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# Conflict or coexistence? Synergies between nature conservation and traditional tea industry development in Wuyishan National Park, China

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Traditional agricultural industries in protected areas (PAs) provide opportunities for both nature conservation and the wellbeing of local residents. However, knowledge about the synergies between nature conservation and traditional agricultural industries is still limited. This research takes the traditional tea industry in Wuyishan National Park as a case to identify and examine the synergistic mechanism between forest conservation and industrial development, why traditional agricultural industries are necessary to the regional economy, and how they secure local livelihoods as well as achieve conservation goals. We conducted literature research and semi-structured interviews with Wuyishan National Park Authority, local government administrations, enterprises and small-scale farmers. The results were obtained through a two-stage mixed method of grounded theory and system dynamics. The findings revealed that: (1) Traditional agricultural industries in PAs were resilient and adaptable in the face of external changes, in which traditional culture and ecological awareness played an important role. (2) Small-scale agri-industries were vulnerable to external shocks, but they also have advantages in terms of moderate agglomeration and standardization, risk perception and response, and market-based diversification of production. (3) The synergetic process of traditional agricultural industries and conservation is mainstreaming biodiversity by cooperation among the government, the park agency, and local people. Thus, we suggested that the local government should work together with the PA management agencies to re-evaluate the existence of traditional agricultural industries for their necessity in the regional economy and the feasibility of improving local livelihoods.

## KEYWORDS

protected areas (PAs), traditional agricultural industries, national park, Wuyishan, synergy

## Introduction

Evidence shows that protected areas (PAs) and other effective area-based conservation measures (OECMs) hold the majority of the world's biodiversity and ecosystem services (CBD, 2010). However, PAs around the world are still facing enormous challenges, such as poaching, overtourism, human-land conflict, inadequate management of resources, and institutional problems including ownership, governance, and policies (Nyaupane et al., 2020). Resolving these potential conflicts is particularly challenging at the intersection of nature conservation and economic development (Stone and Nyaupane, 2018). Literature confirmed that if PAs are to remain as an effective conservation strategy in the future, local communities' livelihoods must not be coerced, especially those which are based on fair and equitable sharing of benefits from the traditional use of natural resources and relevant industrial practices by the inhabitants (Hughes, 2013).

Local communities' livelihoods are closely related to various types of ecosystem services that are produced and transformed to a wide range of benefits in financial or non-financial forms (Western and Pearl, 1989; Wang et al., 2021). Among these, the traditional agricultural industries are one of the most representative livelihood types, and have been a lubricant between biodiversity conservation and community livelihood if maintained under some circumstances. In the context of biodiversity or heritage conservation, traditional agricultural industries were frequently referred to as resource-dependent and extraction agricultural activities, with intensive human/animal power, natural resource input and low technological orientation, including harvesting, agriculture, livestock raising, forestry, fishery and aquaculture, handicraft and weaving, among other sectors (Soliku and Schraml, 2018). Usually, the term "traditional" implies a long-standing existence of economic and livelihood activity in an area (Colchester, 1997; Stevens, 2014). However, "traditional" does not mean static but has also shown a transition from resource to resource-services economies with the impact of modern technologies and concepts (Berkes, 2017). Thus, the traditional agricultural industries in this research are defined as the cumulative body of traditional production methods of knowledge and practices, involving processes of production, processing and marketing, and developed through generations by adaptive processes, being concerned with the economic and ecological relations between the human beings and the environment. Many such industries have become important resource management approaches for the sustainable livelihoods of the community residents, and are abundant in traditional ecological knowledge that helps to sustain both the ecosystem and their livelihoods (Raina et al., 2011; Capistrano and Charles, 2012).

Indeed, traditional agricultural industries are not the only option for local people in protected areas because sometimes they are too economically unacceptable to be

actively maintained by the local communities. But if well adapted to conservation management, it can be one of the most cost-effective options, both economically and socially, for many farming-dependent communities in protected areas. Therefore, when the global conservation discourse shifted from fortress conservation to more socially-inclusive conservation, the continuation and optimization of traditional agricultural industries seemed possible and even necessary to address the legal right of resource use by the local people and to avoid illegal resource use behaviors and hostile attitudes toward conservation policies by community residents (Redpath et al., 2013; Rai et al., 2021). At this time, policymakers and conservation managers, i.e., the major external stakeholders, did not regard traditional agricultural industries as inefficient and even harmful to the environment due to their dependence on biodiversity and natural resources (Colchester, 1996; Vedeld et al., 2012) anymore, and the challenge was to empower the local community and people, i.e., the local stakeholders, to adapt to the rapidly growing needs of conservation by mitigating or eliminating the negative impacts from disordered traditional agricultural industries (Folke et al., 2010), and mainstreaming local communities in resource use and benefit sharing (Mariki, 2013; He et al., 2022). In this way, the weakening and abandonment of traditional agricultural industries, either active due to poor economic returns perceived by the local stakeholders, or passive due to misunderstanding as backward of the external stakeholders, were reversed to development opportunities compatible to conservation.

Globally, some successful cases emerged for small-scale producers. For example, in Slovenia, the Triglav National Park has ensured the quality of agri-products by maintaining traditional land use as a natural habitat for predatory birds and insects (Šviráková and Bianchi, 2018). In Peixe Lagoon National Park of southern Brazil, the agri-products from traditional fishery have been transformed into a national park brand and secured added values that reflect the ecological scarcity and are recognized by following strict ecological criteria in production (Almudi and Kalikoski, 2010). In Botswana, the native people have shifted from hunting wildlife for subsistence to wildlife-based tourism in Chobe National Park, thus building a sustainable loop between PAs, community livelihoods and wildlife conservation (Stone and Nyaupane, 2018). They all proved that on the one hand, traditional agricultural industries fit PA management compared to the growing scale of petroleum agriculture which could harm the environment and biodiversity (Lichtfouse, 2010). On the other hand, the traditional agricultural industries also gradually dovetail with market demand and attract external demand by enhancing scarcity and branding to achieve self-evolution, which is essential to local livelihood security (van der Windt and Swart, 2018). These were guaranteed through PA management that guided and coordinated traditional agricultural industries to involve local communities in a virtuous

agroecological chain to boost production, processing and retailing, and integrated agriculture with ecotourism to harness the material and immaterial values of the land. These examples have demonstrated the ability of the traditional agricultural industrial practices of the community to evolve within the constraints of PA management, which could finally contribute to regional economic development. However, the potential of traditional agricultural activities can only be released with efficient institutional design, true empowerment, stakeholder collaboration, etc., as many such income-generating activities also failed globally (Idrissou et al., 2013). Therefore, exploring how the stakeholders collaborate to fit traditional agricultural industries to nature conservation is both timely and valuable to enrich the case studies.

Balancing rural livelihoods and biodiversity conservation is also important for China when constructing national parks (Ouyang et al., 2016; Tang, 2020a) where traditional agricultural industries are common in the form of farmland, pastureland, tea terraces, forestry, etc (He and Jiao, 2022). In China, community development demands in PAs vary greatly due to differences in regional contexts, i.e., cultural identity, natural resource endowments and economic conditions, etc. Thus, the development, transformation, or abandonment of traditional agricultural industries in and around national parks are not limited to poverty reduction as in common narratives, but a wider topic of fair and equitable development rights. With a large population engaged in the traditional agricultural industries, it is difficult to totally abandon them for local people in terms of both the economic needs and cultural bonds, and for policymakers in terms of the value of traditional ecological knowledge and the challenge to provide new industries. In this regard, it is helpful to explore how the major stakeholders are trying to build synergies between traditional agricultural industries and nature conservation and analyze how they contribute to a sustainable transition for the benefit of the whole region, especially in some populated conservation areas in developing countries. In addition, the interaction of the local government, PA management agency, and local people also matters because industrial development is basically a regional economic issue that links the household and community livelihoods to the regional development, and impacts large-scale nature conservation as an approach to mainstreaming biodiversity. As such, this study makes a unique contribution to understanding the relationship between nature conservation and local industrial development.

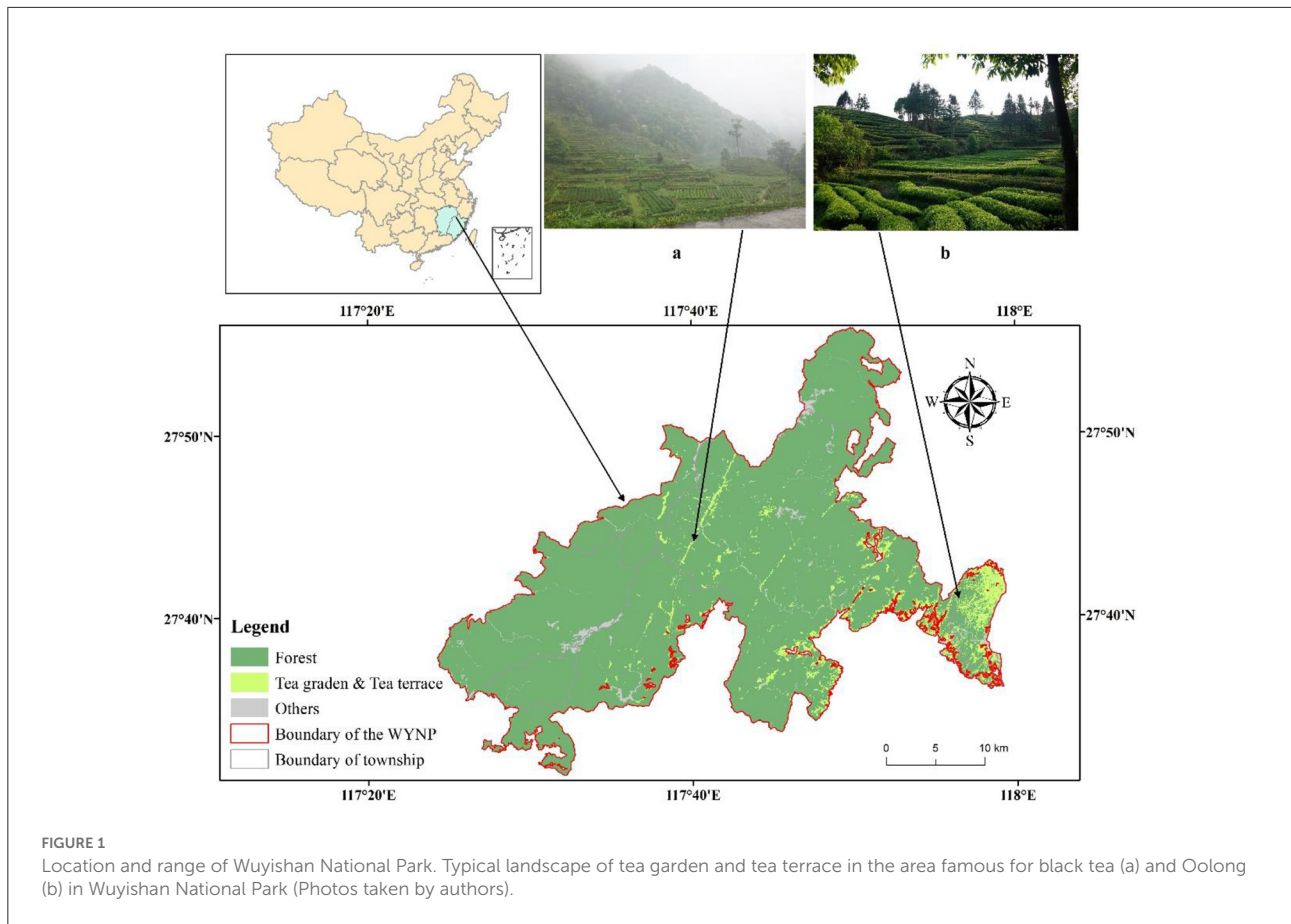
As one of the first five national parks to be officially established in 2021, Wuyishan National Park (WYNP) has experienced rapid social-ecological changes in the past four decades. Traditional agricultural industries have always been an important way to support the livelihoods for local residents since the restriction of timber production under the ongoing conservation policies and measures that were established from the late 1970s onwards. The national park is a complex system

of human–land interactions, and its effectiveness depends on the responsible behaviors and activities of all stakeholders (Wang et al., 2022). During the four decades, tea plantation has experienced periods of disorderly exploitation of land while local stakeholders in WYNP have also been exploring compatible measures for the traditional agricultural industry under science-based conservation and the impact of modern technology. And we believe these experiences in evolving traditional agricultural industries for modern conservation through efficient governance can inspire nature conservation in developing countries beyond China. To this end, this study aims to explore the possible mechanisms for achieving synergy between PAs' management objectives and industrial development and transformative manner, with the Wuyishan (Mt. Wuyi) National Park in China as a case. The research objectives are threefold: (1) Revealing the evolutionary process of the leading traditional agricultural industry (the tea industry) in Wuyishan during the process of conservation management construction; (2) identifying the inner-relationship synergy between the management objectives of the national park and traditional tea industry development and transformative manners; and (3) providing references and management experience for the traditional agricultural industries in and around PAs.

## Materials and methods

### Study area

Wuyishan National Park (WYNP) (27°31'20"-27°55'49" N, 117°24'-117°59' E) is located in northwest Fujian Province, China (Figure 1). Its administrative region covers three counties (cities or districts) of Wuyishan City, Guangze County and Jianyang District, which includes 29 villages with a total area of 1001.41 km<sup>2</sup>. WYNP aims mainly at conserving an integrated and typical subtropical forest ecosystem and biodiversity with a spatial optimization of the previous national nature reserve, the national scenic area, and the national forest park. Mt. Wuyi is also a mixed World Heritage Site. Approximately 3,000 residents live inside the WYNP and about 20,000 residents inhabit around the 2 km of the border, and they are mainly engaged in the tea industry, harvesting of Moso bamboo, and rice plantation. More than 90% of the main income comes from traditional agricultural industries. The tea planting in Mt. Wuyi originated from the Tang Dynasty (circa A.D. 618) due to its favorable climate, and prospered by the end of the Ming and early Qing dynasties (circa A.D. 1662) to own world fame. With the rise in market demand for tea in the recent 15 years, the local tea industry has flourished and become a leading agricultural industry in this region. Therefore, we chose the tea industry, one of the most representative traditional agricultural industries in WYNP for this study.



## Methods

With a wide range of stakeholders, the interactive relationships between humans and nature are complex and difficult to identify. An integrative approach is necessary to apply diverse system-thinking research methods to reveal these interactions so that policymakers can make strategic decisions for the sustainability of social-ecological systems. System Dynamics is a useful tool for identifying the generative structure of problem behavior based on systems thinking, and for analyzing and discovering the causal links within complex systems (Coyle, 1996). It is a modeling method that focuses primarily on feedback structures and outcome behaviors to understand complex systems holistically, enabling the visualization of feedback loops through causal loop diagrams (CLD), and discovering the expectations and evolutionary directions of the system. However, the real world is “chaotic” and it is difficult to extract intrinsic preceding factors and connections from external phenomena by relying solely on System Dynamics. In such cases, the qualitative data provide deeper insights into the connections behind phenomena, thus compensating for this deficiency in System Dynamics. As a popular qualitative research method, grounded

theory is a bottom-up exploratory research method that encourages researchers to explore a field without pre-conceived predictions. The theory refines and abstracts concepts that reflect social phenomena by analyzing qualitative data collected systematically and discovering the logic between these concepts, which in turn generates new theoretical frameworks. By integrating these two methods, a holistic retrospective analysis and predictive insights into strategic policy can be very well provided.

Based on this, a two-stage mixed method of grounded theory and system dynamics has been developed (Figure 2). In the first stage, the key information most relevant to the research topic is extracted through a qualitative analysis of grounded theory. Before the research is formally conducted, archival materials (such as policy documents from different levels of government, documentary materials such as newspapers, reports and journal articles) relevant to the research topic should be first collected and all the information is used to develop the required interview guide. The sampling method and the sample group for the research are then determined based on the research topic, the interview guide and the actual circumstances of the case sites. And in-depth interviews are conducted using the interview guide and the identified sample group, and the sampling

procedure should be stopped when “theoretical saturation” is reached (i.e. no new information relevant to the research topic emerges during the interviews). After collating the acquired text data, the text data is deconstructed and coded by several researchers according to the research topic, and the results are considered to be of high confidence when the similarity of the coded results is high. To make the coding process clearer and more concrete, we used the Straussian grounded theory consisting of open coding, axial coding and selective coding in this study (Kenny and Fourie, 2015). Firstly, through a sentence-by-sentence analysis of the textual content of the literature collection and semi-structured interviews, the sentences close to the research topic were selected and summarized by the researcher to obtain the initial concepts represented behind the text (open coding); secondly, the initial concepts obtained through open coding are categorized and grouped to determine the category relationships between different concepts, while returning to the open coding process and original text during the analysis to ensure that the analysis has reached saturation and no new content has emerged (axial coding); finally, the core coded content with strong associations to the research topic is identified and selected to provide the basis for subsequent modeling of qualitative system dynamics (selective coding).

In the second stage, based on the results of the selective coding of the grounded theory, feedback relationships and loops between the results of the selective coding are co-defined by the researchers based on the field research and the original text. Then, causal loop diagrams are mapped and the data are processed by iterating the system model to determine whether the causal relationships and loops of the variables are reasonable and logical (the researchers gradually added new structures to the system model and iterated on the model behavior that might be triggered by the added structures). In this process, contradictory elements of the model are eliminated by comparing the model with the resulting source material. A model is considered ideal when there are no contradictory elements or disordered logic in the model.

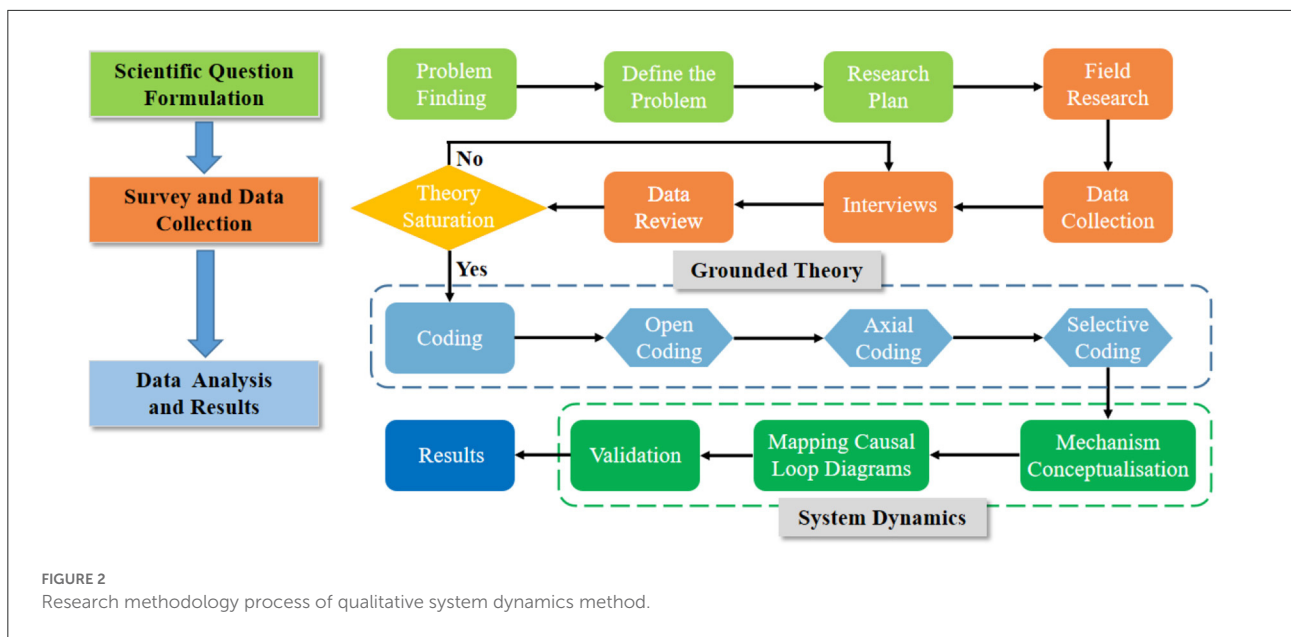
System dynamics could be used to systematically assess certain policy changes and impacts, while also interpreting undefined and unintended outcomes in policies, and helping researchers to better understand complex systems beyond the policy context (Sterman, 2018). The combination of grounded theory and system dynamics can effectively identify the main factors of action in dynamic systems, while visualizing the feedback loops in systems through CLD (Šviráková and Bianchi, 2018; Bastan et al., 2021). Thus, this mixed-method can reveal system characteristics and modes of action more intuitively and provide a new method of qualitative system dynamics with retrospective and anticipatory effects for system research.

Specifically, the research process is fivefold as follows: (1) identify the scientific question and purpose of the study, conduct preliminary background material collection, and define the boundaries of the study; (2) determine research plan based on

preliminary research, conduct semi-structured interviews and secondary data collection with stakeholders around research questions; (3) follow the Straussian’s grounded theory process to code the data obtained from the survey in three key steps: “open coding-axial coding-selective coding” (with detailed and iterative comparisons, discussions and corrections at the end of the coding process, and cross-validation of primary and secondary data to form the final coding results); (4) gradually conceptualize the system and identify the key components of the system and the systematic relationship between the different components based on the coding results; and (5) compare the coding results repeatedly with the acquired primary and secondary data, delete the logically confusing and similarly meaningful codes, determine the feedback polarity of retained concepts by cross-checking, and create the CLD diagram.

## Literature collection and survey

This study used literature collection and semi-structured interviews for data collection. We began our research with a literature review of scientific journals, news articles and government documents on the issues of tea industry development, nature conservation objectives and community livelihood maintenance in Wuyishan in the recent 30 years. The literature was not only used as a background to help us better understand the development of the tea industry and the demand for nature conservation in WYNP, but also as a corpus for analysis in the process of grounded theory analysis following the survey. Based on this, the survey was conducted on 3–7 August in 2020. Firstly, we conducted two discussion sessions with the Wuyishan National Park Authority and local government administrations, i.e., Administration of Tea Industry, Finance and the Development and Reform. Through interaction with officials, we learned about the general development of the tea industry and the status of policy changes in WYNP. Secondly, household surveys were conducted in the WYNP and its surrounding townships (within the boundaries of Wuyishan City) using face-to-face household interviews. To ensure the representativeness of the sample selected for the study, respondent households were selected using theoretical sampling methods (Glaser and Strauss, 2017). Specific administrative villages were identified based on the village population and industry data, and the village officials introduced the industry representative households; thereafter, the interviewees of the industry representative households continued to recommend interviewees using the snowball method. The interviews were conducted while continuously proposing, analyzing and refining the research questions, as well as by examining industrial households of different sizes and at different distances from the National Park boundary to ensure the comprehensiveness of the research sample selection.



The interviewees were asked two main questions about their views on the establishment of WYNP and the development and transformation of the local tea industry, with other questions being adjusted or refined according to their answers. The interviewees were encouraged to freely express their views on the conservation histories, conservation and management issues, the development and transformation of the tea industry, and their personal/family roles in the regional conservation and industry changes. The survey finally obtained first-hand information from 48 interviewees: (1) government officials from Wuyishan City Government and Wuyishan National Park Authority ( $n = 18$ , coded as G); (2) village officials ( $n = 8$ , coded as M); (3) small-scale tea farmers ( $n = 14$ , coded as R); and (4) large-scale tea enterprises ( $n = 8$ , coded as C), with an average interview time of 90 min. During the interviews, audio recordings were used for transcription coding with the knowledge and permission of the interviewees, and for those who did not consent to be recorded, the main interview was recorded in writing. Interviews were conducted anonymously and no private information unrelated to the study was recorded.

## Data analysis

To ensure the reliability of the theoretical analysis and results, it is necessary to extract the core concepts based on realistic data through repeated comparisons and to integrate and reorganize the relationships between the concepts. Thereafter, we extracted the dimensions in a continuous cycle of the “data analysis-concept formation-integration and reorganization-theoretical extraction” process (Charmaz, 2014). Meanwhile, to ensure the comprehensiveness and validity of the findings, we

compared and combined existing concepts if new concepts were found during the subsequent data analysis. Once new categories or paradigms emerged, the overall theoretical scope was revised. In the final stage of coding selection, the causal chains and their feedback polarity in the cross-check were manually selected and removed from the semantically similar codes that existed in isolation, logical confusion and semantic similarity. The specific analysis process for this study is as follows.

### Open coding

Open coding is the process of decomposing, comparing, conceptualizing and categorizing textual material and then recombining and manipulating the codes in new ways (Holton, 2007). During the open coding process, the raw data from the semi-interviews were read line by line to label and code a concept (Table 1). Subsequently, new data was then read and compared with the previous data to determine whether to develop a new concept or modify the previous one. By coding the collected literature and semi-structured interview data, and refining the data in comparison, we obtained a preliminary conceptual analysis that reflects the management goals of the WYNP and the transformation of the traditional tea industry (Table 1), laying the foundation for the axial coding.

### Axial coding

The main purpose of axial coding is to discover and establish relationships between concepts to characterize the linkages between different categories (Holton, 2007). Further iterative comparisons of phenomena, content and interrelationships between categories are obtained by open coding. Based on

TABLE 1 Some representative results from open coding.

Original data	Initial concept
R-03: We always send our tea products to professional institutions for pesticide testing, and those that are sent are tested and have no pesticide residues.	Pesticide residue testing
R-05: Our tea products are tested according to national standards, with a focus on safety testing.	Quality control
C-02: There must be some other means of monitoring if the benefits of ecological tea gardens are to be realized.	Ecological tea garden
C-01: Nature conservation affects the quality of tea, that is, the ecological value of tea.	Ecological value
M-01: Tea garden tourism is in line with the concept of natural experience and environmental education in national parks.	Tea-tourism integration
R-13: When the tea did not sell well, we explored some other side businesses and found that tourism was the way to go.	Tourism and hospitality
M-01: Tea garden tourism must be developed for this ecological experience in line with national park management goals.	Ecotourism
C-04: Tea-tourism integration tours should not only involve scenic views but also have functional areas for tea culture display and experience.	Cultural experiences
C-06: We have tried out some science education programs and attracted a large number of children from Hong Kong, and so far the benefits are quite good.	Science education
R-14: The nature reserve has been established for so many years now and its management measures have been beneficial to the quality of tea.	Nature reserve construction
R-07: I hope to demolish the house and then build a small three-story building, the ground floor for tea processing, the second floor for office and the third floor for reception.	Infrastructure development
R-01: The government strictly restricts the conversion of old houses and factory buildings, we cannot convert them without permission.	Policy restrictions
G-01: Qualifications are required to grow and sell tea.	Qualifications
R-05: I believe the national park is a good thing, but we have not seen its value of it to date	National Park values
G-02: The high visibility of the World Heritage Site has also given us a brand to promote Wuyishan to the outside world (G-02)	World heritage values
R-04: Souchong smoking processing is all about reputation and all we want to do is maintain our repeat customers (R-04)	Reputation
R-09: We are all home-based workshops and would like to be led by a leading company.	Home-based workshops; Leading company
M-02: Everyone says in the publicity that Wuyishan is the birthplace of black tea in the world (G-04)	Brand awareness
R-04: We hope 1 day to have the logo of the WYNP on our tea products too.	Brand leverage
R-05: We have applied for National Geographical Indication Products for our tea products since our customers recognize these official certifications.	National geographical indication products
R-14: The government has agricultural insurance for us, and there are some subsidies in case of disasters.	Agricultural insurance
M-05: There are too many wild boars here, but they are protected animals that cannot be harmed.	Species conservation
R-15: The government is now not allowing the cultivation of tea terraces and is severely restricting such practices	Restricted reclamation
M-03: Community development would be better driven by some greater efforts in ecological compensation.	Ecological compensation
R-12: The government led a tea promotion event and we brought our products there.	Product promotion
R-01: The government also takes our tea products in batches for quality control, and we have a uniform product control method and standard here.	Standardization
M-06: Nowadays, tea farmers' cooperatives are a trend encouraged by the government, and villagers are grouping to form cooperatives.	Cooperatives
G-01: The village has set up a joint-stock economic cooperative to produce and operate tea products.	Collective management
C-05: Some people buy poor-quality tea in other provinces and produce it in this place under a brand name, which is counterfeit and shoddy.	Counterfeit and shoddy goods
C-08: The tendency of inferior products to imitate well-known brands has had a significant negative impact.	Brand maintenance
G-02: Low-quality tea products do not meet national standards, but the government cannot regulate them in the business sector.	Government management
M-01: Lapsang Souchong black tea has a long history, and Zhu Xi (a famous ancient Chinese poet) wrote a poem here	History and culture

the basic logic and the main influencing factors of industrial development, the development path of the tea industry in the Wuyishan region and its logical relationship with the protected area management goals are fully considered from nine main categories (Table 2).

### Selective coding

The core goal of selective coding is to develop a conceptual model of the research. Based on the results of axis coding and the principles of “cause-effect” logic required for the system dynamics model, we selected 29 codes with the strongest relationship between protected area management goals and community tea industry development, using the two directions of “industrial development-nature conservation” as the main categories: standardization, production quality control, deep processing, leading enterprise-driven, production process, industry chain construction, tea-tourism integration, handicraft products, National Geographical Indication Products, heritage value, brand competitiveness, industrial value, industrial diversification, eco-technical specifications, cleaner production, eco-brand maintenance, eco-brand value, brand ecologicalization, ecological tea garden, product ecologicalization, industrial ecologicalization, household waste, non-harmful disposal, tea terraces improvement, ecological compensation, conservation easement, species population conservation, environmental optimization, forest ecosystem conservation.

## Results

The findings revealed that the transformation of the traditional tea industry in Wuyishan has been influenced by multi-stakeholders under the influence of national parks’ management objectives. To realize a synergistic achievement of both nature conservation and industrial transformation, we combined the analysis results of selective coding and identified four causal loops under the themes of industrial transformation and forest conservation (Table 3). In Table 3, the loops were grouped based on a path from demands to solutions combining the coding results. Further, we integrated the four loops that link the management objectives of the WYNP and the development of the tea industry to form a synergistic mechanism (Figure 3). Our narration of the four loops followed a causal logic of “problem-demand-solution.” It started with the problems identified during the field research process, followed by the demands of coupled industrial transformation and nature conservation to tackle the problems, and then we summarized the solutions taken by the WYNP to drive the four loops and the synergistic mechanism.

### Industry chain construction loop (R1)

Loop R1 shows the process of industry chain construction during the transformation of the tea industry in the context of the WYNP management objectives. The tea industry in Wuyishan was dominated by small and medium-scale farmers in a decentralized management way. Home-based tea processing workshops were widespread and densely distributed in the countryside that make the tea industry less organized. Tea farmers were fully engaged in tea growing, making and selling, leaving little space for a multi-functional development of the tea industry, which made the single industry less able to resist risks.

*Seventy to eighty percent of households manage home-based tea processing workshops that concentrate on both growing and making tea. When market prices fluctuate, the negative impact on us is high. M-03.*

Due to the scattered production of tea farmers, personalized workshop design, varied processing infrastructure and differences in management levels, it was difficult to implement tea production standards and product quality was unstable.

*This is the case in our area. We use the ground floor for tea processing, the second floor for accommodation, and the third floor mainly for outside customers’ reception, R-04; Each family has its own “flavor of tea” and we all have our differentiated processing methods, R-05.*

In addition, the relationship between the leading enterprises and tea farmers was mostly limited to a loose buying and selling relationship. There was even competition for profits between the local tea enterprises and external terminal dealers, which led to difficulties in forming a community of interests among practitioners of different scales in the tea industry chain, and the brand was greatly weakened.

*The tea companies just come to us to collect some tea leaves, and they have their ways of processing, G-02.*

The management objectives of national parks need to ensure that community livelihoods are not hampered. In this process, the tea industry should play a dynamic role in shaping the development of community livelihoods for seeking a way of transforming the traditional tea industry. In the past, decentralized and differentiated operations made it difficult to control the quality of tea production in the Wuyishan region. Therefore, there was a demand to strengthen the industry chain construction from growing to selling for quality control and value-adding while maintaining the traditional tea industry.

Under this background, the local government gradually intervened in the transformation and development of the regional tea industries, and promoted the rational improvement



TABLE 2 The results of axial coding.

Main category	Category
B1 Industrial development	Standardization, scale-up, specialization, the professional division of labor, cooperatives, infrastructure development, collective management, expansion of planting, deep processing, and leading enterprises
B2 Production management	Pesticide residues, tea leaves home-based workshop, qualifications, quality control, organic fertilizer, scientific care, restricted reclamation, guest soil, training in tea production, souchong smoking processing, pinewood, residue testing, local standards, and tea safety
B3 Branding	Well-known trademarks, tea promotion, brand awareness, brand competitiveness, brand utilization, tea evaluation, counterfeit, substandard, brand maintenance, Lapsang Souchong black tea, National Geographical Indication Products, World Heritage value, national park value, ecological value, and ecological added value
B4 Market management	Special action for tea terraces remediation, government management, registered tea enterprises, regulatory penalties, guidance, comprehensive remediation, and blocklisting
B5 Policy support	IPO, credit preferences, public welfare forestry subsidies, special funds, financial services, tea e-commerce platforms, tea auction centers, logistics service networks, and industrial poverty alleviation
B6 Cultural heritage	Historical culture, cultural landscapes, agricultural heritage, intangible cultural heritage, and world heritage
B7 Nature conservation	Ecological monitoring, illegal tea terraces reclamation, nature reserve construction, conservation easements, ecosystems, wild boar conservation, forest ecosystems, pine nematode, pest hazards, biodiversity, ecological compensation, ecological red lines, environmental optimization, endangered flora and fauna, species population conservation, domestic waste, domestic sewage, and environmentally sound treatment.
B8 Tourism development	Tea garden experience, ecotourism, nature tourism, cultural experience, tourism and hospitality, educational tourism, handicraft and cultural products, scenic spots, tourism income, tea-tourism integration, and home-stay.
B9 Industrial ecology	Brand counterfeiting, ecological technology, ecological tea plantations, ecological technical specifications, ecological brand, ecological culture, ecological civilization, product ecologicalization, forestry industry development, circular economy, cleaner production, and low carbon economy

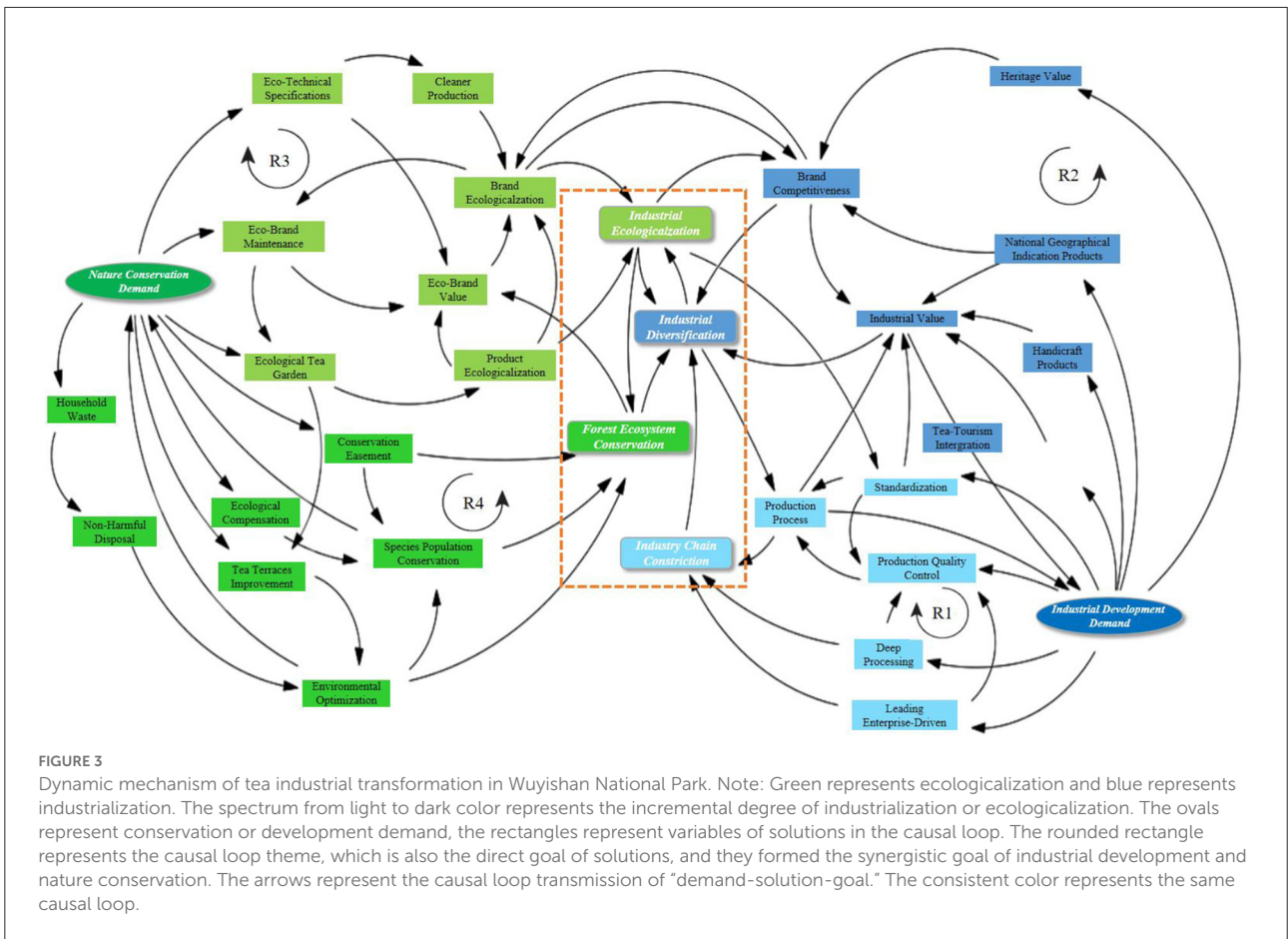
TABLE 3 Causal loops of tea industrial transformation in Wuyishan National Park.

Loop	Variable	Theme
R1	Standardization, production quality control, deep processing, leading enterprise-driven, and production process	Industry chain construction
R2	Tea-tourism integration, handicraft products, National Geographical Indication Products, heritage value, brand competitiveness, and industrial value	Industrial diversification
R3	Eco-technical specifications, cleaner production, eco-brand maintenance, eco-brand value, brand ecologicalization, ecological tea garden, and product ecologicalization	Industrial ecologicalization
R4	Household waste, non-harmful disposal, tea terraces improvement, ecological compensation, conservation easement, species population conservation, and environmental optimization	Forest ecosystem conservation

The loop is a causal logic transmission from demands to solutions. The variable contains the conceptualization results extracted by selective coding, which represent the solutions to the demands. The theme is a summary of the "problem-demand-solution."

of the tea industry chain through a combination of positive guidance and negative control in response to the problems. Firstly, the transformation and scientific management of traditional tea gardens were actively promoted through subsidies and guidance. By providing production techniques, quality control and safety management training, and opportunities for production technology exchanges, tea farmers were encouraged to standardize the construction and management of tea gardens (*standardization and production quality control*). Secondly, the leading enterprises were encouraged to integrate small-scale

tea farmers into a large-scale operation and to optimize labor divisions among farmers of different operational scales (*leading enterprise-driven*). By introducing packaging, design and other production supporting enterprises, the local government promoted the construction of areas for deep-processing of tea, e.g., food, handicrafts, health supplements, etc. (*deep processing*). In fact, through the involvement of multiple types of enterprises and the improvement of the deep processing industry chain, the quality of tea products was directly improved. Lastly, the local government fought against the illegal reclamation



of tea and the building of tea processing workshops without approval, as well as regulating and punishing the illegal use of pesticides and excessive pesticide residues. Through the continuous reinforcement of the positive feedback of this loop, the tea industry in the Wuyishan region has gradually improved in the industrial chain, the production process has gradually returned to standardization, and the quality and competitiveness of tea products have been enhanced. Meanwhile, with more derivative products and better quality of tea, tea industries deepened their interaction with other industries, such as the tourism, which links this loop to the industrial diversification loop (R2).

### Industrial diversification loop (R2)

Loop R2 shows the evolution of the tea industry in the Wuyishan region in terms of industrial diversification. The agricultural industry was dominated by tea processing, resulting in a regional industry that was less resilient in the face of market changes. The unexpected events represented by the COVID-19 pandemic have directly impacted the market demand. Coupled with the inflated prices

due to the pre-existing speculation before the pandemic, tea farmers experienced a sudden drop in customers and their income decreased. This has directly affected the sustainability of the basic livelihoods of small-scale tea farmers.

*We only buy tea leaves and do processing so the unsold tea can still be stored (for future profit after the pandemic), but it is a real shock for those who only sell tea leaves when the price fell too much, R-04; The pandemic has had a great impact on us, and customers who used to come here regularly are not coming to buy tea from us anymore because their income has decreased due to the pandemic, R-02.*

The management objectives of national parks involved many service functions such as scientific research, education and recreation, but how tea farmers and their communities can participate was not yet clear. The tourism management service center of the previous National Scenic Area was still responsible for tourism services, resulting in a fragmentation of the nature conservation and recreation management functions of the National Park Authority, which prevented communities from fully participating in national park tourism services.

*The only three concessionary tourism services in which the community can participate are rafting, sightseeing vehicles and rafting, with little else involved, G-01.*

In the past, some tea farmers have tried to expand the development of the tea industry from the perspective of tourism, but due to the negligent consideration of tea culture, landscape, and ecological values, their trials were blind and the expected better economic and ecological benefits were not achieved. On the one hand, the point of interest of some tourists to the tea-tourism is not only in the tea product, but in the history and culture including the Oolong and black tea such as *Lapsang Souchong*, as well as the Confucian philosophical culture represented by Zhu Xi (a famous ancient Chinese poet and philosopher who was particularly fond of associating tea with philosophy and whose philosophical ideas profoundly influenced the governance of ancient China); on the other hand, the tea farmers simply rent out their houses to tourists for short stays, while charging admission fees to open their tea terraces/gardens to tourists for sightseeing. Such tourism products were homogenous with many other tea-producing areas and did not have a unique appeal to many tourists.

*We have done some home-stay and sightseeing services but the number of tourists decreased and we stopped doing them, R-01.*

To change the situation of the single tea industry, some large-scale tea enterprises have tried to make a breakthrough from the level of tea-tourism integration (*tea-tourism integration*). By taking the tea production and its deep processing process as the main tourist attraction, they designed diverse products of sightseeing, environmental education, study tour, and recreation to make full play of the multi-functions of the tea industry. In addition, they have also developed a series of cultural and creative products based on customers' interests in tea culture. These tea-tourism integrated products took into account the diverse needs of different types of tourists, for example, tea enthusiasts for tea experience, history interpretation, and teenagers for educational tourism, etc., greatly enhancing the willingness of tourists to pay. In fact, the tea-tourism integration facilitated the transformation of the ecological value of nature conservation into the economic value of the traditional agricultural industry, and reinforces the positive effect of the industrial diversification loop into the industrial ecologicalization loop (R3).

*We combined the ecological tea garden sightseeing and tea production process, and invited a design company to do some study tour plans, and the results were quite good, C-01 (handicraft products).*

Meanwhile, the local government has strengthened the promotion of the image of the Wuyishan World Heritage Site and the management of National Geographical Indication Products (*heritage value and National Geographical Indication Products*). It promoted tea as a geographical brand through various means such as exhibitions, online media publicity and intangible cultural heritage displays (*brand competitiveness*). Thus, the soft power of the tea-tourism integration has been further enhanced and the diversification of the industry has progressed gradually.

## Industrial ecologicalization loop (R3)

Loop R3 shows the process of ecological transformation of the tea industry in the Wuyishan region. The Wuyishan region has experienced multi-type conservation management for more than 40 years. Under the management of PAs for decades, the local people have been well endowed with the awareness of nature conservation. The development of its modern tea industry has been accompanied by a shift from the unified purchase and marketing in the era of the planned economy to a market-oriented open business, and has also changed from seeking profit to valuing nature. With a long history of PA management, local people were able to recognize that the importance of brands and the good ecological conditions had a relationship with the value of tea products in the early stages of the industry's development.

*Following the recognition of Mount Wuyi as a World Heritage Site, the Lapsang Souchong was gradually gaining market esteem in the years around 2000, and we believe that the branding and ecological effects have played an important role in this, R-14.*

However, national parks were not a simple continuation of past policies on PAs. Local residents were confronted with a more integrated and nature-oriented approach to industrial and ecological management. In WYNP, residents were generally inclusive and receptive to the creation of national parks.

*I believe the national park is a good thing, but we haven't seen the value of it to date. However, I believe its value will slowly emerge in the future, R-11.*

Balancing economic development and biodiversity conservation priorities was one of the difficult tasks of the national parks' management objectives.

In this regard, industrial ecologicalization was not a problem, but the result of a co-existence and a continuous spiraling process between industry and ecological demands. However, even though the community realized the benefits of industrial ecologicalization, tea farmers were still vague about

how to operate. Thus, the tea industry in the WYNP has tried to promote industrial ecologicalization from three perspectives with the assistance of the government. Since 2016, the Wuyishan government has promulgated a series of local guidelines on the standardized process of ecological production, and provided a series of technical specifications on ecological production for tea farmers (*eco-technical specifications*). These initiatives have encouraged them to use bio-pesticides and organic fertilizers, and have established a professional forecasting and warning system for tea pests and diseases, which has facilitated the formation of ecologically cleaner production mechanisms (*cleaner production*). In terms of eco-branding, the local government has organized regular rectification and counterfeit eco-branding crackdowns on the tea market.

*We have done some special rectification and anti-counterfeiting work jointly with the Bureau of Industry and Commerce to rectify some “counterfeit eco-brand” and “inconsistent brand-product” enterprises here, G-05 (eco-brand maintenance).*

By controlling the quality of tea in the region and implementing the construction of a tea quality traceability system, the eco-brand value of tea in WYNP have been enhanced (*eco-brand value and brand ecologicalization*), and the competitiveness of the region tea brand has been strengthened. It was due to the impact of a series of eco-friendly initiatives that the area of high-standard ecological tea garden construction in and around WYNP has continued to expand, with the total area has reached more than 20% of the tea gardens (Note: Wuyishan City has a total of 9,867 hm<sup>2</sup> of tea gardens or tea terraces, which including about 1,973 hm<sup>2</sup> of ecological tea gardens in 2020. Source: Wuyishan National Park Authority) (*ecological tea garden*). This agroecological management contributes to forest conservation (R4) on the landscape scale. The above initiatives reinforce the positive feedback of the industrial ecologicalization loop, set the ecological standard to further industrial chain construction (R1) and industrial diversification (R2), while responding to the demands for nature conservation in the management objectives of the WYNP.

## Forest ecosystem conservation loop (R4)

Loop R4 shows the process of forest ecosystem conservation in the Wuyishan region under the cooperation between the local government and conservation management authority. PAs vary in terms of management authorities, land ownership and functions, and resource use ways. They are governed and managed by many actors including the state, local communities, private individuals, enterprises, and Non-Governmental Organizations (NGOs). In the past, conservation policies were based on strict management and restrictions on the

local residents, and the livelihood behavior of tea farmers was generally regulated as a cost of conservation. In the process of establishing China's national park systems, forest ecosystem conservation is facing a new phase of governance, especially the streamlining of complex stakeholder relationships. The human wellbeing of tea farmers was given wider attention and nature conservation policies built trust by promoting benefit sharing to ensure legitimacy and support for inclusive decision-making such as from conservation easement, concession, eco-compensation, ranger enrollment, as well as more frequent communication between farmers and NP managers.

In WYNP, the role of the local communities was strengthened when they confronted the principle of the strictest conservation from multi-stakeholder participation and multi-party governance. As guardians of the PAs, local tea farmers have been given greater responsibility to protect the forest ecosystem, whether in terms of direct participation in governance and indirect participation in livelihood options.

*Our tea production and daily lives have been constrained by, and benefited from, the management of PAs, we believe that the existence of WYNP is a meaningful and outstanding event in the long term for us, R-09.*

Although there are some issues to be resolved under strict conservation, for example, the cessation of pinewood smoking for black tea asked for suitable substitutes which were yet to be commercialized from experimentation. Tea farmers were better motivated to explore a “sustainable development-oriented conservation loop” when they were given more information of PA management and their critical roles were recognized. Their understanding of the forest ecosystem has shifted from a pure burden for the community to a foundation for cultural inheritance and industrial diversification, and more possibilities for its future development.

*Our region is blessed with a long history and culture for generations, and the Wuyi culture requires the preservation of this precious ecology and environment, G-02. Nature conservation is not a pressure that falls on us, but responsibility for the development of the next generation, C-05.*

Under the influence of such conservation awareness, the government and residents have taken many actions. Through negotiation between the National Park Authority and tea farmers, the WYNP formed a multi-faceted long-term incentive mechanism with conservation easements, ecological compensation, and concessions (*ecological compensation and conservation easement*). The rights and obligations of community residents under these systems were clarified. In terms of rights, the tea farmers can continue to engage in reasonable production and business activities such as tea cultivation, while also receiving compensation for ceding part

of their land-use rights. In terms of obligations, these include ecological management of the tea terraces and cooperation with the National Park Authority in supervision and inspection. In this interaction, land ownership and use rights were determined to provide institutional safeguards for the diversification of community livelihoods, the conservation of species population, and forest ecosystems. In addition, the restoration of forests from tea terraces and the transformation to ecological tea gardens has greatly reduced the ecological hazards and soil erosion caused by the illegal cultivation of tea bushes.

*The government has taken action against those who reclaim tea terraces indiscriminately, and there are forest rangers to patrol the area regularly. There are more wild boars than before after the environment has improved, R-08 (tea terraces improvement, species population conservation and environmental optimization).*

The centralized and environmentally sound treatments of household waste in WYNP and its surrounding communities have also brought about significant ecological improvements.

*We pay some fees to the village every year and regular rubbish trucks come every week to collect the household waste, R-07 (household waste and non-harmful disposal).*

These initiatives all provide positive feedback to the forest ecosystem conservation loop.

## Discussion

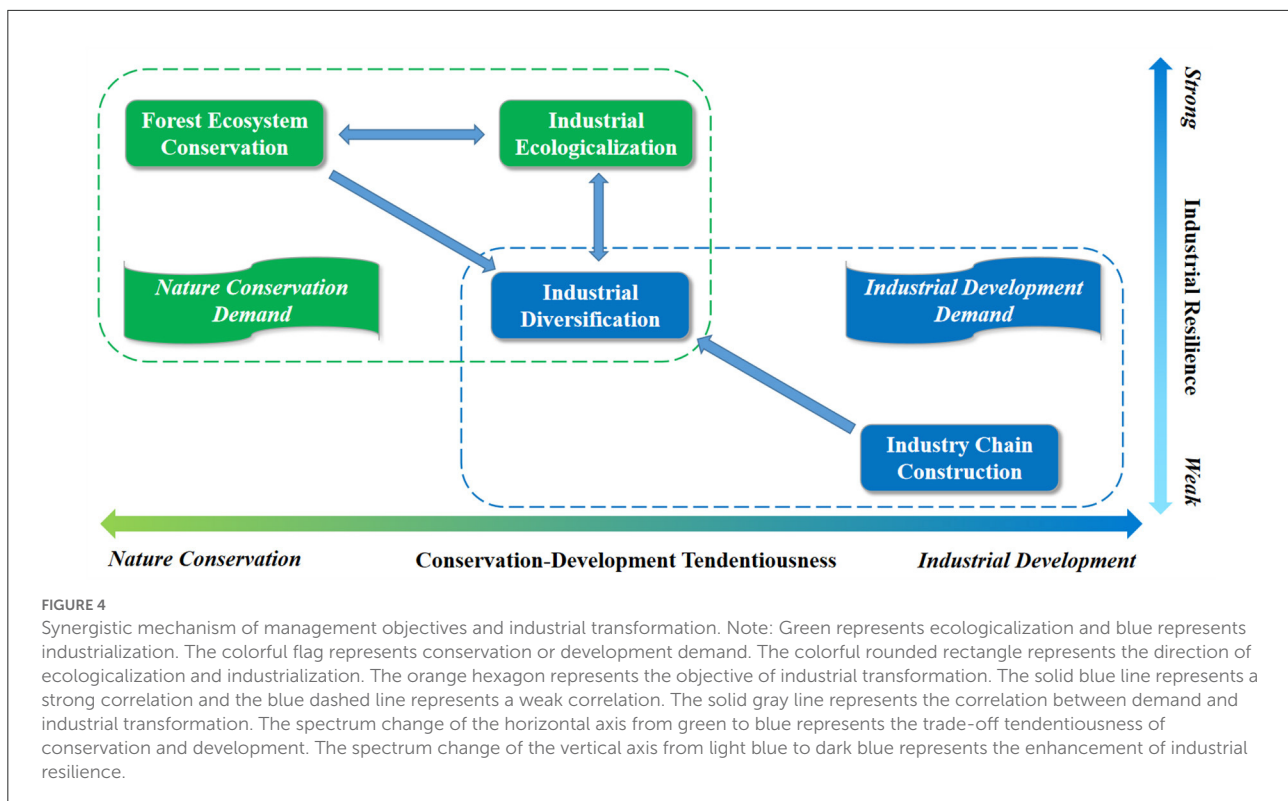
This study used a two-stage mixed method of grounded theory and system dynamics to reveal a synergistic mechanism between the management objectives of Wuyishan National Park and the transformation of the traditional tea industry. Our research confirmed the effectiveness of the method, especially in presenting an integrated view to argue for a causal relationship between variables, and demonstrated the detail and richness that quantitative data cannot provide. The results in WYNP suggested its capacity to stitch together fragmented information into meaningful causal loops for complicated systematic relations, which provides a new analytical tool for the studies of human-land relations.

In the recent 40 years, the Wuyishan region has undergone various conservation policy changes including a series of designations of protected areas such as the national nature reserve (1979), the national scenic area (1983), the world heritage site (1998), and the national forest park (2004). Relatively, local communities have a higher level of ecological awareness compared to common rural areas (He et al., 2018). Under the lasting influence of the nature conservation concept, the precious subtropical forest and rare species of animals and plants have been better preserved by local people (He et al.,

2021). In addition, although WYNP has undergone a long period of change in the governance institutions of the PAs, the local government has never given up the aspiration for the development of local traditional agricultural industries for the prosperity of the regional economy, although sometimes at the cost of ecological degradation. In general, seeking for the synergy became dominant, although it has yet to reach an ideal state and left to evolve in mainstreaming biodiversity in China. On the one hand, the national-territorial space planning now asks for a clearer ecological space zoning that secures the ecological baseline for regional development, and the designation of national parks is the process of practicing this zoning. On the other hand, the management of ecological space zones asks for refined governance that maintains ecological functions while securing human wellbeing. Therefore, national park management interacts with regional industrial layout and affects community industrial practices. Both the ecological and social outcomes must be secured under national park management and adapting human wellbeing to conservation objectives will be especially important to reach human-nature equity (Su et al., 2018). WYNP has provided valuable experience for the necessity of promoting traditional agricultural industries for regional development and the feasibility of their transformation and development within national park management.

The four loops developed in the results seem independent because we would like to present a strong problem-solving-oriented path that was revealed by the local tea farmers and governments. But they were interactive as we hinted at their linkage. An upscaling of their interactions for a deeper mechanism and its broader implication were discussed in Figure 4. The results of the synergistic mechanism between the management objectives of WYNP and the transformation of the traditional tea industry revealed two key points.

Firstly, traditional agricultural industries in protected areas were resilient and adaptable in the face of external changes (Figure 4, the vertical direction). As noted in loops R2 and R4, the long-standing tea culture identity and ecological awareness played key driving roles in the continuation and self-evolution of the tea industry. It is not an isolated and outdated mode of production but contains the traditional wisdom of keeping harmonious human-land relations and is worth cultural preservation. In fact, financial incentives are not the only thing that improves the relationship between indigenous people and nature conservation, as local communities have this long-standing traditional wisdom and cultural beliefs that encourage them to conserve. This is significant because the introduction of alternative sources of income has always been considered a panacea to nature conservation in previous studies, of which many conservation projects failed since they were based on the assumption that improving the economic conditions of local residents will automatically deliver well conservation results (Epananda et al., 2019). In this respect, this research showed that the value of traditional culture and ecological awareness were closely related to the resilience and adaptability



of traditional agricultural industries under the context of nature conservation. As a famous world heritage site, the Wuyishan region has always been regarded as an area rich in traditional cultural and landscape resources. This long-term influence has nurtured the cultural characteristics and industrial resilience of traditional agricultural industries. When facing diverse external changes, such as nature conservation demand and the COVID-19 pandemic threat, the local communities showed cultural confidence in traditional agricultural industries and were willing to actively adapt traditional agricultural industries to new changes.

Apart from this, small-scale agri-production patterns have played an unexpected role. In some literature, the decentralized production and processing by such small-scale farmers have been considered inefficient, unsustainable, and weakly resilient (Jouzi et al., 2017). From loop R1 we found that the tea industry in WYNP has been developed mainly as a family business for tea farmers, and the main livelihood of the community was based on the sale of tea leaves and home-based tea processing. In such cases, it is undeniable that excessive decentralization of the tea industry has weakened the competitiveness and cohesion of the tea industry in the Wuyishan region, while the irrational premium for tea has created path dependence in business. These once had some negative impacts on the local tea industry. However, in our case, we found that small-scale agri-production has advantages in terms of moderate agglomeration and standardization, risk

perception and response, and market-based diversification of production. At the front end of the production and processing process, tea farmers have established professional cooperatives or long-term cooperation with leading enterprises to ensure uniform production quality; at the back end, measures such as pesticide testing and standardization of the processing have been taken to reconcile the problems brought about by decentralized agri-production. This moderate agglomeration has proved that decentralized production and standardized processing were not irreconcilable contradictions. Moreover, although small-scale tea farmers have been vulnerable to external shocks, they exhibited rapid risk adaptation abilities. The results showed that local tea farmers have tried to reduce the risks related to inputs, yield and output price by diversifying their production and market outlets, including the development of mixed tea-cropping patterns, tea-tourism integration, and eco-products strategy. The WYNP has not been a special case in this regard, some cases in Eastern Europe and North Africa have also proved similar advantages for small-scale farming (De Roest et al., 2018; Waha et al., 2018).

Based on these, rather than declining, the traditional agricultural industries of local communities have shown resilience under the influence of national park management objectives and market changes to benefit the regional economy. Local communities were actively expanding the industrial chain constructions in traditional agricultural industries, and were trying to find ways to industrial diversification by deepening

ecological and cultural values as a breakthrough. Thus, the industrial resilience exhibited by the traditional agricultural industry has been a catalyst for synergy between industrial transformation and national park management objectives, and provided a basic human well-being for the livelihood and development of local communities.

Secondly, the industrial transformation was a process of trading off the demands for nature conservation and industrial development, rather than a one-time result (Figure 4, the horizontal direction). The sustainable use of land and resources on which communities depend could not be completely separated spatially from protected areas. Conservation and industrial development were not separate in either space or management sectors, they were like two sides of the same coin that together form the sustainable development of protected areas in the discourse of mainstreaming biodiversity (Naughton-Treves et al., 2005; Roe et al., 2015). In the past, the PAs' governance system in China has been characterized by fragmented conservation, multi-headed management, and unclear division of rights and responsibilities between the PA management agency and the local government (Tang, 2020b). Thus, a primary focus of the national park system reform was the governance reform. In this regard, there will inevitably be the emergence of reorganized conservation management participators and reconstructed relationships among them, especially among residents, government, and PA management agencies.

Appropriate approaches to balance the conservation demand for the public welfare and the development right of the local people have always been under discussion and practice in PA management (Salafsky and Wollenberg, 2000). The relationship between resource use and conservation for local people is a dynamic arm-wrestling process, and communities are also seeking their role and place in this linkage. In the ex-National Park period, the traditional agricultural industrial development and nature conservation were often under a de-facto decoupling state. Local residents were strictly limited to the nature conservation red line, and their subjective motivation for conservation has been suppressed for a long period (He and Su, 2021). After the establishment of the National Park, conservation demands have eventually been transformed into concrete encouraged or discouraged activities, which depended on whether they can help to improve conservation activities and provide ecosystem services. As a result, changes in the concept of conservation awareness have given communities a stronger responsibility for conservation, and provided a window for the transformation of the traditional tea industry. The results of loops R3 and R4 showed that the conservation of subtropical forest ecosystems not only fulfilled the nature conservation objective of PAs, but also ensured the sustainable development of the traditional tea industry and set the foundation stone for tea industrial ecologicalization in WYNP. In addition, when the local government also seeks a greener economy in regional planning, it steered the industrial policies to realize the cultural

and ecological value of the traditional tea industry for local livelihoods. This case proved that relocation is not the only way forward for nature conservation, when industrial development and nature conservation went hand in hand, the realization of industrial ecologicalization was the result.

Our findings in WYNP revealed that the simple reservation or discard of the traditional tea industry could not fully benefit the local people or resolve the problem of biodiversity conservation. The transition of the tea industry must be rationalized in the direction of nature conservation objectives in achieving sustainable development. China's national parks spatially integrated multiple types of protected areas, and the development and transformation of local industries under the influence of management objectives in PAs was not an uncommon problem as a variety of traditional agricultural industries have developed in rural China to support a large population and contribute to the regional economy (Wei et al., 2019; He et al., 2020; Shen et al., 2021). In fact, all the current national parks and pilots in China have management plans to optimize traditional agricultural industries, which is essential to protect the basic rights of local residents and stabilize the regional economy. For example, a traditional agricultural industry utilization area has been reserved for agri-activities in Qianjiangyuan National Park pilot to avoid conflicts between local residents' livelihoods and nature conservation objectives (Zhang et al., 2020). In Three-River-Source national park, yak raising and caterpillar fungus collecting have not been abandoned but regulated as a long-term conservation-compatible approach to achieve good economic and ecological benefits (O'Meara, 2021).

Globally, the concept of PAs has lasted for almost a century through a fence-and-fine approach, also well known as the Yellowstone paradigm (Kitamura and Clapp, 2013). This approach lacks consideration of the diversity of stakeholder livelihood needs and the dynamic processes of social-ecological systems (Bown et al., 2013). It is estimated that almost 70% of the world's PAs are inhabited by human beings, which are concentrated in developing nations (Dudley, 2008). Therefore, PAs' governance in developing countries must value the development right and social equity of human beings and the uneven development in different regions. China's current experience of national park governance has proved that economic development and nature conservation can be synergetic in mainstreaming biodiversity in the traditional agricultural industrial sectors. Cooperation among multiple stakeholders and active engagement of local people is necessary and possible for more efficient PA management.

## Conclusions

Traditional agricultural industries in and around PAs have acted as a connector between the management demands of

nature conservation and the livelihood security of communities and the process of their synergy is mainstreaming biodiversity in the main economic sectors such as agriculture, fishery, forestry, etc. This study proposes a synergistic mechanism between the management objectives of Wuyishan National Park and the transformation of the traditional tea industry through a mixed method of grounded theory and system dynamics. The findings revealed that the transformative development of the tea industry in WYNP has always been centered on regional nature conservation management demands. Interestingly, although the decentralized operations of tea farmers in this region have not fundamentally changed, the traditional tea industry, however, has shown remarkable industrial resilience. Under the combined influence of national park management objectives and market changes, there have been some endogenous changes in the forms of industrial organization and professional division of industrial chains among tea farmers. We believe that traditional culture and the flexibility of small-scale farming have contributed greatly to this self-adaptive ability. These results also suggest that future research could focus on the role of traditional culture in the transformation of traditional agricultural industries in protected areas.

The demands for industrial development and nature conservation are not a dilemma in the decision-making of the local government if the role of the community residents is fully recognized and their practices properly regulated. Both industrial development and nature conservation will inherently support the achievement of conservation management objectives, so long as their trade-off reaches an eco-friendly and sustainable point. From the case of WYNP, the synergistic loops found currently are a review of the practices and experiences of local tea farmers, the government and the NP management agency. Indeed, there are still problems that need to be solved in the process of synergizing traditional agricultural industries and nature conservation objectives, such as the restriction of strict ecological control red lines on the construction of infrastructure for traditional agricultural industries, strict restrictions on the entry of exotic pine wood required for tea processing (preventing pine wilt nematode from harming local forest ecosystems), the heterogeneity of ecological conservation willingness under the difference of farmers' livelihood capital, etc. Additionally, the findings also reveal that the self-adaptive ability of the traditional agricultural industry is limited, which is influenced by residents' ability, household capital, external policies, and characteristics of the production chain. Thus, appropriate guidance from the local government or the authority of protected areas is essential to smooth the relationship between nature conservation management objectives and industrial transformation demands.

This study has some limitations and perspectives that need to be addressed by researchers in future studies. Firstly, the qualitative system dynamics method is not meant to be a complete simulation of the real world, but to understand the

feedback loops and mechanisms of system behavior, prove the reasonability of strategic policies and promote understanding between different stakeholders. This method currently only provides an overall predictive insight and does not allow for fully detailed simulations of the real world. In the future, detailed simulations of individual subsystems can be enhanced to better predict changes in the system over different time scales and policy conditions. Secondly, in our study, the role of social power, including NGOs, Non-Profit Organizations (NPOs) and environmental organizations, inter-governmental forums, etc., have not been fully identified in the linkage between nature conservation and community livelihood security. Emphasis should be placed on encouraging multi-power adaptive co-management to maximize the resilience and adaptability of PA systems in nature conservation and livelihood provision in future practices and studies.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

BW: conceptualization, data collection, methodology, and writing—original draft. SH: conceptualization, data collection, methodology, and writing—review and editing. QM: supervision. XY: data collection and methodology. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



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