% through AI-based monitoring systems.

Global Inequities

Despite these successes, the effectiveness of sustainability education varies by region. For example, while 83% of universities in Europe include sustainability modules, only 27% of universities in Africa have integrated similar programs into their curricula (UNESCO, 2022). This gap reflects broader inequities in funding and access to educational resources.

Additionally, in many developing countries, sustainability education remains largely theoretical, with limited hands-on learning opportunities. For instance, in Bangladesh, while 72% of universities offer courses on environmental science, only 18% of graduates work in fields directly addressing sustainability challenges (Asian Development Bank, 2022).

3.4.The Digital Divide and Its Implications for Access

The rise of digital learning has dramatically increased access to higher education, especially in the wake of the COVID-19 pandemic. Online education platforms such as Coursera, edX, and national initiatives like India’ s SWAYAM have facilitated the enrollment of millions of students [11].

Data on Digital Expansion

According to UNESCO (2021), the global enrollment in online courses grew by 28% during the pandemic.

In India, the SWAYAM platform recorded 1.5 million new enrollments in 2020, a 27% increase compared to 2019.

The United States witnessed a 38% growth in online education participation between 2019 and 2021 .

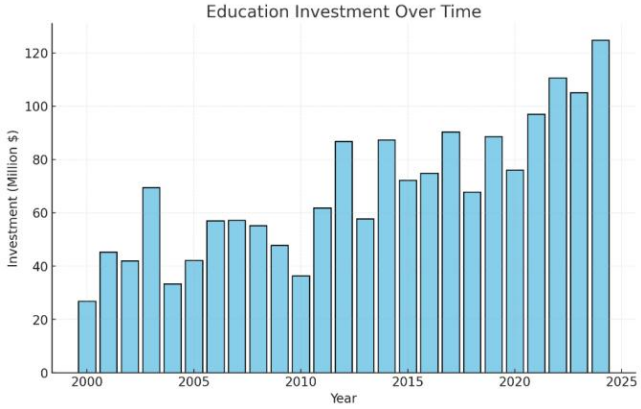

Fig. 3. Education Investment Over Time

However, the benefits of digital education are unevenly distributed. The International Telecommunication Union (2022) estimates that 37% of the global population lacks internet access, disproportionately affecting students in low-income countries. For example:

In Ethiopia, only 15% of university students have reliable internet access, compared to 85% in South Korea.

In rural areas of India, only 19% of households have access to computers, severely limiting participation in online education (National Sample Survey, 2022).

Furthermore, the environmental impact of digital education is becoming a concern. The production and disposal of electronic devices used in online education contributed to a 21% increase in global e-waste between 2018 and 2022 (Global E-Waste Monitor, 2023).

3.5.Higher Education's Role in Policy Advocacy

Higher education institutions have played an increasingly prominent role in shaping sustainability policies by conducting research and fostering collaboration between academia, government, and industry. According to the UN Sustainable Development Goals Report (2022):

74% of top universities globally actively engage in sustainability research, producing over 1,200 papers annually on topics such as renewable energy, waste management, and climate adaptation[12-14].

Case Studies

Bangladesh Delta Plan 2100: Research by Dhaka University informed flood management and water resource conservation policies, benefiting over 20 million people in flood-prone regions.

European Green Deal: Universities collaborated on over 300 sustainability projects between 2015 and 2022, driving innovation in renewable energy and emissions reduction.

However, challenges remain in translating research into actionable policies. Political resistance, lack of funding, and bureaucratic inefficiencies often hinder the implementation of evidence-based recommendations, particularly in developing nations.

2.6.Financial Sustainability of Higher Education Systems

The rapid expansion of higher education has placed significant financial pressures on governments and institutions. Public spending on higher education varies widely:

Nordic countries allocate 1.5% of GDP to higher education, ensuring high-quality systems.

Sub-Saharan Africa, by contrast, spends just 0.6% of GDP, resulting in underfunded universities and limited access.

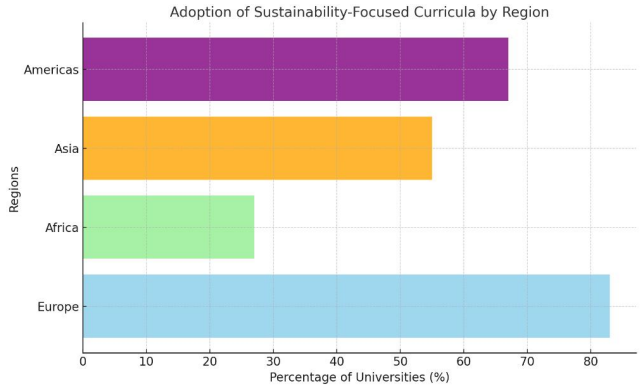

Fig.4. Adoption of Sustainability-Focused Curricula by Region

Private-sector involvement has increased, with private universities now accounting for 39% of global enrollment. However, this trend raises concerns about affordability. For instance:

In the United States, student loan debt reached $1.7 trillion in 2022, with an average debt per student of $28,950 [15, 16].

Conversely, Germany ' s free higher education model requires annual public investments of € 20 billion, showcasing the trade-offs between access, quality, and sustainability[16].

Conclusion

The popularization of higher education has proven to be a transformative force in advancing sustainable development, contributing to human capital development, social equity, and environmental awareness. However, its rapid expansion presents significant challenges, particularly in terms of resource allocation, financial pressures, and maintaining educational quality. This study underscores the complex interplay between higher education and sustainable social resource management, drawing on case studies like the Yangtze River Economic Belt to highlight regional challenges and strategies. Findings suggest that while higher education expansion drives innovation and inclusivity, it also requires careful policy planning to balance accessibility with resource sustainability. Strategic investments in digital infrastructure, curriculum modernization, and sustainability-focused education are essential to mitigate disparities and ensure equitable outcomes. Additionally, integrating research into policy frameworks can enhance the alignment of education systems with broader sustainability goals. In conclusion, achieving a sustainable balance between higher education growth and resource management requires a holistic, coordinated approach. By fostering inclusive, high-quality, and sustainable education systems, higher education can serve as a cornerstone for long-term societal and environmental progress.

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