Characteristics of rainfall pattern change in mountainous area based on dynamic adaptive and sustainable development of agricultural tourism

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Abstract
The research content of optimal control is to find out the admissible control rules according to the dynamic characteristics of the control system under specific constraints. According to the control object to be executed, the corresponding performance index is optimized. This kind of problem generally exists in the field of technology and practical engineering. In order to solve the optimal control problem, it is necessary to establish a mathematical model describing the motion process of the control object, specify the initial state and target set, give the allowable control range of the control variables, define the performance index, so as to evaluate the quality of the motion process. According to the analysis of the splash rule of single raindrop on loess, the experiment of increasing rainfall was carried out, and the splash holes were produced around the slope in the first 10 min. With the increase of water, the slope erosion trough is formed due to continuous rainfall, which gradually expands to both sides and develops to the deep, resulting in small-scale collapse on both sides of the trough. With the acceleration of urbanization, ecoagricultural tourism is becoming more and more popular among tourists. Ecoagricultural tourism alleviates the environmental damage caused by over exploitation of tourism resources, makes the new agricultural mode and new business form obtain greater economic benefits, and also makes tourism find a new development path in China. This paper first expounds the background of the development of ecoagricultural tourism and the significance of the topic selection. On the basis of studying a large number of domestic and foreign literature on the development mode and approach of ecoagricultural tourism, it explains the related concepts and theoretical basis of ecoagricultural tourism.

Keywords Dynamic adaptation · Change of rainfall pattern in mountainous area · Agricultural tourism · Sustainable development

Introduction
The generation of rainfall pattern is a process of “coupling of heaven and earth”. The prediction, monitoring, and early warning based on rainfall condition are some of the important means of disaster prevention and mitigation, so they have become a research topic of people’s attention (Jaagus 2006). However, due to the complex changes of the precipitation process itself, the research on the influence of rainfall on soil surface and its inducement is more complex. It is difficult to accurately grasp the critical rainfall in the rainfall process. The key to study the flow and control action mechanism is to study the rainfall conditions and prediction, which affects the reliability of the prediction standard to a certain extent. In the long process of historical development, agriculture has always been an important part of the national economy and people’s life (Lu et al. 2015). It not only solves the survival problem of a large number of Chinese populations, but also eases the pressure between environment and population. When ecological agriculture and tourism combine with each other through their relevance, a new industry will be formed, that is, ecological agriculture tourism, which is the inevitable product of the continuous development of modern agriculture and tourism (Perkins and Alexander 2013).
The development of ecoagricultural tourism not only makes full use of a large number of agricultural ecological resources in China, but also increases agricultural income, which plays an important role in coordinating the relationship between China’s economy and environment. With the acceleration of urbanization, ecoagricultural tourism is becoming more and more popular among tourists. Ecoagricultural tourism not only makes the new agricultural model obtain greater economic benefits, but also makes tourism find a new way of development in China (Piticar 2018). Moreover, with the rapid development of the city, people’s living environment is constantly compressed, and their physical and mental health is adversely affected, so they are more eager to return to the countryside and get peace and tranquility (Schar et al. 2004). With the development of economy, people’s disposable income is increasing, and their demand is becoming more and more diversified. This demand not only improves work efficiency and increases leisure time, but also improves rural infrastructure and enriches people’s spiritual life due to the improvement of traffic conditions and the introduction of paid vacation system (Smida et al. 2019). Coupled with the progress of science and technology, the popularization of information, urban residents’ tourism demand gradually changes from long distance, long time, single frequency to short distance, short time, and multi-frequency. People are more yearning for good natural ecological environment, beautiful rural scenery, original ecological folk culture, and farming experience activities as the carrier of tourism activities. China’s ecoagricultural tourism is in such a situation has been rapid development (Rahimzadeh et al. 2009).

Materials and methods

Layout of monitoring points

As can be seen from Fig. 1, a river basin is rich in water resources and has many rivers. These rivers have good water quality and clear bottom. They flow into a river, then flow out from the lower Longmen at the outlet of the basin, and finally flow into Erhai Lake through Miju river (Tomczyk and Sulikowska 2018).

Meteorological data acquisition method

A weather station is arranged at the outlet of a small river basin to obtain daily rainfall, minimum temperature, and average temperature. The location of weather stations in small watersheds was monitored from 2011 to 2019. The historical meteorological data of Dali Prefecture comes from the National Meteorological Administration.
\[
\varphi_2 \left( \varphi_1^2 \right) = \varphi_1 \left[ x_1 - x_2/l_1 \right] T
\]

**Design of raindrop splash test device**

As shown in Table 1, the artificial device generates individual raindrops with different diameters. Four needles with different diameters are used to simulate the shape of a single raindrop, and 4#, 3#, 2#, and 1# needles are selected respectively, and a total of 4 needles are used. In the test, a raindrop generator with a certain size was used. After calculation, the control valve controls the water outlet frequency of 60 drops/min, and the diameter of the hole is measured with camera image technology (Varfi et al. 2009).

**Calculation of rainfall energy in mountainous areas**

When the raindrop goes through the falling process, assuming that the mass of the raindrop is \(m\), according to Newton’s second law, the equation of the raindrop during the vertical falling process is as follows:

\[
m \cdot \frac{d v}{d t} = mg - F
\]

among them, \(M\) is the mass of raindrops (Mg); \(v\) is the instant speed (m/s); \(F\) is the air resistance force (N).

When raindrops fall and hit the surface soil, the kinetic energy of the raindrops will be converted into impact force, and the impact pressure generated by the soil will cause the loss of the movement of individual raindrops. This part of the movement loss is the same as the movement contained in the droplets of soil particles in the top soil. On a sloping slope, the component of the wind force is perpendicular to the slope, and sometimes, the slope is added (Watts et al. 2018). The speed of raindrops gradually increases during the vertical fall. As soon as the raindrops hit the soil, they will get the speed instantly, \(f(t)\) is the force of the raindrops hitting the soil particles. In the short time when the raindrops hit the soil, the energy will be transferred to the soil, and the speed will become zero. According to the momentum theorem:

\[
f + ma = 0
\]

\[
\int_0^t \left( f(t) - mg \right) dt + \int_0^\infty 4/3 \pi R^2 d_v = 0
\]

\[
f = 1/8 \rho \pi d^2 v_m^2
\]

\(F\) is the force when colliding with soil (N); \(A\) is the acceleration (2m/s); \(\rho\) is the raindrop density (3cm/g); \(R\) is the raindrop diameter (mm); \(V_m\) is the speed before collision (s/m); \(D\) is the diameter of the raindrop (mm).

The energy contained in the maximum impact of raindrops on the soil is directly related to the diameter of the raindrops and the velocity before the impact (Ye et al. 2018). The work performed by raindrops is the energy consumed by particles in the soil that bounce them up when they hit the soil. The kinetic energy of raindrops before the collision is as follows:

\[
E_k = 1/2 \cdot m v_m^2 - 1/2 \cdot m \cdot \rho \cdot \pi \cdot d_m^2 v_m^2 = 1/2 \cdot \rho \cdot \pi d_m^2 v_m^2
\]

The kinetic energy of raindrops before the collision is closely related to the diameter and speed of the raindrops, which changes accordingly.

**Results**

**Impact of rainfall intensity on the water quality of mountain rivers**

As can be seen from Fig. 2, a river basin covers an area of 219 km², including 9 administrative villages in Fengyu Town, including Zhenxing village, Zhuangshang village, Fenghe village and Qifeng village, and 2 administrative villages in Bihu Town, including Songhe village and Fengyan village. The total population is 35404, of which 27% are town residents.

As can be seen from Fig. 3, the main industries of a river basin are planting and breeding, mainly including rice, corn, and flue-cured tobacco. The farming industry in the basin is mainly scattered farming in rural areas, and there are no large-scale farms.

Figure 4 shows the dynamic change of runoff at the outlet of a small watershed during January 2018 to December 2019. It can be seen from the figure that during the monitoring period, the variation trend of rainfall and runoff in a small watershed is highly consistent; while in nonflood season, the rainfall is smaller, and the runoff is smaller. The total annual runoff at the outlet of a small watershed in 2018 is 35.98 m³/s⁻¹. The maximum runoff is in August, with a flow value of 12.67 m³/s⁻¹. The minimum runoff is in January and
February, with a flow value of $0 \text{ m}^3\text{s}^{-1}$; the total amount of runoff in flood season is $24.35 \text{ m}^3\text{s}^{-1}$, accounting for 68% of the annual runoff, accounting for more than half of the annual runoff in 2018. In 2019, the total annual runoff is $159.40 \text{ m}^3\text{s}^{-1}$, which is four times of that in 2018. The maximum runoff is in September, with a flow value of $21.97 \text{ m}^3\text{s}^{-1}$. The minimum runoff is in May, with a flow value of $6.57 \text{ m}^3\text{s}^{-1}$. The total runoff in flood season is $76.76 \text{ m}^3\text{s}^{-1}$, accounting for 48% of the annual runoff.

It can be seen from Fig. 5 that the reason for the increase of nitrogen and phosphorus concentration in nonflood season may be that nitrogen and phosphorus from farmland, livestock and poultry breeding, and rural life flow into the water body, resulting in the increase of nitrogen and phosphorus content in the river. However, with the increase of rainfall in flood season, a river basin belongs to mountainous and hilly area, which is easy to produce runoff during rainfall, so the runoff also increases. A large amount of nitrogen and phosphorus content flowed into the water body with the erosion of runoff, but at the same time, the larger rainfall in the flood season also played a role in diluting the nitrogen and phosphorus content in the river.

It can be seen from Fig. 6 that the variation tendency of TN/TP monthly average concentration and monthly average rainfall at the river outlet (Fig. 6) shows the variation of N/TP monthly average concentration at the river outlet. From 2018 to 2020, the trend of the basin is basically consistent with the average monthly rainfall. Among them, the trend of TN/TP in rainy season (June to September) is very consistent with the trend of monthly average rainfall, and the concentration is higher than that in nonrainy season. The trend of TN/TP in nonrainy season is relatively stable. In addition, the average monthly concentration of TN in 12 months of a year is higher than that of TP.

As shown in Table 2, light rain accounts for 66.06%, moderate rain accounts for 3.64%, heavy rain accounts for 8.48%, and heavy rain accounts for 1.82%. Heavy rain mainly occurs in June, July, and September. The average annual rainfall in Dali Bai Autonomous Prefecture is 1050 mm. According to the data of China Meteorological data network, from 2018 to 2020, light rain accounted for 79.78%, moderate rain 14.04%, heavy rain 5.06%, and heavy rain 1.12% (mainly from July to September). This fully shows that the rainfall characteristics of the river basin are consistent with those of Dali Bai.
Fig. 4 Relationship between rainfall and discharge at the outlet section of a small watershed.

Fig. 5 Variation trend of water quality in flood season and nonflood season of a river basin.
Autonomous Prefecture, and the variation of rainfall distribution in some areas of the region is small.

**Analysis of raindrop splash test results of different rain patterns**

It can be seen from Table 3 that under a certain degree of tightness, when the raindrop energy is $1.14 \times 10^{-4} \text{j}$, the depth of the soil hole is 4mm, and the diameter of the hole is 5mm, which has the least impact on the soil. The experimental results show that after the raindrops with this kind of energy contact the soil surface, the water will penetrate rapidly, and the particles on the soil surface will not be eroded by the droplets, so it is difficult to form an effective impact force. This shows that the energy destructive power of raindrops and the cohesion between soil particles are in a critical state of almost equilibrium, that is, the critical $E_k$ of minimum dispersion.

It can be seen from Table 4 that with the increase of raindrop energy, the soil saturation speed and water content speed up, the soil is seriously damaged, the water content changes, and the soil cohesion and internal friction angle change. With the increase of water content, the cohesion and internal friction angle of soil decrease, and the overall shear strength of soil decreases. It is known that the size of the energy contained in raindrops has a great relationship with the final destruction of soil. The larger the energy of raindrops is, the more serious the soil is damaged. The smaller the energy of raindrops is, the weaker the soil quality is damaged. With the increase of the angle of soil cohesion and internal friction, the greater the change of the energy of raindrops, the weaker the soil’s resistance to rain erosion.

**Analysis of simulation results of rainfall intensity under different rainfall patterns**

It can be seen from Fig. 7 that according to the statistics of long-term monitoring data, from June to August, flood period is a period with high natural disaster occurrence rate, and the maximum rainfall is about 120mm. The parameters of the numerical simulation slope model are obtained from the above, and the height of the model slope is 10m close to the natural slope. According to the actual groundwater level data, the groundwater level is set to be $-3m$ down from the surface of the simulation model. The dry density was 1.61g/cm$^3$, and the moisture content was 8.4% near the natural state. In the calculation, the soil is assumed to be homogeneous. According to the rainfall information of the region, there are four types of rainfall, which are uniform rainfall, intermediate rainfall, intensified rainfall, and weak rainfall.
It can be seen from Fig. 8 that the finite element numerical simulation software divides the slope model into many grids to effectively calculate the approximate solution of temporary seepage of slope under different rainfall conditions. In this paper, elements are divided into triangular meshes. The more detailed the grid, the more accurate the solution. According to the permeability parameters of physical experiments, the initial contact area is divided more closely due to the rainfall on the slope surface, and the mesh from the slope surface to the interior is more and more sparse. This is also the result of the combination of the duration of the software solution and the accuracy of the solution.

Starting from Fig. 9, through the indoor physical slope rainfall experiment, the slope and slope rainfall of the first contact interface, along with the long-term rainfall slope and slope permeability coefficient, the rainfall infiltration depth gradually increases. After a period of rainfall, not only the upper slope is limited by the rain damage, but also the water content of the slope body is increased and the matrix attraction is reduced, which also leads to the internal damage and the overall stability of the slope body is destroyed. Therefore, in this paper, points A and B are selected as the monitoring points of the upper slope and the slope, and point C is selected as the monitoring point of the sliding surface of the adjacent slope.

Starting from Fig. 10, the attraction of the matrix at point A on the top of the slope and point B on the slope changed greatly, and the attraction of the homogeneous rainfall matrix changed steadily and gradually decreased. Starting from Fig. 10, continuous rainfall at a certain speed of 12 h increases the gradient of water components in the front, slope, and saturated soil. The rainfall reaches 36 h. Due to the depth of rainwater infiltration at point C and the influence of rainfall, the matrix attraction in the slope decreases, and water is difficult to drain out of the soil. As a result, the saturated area becomes larger and larger.

Table 3 Relationship between the depth and aperture of the pit and the energy of raindrops

| Raindrop energy | Raindrop diameter | Compactness | Drop high | Loess pit depth | Aperture of loess pothole |
|----------------|------------------|------------|----------|----------------|--------------------------|
| 5.3            | 4.7              | 89         | 1        | 12             | 16                       |
| 3.1            | 3.8              | 11         | 1        | 11             | 14                       |
| 2.2            | 3.3              | 9          | 1        | 9              | 13                       |
| 1.1            | 2.8              | 7          | 1        | 7              | 6                        |

Table 4 Relationship between splash time and water content of different raindrop energy

| Time  | Raindrop energy | Cohesion reduction Δc | Internal friction angle reduction Δψ |
|-------|-----------------|-----------------------|-------------------------------------|
| 0–60  | 5.3             | 85.4                  | 57.13                               |
interdependent and close combination of agriculture and tourism. It is a kind of tourism activity that promotes tourists to come to scenic spots for tourism and leisure on the basis of agricultural production by using rural ecological science and technology. China is a big country with vast territory and numerous people. Different regions have unique charm of different regions. There are tropical rare species in the south of China, snow covered forests in the north, vast sea in the East, and vast grassland in the West. These different regional characteristics add different styles to China’s ecological agriculture tourism. The traditional agricultural model only uses people to work on the land. With the progress of science and technology and the development of the times, the traditional agricultural model cannot meet the requirements of the new era. Therefore, it is inevitable to change to ecological agriculture. Of course, the production of ecoagricultural tourism is different from the original agricultural tourism. Ecoagricultural tourism mainly needs to be based on the original ecological environment of the local rural areas. At the same time, it uses the landscape formed by agricultural work and the green food produced by science and technology as tourism resources to attract a large number of tourists. Similarly, if the ecological agricultural production or other agricultural carriers are separated from the agricultural products under the ecological technology, there will be no so-called ecological agricultural tourism. The natural landscape, the original ecological environment, and even the air in each ecotourism area are the basis for the survival of ecoagricultural tourism. If there is no good ecological environment and good ecological technology, compared with the current traditional tourism industry, ecoagricultural tourism has no advantages, and the probability of tourists choosing ecoagricultural tourism will be greatly reduced. The development of ecoagricultural tourism further promotes the development of ecoagricultural construction and

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**Fig. 7** Different rainfall types

(a) Uniform rainfall  
(b) Intermediate-type rainfall  
(c) Intensified rainfall  
(d) Weakened rainfall

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**Fig. 8** Value analysis model (unit: m)

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strengthens the safety of pollution-free. The green and pollution-free agricultural products production base established by enterprises for agricultural tourism, using domestic advanced technology, is not only conducive to

![Fig. 9 Location of monitoring points](image)

![Fig. 10 Variation of matric suction during uniform rainfall](image)

(a) Initial state  (b) 12 hours of rainfall  (c) 24 hours of rainfall

(d) 36 hours of rainfall  (e) 48 hours of rainfall  (f) 60 hours of rainfall

(g) 72 hours of rainfall  (h) 84 hours of rainfall  (i) 96 hours of rainfall

Fig. 9 Location of monitoring points

Fig. 10 Variation of matric suction during uniform rainfall
promoting the publicity and promotion of China’s advanced agricultural science and technology, but more importantly, to make more people understand green agriculture and green food, which has a more positive role in promoting the safety of the whole society.

Environmental protection as the premise

With the emergence of automobile exhaust pollution, abnormal temperature, and other problems, it shows that we are facing a struggle with the deteriorating ecological environment. At the same time, urban residents are more and more eager for natural and peaceful life. The requirements of ecoagricultural tourism on the ecological environment are very high. A good ecological environment is an important resource for the development of ecoagricultural tourism, and it is also the key to the development of ecoagricultural tourism. In order to achieve this demand, we must abide by the ecological law, ensure the protection of the local natural environment, and adhere to the principle of sustainable development in China. Therefore, in order to highlight the differences between ecoagricultural tourism and traditional tourism, we should make full use of the advantages of ecoenvironmental resources to carry out ecoagricultural tourism activities, strengthen sustainable development, and do a good job in the communication between agricultural ecotourism and local regional environment. Therefore, in the process of developing ecoagricultural tourism, enterprises must put the ecological environment in the first place of many factors and make clear their own goals. In the process of development, they should not destroy the local original ecological landscape. According to their own actual situation, they should adjust measures to local conditions and should not blindly imitate the development to cause damage and waste.

Fig. 11 Variation of matric suction during intermediate rainfall

(a) Initial state (b) 12 hours of rainfall (c) 24 hours of rainfall
(d) 36 hours of rainfall (e) 48 hours of rainfall (f) 60 hours of rainfall
(g) 72 hours of rainfall (h) 84 hours of rainfall (i) 96 hours of rainfall
of local natural landscape resources. It can strengthen the combination of various parts in regional planning, maintain the connection between local ecosystems, and ensure the balance of ecosystems.

Relying on rural culture

For the tourism industry, most of the contents of tourism are original scenic spots. However, compared with traditional tourism, ecoagricultural tourism has more distinctive rural cultural connotation. Most of the local customs and customs in rural areas are included in the tourism products, which fully reflect the rich connotation of different ethnic and regional cultures. Every region’s humanistic feelings are left behind by the continuous development of society. Therefore, the embodiment of humanistic feelings is conducive to make the brand of ecoagricultural tourism more dependent (Hoseini et al. 2013). Although the ecological environment and natural landscape are the basis of ecoagricultural tourism, another important part of ecoagricultural tourism still includes local rural people’s customs and working methods. In different areas, they have different planting concepts, different clothing preferences, and architectural styles. These differences create the unique charm of ecoagricultural tourism in different regions. Therefore, for the development of ecoagricultural tourism operators, for this part of the obvious differentiation of rural cultural resources can be used, vigorously develop different characteristics of ecotourism, not just blindly follow. At the same time, this practice also greatly strengthens the protection of traditional culture, helps to prevent the loss of rural culture, and helps to enhance the cohesion of the same region. Therefore, under the premise of ecological protection, we pay...
more attention to the inheritance and development of traditional rural culture, protect more multicultural, make China’s cultural world colorful, and increase tourists’ interest in ecological agricultural tourism.

**Enhancing experience**

With the increase of tourism projects year by year, many tourists are no longer interested in the current ornamental projects and are more willing to try some tourism projects that they have never done or can do. As a result, travel experiences are often diverse (Gosling et al. 2009). The experience of tourism participation is very unique. At present, ecoagricultural tourism includes orchard, vegetable garden, garden, comprehensive sightseeing, and high-tech agricultural technology. Among them, we can not only learn and visit the high-tech means used in the production of green food and understand the living habits of local rural people, but also use different forms to let tourists participate in tourism projects, such as allowing tourists to participate in the agricultural activities of local farmers. Let tourism projects and experiential projects deeply combined. It shows people all kinds of extraordinary and diversified travel activities, and it shows people a new visual experience. In addition to improving tourists’ satisfaction with tourism, these activities can also make tourists realize the hard work of agriculture, treasure more what we have gained today, understand more the urgency of resources, and further arouse people’s love for labor, life, and nature.

**Problems of agricultural ecotourism**

To sum up, after a lot of investigation and analysis, the author found that in recent years, the ecological farm has done a
better job in the development of ecological agricultural tourism, and the speed of its industrial development is obvious. This can be seen from the continuous increase of its passenger flow and the continuous expansion of the scale of the scenic area (Ghavidel Rahimi and Ahmadi 2015). However, from the overall development process of ecotourism, ecoagricultural tourism of ecomanor is still in the transition period from the initial stage to the growth stage; there are all kinds of problems.

First, the local flavor is not strong, and the experience and participation are not enough. There are various types of agricultural tourism resources in China and obvious regional differences, which have full advantages for the formation of tourism projects with different characteristics in different regions. But at present, there are few ecoagricultural tourism projects with local characteristics in China, even if the development mode of ecoagricultural tourism in different regions is often very similar. In this way, Tianzhu ecologic manor is similar to Laibao manor in this area. The development projects are picking, farmhouse entertainment, and planting green vegetables. On the contrary, there is little development for popular science education projects and ornamental crop display bases, and even less development for agricultural labor and cultivated plants that can be experienced by tourists, which leads to the sameness and lack of characteristics of various tourism projects.

Second is the backward infrastructure and repeated construction. In Tianzhu manor, it is hard to see wooden chairs and benches for tired tourists to rest. If you want to have a short rest, you can only go back to the dining area by the way. At the same time, there is no garbage can, garbage scattered on both sides of the road, probably due to more tourists and less staff, relatively busy, in the whole manor did not see the relevant staff along the way to clean up garbage, leaving a very bad impression on tourists. The number of signboards in Tianzhu manor is also small, and it is difficult for tourists to find a place without guidance and explanation. Due to the imperfect road signs, the bulletin board of the manor is relatively incomplete, which seriously affects the leisure activities of tourists.

Third is the lack of scientific design planning and management. At present, the construction level of many ecoagricultural tourism in China is very low (Ekamper et al. 2016). Just like the ecomanor, there is no scientific planning and design in the construction and development, no specific in-depth study of the detailed strategy, but rough layout. After it is put into operation, there is no strengthening of the staff training in the manor, nor a set of detailed management methods. At the same time, we failed to do a good job in publicity, which is not conducive to the rapid development of the manor (Feudale and Shukla 2011). This point can be seen from the questionnaire survey about the design of the signboard in the scenic spot and the satisfaction of the staff. The whole manor planting area and the viewing area are not well integrated, which is too jumbled and difficult to identify; The service attitude of employees is not very good and needs to be further strengthened.

Fourth, there is no industrial chain, and the product development is single. At present, the well-developed ecoagricultural tourism projects in China cover many characteristic foods, organic vegetables, or breeding bases, but they have not formed a certain industrial support capacity. Ecological manor is still in a low-level development stage. It mainly uses picking and sightseeing as the main means. It does not fully tap the value of natural landscape resources in Guelu village, Dazheng town. There are few experiential projects, which are not enough to support the diversity and interest of tourism projects. The integration of relevant cultural characteristics is not enough, so it fails to form a complete industrial system, only a single list of regions, not a joint list (Ghavidel Rahimi 2011). The questionnaire survey about whether it can reflect the local characteristics, the conclusion of tourists is that the sense of experience is not strong, which indicates that the ecological manor for product resource development is insufficient, and the industrial integration is relatively poor (Ghavidel et al. 2015).

Fifth is the lack of brand effect of ecotourism agriculture. In the survey on whether they are willing to revisit their hometown or not, only half of them choose to revisit. With the establishment of “farmhouse” and many large-scale ecological parks, it is a big problem that how to let people choose Tianzhu from many choices. For example, ecological manor has a certain market and reputation in the production of organic green food. When people in Zhuanghe mention organic green vegetables, they will think of ecological manor for the first time. This is the brand effect. However, in the brand effect of ecoagricultural tourism, Tianzhu has not done enough. Especially in Zhuanghe in recent years, the development of ecoagricultural tourism manor is not a few; more and more tourists choose; how to rely on their own characteristic products to establish the brand of ecoagricultural tourism is a top priority.

Sixth, the propaganda is obviously insufficient. The results of the questionnaire show that most tourists know about the ecological manor from their relatives and friends. Otherwise, they do not know about the existence of Youtianzu manor. This shows that the publicity of the ecological manor is obviously not enough. Publicity is the simplest way to make the public know and communicate with tourists. Good brand promotion can help to enhance the popularity of the manor, improve the established impression of the manor in the hearts of tourists, and play a positive role in promoting the development of manor tourism.

Seventh, the way of financing is too single. Through the communication with Sui Zhi, the owner of the ecological manor, we know that the financing mode of the ecological manor is limited to his own. The government will give subsidies to Tianzu
ecological manor every year according to the corresponding policies. The tax authorities also have corresponding tax reduction and exemption policies for the agricultural industry, but it is still not enough for Sui Zhi, who has always wanted to expand Tianzu manor. Facing the problem of aging and unsound facilities, Sui Zhi said that he could do nothing about it. A lot of money was spent on product development and production of agricultural and sideline products, and there was no way to start with the capital demand for improving the ecotourism environment (Austin et al. 2020). Therefore, the expansion of financing methods and the solution of the financial gap of manor in ecoagricultural tourism can fundamentally solve the infrastructure problem of manor tourism.

**Sustainable development strategy of agricultural tourism**

**Increase the characteristics of manor products**

At present, many development models of ecoagricultural tourism in China are very similar, and most of them can replace each other, leading to fierce competition among the whole ecoagricultural tourism industry. Because the ecoagricultural tourism relies on the local natural landscape, and the flowers and trees are deeply affected by the seasons, the ecoagricultural tourism will also be divided into low season and peak season according to the change of seasons. Judging from the current ecoagricultural tourism activities, they only stay in the relatively low-level service projects, such as watching flowers in spring, fishing in summer, and picking fruits in autumn. All the activities are relatively flat and have no characteristics, such as organizing barbecue and picking. The projects of each ecoagricultural tourism base are the same and have no new ideas. If the construction of ecoagricultural tourism base is far away from the city, the tourist resources will be relatively scarce, and the tourists’ visit will be more scarce. So repeatedly, investors are not willing to invest more money to strengthen the infrastructure construction of the base, and they have no strong desire to do product development, let alone consider how to inherit culture and innovate products in tourism projects (Troutt et al. 2012).

Zhuangehe is rich in tourism resources, and many agricultural product bases have the foundation to develop and form tourism resources. We can learn more from some well-developed ecoagricultural tourism projects but do not follow blindly. With the continuous change of tourist demand, tourism projects should also be reforming and innovating, and more advanced projects that meet the needs of consumers will be developed to attract tourists. Only in this way can the manor keep its advanced nature and competitiveness at all times and stand firmly in the colorful market of tourism products. For example, for small families in many cities, a “Happy Family Relaxation Tour” can be launched for them in a short holiday; For urban teenagers, we can launch “rural knowledge learning tour” for them; For those educated youth who once went to the countryside to jump in the queue, but now have returned to the city, we can launch the “memories Tour” and so on.

**Strengthen the construction of manor facilities**

Infrastructure construction plays an important role in the development of tourism. With the continuous improvement of infrastructure, tourism can continue to develop and bring new opportunities to local tourism. Now is the golden period for the development of China’s tourism industry, the period for the development of new tourism products of ecoagricultural tourism, and the important period for China to build a more satisfactory modern service industry. For the future development of tourism, in order to adapt to the increasing demand of public tourism, improve the tourism environment and conditions, and constantly meet the needs of ordinary people for tourism and leisure services, we must pay more attention to the construction of infrastructure. In a word, the construction of infrastructure is closely related to the development of manor tourism projects, which provides sustainable power for the development of tourism projects (Aalijahan et al. 2019).

The manor should take all tourists as the center to solve the basic problems of tourists. First, we should increase the number of toilets and make them equally distributed. In order not to affect the overall decorative effect, the layout and appearance of the toilet should be adjusted to a unified style and keep the toilet clean. At the same time, it needs a lot of physical labor to set up rest facilities such as benches, picking, and other sightseeing projects. In order to avoid making tourists go back and forth for many times, we should set up rest facilities in each link or area to improve tourists’ satisfaction and feel the original intention of the manor to make tourists feel warm from the bottom of our heart.

In the overall design of the ecological manor, we must emphasize the main position of the agricultural sector, and reflect the agricultural elements into the overall design style, architecture, and road planning. Road signs, garbage cans, some public seats, and other details need to be carefully designed to create an agricultural cultural atmosphere. In addition, in the selection of relevant works of art, we must emphasize the taste of agricultural culture. Agricultural products and production tools can make full use of artistic creation. In addition, it can also combine the myths of the agricultural era with the humanistic stories to bring the unique artistic effect of ecological agricultural civilization to the whole manor.

**Conclusion**

The rainfall pattern in mountainous area adopts uniform rainfall to study the variation law of rainfall infiltration. With the
duration of rainfall, the slope changes from the initial stage of slope erosion to the formation of ponding to the stage of runoff to the final stage of erosion gully formation. The soil on both sides of the gully collapses and develops to the depth of the slope and circulates back and forth to the stage of slope collapse. Whether the ecological environment is good or not is an important factor affecting the development of ecotourism. Ecotourism is developed on the basis of good ecological environment, and depends on the ecological environment for a long time. First of all, in the process of ecotourism development, we should act according to our ability and put an end to the short-term high growth of tourism economy on the premise of destroying the ecological environment; Secondly, in the process of ecotourism development, we should give consideration to the protection of the environment, and achieve “prevention first, prevention combined.” Furthermore, encourage the development of three-dimensional circular agriculture, and give policy support and financial incentives to the operators who actively develop three-dimensional circular agriculture. In short, in the process of economic transformation at this stage, we should not only pay attention to the benign protection of the ecological environment, but also steadily promote the development of ecotourism under the premise of environmental protection. The sustainable and healthy development of ecotourism must be based on respecting the objective law of ecological environment. Therefore, it is necessary to promote the coordinated development of ecotourism and ecoenvironmental protection, and unwaveringly take the road of sustainable development.

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Declarations

Conflict of interest The author declares that she has no competing interests.

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