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Examining the impact of integrating agriculture and tourism on the ecological environment in rural Hunan Province: A study of the rural revitalization movement

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ABSTRACT

Aims: The integration of agriculture and tourism represents a pivotal breakthrough point in realizing rural revitalization. To ensure sustainable development and attain ecological livability, there is a pressing need to investigate the impact mechanism of agricultural tourism integration on rural ecological environments.

Study design: This study examines the current state of agricultural tourism integration and ecological livability in Hunan Province, China. The research constructs an influence mechanism to assess the impact of agricultural tourism integration on the rural ecological environment, utilizing empirical data covering the cities and prefectures of Hunan Province from 2015 to 2021.

Results: Our findings indicate a significant correlation between agricultural tourism integration and the rural ecological environment. However, whether such integration has a positive effect on the environment depends on the availability of scientific and reasonable development plans.

Conclusion: Our analysis underscores the importance of promoting eco-friendly practices and preserving biodiversity within the context of agricultural tourism integration. Overall, this study provides critical evidence regarding the factors that influence agricultural tourism integration on rural ecological environments, thereby underscoring its significance as a means of promoting ecological sustainability in rural areas.

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Keywords: Rural revitalization; agriculture-tourism integration; ecological environment; ecological livable; hunan Province

1. INTRODUCTION

The ecological environment is a fundamental element for human survival[1]. The ecological environment is a fundamental element for human survival. To achieve the harmonious

30 coexistence of man and nature, it is essential to adhere to the concept of ecological and
31 environmental protection during industrial integration and development processes[2].
32 Ecological livability constitutes the cornerstone for rural revitalization[3]. The integration of
33 agriculture and tourism has important practical significance for promoting new industries and
34 new formats in rural areas, realizing ecological livability and increasing farmers' income[4].
35 While agricultural tourism integration serves as a critical means to facilitate rural
36 revitalization, its significant role in enhancing the ecological environment of rural areas has
37 yet to receive sufficient attention from academia. Currently, most scholarly research on this
38 subject has focused on examining the impact of agricultural tourism integration on rural
39 industrial structure, thereby overlooking its potential contributions to promoting
40 environmental sustainability in these regions.

41 In recent years, China has demonstrated an increased focus on rural development due to
42 the sustained progression of the rural revitalization strategy. To address the "three rural"
43 issues and promote the modernization of agriculture and rural areas, China is developing
44 leisure agriculture and rural tourism boutique routes, optimizing rural leisure tourism, and
45 promoting the integration of agriculture and tourism. New forms of leisure agriculture such as
46 pastoral health preservation, research and science popularization, farming experience,
47 leisure fishing, and home stay health care have been developed[5]. In addition, China has
48 implemented a five-year action to improve the rural living environment, including the
49 demonstration and creation of beautiful livable villages and beautiful courtyards[6]. Hunan
50 Province has also committed itself to promoting the modernization of agriculture and rural
51 areas by taking the integration of tourism and agriculture as a breakthrough point to address
52 the "three rural" issues. The rapid development of leisure agriculture in Hunan Province has
53 transformed it from high-speed development to high-quality development. It has become an
54 important driver for promoting high-quality and efficient agriculture, livable rural areas, and
55 prosperous farmers, as well as an essential starting point for promoting the integration of the
56 three industries. Empirical research conducted by Wang et al. (2022) analyzed the impact of
57 the integration of agriculture and tourism on the quality of the rural ecological environment
58 based on the three dimensions of agricultural production and rural living environments. The
59 study found a significant positive correlation between the integration of agriculture and
60 tourism and the quality of the rural ecological environment. Therefore, the integration of
61 agriculture and tourism has a positive effect on improving the quality of the rural ecological
62 environment[7].

63 This paper examines the effects of the integration of agriculture and tourism on the rural
64 ecological environment in Hunan Province, taking into account the government's support for
65 the development of ecological livability in various regions. The second part explores the
66 relationship between agricultural tourism, rural tourism, and agricultural tourism integration,
67 drawing on relevant literature research by various scholars. In the third part, the paper
68 outlines the influence mechanism of the integration of agriculture and tourism on the rural
69 ecological environment. The fourth part adopts a perspective of modern sustainable
70 development, combined with the current situation of agricultural tourism integration and
71 ecological livability in Hunan Province, to analyze the various elements of rural
72 environmental investment and establish an empirical model. Finally, the paper concludes
73 with suggestions for future research and policy, based on the findings of this study.

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75 **2. LITERATURE REVIEW**

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77 The integration of agriculture and tourism can be traced back to Germany's "citizen
78 paradise" in 1850 and began to take root in China in the 1980s[8]. While Phillip et al. (2010)
79 have summarized the characteristics of the integration of agriculture and tourism, there is no
80 strict definition of this concept in academia[9]. However, there is no strict definition of the
81 integration of agriculture and tourism in academia. Therefore, based on a comprehensive
82 understanding of the integration of agriculture and tourism, this paper posits that it involves

83 the rational development and utilization of agricultural tourism and land resources while fully
84 respecting the functions of the agricultural industry. This includes the development of
85 agricultural tourism and leisure projects, agricultural supporting commercial projects, and
86 agricultural tourism real estate projects as the core functional structure, resulting in higher
87 overall service quality[10].

88 The integration of agriculture and tourism is different from the traditional mode of agricultural
89 Eco-tourism and the traditional mode of agricultural Eco-tourism pays more attention to the
90 protection of the ecological environment[11]. The new agricultural ecological model of
91 agricultural tourism integration focuses more on the running-in and sustainability of
92 economic and ecological benefits[12]. The new format formed by the integration of
93 agriculture and tourism has many expressions, such as rural tourism, agricultural tourism
94 and so on. In short, it is a new model for the development of rural tourism and leisure
95 agriculture. Leisure agriculture is an important part of the rural industry. It is an important
96 carrier for the multi-functional expansion of agriculture, the integrated development of rural
97 primary, secondary and tertiary industries, and the superposition of the whole industrial
98 chain[13].

99 “Ecological livability” has been identified as a key component of rural revitalization efforts
100 following the proposal made by the 19th National Congress of the Communist Party of
101 China. Furthermore, it has been recognized as a new requirement for the development of
102 beautiful villages. In the context of rural construction, ecological livability encompasses not
103 only the natural environment but also the quality of life of rural residents through enhanced
104 village appearance and infrastructure. Thus, ecological livability can be defined as an
105 environment that is both suitable for working and living, with emphasis on the protection and
106 management of the natural environment, and improvement of the overall living standard[14].
107 Honarpisheh (2011) found that rural tourism development can effectively reduce damage to
108 the local environment and promote a more sustainable ecological structure in surrounding
109 rural areas[15]. Tong (2013) conducted a comprehensive study of farmers' environmental
110 management in relation to rural tourism by conducting literature reviews and experimental
111 research[16]. Deng (2017) explained how to address the main ecological problems that arise
112 as a result of rural tourism development and protect the rural ecological environment[17]. Ma
113 (2017) emphasized that effectively reconciling the tensions between rural tourism and the
114 environment is critical for achieving sustainable tourism development. Although rural tourism
115 development and construction may have certain impacts on the environment, subsequent
116 tourism development can effectively promote ecological sustainability. Thus, the relationship
117 between tourism and environmental construction should be complementary[18]. A recent
118 investigation and analysis by Weyland et al. (2021) indicated that farmers engaged in rural
119 tourism are more willing to safeguard the uncultivated environment than those who are not
120 involved in such tourism activities[19].

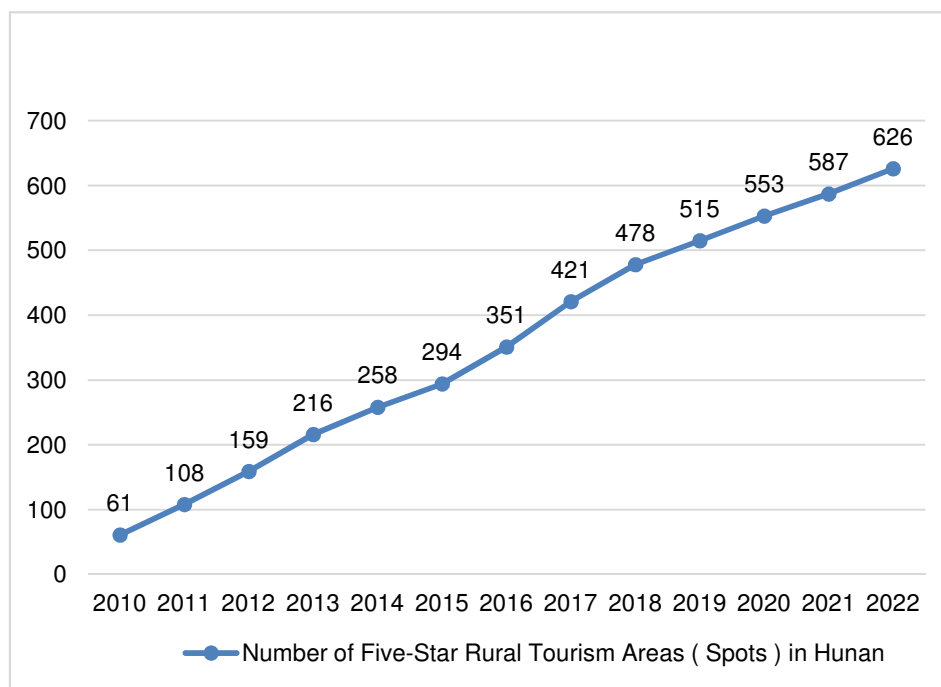
121 Privitera (2009) analyzed the ecological characteristics that influence the integration of
122 agriculture and tourism and concluded that this integration has positive effects on economic
123 benefits, employment opportunities, and rural landscape protection[20]. Wu (2016) argued
124 that environmental issues are closely linked to tourism development, with protecting the
125 environment being capable of attracting more tourists and tourism contributing to the
126 economy to build environmental sustainability[21]. Based on the concept of ecological
127 civilization construction, Tang et al. (2017) constructed rural ecological agricultural tourism
128 mode, rural ecological cultural tourism mode, and rural ecological food tourism mode using
129 Cherry Valley Village, Great Wall International Cultural Village, and Liugou Village as typical
130 cases[22]. Li et al. (2020) believed that integrating agriculture and tourism was conducive to
131 promoting the green transformation of rural industries, enhancing governance over rural
132 resources, ecology, and human settlements, and improving rural ecological livability[23].
133 Raftopoulos (2020) proposed that rural community tourism can reshape the relationship
134 between human beings and the environment, reevaluate environmental values and
135 significance, and promote ecological environment protection[24]. Chen et al. (2020) applied

136 the analytic hierarchy process to identify core evaluation indicators of rural ecotourism,
 137 finding that both human and natural conditions are critical elements of rural ecotourism
 138 resources, and the ecological environment plays a crucial role in rural ecotourism[25].
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140 **3. THEORETICAL ANALYSIS**

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 142 **3.1 Analysis on the development of agricultural tourism integration in Hunan**
 143 **Province**

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 145 The integration of agriculture and tourism in Hunan Province is a new format produced by
 146 the integration of leisure agriculture and rural tourism. It is one of the regions with earlier
 147 integration of rural tourism and leisure agriculture and more mature products and markets.
 148 The overall development of rural tourism in Hunan Province is strong, and has basically
 149 formed four distinctive rural tourism areas: Changsha - Zhuzhou - Xiangtan economic
 150 development zone, Dong Ting Lake area, central and southern Hunan and western Hunan
 151 mountainous area[26]. It can be seen that the development momentum is good and the
 152 effect is remarkable.
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Fig. 1 Number of Five-Star Rural Tourism Areas (Spots) in Hunan

158 Figure 1 present the temporal distribution of Five-Star Rural Tourism Areas (Spots) in
 159 Hunan Province. From the perspective of the development scale of five-star rural tourism
 160 areas (spots) in Hunan Province, there were only 61 five-star rural tourism spots in Hunan
 161 Province in 2010, and the number has increased to 626 by 2022, which is about ten times
 162 the number in 2010. The number of leisure agriculture business entities in Hunan increased
 163 from 1860 in 2006 to 17,244 in 2021. The number of tourists received per year increased
 164 from 48 million to 206 million, and the total annual operating income increased from 2.65
 165 billion to 47.04 billion. By 2020, Hunan has created 9 ‘Hunan leisure agriculture and rural
 166 tourism demonstration counties’, 180 ‘Hunan leisure agriculture demonstration sites’, and
 167 100 ‘Hunan leisure agriculture agglomeration development demonstration villages’. These

168 efforts have greatly facilitated the transformation and upgrading of leisure agriculture in
169 Hunan Province.

170 From the above data, it can be seen that leisure agriculture and rural tourism play an
171 irreplaceable role in realizing strong agriculture, rural beauty and rich farmers. In addition,
172 cities and prefectures in Hunan Province attach importance to tourism development. With
173 the support of the government, the speed of industrial development has been significantly
174 accelerated, and the quality has been continuously improved, which has promoted the
175 development of rural economy.

176 Regional disparities and imbalanced development are apparent in Hunan Province. The
177 province spans a vast territory, and each region has its distinct resource characteristics and
178 human environment, which give rise to their unique regional advantages. Based on these
179 differences and local conditions, different regions have created personalized rural tourism
180 destinations that cater to their tourist offerings. From a spatial distribution perspective, Xiang
181 Xi area focuses on ethnic culture and characteristic villages and towns; the eastern Hunan
182 area features agricultural experience and leisure sightseeing types, while health sports are
183 predominantly concentrated in southern Hunan. By capitalizing on each region's strengths,
184 the integration of agriculture and tourism can avoid the problems associated with a
185 duplication of product types. Nevertheless, due to rapid development, it is challenging to
186 prevent the occurrence of identical products. Therefore, in subsequent tourism development,
187 it is imperative to explore the rural characteristics from local historical heritage and folk
188 customs and form a distinct brand that highlights the region's uniqueness.

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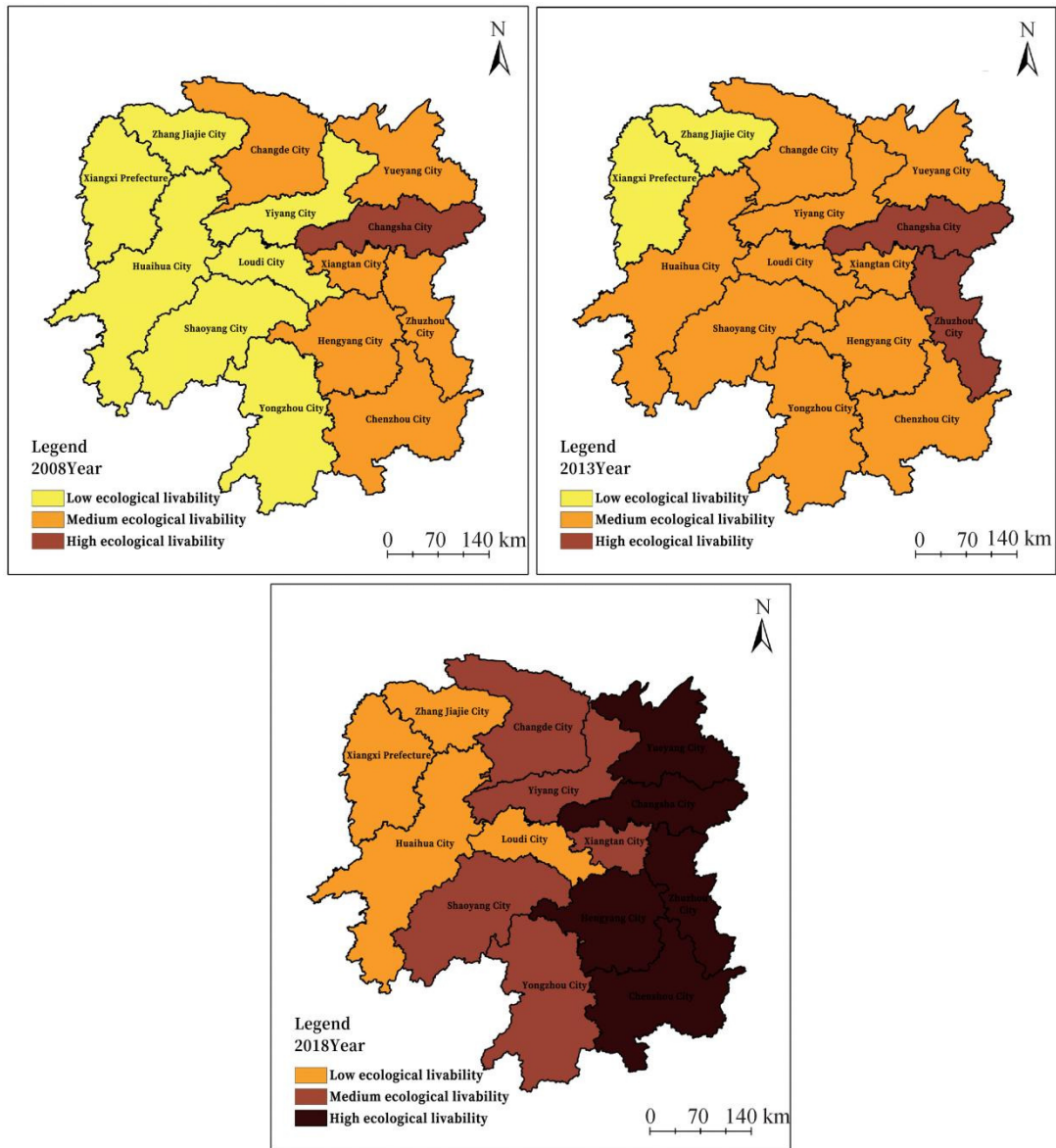
190 **3.2 Analysis of ecological livable development in Hunan Province**

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192 While developing leisure agriculture and rural tourism, Hunan Province adheres to the
193 implementation of national policies, actively promotes the governance of rural ecological
194 environment in development, and is guided by the construction of beautiful and livable
195 villages. The year 2019 was a critical year for the "three-year action plan" aimed at
196 combating pollution in Hunan Province. By prioritizing the implementation of environmental
197 governance measures, the air and surface water quality in Hunan Province have seen
198 continuous improvements, leading to effective protection of the natural ecological
199 environment. However, the environmental problems in many cities are still prominent, and
200 the situation of urban environmental governance is still severe.

201 Upon conducting a thorough search for relevant research data, the ecological livability
202 changes of various provinces and cities in Hunan Province from 2008 to 2018 were
203 examined, and the results are presented in Figure 2.

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Fig. 2 Ecological livability trend of Hunan Province[27]

From a temporal perspective, the construction of ecological livability in Hunan Province has witnessed steady growth. Generally, the level of ecological livability is lower in the central and western regions but higher in the eastern region. In 2008, Changsha City was the only region with high ecological livability, while the ecological livability level was moderate in the eastern region and substantially lower in the western region. By 2013, there was significant improvement throughout the province, particularly in Zhuzhou City, where the level of ecological livability had reached that of Changsha. By 2018, Hunan Province's ecological livability had made a qualitative leap, especially in the eastern region where it was relatively high.

From 2017 to 2022, the construction of beautiful rural demonstration villages in Hunan Province has been steadily promoted. In 2021, the list of beautiful rural demonstration villages has reached 301, and the rural living environment has been greatly improved.

221 **3.3 Analysis of the influence mechanism of the integration of agriculture and** 222 **tourism in Hunan Province on the rural ecological environment**

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3.3.1 Positive influence

The integrated development of agriculture and tourism and the construction of beautiful villages complement each other. The integration of the two not only promotes the construction of beautiful villages, but also improves the level of rural ecological livability[28]. This paper divides the rural ecological environment into rural natural ecological environment and rural humanistic ecological environment. and analyzes the positive impact of the integration of agriculture and tourism from these two aspects (see Figure 3).

The integrated development of agriculture and tourism is intrinsically linked to the utilization of local resources. In order to create tourism attractions, it is crucial to preserve the region's natural beauty. In the development process, a series of protective measures need to be implemented to safeguard local biodiversity and ecological balance[29], conduct ecological restoration projects, and make rural environments more visually appealing and livable.

The integration of agriculture and tourism can effectively promote local agricultural product development, encourage the growth of organic, green, and pollution-free agricultural products, reduce the use of pesticides, fertilizers, and other harmful environmental factors, increase the ecological value of agricultural resources[30], and enhance the income of local farmers while promoting their understanding of environmental protection.

The development of rural environmental construction necessitates that villagers have a deep appreciation for environmental protection. The economic benefits arising from the integration of agriculture and tourism can enable residents to realize the importance of independent ecological environmental protection, encouraging them to be more attentive to the environment, enhancing their awareness of environmental protection, translating economic benefits into ecological ones, and making sustainable environmental protection a fundamental aspect of everyday life[31].

The integration of agriculture and tourism can also support ecotourism, cultivate ecological tourists, and foster low-carbon and environmentally friendly approaches to travel, including cycling and hiking, which can minimize automobile exhaust emissions and land resource waste, reducing damage to the local ecological environment. Moreover, merging primary and tertiary industries can diminish the construction of polluting industries to some degree, reducing air pollution generated by industries, and significantly boost the natural ecological environment of rural areas.

The integrated development of agriculture and tourism necessitates maintaining a pristine natural landscape in rural areas. In order to enhance tourist satisfaction, many villages have improved their roadways, sewage treatment systems, garbage receptacles, public restrooms, and other infrastructure, renovated the rural environment, revitalized the appearance of the village, and enhanced the overall rural living environment. Meanwhile, efforts are made to strengthen the safeguarding of rural traditional folk customs to enhance the appeal of rural tourism. Tourist influx can bring about significant ideological impacts, and advanced ideologies and cultures can transform existing bad habits of rural communities to some extent. To become the foundation of leisure agriculture and tourism, some villagers actively learn Mandarin, improve their skillsets, and alter the collective spiritual outlook of the countryside.

3.3.2 Negative influence

As a novel business model under industrial integration, the integration of agriculture and tourism often prioritizes economic benefits at the early stage of integration, resulting in improper resource utilization. In addition, uncivilized tourist behavior and poor tourism operator management may also undermine the ecological environment.

274 In the process of industrial integration of agriculture and tourism, the development of
275 agricultural tourism resources has become one of the important measures for rural local
276 governments to develop local economy. However, in some areas, when developing tourism
277 resources, there is a lack of comprehensive feasibility investigation and scientific tourism
278 project planning. Conformity and blind development ignore sustainable development,
279 resulting in many tourism resources being snatched and developed, causing damage and
280 waste of resources.

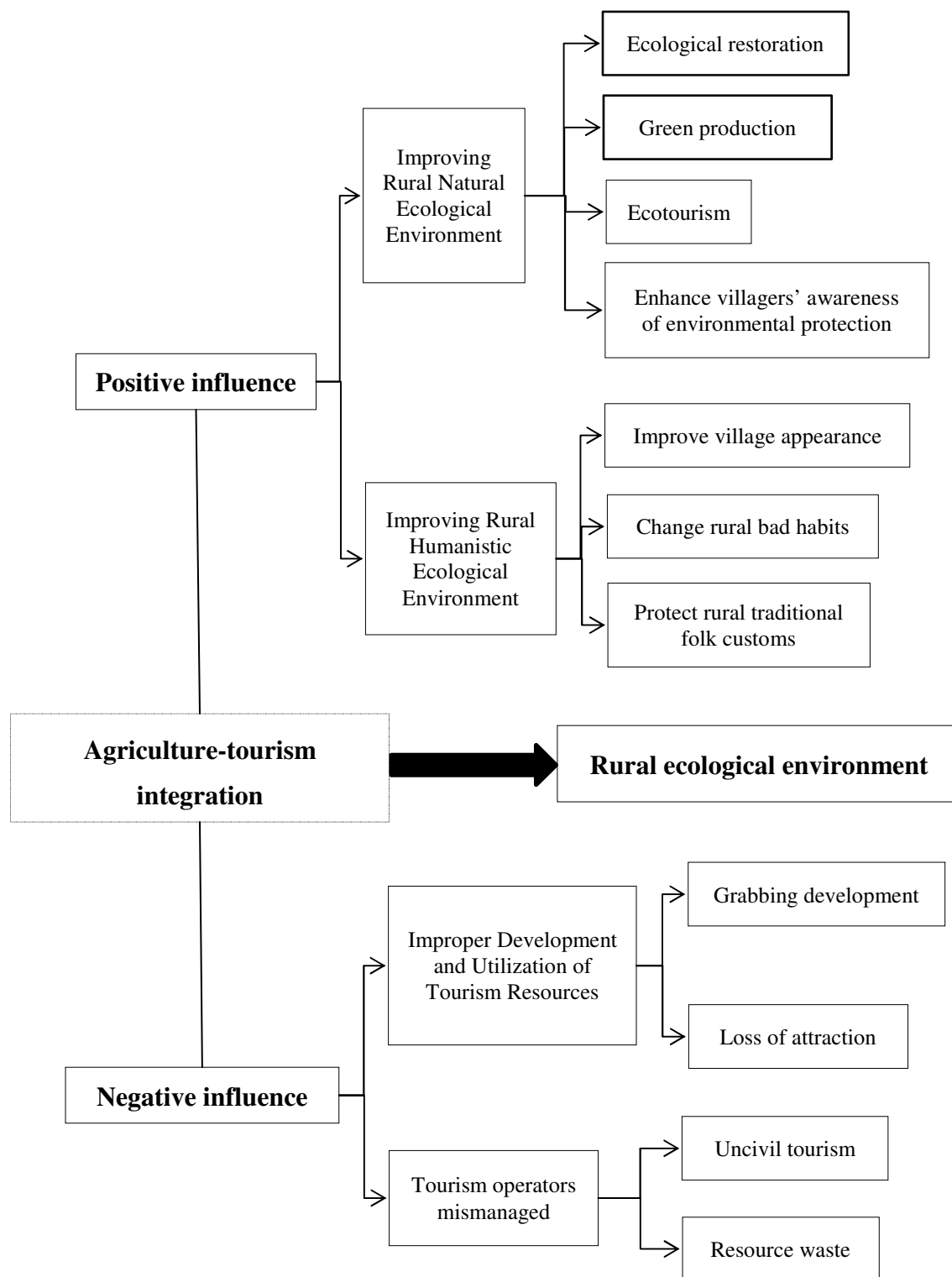
281 Because the integration of agriculture and tourism generally requires the use of land
282 resources and water resources, if improperly developed, it may cause irreversible damage to
283 the local ecological environment. For example, over-harvesting and hunting wildlife destroy
284 the local ecological balance; large-scale construction of tourism facilities and hotels may
285 lead to ecological problems such as soil erosion, waste of water resources and land
286 desertification.

287 During rural tourism destination management, relevant departments often overlook the
288 carrying capacity of the ecological environment and lack standardized management of
289 scenic spots. Consequently, some rural tourism operators prioritize short-term profits and
290 disregard sustainable development in their operations. They fail to effectively manage the
291 garbage generated by tourists and improperly discharge wastewater and other pollutants in
292 the scenic spot, leading to excessive accumulation of tourism debris and pollution of rural
293 vegetation and rivers. Furthermore, inadequate rural tourism supporting facilities and
294 infrastructure construction indirectly disrupts the ecological environment[32]. Repeated
295 construction of artificial landscapes that do not align with natural landscapes or excessive
296 pursuit of uniformity in rural houses lead to indistinguishable rural villages and the loss of
297 character.

298 The rural ecological management approach in Hunan Province primarily focuses on pastoral
299 health preservation, experiential observation, crop planting, and recreational fishing. In this
300 mode, a large number of tourists can experience various sightseeing activities daily.
301 However, if tourists behave uncivilized, it may pollute the farmland and rural surrounding
302 environment.

303 Agriculture and tourism are resource-dependent industries that rely on the resources of
304 tourism destinations. Thus, effective attraction of tourists entails adequate protection and
305 development of these resources. The impact of agricultural tourism integration on the rural
306 ecological environment has both positive and negative aspects, depending on the
307 development planning and execution. Therefore, only a scientific and reasonable approach
308 to development planning that prioritizes sustainable development can ensure that the
309 integration of agriculture and tourism plays a positive role in promoting the rural ecological
310 environment.

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313 **Fig.3 Influence Mechanism of Agricultural and Tourism Integration on Rural**
 314 **Ecological Environment**

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316 **4. AN EMPIRICAL ANALYSIS OF THE IMPACT OF RURAL TOURISM** 317 **INTEGRATION ON RURAL ECOLOGICAL ENVIRONMENT FACTORS**

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319 **4.1 MODEL CONSTRUCTION**

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321 In order to verify the impact of the integration of agriculture and tourism in Hunan
 322 Province on the rural ecological environment, this paper constructs the following
 323 panel model:

$$324 \ln Y_{it} = \alpha + \beta_1 \ln X_{it} + \beta_2 \ln Z_{it} + \varepsilon_{it} \quad (1)$$

325 In formula (1), i represents 14 prefecture-level cities in Hunan Province, and t
 326 represents time (2015-2021). Y is the dependent variable for the rural ecological
 327 environment (REN) of cities and prefectures in Hunan Province. The independent
 328 variables include core independent variables and control variables. The core
 329 variable is the level of integration of agriculture and tourism (RTUR) in various cities
 330 and states of Hunan Province; the control variables include local fiscal revenue level
 331 (LFIN), urbanization level (URB), labor force (LAB), rural science and technology
 332 development level (RTEC), rural infrastructure level (RINF) and foreign direct
 333 investment level (FDI).

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335 **4.2 SOURCES OF DATA**

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337 This paper uses the panel data of cities and states in Hunan from 2015 to 2021. The
 338 original data of each variable are from the website of Hunan Provincial Bureau of
 339 Statistics and the website of Hunan Provincial Department of Culture and Tourism*.
 340 Specific instructions:

341 Ecological livability (REN) variable: This paper uses the amount of chemical fertilizer
 342 applied in various cities and prefectures in Hunan to measure*. Excessive
 343 application of chemical fertilizer is an important factor affecting the rural soil
 344 environment and water environment, which has certain representative.

345 The level of integration of agriculture and tourism (RTUR) variables: The level of
 346 integration of agriculture and tourism is the core variable of this paper. This paper
 347 uses the ratio of the number (stock) of five-star rural tourism areas (points) in Hunan
 348 Province to the population size in each year of each city and state to measure;

349 local fiscal revenue level (LFIN) variable: This paper uses the total fiscal revenue of
 350 each city and state in the year;

351 urbanization level (URB) variable: This paper uses the annual urbanization rate
 352 index of each city and state;

353 the number of labor force (LAB) variables: this paper uses the scale of rural
 354 employment to measure;

355 rural science and technology development level (RTEC) variable: this paper uses
 356 the total power index of agricultural machinery to measure;

357 the rural infrastructure level (RINF) variable: This paper uses the total mileage index
 358 of rural roads to measure[The total mileage of the four-level highway in Hunan
 359 Province is adopted.];

360 foreign direct investment level (FDI) variables: This paper uses the total foreign
 361 direct investment index to measure.

362 Descriptive statistical analysis of each indicator is shown in Table 1.

363

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Table 1. Descriptive statistical analysis of variables

VARIABLES	N	Unit	Mean	SD	Min	Max
REN	98	Ten thousand tons	16.86	7.980	5.580	37.52
RTUR	98	-	0.174	0.112	0.0190	0.487
LFIN	98	Ten thousand yuan	1.740e+06	2.160e+06	315,761	1.188e+07
URB	98	proportion	54.40	9.573	41.13	83.16
LAB	98	Ten thousand people	223.7	79.91	79.70	395.6
RTEC	98	Ten thousand kilowatts	452.3	166.6	109.4	673.9
RINF	98	kilometer	13,900	4,508	4,341	20,136
FDI	98	Ten thousand yuan	98,568	137,378	219	728,165

365 *The number of rural employees in 2020-2021 and the total power of agricultural
 366 machinery in 2020 are estimated from previous data.

367 Fertilizers referred to herein, excluding organic fertilizers.

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369 **4.3 Empirical Analysis Results**

370

371 Model 1 is the regression result without control variables, and Model 2 is the regression
 372 result with control variables, as shown in Table 2.

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Table 2. Regression results of each model

VARIABLES	(1)	(2)
	REN	REN
RTUR	-0.102*** (-8.42)	-0.090*** (-3.08)
LFIN		0.125** (2.23)
URB		0.127 (0.59)
LAB		1.444*** (3.03)
RTEC		-0.007 (-0.05)
RINF		-0.174 (-1.12)
FDI		0.012*** (2.72)
Constant	2.499*** (101.86)	-5.873* (-1.75)
Observations	98	98
R-squared	0.461	0.558
Number of city	14	14
F test	0	0

r2_a	0.370	0.443
F	70.96	13.90

z-statistics in parentheses
 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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The quantitative analysis results indicate that there are notable variations in the integration of agriculture and tourism across different cities and states in Hunan Province. However, the impact on the rural ecological environment is generally consistent. There is a significant negative correlation between the level of integration of agriculture and tourism and ecological livable variables:

The integration of agriculture and tourism development, in order to attract tourists, in the development process will consider the local ecological environment, take a series of protection measures, ecological restoration; it will also promote the development of local agricultural products, promote organic, green, pollution-free and other agricultural ecological products, thereby reducing the use of chemical fertilizers or using organic chemical fertilizers, but there are villagers who over-fertilize to promote crop growth, resulting in land resources and water resources. At the same time, the increase of rural population flow will bring some pressure to the ecological environment. If it exceeds the local ecological carrying capacity, it will lead to ecological imbalance. The level of integration of agriculture and tourism is significantly negatively correlated with the ecological livability variable at the 0.01 level, and the correlation coefficients are -0.102 and -0.090 . It can be seen that the negative impact of the integration of agriculture and tourism on the rural ecological environment in Hunan Province from 2015 to 2021 is greater than the positive impact, but its correlation coefficient is not large. It reflects that the impact of the integration of agriculture and tourism on the rural ecological environment can be controlled by the scientific and rational development planning in the early stage of development and the implementation of relevant measures in the implementation process, which verifies the conclusion of the above impact mechanism analysis.

There is a notable positive correlation between the ecological livable variables and the local fiscal revenue level, foreign direct investment level, and labor force level. Economic development is closely linked to industrial integration, and a more extensive labor force is fundamental to such development. The higher the level of economic development and labor force, the more positive is the impact of the integration of agriculture and tourism on the rural ecological environment, and the more prominent are the financial and human resource guarantees.

The level of urbanization, rural science and technology development, and rural infrastructure show no significant impact on ecological livability and have yet to reach an ideal level. This may be attributed to the fact that higher levels of urbanization imply that rural areas have already become urbanized, and the combination of agriculture and tourism cannot be carried out. Additionally, during urbanization, more attention is paid to urban environmental construction, and relatively insufficient investment is allocated to rural infrastructure and environmental protection. Ultimately, agricultural machinery indirectly affects the ecological environment by changing agricultural planting structures and affecting chemical input and waste treatment, but it also leads to substantial energy consumption and carbon emissions, thus having both positive and negative impacts.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

Based on the panel data of 14 cities and prefectures in Hunan from 2015 to 2021, this paper uses the fixed effect model to empirically study the impact of factors such as the integration level of agriculture and tourism, local fiscal revenue level, urbanization level, labor force, rural science and technology development level, rural infrastructure level and foreign direct investment level on rural ecological environment. The results show that the development of

426 agricultural tourism integration in Hunan Province under scientific and reasonable planning
427 can effectively promote the construction of rural ecological environment.

428 The existence of a scientifically and reasonably designed development plan that takes into
429 account sustainable development is directly related to the potential positive impact of
430 agricultural tourism integration on the rural ecological environment. When implemented
431 through scientific and reasonable planning, the development of agricultural tourism
432 integration can enhance the natural ecological environment and humanistic ecological
433 environment of rural areas. Additionally, the integration of agriculture and tourism has
434 significantly reduced the amount of harmful substances produced during agricultural
435 production processes, thereby promoting the development of the agricultural ecological
436 environment. In terms of the impact on rural residents, promoting the integration of
437 agriculture and tourism can raise awareness of environmental protection among residents
438 and promote the sustainability of the rural ecological living environment. From the
439 perspective of the tourism industry, the ecological construction of tourism destinations is
440 necessary to attract tourists. By prioritizing ecological considerations during the development
441 of tourism destinations, the integration of agriculture and tourism can have a positive impact
442 on the rural ecological environment.

443 The economic support is the key to promote ecological livability in the integrated
444 development of agriculture and tourism in Hunan Province. Promoting the organic
445 combination of rural agriculture and tourism can improve the level of economic development.
446 From the empirical results, promoting the integration of agriculture and tourism in areas with
447 higher levels of local fiscal revenue and foreign direct investment can have a positive impact
448 on the rural ecological environment. For example, the Chang - Zhu - Tan area is not only a
449 region with rapid development of tourism, but also a region with high ecological livability.
450 With the support of the economy, the ecological environment has been reasonably protected
451 in the development process, and the number of tourists has increased in an orderly manner
452 without exceeding the ecological carrying capacity. The economy and the environment
453 complement each other; Xiang Xi area is a gathering area of Tujia and Miao ethnic
454 minorities, with prominent ethnic characteristics, ethnic architecture and folk culture with
455 regional characteristics, and the natural resources of rural tourism in this area are very rich.
456 In recent years, rural tourism has developed very rapidly. However, due to the slightly
457 backward local economic development and relatively small investment in environmental
458 protection, the ecological environment in this area has been damaged to a certain extent.
459 Based on the above findings, we put forward the following policy suggestions.

460 1. In the process of integrated development of agriculture and tourism, Hunan Province
461 combines different development progress and location characteristics of various regions,
462 innovates planning concepts, and optimizes industrial function layout. Combined with the
463 regional development status of 'Great Xiang Xi Poverty Alleviation and Critical Pilot Area'
464 and 'Dong Ting Lake Eco-economic Circle', the comprehensive improvement of the rural
465 environment around the drinking water source protection area and the 'Dong Ting Lake Eco-
466 economic Circle' is promoted as the focus of remediation.

467 To ensure effective implementation, the leading mechanism for promoting the county as a
468 whole should be established. Relevant departments should integrate their strengths, invest
469 multiple resources, and closely cooperate with each other. For instance, the environmental
470 protection department should undertake comprehensive supervision of the environment, with
471 a focus on the rural domestic waste treatment system and the formation of an environmental
472 protection team. Meanwhile, the residential construction department should be responsible
473 for establishing township sewage treatment facilities, while the water conservancy
474 department should oversee rural drinking water safety projects. Additionally, the agriculture,
475 animal husbandry, and aquaculture departments should work together to reduce non-point
476 source pollution in agriculture and aquaculture. By setting up a leading mechanism and
477 integrating the efforts of different departments, we can ensure the effective promotion and

478 implementation of the county's development plans. In doing so, we can establish a
479 sustainable and livable county that benefits everyone.

480 2.The government should formulate scientific development plans and promote the deep
481 integration of agriculture and tourism. In the process of integrated development of agriculture
482 and tourism, through systematic planning, organic integration of rural tourism resources, the
483 development of agriculture, rural areas and farmers is highly integrated, so that leisure
484 agriculture and rural tourism become the primary development industries in rural areas.
485 According to the feasibility analysis of the situation of each township, strengthen the training
486 of farmers' agricultural technology and business knowledge, improve the willingness of rural
487 residents to develop leisure agriculture and rural tourism, improve their ability to run tourism,
488 actively explore the local characteristics and historical culture of the countryside, enhance
489 the economic benefits of tourism, so that the majority of farmers really benefit.

490 To formulate a scientific rural ecological environment protection plan, with the protection of
491 the rural ecological environment as the core, focusing on increasing the employment
492 opportunities and income of residents, maintaining the rural style and local humanistic
493 characteristics, taking the road of standardization, scale, specialization and brand
494 integration, promoting the development of rural tourism industrialization, and finally realizing
495 the sustainable development of rural tourism and ecological livable construction.

496 3. The government should strengthen the improvement of rural ecological environment laws
497 and regulations, improve the ecological environment benefits. We should firmly adhere to the
498 concept of 'lucid waters and lush mountains are invaluable assets', adhere to the land use
499 policy of 'developing in protection and protecting in development', and formulate relevant
500 policy documents for implementing ecological environment protection and soil and water
501 conservation. In the process of integrated development of agriculture and tourism, in addition
502 to following the existing various protection laws related to land and water resources, it is also
503 necessary to speed up the formulation of special protection laws and regulations for rural
504 ecological environment, provide codes of conduct for all walks of life, and promote the
505 sustainable development of agriculture and tourism integration. All kinds of tourism
506 enterprises should also formulate relevant tourism environmental protection systems to
507 ensure that tourism development activities are carried out within the ecological capacity.

508 Adhering to the principle of "who develops, who protects" and "who destroys, who
509 restores"[33], the government should prioritize the development and construction projects of
510 rural tourism across various departments. Additionally, we must reinforce the management
511 of scenic operators, ensuring that they meet environmental standards. Hotel pollution control
512 can be improved by implementing a pollution charge system, which encourages hotels to
513 reduce their impact on the environment. We must also strengthen the construction of a
514 punishment system for tourists who engage in uncivilized tourism behavior. At the same
515 time, law enforcement departments should increase the implementation of relevant systems
516 to ensure that violators are held accountable.

517 By adopting a comprehensive approach to environmental protection and sustainable tourism
518 development, we can promote the long-term development of rural tourism while protecting
519 the natural environment. This will not only benefit tourists but also contribute to the well-
520 being of locals and promote the overall development of rural areas.

521 4. Investment in Rural Construction and Supporting Ecological Environment Protection
522 should be prioritized to push the integrated development. The level of economic support is
523 the main influencing factor of the construction of ecological environment in the process of
524 agricultural tourism integration in Hunan Province, and it is also an important basis for the
525 construction of urban ecological livability. The level of economic development among 14
526 cities in Hunan Province is quite different. For areas with relatively low economic
527 development levels such as Xiang Xi Autonomous Prefecture, Huai Hua City and Zhang
528 Jiajie City, attention should be paid to economic development in the process of integration of
529 agriculture and tourism. At the same time, we should adhere to improving the carrying
530 capacity of the ecological environment. For the central and eastern regions with rapid

531 tourism economic development and high environmental quality, residents' awareness of
532 environmental protection should be continuously improved.

533 To promote the further in-depth development of the integration of agriculture and tourism,
534 improve economic efficiency, make the achievements of economic development benefit
535 more people, enhance the sense of gain of rural residents, and then feed back the protection
536 of ecological environment. When the economic benefits brought by the development of rural
537 tourism are comparable to the economic benefits brought by other heavy industries that
538 pollute the ecological environment, more capital enterprises will take tourism as the focus of
539 development, so as to increase the capital investment in the integration of agriculture and
540 tourism industry and support the protection of ecological environment[34].

541 5. It's critical to strengthening the propaganda of rural ecological civilization and improving
542 the environmental protection consciousness of villagers and tourists.

543 Currently, urban residents have demonstrated a high level of moral quality, but some rural
544 areas still lack awareness of environmental protection. Therefore, to better protect the
545 ecological benefits of agricultural tourism integration, it is necessary to ensure that residents
546 in rural areas share the same values of environmental protection. In promoting environmental
547 protection efforts, increasing the participation of villagers in environmental governance and
548 involving them in rural construction planning can enhance their sense of ownership and
549 stimulate their potential for environmental protection. Additionally, this approach can
550 generate employment opportunities for villagers. It is also crucial to focus on publicity efforts
551 related to environmental protection during the development and construction phase. Local
552 governments can use propaganda films and manuals to raise awareness of civilized tourism,
553 and scenic spots should improve their interior signage promoting civilized tourism.
554 Volunteers can be arranged to help maintain a civilized atmosphere within the scenic spot.
555 By establishing a connection between residents and the ecological environment, we can
556 foster a correct understanding of ecological civilization and create an atmosphere of
557 environmental protection. In conclusion, promoting the participation of villagers in
558 environmental governance and increasing public awareness of ecological protection can
559 help to better protect the ecological benefits brought by the integration of agriculture and
560 tourism while creating a sustainable environment for all stakeholders.

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