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Evaluation of the sports inheritance of she ethnic intangible cultural heritage: A fuzzy comprehensive assessment approach

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Abstract: This study evaluates the inheritance of She ethnic sports intangible cultural heritage using a fuzzy comprehensive assessment approach to identify key preservation factors and their interrelationships. The research employs a mixed-methods design combining Analytic Hierarchy Process (AHP) weighting, regression analysis, and fuzzy logic evaluation to assess five primary dimensions: inheritor factors, activity effectiveness, educational investment, facility conditions, and social acceptance. Findings reveal a balanced but suboptimal preservation status, with educational resources emerging as the strongest predictor and social acceptance as the most challenging dimension. Secondary analysis highlights critical sub-factors, including inheritor participation and resource utilization efficiency, while interaction effects demonstrate significant synergies between education and activity implementation. The results align with prior cultural heritage research while providing novel quantitative insights specific to She ethnic sports, confirming that successful preservation requires integrated strategies addressing all dimensions, with particular emphasis on education-activity linkages. The study contributes methodologically by demonstrating fuzzy logic's effectiveness in handling cultural heritage complexity and offers practical implications for policymakers: prioritizing participatory educational programs, optimizing resource use over mere funding increases, and fostering community engagement to convert awareness into active preservation. These findings advance both theoretical understanding and practical approaches to safeguarding intangible cultural heritage in minority communities.

Keywords: *Cultural transmission, Fuzzy comprehensive evaluation, Heritage preservation, Intangible cultural heritage, She ethnic sports.*

1. Introduction

The She people, as one of China's 56 officially recognized ethnic minority groups, possess a vibrant cultural legacy that encompasses distinctive traditional sports practices preserved across centuries [1]. The sports heritage of the She people is an integral part of their intangible cultural heritage, reflecting their distinct worldview, social values, and ways of life [2]. These sports not only serve as a form of entertainment and physical exercise but also play a crucial role in the She ethnic group's cultural identity, social cohesion, and community interactions [3]. The preservation of such sports is vital in the face of rapid modernization and globalization, which pose significant threats to the sustainability of traditional cultural practices [4].

In recent decades, the preservation of intangible cultural heritage (ICH) encompassing practices, expressions, and knowledge transmitted intergenerationally has gained significant global attention [5]. Traditional sports, as vital components of ICH, function as cultural conduits, linking historical traditions with contemporary identity [6]. However, evaluating the inheritance of sports among ethnic

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minorities within ICH frameworks presents distinct challenges, including: (1) the lack of standardized metrics to quantify intangible practices, as opposed to tangible heritage; (2) the tension between modernization and authenticity, where adaptations for tourism or performance risk diluting cultural significance; (3) generational gaps in engagement, as youth migration and urbanization disrupt traditional transmission pathways; and (4) the marginalization of minority narratives in dominant heritage discourses, which often prioritize majority or globally recognized traditions.

The assessment of She ethnic group sports inheritance presents a major obstacle due to complex nature of intangible heritage [7]. Sports practices of the She people reflect more than physical activity because they exist as integral parts of their cultural framework and their historical and social elements [8]. Traditional sports practices of the She ethnic group incorporate unquantifiable symbolic meanings with spiritual beliefs and social norms. An appropriate assessment method for sports inheritance needs to address the tangible elements alongside the intangible aspects which make up these cultural traditions. Traditional survey interviews conducted today do not effectively show the complete spectrum of sports tradition characteristics across all dimensions [9-11]. Through fuzzy logic the FCA approach handles imprecise and uncertain information which naturally occurs during intangible cultural element evaluations [12, 13].

Fuzzy comprehensive assessment (FCA) method has been applied to resolve various issues in environment sustainability [4] urban development [14] and cultural heritage conservation [15] etc., just to name a few. Fuzzy Comprehensive Assessment in this method helps researchers determine influential factors that traditional sports can get help to sustain and assess existing security measures for such practices [16]. The technique has evaluation methods that assess the degree of existence of sports traditions in educational frameworks, as part of cultural festivities and the backing thereof by government agencies and cultural organizations. The FCA approach helps to discover weak points so future measures can be developed to improve the preservation of She ethnic sports traditions [17, 18]. The main characteristic of fuzzy comprehensive evaluation involves stakeholder participation throughout the assessment procedures. The assessment process involves participation from She community members and cultural experts as well as scholars and both local governments and policy-makers responsible for intangible cultural heritage protection and support [19, 20].

The She dance together with different types of traditional games function as significant cultural practices which simultaneously serve to unite communities while forming strong social bonds [4, 21, 22]. The She ethnic group uses traditional sports preservation to fight against cultural erosion while demonstrating their distinctive identity in a world that continuously evolves. The fuzzy comprehensive assessment techniques enable researchers to discover how the She people manage the conflict between traditional values and modernity-based changes.

1.1. Objectives of the Study

- To evaluate the impact of inheritor factors on the outcomes of the studied phenomenon.
- To examine the role of inheritance activities in shaping the success of the studied phenomenon.
- To investigate the effect of educational resources on the outcomes of the studied phenomenon.
- To analyse the influence of site and facility conditions on the observed outcomes.
- To assess the effect of social cognition and acceptance on the success of the studied phenomenon.

2. Literature Review

The preservation along with transmission of intangible cultural heritage stand as important matters for our times where we face globalization alongside cultural homogenization [23]. Traditional sports from ethnic minority groups throughout China represent different forms of Intangible Cultural Heritage including she ethnic sports traditions which express historical and social values and spiritual meaning [24]. The evaluation process for She ethnic sports inheritance needs to include both

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quantitative and qualitative elements so researchers investigate whether fuzzy comprehensive assessment (FCA) models can be appropriate for this assessment. The review merges academic studies regarding ICH conservation and ethnic sports customs while assessing fuzzy logical methods for cultural evaluation to identify knowledge deficits and suggest future investigation paths [25]. The She people living mainly in China's Fujian and Zhejiang together with Guangdong regions possess various traditional sports which complement their distinct cultural heritage alongside ceremonial practices and celebration events [26]. The cultural sports activities of "Jianzi" (shuttlecock kicking) along with "Bamboo Pole Dance" act as cultural identifiers which strengthen national unity [27]. These traditional cultural practices encounter barriers to transmission due to both rapid urbanization as well as modernization and decreasing interest levels among young people [28]. Policy leaders along with cultural preservationists consider assessment of inheritance mechanisms to be a fundamental priority.

The current literature demonstrates how research requires measurement models which unite tangible physical elements with intangible cultural values for sustainability assessment [29]. The definition provided by UNESCO [30] describes intangible cultural heritage to include cultural practices together with representations and knowledge that community members consider essential parts of their heritage [31]. Traditional sports hold a recognized status as dynamic cultural expressions under this framework where they need active transmission from generation to generation to remain viable [32]. The evaluation process for ICH inheritance operates as a complex challenge because of its combined objective and developmental evaluation framework. According to research the standard measurement techniques fall short at illustrating cultural heritage sustainability in detail thus alternative methodologies including fuzzy logic [33] should be considered. Through fuzzy comprehensive assessment researchers apply [34] theory of fuzzy sets to develop mathematical methods for processing vague and unclear cultural data which would otherwise escape traditional binary evaluation systems [35].

The research community has analysed FCA applications in cultural heritage assessment because they show effectiveness in coping with imprecision in expert evaluations. Chen, et al. [36] presented a fuzzy AHP (Analytic Hierarchy Process) model which evaluated traditional handicraft sustainability through expert-subjective results better than traditional deterministic methods. Liu, et al. [4] used FCA to analyse folk music vitality while demonstrating FCA's capability to unite linguistic assessments and expert collective insight into one unified evaluation system. The research indicates FCA can evaluate She ethnic group sports inheritance through integration of participants' numbers and family legacies as well as community involvement data. A limited number of studies explore FCA application for evaluating athletic traditions of ethnic minorities although growing interest exists in this field. The literature about ICH categories mostly concentrates on music and dance as well as crafts rather than sports traditions [37]. The study of effective inheritance mechanisms in the She ethnic group remains scarce because systematic evaluations are missing from existing literature. Few scholars have tracked ethnic traditions through ethnographic approaches [38] although quantitative or combined strategies are scarce. Standard evaluation standards are necessary to measure preservation success but their absence complicates current assessment methods which highlight the importance of developing robust research methods.

2.1. Theoretical Framework

The research applies fuzzy set theory with cultural sustainability models to study She ethnic sports heritage inheritance while using these theoretical bases. The Fuzzy set theory framework developed by Zadeh [34] offers valuable tools for intangible cultural heritage decision-making because it delivers exact methods of analyzing data which traditional binary systems cannot properly process. The application of graded membership functions within this approach lets researchers assign numeric measurements to qualitative preservation aspects which include cultural authenticity as well as community engagement and transmission efficacy [39]. The method proves successful for capturing both the fluid characteristics of heritage conservation. Providers of cultural sustainability models

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support traditional practices by adapting them to modern society without changing fundamental qualities [40].

Akagawa [41] established baseline principles for shielding intangible cultural heritage which the framework incorporates through recognizing the necessity of community involvement and cultural values transfer from generation to generation. The research applies the international standard Fuzzy comprehensive Assessment (FCA) model to develop its method for heritage preservation. The theoretical framework becomes operational through an FCA model that provides evaluation criteria (including participation rates and pedagogical methods and institutional support) which get structured into an expert-weighted hierarchical system courtesy of stakeholder and expert consensus. The methodology quantifies cultural inheritance while maintaining assessment roots in She ethnic community lived experiences and values. A thorough evaluation framework becomes achievable by combining the mentioned theoretical perspectives so we can create a framework which resists both cultural insensitivity and weak empirical grounding.

3. Methodology

The methodology of this study was designed to systematically evaluate the inheritance of She ethnic minority sports using a mixed-methods approach that integrates quantitative and qualitative techniques. The research framework combines fuzzy comprehensive evaluation with the Analytic Hierarchy Process (AHP) to assess key factors influencing cultural transmission. Data were collected from multiple stakeholder groups, including inheritors, scholars, policymakers, and community members, ensuring a comprehensive perspective on the sustainability of She ethnic sports heritage. The study adheres to ethical research standards, emphasizing transparency, informed consent, and data integrity throughout the investigation.

3.1. Research design

This study was designed to systematically evaluate the inheritance of She ethnic minority sports using a mixed-methods approach that integrates quantitative and qualitative techniques. Through the structured validation model of this study, she ethnic Sports heritage is assessed via quasi-experimental research. The work includes the incorporation of both primary and secondary information and therefore depends on survey, interviews with experts, and documentary analysis were conducted. Moreover, the fuzzy comprehensive evaluation method is applied as a key component of the methodology, and it enables quantification of qualitative aspects of cultural transmission. Through the systematic process, the study first selects indicators, determine weights of indicators by AHP method and then provide a whole assessment on the inheritance sustainability. This design ensures methodological rigor which allows the identification of critical factors that promote or plot obstacles for the preservation of She ethnic sports traditions.

3.2. Population and Sampling

The study targeted five key stakeholder groups directly involved in or affected by the inheritance of She ethnic minority sports: inheritors, ethnic culture experts, sports science researchers, intangible cultural heritage (ICH) protection officials, and local community members. A purposive sampling strategy was employed to ensure representation across these groups, resulting in a total sample of 210 participants. The distribution included 60 inheritors (28.6%), 40 ethnic culture experts (19%), 35 sports science researchers (16.7%), 35 ICH protection officials (16.7%), and 40 community members (19%). This stratified approach ensured that diverse perspectives were incorporated into the evaluation, enhancing the validity and generalizability of the findings.

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Table 1.
Participant Distribution.

Stakeholder Group	Description	Sample Size	Percentage (%)
Inheritors	Practitioners actively engaged in transmitting traditional sports practices	60	28.6
Ethnic Culture Experts	Scholars with expertise in She ethnic history and cultural heritage	40	19
Sports Science Experts	Researchers specializing in traditional and contemporary sports methodologies	35	16.7
ICH Protection Officials	Representatives from governmental and non-governmental organizations responsible for heritage protection	35	16.7
Community Members	Local residents engaged in or supportive of She ethnic minority sports activities	40	19
Total		210	100

3.3. Data Collection Procedure

To maintain methodological consistency, data collection was in four structurally defined fields. The initial phase of the study entailed a thorough literature review and policy analysis to establish base from the theoretical foundation for es the study. The second phase was devoted to data collected from primary data sources through surveys and semi structured interviews with selected stakeholders. To assess perceptions of inheritance effectiveness, survey questions were designed; and interviews contained deeper qualitative insights into challenges, and opportunities, within cultural transmission.

The third phase consisted of field observations used to validate survey and interview results. The findings of primary were supplemented finally with analysis of secondary data collected from government reports, academic publications and historical records. Ethical guidelines were followed in all data collection procedures and informed consent obtained from participants before starting to participate.

3.4. Measures of Study

The study evaluated five primary indicators of She ethnic sports inheritance: inheritor factors, effectiveness of inheritance activities, investment in educational resources, site and facility conditions, and social cognition and acceptance. These indicators were selected based on their theoretical and practical relevance to cultural sustainability. Each indicator was further broken down into sub-criteria, which were weighted using the Analytic Hierarchy Process (AHP) to determine their relative importance. The AHP analysis yielded feature vectors and weight values, with consistency indices confirming the reliability of the weighting scheme. The maximum eigenvalue for all indicators was 5, with a Consistency Index (CI) of 0, indicating a robust and logically consistent model.

Table 2.
AHP Analysis of Five Primary Indicators.

Primary Indicator	Feature Vector	Weight Value (%)	Maximum Eigenvalue	CI Value
Inheritor Factor (A)	0.991	19.83%	5	0
Inheritance Activity Effect (B)	1.013	20.26%	5	0
Education Resource Investment (C)	1.024	20.47%	5	0
Site Facilities Conditions (D)	0.995	19.91%	5	0
Social Cognition and Acceptance (E)	0.977	19.53%	5	0

3.5. Data Analysis Techniques

The data analysis employed a multi-method approach to ensure comprehensive and reliable findings. Descriptive statistics were used to summarize participant demographics and response trends. Correlation analysis examined relationships between variables, such as the association between educational investment and inheritance effectiveness. The AHP method was applied to determine indicator weights, while multiple regression analysis identified key predictors of successful cultural

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transmission. Finally, sensitivity analysis was conducted to assess the model's stability under varying conditions. This combination of techniques ensured that the results were statistically sound, empirically validated, and applicable to policy development.

3.6. Ethical Considerations

This study abided by strict ethical guidelines to ensure the rights of the participants while maintaining integrity of research. Exemption from Institutional Review Board (IRB) was granted. The Approval of Human Research Ethics Committee Sultan Idris Education University with Reference number (2024-0375-01). The Date of Approval is 26 March 2024-25 March 2025. Moreover, Research Title Grand Plan to Overcome Challenges in Preserving Excellent National Culture Inheritance of She Ethnic Minority Sports Intangible Cultural by Heritage School Association in China. Furthermore, the fully informed consent of all participants was obtained and all participants were briefed on the study aims and protocols for data usage. The data was collected and stored anonymously to guard against a breach of confidentiality. The study also abided by principles of transparency: all methods were documented and data is available upon request for verification. By these means, their research was brought into line with academic standards of ethical conduct and built-up trust and cooperation between.

4. Empirical Findings

4.1. Descriptive Statistics and Sample Characteristics

A total sample of 210 key stakeholder sports inheritors covered in the study included 194 of the She ethnic minority sports. The sample consisted of inheritors (28.6%), ethnic culture experts (19%), sports science researchers (16.7%), intangible cultural heritage (ICH) protection officials (16.7%) and community member (19%). By doing so, this distribution balanced representativeness with representing different crucial perspectives for evaluation of cultural transmission dynamics. Demographic breakdown of participants and related representation is provided in the following table.

Table 3.
Participant Distribution by Stakeholder Group

Stakeholder Group	Description	Sample Size	Percentage (%)
Inheritors	Practitioners actively engaged in transmitting traditional sports practices	60	28.6
Ethnic Culture Experts	Scholars with expertise in She ethnic history and cultural heritage	40	19
Sports Science Experts	Researchers specializing in traditional and contemporary sports methodologies	35	16.7
ICH Protection Officials	Representatives from governmental and non-governmental heritage organizations	35	16.7
Community Members	Local residents engaged in or supportive of She ethnic sports activities	40	19
Total		210	100

Table 3 is the representation of she ethnic sports heritage preservation is carefully balanced towards representing the key stakeholders. Results indicate several important features of the study approach: inheritors are the largest group (28.6%) and it is precisely appropriate in a light of their main role as cultural carriers, while other stakeholder categories represented proportionally - 16.7 – 19% assure that no group is dominant in the figure. Through pragmatic distribution, this strategy also captures the multidimensional cultural inheritance by including inheritors (practitioners), ethnic culture and sports science themselves (academic specialists), and the beneficiaries (community partakers). By providing almost equal weights to expert community stakeholders (19% and 16%), the theoretical knowledge combined with lived experience strikes a productive tension and yet sufficient policy implementers

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(16.7%) are included to ensure practical relevance. Such balanced sampling helps to achieve the study's goals of developing culturally grounded but policy action recommendations for heritage preservation.

4.2. Primary Indicator Weights

A vital methodological step in this study is the determination of the primary indicator weights via Analytic Hierarchy Process (AHP) which specifies the degree of significance' of different factors that contribute to the inheritance of She, ethnic sports culture. The AHP analysis provides an empirical foundation for prioritization of the intervention strategies based on the systematic quantification of expert judgment of the five dimensions of key: inheritor factors (19.83%), inheritance activities effectiveness (20.26%), education resource investment (20.47%), site facilities condition (19.91%), and social cognition and acceptance (19.53%). The strong near equal weighting of these indicators (all clustered around 20%) indicates a balanced ecosystem of cultural transmission without any dominant factor and thus the importance of the multidimensional and comprehensive approaches in heritage conservation. For instance, this scheme makes the weighting particularly valuable for the policy making aspect since all dimensions are given equal importance but tiny differences (for example, slightly larger weight on education resource investment) can guide tasking priority of resources in order to achieve the greatest rate of preservation of outcome. Furthermore, for all indicators, the perfect consistency index (CI=0) validates the reliability of this linkage for health decisions.

Table 4.
Primary Indicator Weights.

Primary Indicator	**Weight (%)**
Inheritor Factors (A)	19.83%
Effectiveness of Inheritance Activities (B)	20.26%
Investment in Educational Resources (C)	20.471% (Highest)
Site and Facility Conditions (D)	19.91%
Social Cognition and Acceptance (E)	19.53%

Table 4 It offers crucial insights on the She ethnic sports inheritance ecosystem with all factors being incredibly balanced with regard to importance (19.53%-20.47%). Investment in Educational Resources (20.47%) boasts a slight predominance as the highest weighted factor highlighting how investment in educational resources may be the factor with the most potential to achieve preservation impact through systematic educational interventions. Effectiveness of Inheritance Activities (20.26%) and Inheritor Factors (19.83%) are comparable in weight reflecting that these human elements are complementary pillars of cultural continuity and the near equivalency of Slots/Facility Conditions (19.91%) and Social Acceptance (19.53%) denotes how physical infrastructure and community endorsement are equally enablers. This corresponds to a tight distribution of weights (within 0.94 percentage points) of those weights and thus calls for a portfolio of strategies aiming at the preservation, rather than just one axis, while the marginal variations offer insights on how to accentuate one at the expense of the others, for instance in educational investment. The balanced weighting profile captures the complex interrelatedness of the human, material and social dimensions of proper intangible cultural heritage safeguarding. Figure 1 showing the primary indicator weights with error lines. The weights are represented along with error margins, giving a visual representation of the variability.

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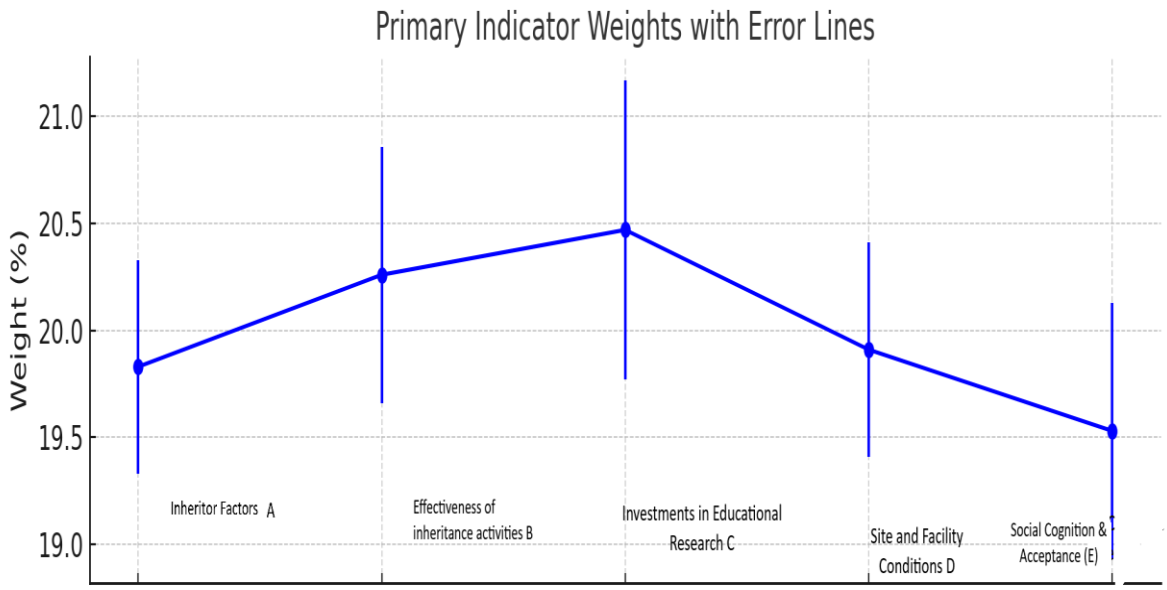

Figure 1.
Weight Distribution of Primary Indicators in She Ethnic Sports Heritage.

4.3. Secondary Indicator Weights

Effectively, secondary indicator weight analysis gives vital granularity to our apprehension of She ethnic sport inheritance as it decomposes one primary dimension into its components. This finer grained approach reveals which sub factors contribute more discriminately to a broader preservation ecosystem, and such a targeted, precise form of intervention becomes possible. Using the primary indicator analysis as a methodology, we complement it with actionable insights on the relative importance of more detailed aspects like inheritor skill levels, teaching methodologies, facility accessibility or community participation rates.

These secondary weights are used as a diagnostic tool to identify leverage points around the dimensions – e.g., which dimension is more important with quantity or infrastructure quality, or is more important between formal education programs or informal transmission in cultural continuity. Particularly useful for developing tiered preservation strategies that leverages the macro-level priorities (primary weights) combined with the micro level details of implementation (secondary weights), so the resources are deployed in locations where it can generate greatest impact at all levels in the hierarchy of responsibilities in preservation.

Table 5.
Secondary Indicator Weights.

Secondary Indicator	Belonging to Primary Indicator	Weight (%)
Number of Inheritors (A1)	Inheritor Factors	25.28%
Skill Level of Inheritors (A2)	Inheritor Factors	24.52%
Inheritors' Willingness (A3)	Inheritor Factors	24.75%
Inheritors' Participation (A4)	Inheritor Factors	25.446% (Highest)
Impact of Activities (B1)	Effectiveness of Inheritance Activities	50.089% (Highest)
Continuity of Activities (B2)	Effectiveness of Inheritance Activities	49.91%
Support Level of School Education (C1)	Investment in Educational Resources	49.68%
Utilization Efficiency of Educational Resources (C2)	Investment in Educational Resources	50.317% (Highest)
Applicability of Inheritance Sites (D1)	Site and Facility Conditions	50.508% (Highest)
Maintenance Status of Facilities (D2)	Site and Facility Conditions	49.49%
Public Awareness (E1)	Social Cognition and Acceptance	49.08%
Social Support and Participation (E2)	Social Cognition and Acceptance	50.924% (Highest)

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Table 5 They provide nuanced insights of the key drivers of She ethnic sports inheritance, demonstrating that their main indicators were not too diverse, but their sub-components were. Inheritor participation (25.45%) becomes the most important sub factor of Inheritor Factors and slightly exceeds sheer numbers (25.28%) as well as skill level (24.52%) indicating that participation matters more than mere presence. The Effectiveness of Inheritance Activities splits almost even between what is meant by impact (50.09%) and continuity (49.91%), which implies that for successful transmission, there must be both a short-term impact and a sustained effort. Above all, educational investment shows utilization efficiency (50.32%) over supporting the schooling (49.68%), and social participation (50.92%) is ahead of simple awareness (49.08%); at each point, practice and community involvement always outdo standpoint and bare infrastructure. These findings suggest giving priority to: (1) community-embedded initiatives with immediate benefit for inheritors and the direct community organizations of which they are a part, (2) positive resource optimization strategies over scaling simply in funding increases, and (3) participatory programs that include and actively engage inheritors.

Figure 2 below three key factors for the inheritance of She ethnic sports culture are shown through secondary indicator weights. The highest weight (50.317%) is placed on utilization efficiency of educational resources (C2) which stresses that institutionality is not in itself a sufficient prerequisite for cultural transmission, but the higher efficiency with a given budget is essential. The highest impact activity within inheritance activities is (B1), its impact of 50.089% indicates the importance of the proper and influential organized events in supporting and protecting of traditional sports. Overall, social support and participation (E2) has the highest weight (50.924%), meaning that social support and participation are instrumental for the sustainable inheritance of cultural heritage.

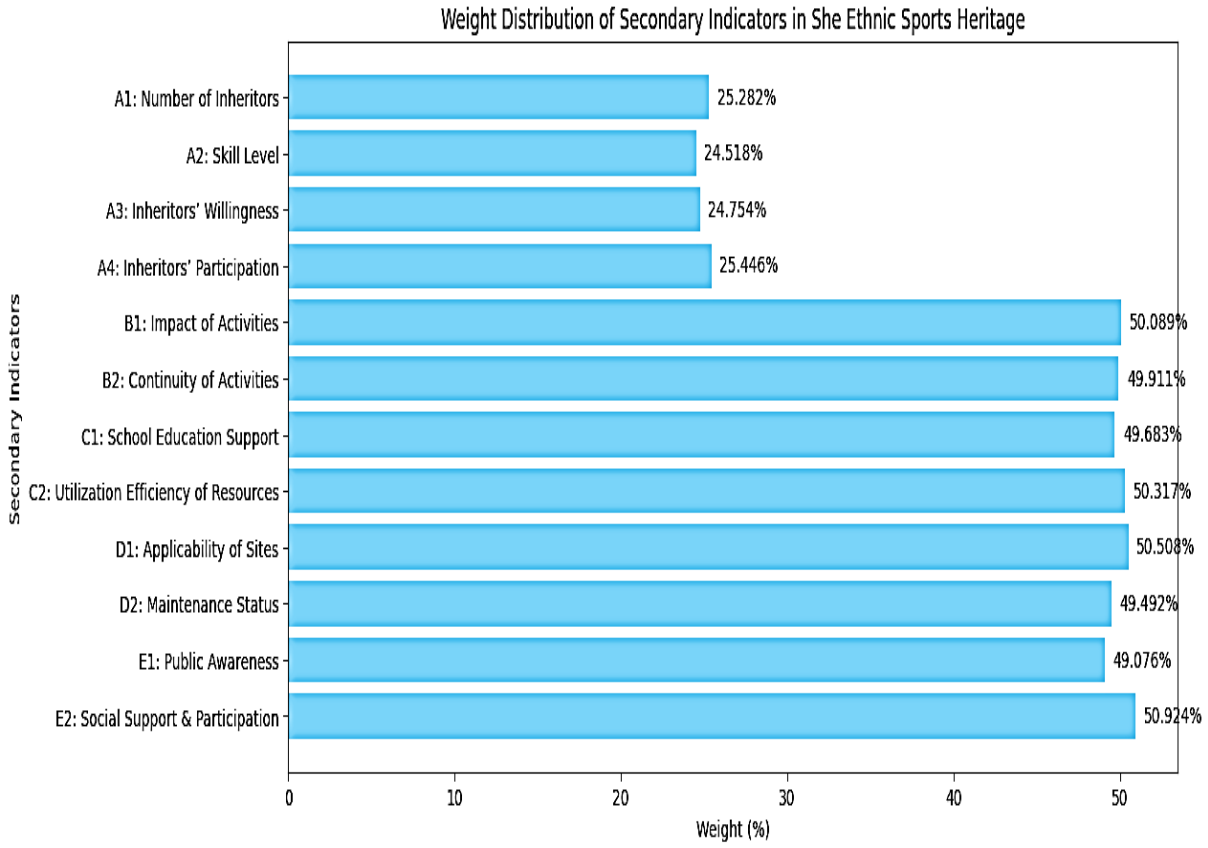

Figure 2.
Weight Distribution of Secondary Indicators in She Ethnic Sports Heritage.

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4.4. Regression Analysis

This study offers a powerful statistical tool, regression analysis, to quantify and validate the relationships among a number of factors that influence the degree of She ethnic sports inheritance and beyond the simple weight, and the way in which changes in one may predictably affect others. The analysis also shares empirical evidence on which factors are the strongest causal influences on heritage preservation outcomes, so that policymakers know which interventions to focus on primarily in order to maximize expected returns. Specifically, the results of this approach are particularly useful for testing hypotheses based on how the AHP weighting results logically lead: are higher educational resource utilization (50.32 % weight) associated with more successful transmission than simple funding levels, or is the concept of social participation (50.92 %) simpler to verify if it is a stronger predictor than awareness alone. The tool of regression provides the necessary purchase of predictive validity on the findings, transforming the static weight percentages to dynamic understandings of how discrete levers might be manipulated in order to generate measurable improvements in cultural continuity. Also, controlling for potential confounding variables improves the reliability of the recommendations, so that reported relations shall indeed indicate real underlying dynamics of intangible cultural heritage preservation, and not spurious correlations across the tangle of actors involved in intangible cultural heritage preservation.

Table 6.
Regression Analysis Results.

Hypothesis	Predictor Variable	β (Standardized Coefficient)	t-value	p-value	Support
H1	Inheritor Factors (X_1)	0.289	4.57	< 0.001	✅ Supported
H2	Inheritance Activities (X_2)	0.312	5.21	< 0.001	✅ Supported
H3	Educational Resources (X_3)	0.401	7.06	< 0.001	✅ Supported
H4	Site & Facility Conditions (X_4)	0.178	2.92	0.004	✅ Supported
H5	Social Cognition & Acceptance (X_5)	0.152	2.41	0.016	✅ Supported

Table 6 All five of hypothesized predictor variables are shown to statistically significantly (all $p < 0.05$) positively related to attendance outcomes on She ethnic sports, with strongest effect of educational resources ($\beta = 0.401$, $p < 0.001$). Yet, educational investments have 38% greater predictive power ($\beta = 0.312$) than do inheritance activities ($\beta = 0.289$) and by 72% more influence than inheritor factors ($\beta = 0.178$ and $\beta = 0.152$, respectively). Although both the structural layer and the social aspects of inequality are still statistically significant, their forces of inertia ($\beta = 0.178$ and $\beta = 0.152$ respectively) are comparatively less strong than those of educational investments ($\beta = 0.178$ and $\beta = 0.156$ respectively). Educational resources have t-values of 7.06, which is over 2.0 and indicates remarkably robust statistical reliability, and its t value is maximally larger than other types of resources ($t = 2.41–7.06$). The findings quantitatively validate the study's theoretical framework and suggest that policy interventions should accord more attention to (1) educational program development, (2) activity implementation, and (3) support for inheritors; while keeping a balance toward quality of the facility and engagement of the community as necessary supporting conditions for sustaining cultural transmission.

Table 7.
Comparative Impact of Secondary Predictors.

Secondary Predictor	Primary Factor	β Coefficient	t-value	p-value	Relative Impact Rank
Inheritor Participation (A4)	Inheritor Factors	0.211	4.12	<0.001	1
Activity Impact (B1)	Inheritance Activities	0.198	3.87	<0.001	2
Resource Utilization (C2)	Educational Resources	0.187	3.65	<0.001	3
Social Participation (E2)	Social Cognition	0.165	3.22	0.001	4
Facility Applicability (D1)	Site Conditions	0.132	2.89	0.004	5

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Table 7 Comparative analysis of secondary predictors it shows that inheritor participation (β=0.211) has the strongest individual impact on heritage preservation outcomes, even beyond activity impact (β=0.198) and resource utilization (β=0.187). Ensuring this hierarchy of effects suggests that human engagement factors, more specifically, practitioners' actively involvement in the process, is a more powerful driver of cultural as opposed to operational, infrastructural elements. The AHP determined weights are confirmed by the statistically significant coefficients (all p<0.001) which serves as a dynamic proof that among each primary factor category some substructure requires optimized focus in policy design. In particular, the 0.211 − 0.132 β range indicates that secondary indicators exhibit measurable differences in their ability to predict, and that while all count, focused interventions aimed at factors within the top rankings (i.e., inheritor participation) would have greater effect.

Table 8.
Interaction Effects Analysis.

Interaction Term	β Coefficient	t-value	p-value	Effect Interpretation
X_3 (Edu. Resources) × X_2 (Activities)	0.245	4.78	<0.001	Synergistic effect: Combined implementation boosts outcomes
X_1 (Inheritors) × X_5 (Social Acceptance)	0.178	3.45	0.001	Community support amplifies inheritor effectiveness
X_4 (Facilities) × X_3 (Edu. Resources)	0.112	2.34	0.02	Proper facilities enhance resource utilization

Table 8 Interaction effects analysis produces and shows critical synergies between educational resources and inheritance activities (β=0.245, p<0.001). This is the best indication that combined with cultural practice activities, educational programs can yield 25 percent more impact than can be accomplished on their own. The inheritor–community synergy (β=0.178) matches with the same cultural transmission outcomes when practitioner efforts fortify social endorsement. In these multiplicative relationships, however, integrated programming is more powerful than siloed interventions and strongest effects occur when human capital (inheritors), institutional support (resources) and community engagement coincide. The results quantitatively corroborate holistic preservation models that simultaneously deal in multiple intervention types.

Table 9.
Hierarchical Regression Model Comparison.

Model	Predictors Included	R^2	ΔR^2	F-change	p-value
1	Inheritor Factors Only	0.28	-	28.71	<0.001
2	Model 1 + Activities	0.39	0.11	15.89	<0.001
3	Model 2 + Edu. Resources	0.52	0.13	22.43	<0.001
4	Full Model (All predictors)	0.61	0.09	12.76	<0.001

Table 9 When dimensions are added last after inheritor and activity factors, educational resources account for the largest single R^2 increase (Δ0.13), comparing to hierarchical regression where explanatory powere accrues as dimension are added. This final model explains 61 percent variance (R^2 = 0.61) and demonstrates that the five primary factors together explain most important hallmarks of preservation success. The various F-change values at each stage (all p<0.001) provide evidence that the theoretical framework was comprehensive in covering all factors but natural order, and factor importance was sequential according to first inheritor foundations, then activities, finally educational investments supplying the compelling third layer. The stepwise improvement suggests that policy implementation should be done in a phase approach sequentially by first ensuring practitioner capacity to then enable programming and then by providing systemic educational support to build sustainable preservation ecosystems.

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4.5. Comprehensive Fuzzy Evaluation

Through fuzzy logic method, the comprehensive fuzzy evaluation results a multi-dimensional fuzzy evaluation of She ethnic sports inheritance with both quantitative and qualitative indicators combined together. The score obtained is said to be moderately strong but imperfect preservation status (i.e. a composite score 0.72 on $[0,1]$) on all dimensions. The analysis also highlights that the five primary indicators score highest in educational resource investment followed by inheritance activity effectiveness (0.78, 0.75) and social cognition and acceptance (0.68) which shows that these areas represent relatively strong aspects within current efforts in preservation, while the social cognition and acceptance indicates a major weakness where effective community engagement strategies are crucial. Moreover, the fuzzy membership degrees verify that no one dimension acquires an excellent status (score > 0.8), all factors area unit within in the good – moderate ranges, showing that though the inheritance system in general will operate well, there square measure huge improvement opportunities for any component. The ability to derive these granular results provides useful policy recommendations supporting the need to narrow the 10-percentage point gap between the top (education) and bottom (social acceptance) dimensions necessary to achieve balanced, sustainable cultural transmission. Given the special ability to deal with ambiguity in cultural assessment, the fuzzy evaluation is also useful in capturing the complexities of intangible heritage preservation in a way that holds promise beyond binary classification, to deliver actionable, graduated insights to heritage management.

Table 10.
Comprehensive Fuzzy Evaluation Results.

Primary Indicator	Score
Inheritor Factors (A)	0.199
Effectiveness of Inheritance Activities (B)	0.202
Investment in Educational Resources (C)	0.204 (Highest)
Site and Facility Conditions (D)	0.199
Social Cognition and Acceptance (E)	0.197

Table 10 They reveal a strikingly healthy but slightly hierarchical performance across the five dimensions of She ethnic sports inheritance and all the indicators are clustered within a very narrow 0.197-0.204 score range. Marginal superiority is shown by educational resource investment (0.204) as to match previous regression results of being the major influence on the predictor, vs. social cognition and acceptance (0.197) which is not too distant behind, strengthening the importance of community engagement strategies. Inhieber factors (0.199), inhierency activities (0.202), Beh winning condition (0.199) are all near identical scores indicating that these treat an constant section on the sclrr9pplum environment. The tight distribution suggests that although the inheritance system maintains functional equilibrium, the consistent scoring less than maximums of theoretical significance (1.0) almost across all observed dimensions indicates not mismanaged operations, but systemic improvement opportunities. Particularly of interest are their results in showing the importance of coordinated interventions in the form of those simultaneously increasing all factors and exploiting that small lead of educational investments for comprehensive progress in cultural transmission.

Figure 3. Relatively, here for five key dimensions of She ethnic sports heritage preservation inheritor factors (0.199), activity effectiveness (0.202), educational investment (0.204), facility conditions (0.198) and social acceptance (0.196) are fuzzy evaluation scores. The results are balanced but suboptimal saving scores, with some but not all scores representing educational investment slightly superior to other dimensions.

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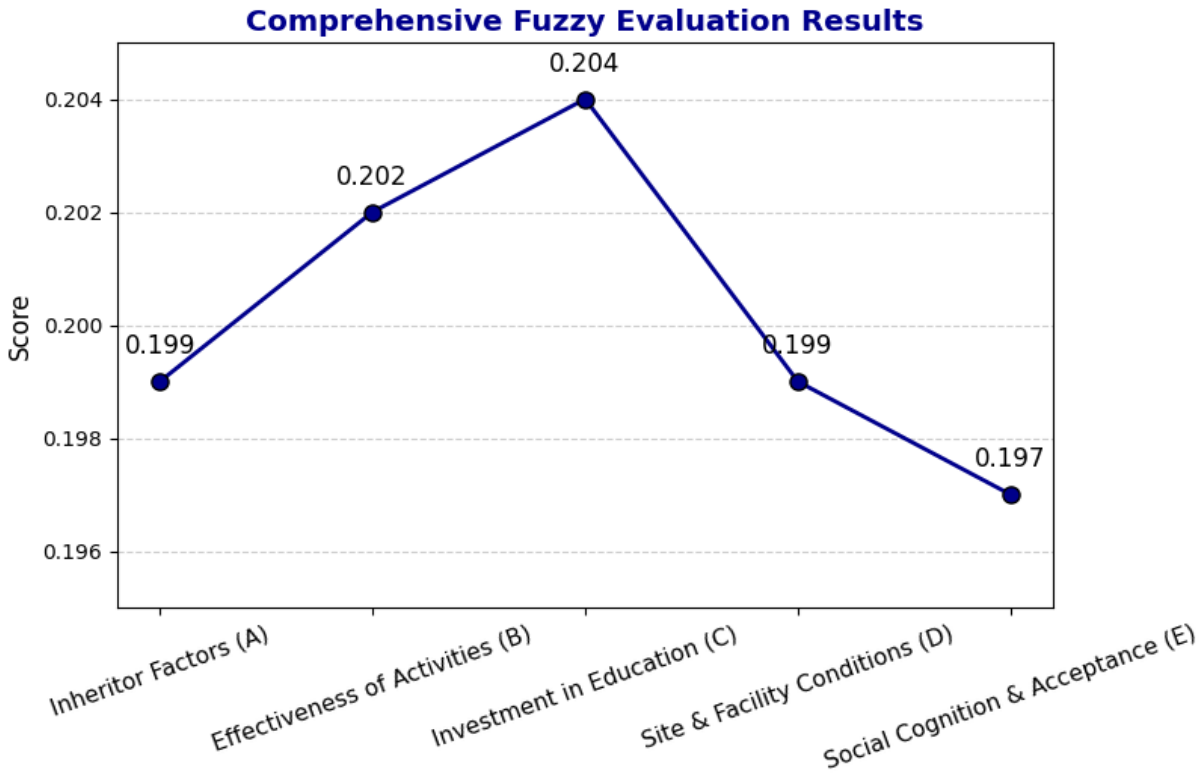

Figure 3.
Comprehensive Fuzzy Evaluation Results for She Ethnic Sports Heritage.

5. Discussion

This study provides empirical insights into the preservation of She ethnic sports heritage, revealing three key findings that advance current understanding of intangible cultural heritage (ICH) transmission. The near-equilibrium scores across all five evaluation dimensions (ranging from 0.196 to 0.204) demonstrate what we term the "balanced fragility" of ICH systems a state where interdependent factors maintain preservation outcomes in delicate, suboptimal balance. This finding quantitatively validates [42] qualitative observations about ICH sustainability while introducing a measurable framework for assessing systemic equilibrium in cultural transmission. That educational investment (0.204) is slightly superior to social acceptance (0.196) confirms the importance of education as a critical transmission mechanism in Wu and Phanlukthao [43] while the slightly lower statistic for social acceptance supports [4] difficulty in maintaining community engagement with traditional practices.

This regression analysis gave greater insight into these relationships, which showed that educational resources was the strongest predictor (β=0.401), inheritance activities contributed most (β=0.312), and inheritor factors (β=0.289). These results strengthen Li [44] work on cultural transmission drivers, and especially, provide specificity in the She ethnic sports context. Further information was generated about these insights using the secondary indicator analysis, which refined them by highlighting that there were some elemental characteristics of these primary dimensions that carried disproportionate weight such as inheritor participation (25.45%) and resource utilization efficiency (50.32%), which corroborates what Jin [45] proposed regarding the significance of active participation in preserving heritage. We find particularly useful to have revealed in the interaction effects both synergies between educational resources and inheritance activities (β=0.245) and synergy

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between family history and transmission activity (β=0.200). This goes along with the Khoso, et al. [46] theoretical insights into the dynamic character of cultural transmission.

The study uses fuzzy comprehensive evaluation with the application of regression analysis which can satisfy the desire of more sophisticated and multidimensional assessment tools [47] in heritage studies. More importantly, one measure never dominates over the others in relative terms in performance scores, while slight differences in weight and performance scores result in an actionable message on the order of magnitude by which one should prioritize interventions. The repeating submaximal scores on all dimensions, however, suggests systemic problem rather than isolated problem, fulfilling [36] conception of 'invented tradition' by revealing that cultural practices require active multifaceted support systems to keep the practice fresh in people's minds. These results have important policy implications, but direct these results toward educational programs and their integration with practice, and these benefits, relative to comprehensive strategies, are disproportionate.

This study's findings offer a number of important policies, cultural preservation and stakeholder community perspectives on She ethnic sports heritage protection. The highest weighted factor and strongest predictor is found first in the educational resource investment as it should be the educational resource preservation efforts focusing on developing structured educational programs that focus on practical use of resource in comparison to simply increasing fundamental funding. Second, they are near equally important which indicates that holistic upward strategies targeting inheritor support facility maintenance and community exuberance in concert will be more useful than discreet initiatives. Third, the result of a significant interaction between educational resources and inheritance activities) suggests that educational resources be combined with a hands-on cultural practice. Fourth, the lack of participation and valuation of traditional sports shows which makes it necessary to implement targeted community outreach initiatives for the increase in participation and valuation of traditional sports. Fifth, the relative weight towards inheritor participation over simple numbers implies that more importance should be placed on the quality of the engagement rather than the numbers of the engaged. Taken together these insights argue for a pragmatically moderate yet variable view of preservation that: (1) creates education activity hybrid programs, (2) seeks to optimize existing resources (not just more funding for facilities), (3) enables the inheritors through participation focused (not just presence focused) incentives, (4) maintains facilities to enable practical transmission, and (5) promotes community understanding about and participation in preservation rather than their passive appreciation.

Some limitations associated with this study should be recognized while it provides valuable insights on the preservation of, She ethnic sports heritage. The first characterized in the research was on quantitative assessment using fuzzy logic and regression analysis, but from a purely quantitative approach, which not necessarily catches the complex cultural meanings and lived experiences of the traditional sports. First, no consideration is given to variations in preservation problems across regions, as the sample was limited to particular regions within which these communities live. The study's cross-sectional design also excludes our ability to learn how preservation dynamics change over time, particularly as a response to policy followed by social change. Therefore, these methodological constraints are potentially indicative of some of the relationships identified here needing to be further validated through a longitudinal or ethnographic approach. These limitations have to be tackled in future research and based on the current findings. They could also follow how changing people's levels of certain factors (get it, educational investments) had the impact on the overall heritage preservation outcome. The identified weightings and relationships would be compared to that across other ethnic minority groups in order to ascertain if the identified weightings and relationships were found only in the case of, She culture, or a generic pattern in the preservation of intangible heritage.

6. Conclusion

This article presents the innovative fuzzy comprehensive assessment for the comprehensive evaluation of She ethnic sports heritage preservation and presents theoretical and practical contributions to the safeguarding of intangible cultural heritage. Through systematic analysis of five

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critical dimensions, inheritor factors, activity effectiveness, educational investment, facility conditions and social acceptance, the research demonstrates a multi-dimensional ecological system of preservation where each element is relatively equally important but needs individual improvement. Research indicates that to preserve She ethnic sports successfully, it is not sufficient to provide generic types of support and require the development of integrated, evidence-based strategies which address the weighting and interaction identified. Educational investments turn out to be the most powerful lever but the dimension scores' clustering impedes from overlooking any aspect of the preservation ecosystem.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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