

Agricultural Heritage in China and Its Traditional Production System: Protect or Perish?

DONG Wenjing^[a]; TIAN Qian^{[b],*}; XIE Cathy Ping^[c]

^[a]Chongqing Agricultural Financing Guarantee Group Co. Ltd, China.

^[b]Southwest University, China.

^[c]Beijing Normal University, China.

*Corresponding author.

Supported by Innovation Collaborative Project of Basic Research in Southwest University Under the Auspices of Ministry of Education, China (SWU1609102). The authors would like to express their special thanks to Xue CHEN, Kun LIU and Peng SONG for their assistance in data collection.

Received 19 September 2021; accepted 23 October 2021
Published online 26 December 2021

Abstract

Coptis, as one of the plants in the family of Ranunculaceae, with the major component berberine in its rhizome, has been dominantly researched in biomedical and pharmacotherapy field. As a newly emerging China-NIAHS in 2017, the significance of Coptis is acknowledged as an agricultural heritage system. This study is the first on Coptis to provide an anthropological perspective on the China-NIAHS of Shizhu Coptis traditional production system (CTPS) in Chongqing, China. Since 2002, when FAO initiated the protection of Globally Important Agricultural Heritage Systems (GIAHS), the value and significance, as well as the urgency, of agricultural heritage systems has been widely emphasized. However, such heritage systems, especially the case in this paper, which is currently the only one agricultural heritage system with great medical values, have not been completely assessed for their contribution to the development and civilization of the society, as each reflects a particular context with complexity. Also, the criteria and process of the assessment, the conservation and management of these heritage systems would be complicated. This study, therefore, is sampled purposively to take Shizhu CTPS as a unit of analysis to explore the relationships and features between the agricultural heritage system and its contexts, particularly the watershed in which

it is embedded. Four features of Shizhu CTPS with its best “fit” in the watershed were analyzed. The embedded cultural element and proposed approaches were discussed to illuminate the future research of agricultural heritage system through an anthropological lens. It contributes to the related knowledge base and would provide possible approaches and strategies for the conservation and management of such systems in China and globally.

Key words: Coptis; Agricultural heritage system; Anthropological lens; China-NIAHS; GIAHS; Coptis traditional production system; Shizhu County

Dong, W. J., Tian, Q., & Xie, C. P. (2021). Agricultural Heritage in China and Its Traditional Production System: Protect or Perish?. *Canadian Social Science*, 17(6), 72-83. Available from: <http://www.cscanada.net/index.php/css/article/view/12388>
DOI: <http://dx.doi.org/10.3968/12388>

1. INTRODUCTION

Coptis, known as goldthread, or Coptidis in many countries, is a flowering plant from the family of Ranunculaceae with its Latin name of Coptis chinensis Franch (Chen et al., 2017) as shown in figure 1, and its rhizome (Figure 2) has been widely used in traditional Chinese herbal medicine for centuries (Kamath et al., 2009; Xiang et al., 2016). Coptis and its major component, berberine, have drawn extensive attention toward their antineoplastic effects in the recent years in treating diseases by dispelling dampness, removing toxicosis and antimicrobial activity (Tjong et al., 2011, Friedemann et al., 2016; Cui et al., 2016), as well as its potential to treat breast cancer (Kaboli et al., 2014). Also, that Coptis contains specific alkaloids, which other phylogenetically related North American species don't, contributes the significance to the biomedicine (Kamath et al., 2009).



Figure 1
Coptis, the Plant (photographed by Qian TIAN)



Figure 2
Rhizome of Coptis Figure 1: Coptis, the Plant (photographed by Qian TIAN)

Coptis chinensis is indigenous plant in China, particularly those cool areas and edges of forests, which are primarily located in the provinces of mid and southwest China, including Hubei, Sichuan, Yunan and Chongqing. It grows best in damp boggy spots in woods with light, slightly acidic soils and much moisture.

Due to its increasingly medical efficacy, *Coptis* is cultivated to meet the demand of the market. *Coptis* traditional production system created in ancient times to save lives, symbolize the adaptive relations between humans and nature (Hou et al., 2017). Many variations of *Coptis* production processes have survived and are still the important production system, which includes appropriate planting, processing technology and knowledge of local culture. However, with the modern development, which brings about technological change, social and economic transformation, the traditional *Coptis* production system undergoes increasingly challenges (Ibid). Recognizing the vulnerability, meanwhile, the significant contribution of this system to the traditional Chinese medicine, the traditional *Coptis* production system in Shizhu County, Chongqing, was designated as one of the China-GIAHS systems in 2017.

Agricultural heritage systems are priceless treasures, which are of great values of sustainability (Min, 2011). Shizhu *Coptis* has been acknowledged with its unique medical significance and its traditional production system is of great value culturally, socially and economically, which has become a great concern whether it would survive under the current development of urbanization, and how it could be conserved and developed sustainably.

Shizhu Tujia Autonomous County in Chongqing is located in the Dragon River watershed, and rich in valuable Chinese medicinal plant *Coptis*. It is also known as the Chinese home town of *Coptis*, which was identified as the authentic *Coptis* at the first conference on Chinese Genuine Crude Drug in 1989. *Coptis* traditional production system at Shizhu County was successfully designated as China's nationally important agricultural heritage systems (China-NIAHS) in June 2017, by the Ministry of Agriculture in China. The conservation and management of Globally Important Agricultural Heritage Systems (GIAHS) was initiated by Food and Agriculture Organization (FAO) of the United Nations in 2002. China is one of the first countries to respond accordingly at the national level and was designated the first GIAHS in 2005. Subsequently, Chinese Ministry of Agriculture embarked on identifying and managing China-nationally important agricultural heritage systems in 2012. The purpose of establishing China-NIAHS is to recognize the importance of agricultural heritage systems and develop institutional and national support to improve the natural environment, and also to promote better living standards by generating and adding economic values to goods and services of such systems sustainably. Meanwhile, it aims to maintain and develop the ecological balance, leverage the relationship between the mankind and the natural environment so as to ensure the harmonious development of the nature and the human society, and eventually achieve urbanization, greening and agricultural modernization in China (Li et al., 2006).

Agricultural heritage is a relatively new, and dynamic construct of cultural protection and inheritance with its own characteristics, following the concepts of World Cultural Heritage, World Natural Heritage, World Cultural Landscape and Intangible Cultural Heritage. It requires to be managed and developed effectively and sustainably in accordance with the local status quo and its wider contexts (Min et al., 2006). As a large agricultural country, China abounds with rich agricultural and cultural heritage resources. With the development of the country and the awareness of the cultural importance, the emphasis on agricultural and cultural heritage has been gradually placed. However, research on agricultural heritage is still scarce. The implementation of GIAHS in China is still in its infancy. And it has challenges in developing the expertise in this field, exploring various means of conservation and management to work collaboratively (Jiao & Min, 2017). Under such circumstances, drawing upon the historical origins and theoretical framework of agricultural heritages, Chinese scholars begin to investigate more. Their study could primarily be categorized into the following four areas: (1) Literature review of ancient agricultural history, agricultural technology history, agricultural economic history; (2) Interdisciplinary study of agricultural heritage with history, archeology

and ethnology; 3) Research on agricultural heritage involved in information technology and other technical means; (4) Investigating living inheritance and protection of indigenous agricultural heritage. Thus, a limited number of monographs and academic journal articles were produced within small scopes of study, which was restricted to certain regions or provinces as well. Therefore, this study provides the first attempt of analyzing an agricultural heritage system through an anthropological perspective, particularly an angle of the watershed in which the system is embedded.

Despite the prominent roles of Coptis in medicine, such as the emerging evidence that Coptis is effective in the treatment of neurodegenerative diseases associated with oxidative stress (Friedemann et al., 2016), our understanding of this designated China-NIAHS is limited by a lack of research and awareness. Therefore, given the emerging value of Coptis in biomedicine and agricultural heritage systems, this study is to investigate this uniquely medical-related agricultural heritage in China. Drawing upon the complexity theory (Kauffman, 1992; 1990) and ecological systems theory (Bronfenbrenner, 1979), this study aims to explore this agricultural heritage system through an anthropological lens, particularly positioning the case site within a ‘watershed’ framework, which is to be interpreted and defined in the following section, to illustrate the interplay of the land, the people, and the culture.

Watershed is a construct which is defined literally as “an area or region drained by a river, river system, or other body of water” in Oxford dictionary. It also could be interpreted from the four dimensions: 1) from the cultural perspective, the watershed is a time-space channel for the origin, evolution, dissemination, blending and development of different cultures; 2) from a holistic point of view, the watershed is also an architecture that forms one sectorial network by connecting small rivers and water basins; 3) from a social perspective, the watershed is a problem domain that brings various problems related to different aspects, such as ecology, population, resources, and ethnic groups and their relationships; 4) from a methodological point of view, watersheds can serve as a cognitive paradigm.

In this study, watershed, from an anthropological perspective, is defined as a natural-social complex, which is centred by rivers, featured by interactions of humans, earth and water along the communities to serve as an integrated and dynamic construct. In order to better understand why and how the agricultural heritage systems could be conserved and managed in a sustainable way, this study provides the first exploration through the perspective of the watershed, which has the characteristics of humanistic features, emphasizing the regional integration and highlighting the natural-ethnic symbiosis. By examining the case of Shizhu traditional Coptis production system in Chongqing, China, it would contribute to the knowledge of Coptis’s uniqueness to

the Dragon River watershed, developing the economic, cultural, historical and ecological value of its agricultural heritage system, and also plays an exploratory role in enhancing regional confidence in agricultural culture, promoting sustainable development and boosting industrial upgrades. The study site, its contextual and brief historical information is illustrated in the next section. Following that is the theoretical framework, which underpins the analysis, and the methods employed. The findings of this research are analysed. Moreover, the significance and possible applications with eco- and cultural -sustainable strategies regionally, nationally and internationally involved in residents, communities, local and national governments, to conserve and manage Shizhu CTPS effectively and sustainably are discussed. Further implications serve as the conclusion of this paper.

2. THE STUDY SITE

2.1 Shizhu County and the Dragon River Watershed

Shizhu County, officially named as Shizhu Tujia Autonomous County, is located in southeast Chongqing Municipality, China (Figure 3). It is south to the Yangtze River and in the center zone of three gorges reservoir region. Also, it is the only autonomous county for ethnic minorities in this region. Shizhu literally means “stone pillars”, which is named after two big human-like natural stone pillars standing on Longevity Mountain, as described by the informants, which symbolises a Chinese version of “Romeo and Juliet”, who objected to feudal oppression of freedom for love and died together tragically.



Figure 3
The location of the study site of Shizhu County in the Dragon River watershed in Chongqing Municipality

The Dragon River is a tributary of the Yangtze River, and also located in the southeast of Chongqing, China. The north and south branches of the upper reaches of the river originate from Shizhu County. The watershed of the Dragon River shapes generally as a rectangular, spreading

through Shizhu County and Fengdu County, as shown in figure 3. The region lies in east coast of the Yangtze River south bank, east longitude 107° 59' to 108° 34', and latitude 29° 39' to 30° 33'. The watershed covers an area of 3012.51 square kilometers, with a length of 98.3 kilometers from north to south and a width of 56.2 kilometers from east to west with a population of 547,900.

2.2 The Contextual Background of Coptis Traditional Production System (CTPS)

2.2.1 The Origin and Development of CTPS

Coptis is one of the indigenous plants of Coptis chinensis Franch in China. Its medicinal material is called Wei Lian in Chinese pinyin, which has the functions of clearing away dampness and detoxification as introduced in the first section of the paper. The records of Coptis started in the book *Shen Nong's Herbal Classic*, categorized it as the top quality herbal medicine. The Chinese medicine classic, *Compendium of Materia Medica* states that the colour of its root is yellow, hence the name [huang lian in pinyin]. In *Supplementary Records of Famous Physicians*, it records that Huang Lian is born in Wuyang and Shujun mountains [in south China], and can be collected in February and August.

Shizhu County has a long history of Coptis planting and its business. According to the accountable records in the literature, the earliest date of Coptis in Shizhu County can be traced back to Tang Tianbao in 742 of Tang Dynasty, over 1,200 years ago. Besides, there were records in the National Chorography during the Reign of Yuanfeng [Yuanfeng Jiuyu Zhi] in Song Dynasty, stating that Shizhu delivered Coptis ten jin [176.4 ounce], and Muyaozi [Chinese herbal medicine] 100 granules to the emperor as the gift. During the 10th to 13th centuries (Northern Song Dynasty), *General Geography of the World Records of the Pacific* states that five counties in Zhongzhou: Linjiang, Fengdu, Dianjiang, Nanbin, Guixi, are indigenous to bitter herbs, such as Coptis. During that era, the empire state covered five counties, but only Nanbin (now Shizhu) County had Coptis. In about 1360 (late Yuan Dynasty and early Ming Dynasty), Coptis began to be cultivated. At the beginning of the Ming Dynasty, farmers at Huangshuiba and Shuanghe (now Fengmu town in Shizhu) made their living and supported their family by planting Coptis.

In mid-Ming Dynasty, techniques of planting Coptis were improved, and subsequently in the late Ming Dynasty, Huangshuiba at Shizhu County became a collecting and distributing centre, where drug dealers from other cities and provinces in China, such as Chongqing, Wuhan, Jiangxi, came and met. In 1175 during Qing Dynasty, as Shizhu Chronicles records, there was large production of Coptis with busy exchange trade and business. In 1842, in the *Supplementary Records of Shizhu*, it describes that there was the largest production of Coptis chinensis, which shared similar feature with

Yalian [another type of Coptis]. In 1909, more detailed records illustrate that Coptis is rich in areas like Huangshui and Shuanghekou at Shizhu, where it often takes six to seven years from seedlings to collection.

During the field work, many sites of ruined houses, Coptis shed and pit areas were discovered in the deep jungle of Dafengbao and Huangshui Caojia Gully, Dongmuping Town at Shizhu County. According to the accounts from the ancestors and the assessment of the recovered trees at the ruined areas with their growth-rings by experts, it was evidenced that it had been three to four hundred years since Shizhu began to adopt the techniques of 'shade from the shed and dry over the trench' to produce and process Coptis. The annual output during Qing Dynasty from 1871-1908 of Guangxu Emperor, reached 1000 Dan, which is equivalent of around 1764 ounce. During the Republic of China in the early 20th century, the annual output of Coptis came to 4000 Dan [around 7055 ounce]. Later in 1934, it was recorded in the book compiled by Bank of China on Herbal Crude Medicine in Sichuan Province that Coptis could only be cultivated in Shizhu within family business. In 1959, a journal article called *The History of Coptis in Journal of Sichuan Medical College* recorded that Coptis cultivated in Shizhu was in high quality and largest production in the country, whilst some wild Coptis could be found in other areas in Sichuan Province such as Emei and Hongya.

2.2.2 Shizhu CTPS Before the Founding of PRC

Shizhu Coptis has always been a popular goods among drug dealers since such business started in 1368 of Ming Dynasty. In 1644, XIONG Laicheng, a drug dealer from Pingcheng Town, Jiangxi Province, moved to Xituo and opened a "xiong heng tai" drug store, purchasing Coptis and other indigenous herbal medicinal materials. Most Coptis he purchased was shipped to other areas along the Yangtze River, and some were processed into fried Coptis with wine, ginger juice, and Fructus Evodiae respectively, then traded locally. In 1889, the Customs statistics showed that Coptis exports from East Sichuan Province accounted for the 16th among all crude medicinal materials, i.e. about 150,000 jin, or 2646 ounce, most of which was produced in Shizhu County, and a small part from Wuxi, Chengkou Counties.

During the Republic of China, there were countless numbers of companies and dealers from other areas operating the business of Coptis, especially those from Chongqing, Hankou, Jiangxi, Wanxian, Guangzhou, Zhongxian, Fengdu, Fuling and so on. There were more than ten brands and companies to do business frequently, such as Xianghe, Chengfu, Tianchengxing, Xingfa Xiang, Xiaohengtai, Yuanfeng, Xingran, Hecheng and Xiong Changxing, whose purchase and selling accounts for about 80-90 percent of the total production each year. They marketed it in Hunan, Guangdong and Zhejiang provinces or exported to Hongkong, Nanyang, India

and Japan via Liuzhou, Guangzhou, Wusongkou ports. During 1931 to 1933, the average export volume of Coptis ranked the third among other herbal medicine in Sichuan province. The account in Chongqing Railway Economic Report in 1937 showed that the export of Shizhu Coptis occupied 60 percent of all exported herbal medicinal materials, which were mostly shipped to Shen, Han with a peak time in 1933 when the export amount was 700 dan, or 1235 ounce. Other journal articles, such as Shizhu Coptis Economic Introduction in Economics Quarterly in Sichuan Province also stated that Coptis was a special local product at Shizhu, particularly in Huangshui town with alpine and cold conditions, where a majority of domestic and foreign trades started.

In 1945, an article called Today's Huangshuibai, in Xinhua Daily newspaper published that although there were only about twenty stores in the area, drug merchants from Chongqing and Wanlian gathered there and also around 2-3000 dan, or 3527-5291 ounce, were exported annually. Shizhu Coptis had been in great demand since then, except the critical periods of transport during anti-Japanese war and the civil war later. All the annual production was sold out in those years, particularly to Chongqing, Wanxian and Hunan. In 1944 and 1946, all production of 2900 dan and 2500 dan, or 5115 ounce and 4409 ounce respectively, was sold to various areas around the country, such as Chongqing, Wanxian, Shanghai and Hankou.

Before the founding of the People's Republic of China, drug dealers who had the acquisition of Coptis were named differently. Those small vendors, who often purchased small amount of Coptis with limited budget, obtained commission fee when they facilitated the bigger dealers trade successfully. Those native landowners and foreign capitalists run big pharmacies in the field (such as Chongqing Tong Junge) and purchased Coptis and marketed it to other dealers with a large sum of business. In 1948, regular drug stores in Huangshuibai included five from Chongqing, four from Wanxian and two from Hankou. Local owners and foreign dealers were differentiated by capital and stocks, both of whom hired small vendors to purchase Coptis with lower prices and cheated weight from the Coptis farmers. Some disputes occurred when the price roared or plummeted sharply.

2.2.3 Coptis Business in Shizhu After the Founding of PRC

After the founding of PRC, in July 1950, China's industrial and agricultural trading company set up Wanxian Branch as an acquisition group in Xituo, which started the official trade on Coptis at Shizhu. It, then, was expanded in 1952 into an office, and set up another acquisition group in Huangshui in 1953, who sent staff to purchase Coptis. Private business dealers had to visit each household to enquire the purchase. According to the statistics of Xituo Office in June 1953, state-owned enterprises purchased over 70 percent of Coptis production, which accounted for 86.6 percent of all purchases. In 1953, the quota of Coptis purchase was set

by the central government for state-owned enterprises, joint companies and private dealers. Since 1954, Shizhu Coptis was designated as the Chinese national herbal medicine and top tier byproduct of agricultural production, which could not be purchased by private dealers or organizations rather than state-owned drug companies, licensed foreign trade companies, as well as supply and marketing cooperatives. Shizhu Coptis was managed and coordinated with planned purchase and distribution to other parts of China and overseas by the government. It was exported to foreign countries, such as Japan, Singapore, Malaysia and America and so on.

In order to regulate the purchase of Coptis, policies were modified since 1954, when the designated purchase department in the county government purchased Coptis from certified farmers with written permission by officials, which prevented the illegal reselling by the drug dealers. In 1962, a special award system was promoted that the farmers who sold one dan, or about 18 ounce, to the state would be entitled to receive 150 jin grain, and 15 chi cotton cloth. And later the exchange amount was raised with more favor to the farmers. Since 1963, the private drug dealers were allowed to purchase Coptis with certificates from three levels of administrative departments, i.e labor team (sheng chan dui), united group (da dui) and community (gong she).

In 1978, the planned purchase of Coptis was changed into prescribed purchase, which strictly prevented private purchase and smuggling. In 1984, the state completely loosened the rules of the purchase and sale of Coptis, adjusted the Coptis into the third category of agricultural and sideline products, canceled the purchase and sale quotas of shares, and implemented a free trade in which state-owned companies, collective groups and individuals were all allowed to purchase. After the implementation of this policy, foreign businessmen came to compete in trade and most of the Coptis purchased was exported to coastal areas such as Guangdong, Shenzhen, Shanghai and Fujian, while the remaining parts were exported to Chongqing, Chengdu, Hubei, Hunan, Guangxi, Jiangxi, Hebei, Jiangsu, Zhejiang, Beijing, Tianjin and other provinces, municipalities and autonomous regions, and some also for export, of which 490 dan are exported.

The couplet now existing in Coptis market in Huangshui town, which is the biggest exchange center in China (Figure 4), displays that the growth demands more than two thousand days, enduring rains, snows, wind and frost in four seasons, which survived after over six hundred years with its genuineness and saved patients all over the world. That was the illustration of its long history and life cycles. Meanwhile, due to the large production, Shizhu Coptis occupies sixty percent of domestic market shares with the best and reliable quality. Therefore, Shizhu has a reputation of the hometown of Coptis and was designated as China-NIAHS in June 2017.



Figure 4
Coptis market in Huangshui, Shizhu County (provided by Shizhu County Office)

3. FRAMEWORK AND METHODS

The agricultural heritage systems are complex with multiple layers, facets and functions (Fuller & Min, 2013). The complexity involves its core systems and subsystems with regards to social, ecological and historical dimensions (Jiao et al., 2016). Their inter-dependence of each dimension would not be linear relationships, which would be underpinned by the complexity theory (Kauffman, 1992; 1990) and ecological systems theory (Bronfenbrenner, 1979), discussed in the following section.

3.1 Complexity Theory and Ecological Systems Theory

Complexity theory has been studied by researchers from different fields, from organisational sciences to computational technology, which reflects various conceptual constructs such as cybernetics (Wiener, 1961), neural networks (McCulloch, 1943), and organism (Whitehead, 2011). The core element of complexity theory emphasises the nonlinear (Casti, 1944) intervention and interaction of variables in a complex system, which could be different from the simply sum of the parts in the system. As in the agricultural heritage systems, the change of one or two parameters, such as the awareness of its importance, or the government policy intervention, would dramatically affect the sustainability of the whole systems. Although the output of the whole systems would be difficult to anticipate, it would be likely to address the dynamic interactions among various components and their external forces (Fuller et al., 2015), which situates in the exo-system in Bronfenbrenner's theory (Bronfenbrenner, 1979). Three categories of complexity, i.e. algorithmic complexity, deterministic complexity and aggregate complexity, were reviewed and discussed, which offered a perspective on a disciplinary basis (Manson, 2001).

However, this paper would have the novice attempt of synthesizing the complement of the complexity theory with the ecological systems theory to delineate how each system within the agricultural heritage systems is complicatedly interwoven. Ecological systems theory (Bronfenbrenner, 1979) was originally developed to study a child's development within various contextual factors that builds her or his environment. The complex layers, i.e. micro-, meso-, exo-, macro- and chrono-, have an interconnected influence on a child's growth. The conservation and management of a precious agricultural

heritage system is similar to the development of a person who would not survive in an isolated environment. It is in its infancy with regards to be developed sustainably. To protect the agricultural heritage systems, it could not be feasible to look at the systems themselves, but could emphasize the inner relational connections among layers of these systems. Drawing upon the abovementioned theories, the theoretical framework, which underpins this study, would be interpreted in two dimensions: Firstly, the dynamic, rather than static, complexity would be focused, which is consistent with the liveliness of agricultural heritage systems. Second, the integration of complexity among various layers of ecological systems theory would serve as an overarching framework to analyse the agricultural heritage system as an integral entity. Though, among five layers of ecological systems theory, there would be complexity within each layer, this study focuses upon the complex relationships among different layers.

3.2 Methods

There are forty-four GIAHS systems in the world till 2017, which, characteristically, are rich in agricultural biodiversity and associated wildlife, and are important resources of indigenous knowledge and culture. This study takes a China-NIAHS system of Shizhu Coptis traditional production system (CTPS) as a case study to delineate in depth the complexity of the conservation and management of the system, as well as propose possible suggestions to other areas or countries to understand the collective efforts on the conservation and management of agricultural heritage systems.

Shizhu Coptis traditional production system, as a designated China-NIAHS system, is situated geographically, historically and culturally in the study. Data were collected by means of documents, face-to face interviews, participatory observations and field notes. Numerous field visits were conducted from August 2016 to November 2017, to several towns and villages in Shizhu County, which mainly included, but was not limited to, Huangshui, Fengmu, Yuelai, Lengshui, among which Huangshui and Fengmu were focused, particularly Qinggangping, Dafengbao and Fengmu villages. The participants included the government officials from Agriculture and Forestry Bureau, leaders and staff of towns and enterprises, cadres of various village groups, farmers who planted Coptis, and other villagers in Shizhu County.

Documents, related medical books and accounts, local chronicles and records, annals of Shizhu County, statistical resources on agriculture and forestry were collected and referred to during the field work and data analysis.

4. FINDINGS

Drawing upon the historical development of Shizhu CTPS in the literature and data collected from the field work, four thematic watershed characteristics were analyzed and discussed in this section.

4.1 Ecological Characteristics of the Watershed

The Dragon River, as a tributary of the Yangtze River, originates in Shizhu, the junction of Hubei province and Chongqing municipality, and traverses in the mountains, valleys and hills, covering 164 km, among which 104 km was in Shizhu County. The Dragon River flows through more than twenty towns and villages in Shizhu and Fengdu counties, where it forms the unique Dragon River watershed. Because of its geographical conditions with valleys, water basins and mountainous areas in the vicinity of 30 ° N latitude, it is very difficult to carry out the large-scale agricultural production. However, it is more likely to be suitable for the growth of Coptis. There is a local saying that no other species expect Coptis could grow in that piece of land, which reflected the interdependence of the nature and the people with right choice to maintain sustainable ecology, at the mean time support the livelihood locally.



Figure 5
Ecological feature of Shizhu in the watershed (provided by Shizhu County Office)

Moreover, Coptis enjoys cool and cold areas, and the core processing area for Coptis is located in the Dragon River watershed around Lengshui and Huangshui towns in Shizhu County. These alpine regions, about 1600 meters above sea level, with cool climate, abundant rainfall and little sunshine and frost-free period, fit Coptis growth, and also ensure the yield of Coptis, which is naturally home to Coptis. Therefore, those conditions predetermine the interaction of choosing and planting the suitable plant in the watershed with good production and quality.

4.2 Landscape Features of the Watershed

In the landscape ecosystem, Shizhu CTPS has a strong feature of the Dragon River watershed, which is composed

Shizhu County is located in the Dragon River watershed with a mild climate, abundant rainfall and four distinctive seasons. It has an early spring, long summer, short autumn, and late winter around the year. It has little sunshine and the very differentiated climate with the annual average temperature of 16.5 °C, ranging from highest 40.2 °C to lowest -4.7 °C. The area, which is suitable to cultivate Coptis, generally ranges between 1000-1800 meters above sea level. If the altitude is too high or too low, it will affect the growth of Coptis. The annual average temperature in the main producing area of Coptis in Shizhu is about 10 °C, with the highest average temperature in July of 20.1 °C and the lowest in January of only 0.4 °C. There are almost seven months, which has average temperature of over 8 °C, and four months with more than 15 °C averagely. The annual accumulated temperature is 3419.6 °C. The average daily temperature for Coptis to grow is 5 °C -22 °C. The average daily temperature of vegetative growth period (April-June and September-October) is 10 °C -17 °C. The amount of rainfall in Coptis planting area is between 1300mm-1700mm, and the moisture content of the soil remained at about 40%. The annual rainfall of the main producing area of Huangshui Town is 1372.6mm with the highest of 208.4mm in July and the lowest of only 22.3mm in January. The monthly precipitation is more than 100mm for 7 months. The ecological features of the watershed, particularly Shizhu County (Figure 5), provide the natural conditions for Coptis to be possibly cultivated in this area.

of natural landscape (Figure 6) and cultural landscape. Natural landscapes consist of four aspects, which include biological, land, astronomical and hydrological landscapes; and cultural landscapes mainly include historical sites, folk customs and historical legends. Shizhu has suitable ecological environment and the core landscape ecological resources, which connect two parks, one land, one street and one character of heroine, explained by the local government in interviews. Because of its location and sea level at an altitude of 800 meters -1900 meters, Shizhu, especially Huangshui tourist resort with average sea level of 1,500 meters, enjoys excellent agreeable climate, abundant mountain vegetation landscape. Statistics in the annals of Shizhu County shows

that 98 percent of the days annually has the quality air, with the forest coverage rate 56.4%, grassland coverage rate 8.7%. The water in the Dragon River watershed

reaches the drinking water standards, and so the forest area with national Level one water standards.



Figure 6
Bird's-Eye-View Natural Landscape of Shizhu County in the Watershed (provided by Shizhu County Office)

Moreover, Shizhu County also owns the natural and cultural landscape, which is illustrated by two parks, one land, one street and one heroine. Two Parks refers to the Yellow River National Forest Park and National Geopark at Qiyao Mountain. There are one land called Qianye Pasture and one street called Cloud Stairs in Xituo and one heroine named Qinliangyu, which exemplifies green ecology, indigenous customs and historical culture.

Furthermore, Shizhu is an autonomous county with Tujia ethnic minority groups, and retains distinctive features of folk culture in the Dragon River watershed, particularly well known for its folk songs and dances throughout China. The song, called Happy with Sunshine, and waved dance are household cultural elements at Shizhu, and also in south China. Besides, Xituo town in Shizhu County was designated as a historic site in China for its salt trade from Han Dynasty to Qing dynasty. In addition, the Yangtze River culture, Tujia food culture are other prominent features which were discovered and commonly shared in the interviews with local residents.

4.3 Soil Characteristics of the Watershed

Shizhu County is located in southeast Chongqing, and the parent rock is exposed most completely, with a total of 5 soil types, 22 soil genus, 95 soil species. In the Coptis producing area, the geological structure of Jurassic Shaximiao Formation is mainly composed of feldspar quartz coarse sandstone and purple shale. Soil is light loam, loamy soil. The basal soils are acidic to slightly acidic with a pH value of 4.6-7.5. The soil contains a little potassium, nitrogen and little phosphorus. The nitrogen content is generally 120-170 mg / kg; the available phosphorus is within 3.5-20 mg / kg; the available potassium is between 150- 350 mg / kg; calcium generally 5-20mg / kg. Soil contains least phosphorus, and available phosphorus, potassium content is low, with varied iron and manganese. Also, the soil is loose and porous, which allows good ventilation. The Soil moisture content occupies between 42% -47%, and the surface of the soil has a greyish-grained structure. Particularly, the yellow soil has no aggregate structure, whilst the content of organic matter and the total nitrogen and potassium is high. In this watershed, the available nitrogen is basically not lacking in the soil, thus potential fertility is achieved. Among

them, purple soil and yellow brown soil had 11.5% organic matter, 0.484% total nitrogen, 417 mg / kg nitrogen, 11.2 mg / kg available phosphorus and 349 mg / kg available potassium. The all factors related to soil mentioned above act together, and provides the best suitable 'base' for Coptis cultivation with high yield and quality. According to the statistical report by Chongqing Agricultural Environment Monitoring Center in the Ministry of Agriculture, the soil quality of Shizhu Coptis producing areas meets the soil "environmental quality standards GB15618-95" level two, which serves the ideal soil foundation for Coptis to be developed at Shizhu County.

4.4 The Cultivation and Processing of Coptis in the Watershed

Due to various types of Coptis, the variety of Coptis Shizhu County is also scrutinized strictly for planting and promotion. The process of planting Coptis (Table 1) at Shizhu was taught, adjusted and inherited generation after generation, explained by Coptis farmers. Site selection, planting seedling and preparing for the shed are the important steps in order to ensure the suitable timing for Coptis to grow (Figure 7). During the field work and research in the literature, it was found that the Coptis germplasm resources in Shizhu are very rich, mainly including Gedaye, gehuaye, Gexiye, Zhidaye, Zhihuaye and Zhixiye. However, after the selection and pilot planting, it was reported that Gedaye and Zhihuaye stood out with their high yields and medical efficacy and were promoted to plant in large scales at Shizhu.

Given the history of Shizhu CTPS discussed in Section 2, it was reported by the informants during interviews that most Coptis farmers and families in current generation had cultivated for at least thirty years, and retained traditional cultivating techniques. Valuable experiences, techniques and methods were passed down generation after generation (Table 2), which provides useful foundation for the next generation to grow Coptis (Zhou & Peng, 2012). During the field work, the process of baking the raw roots of Coptis (Figure 8) was observed, which serves as the very step to transform the Coptis plant into the medicinal ingredient. The filtering step in the particular cage (Figure 9) differentiates the quality of Coptis.

Table 1
Brief Process of Coptis Cultivated in Shizhu

Steps	Processes	Methods
1	Selection of breeds	
2	Seed collection and storage	Scaffolding stratification and cave collection
3	Nursery	1. The site selection; 2. Shade; 3. Site preparation; 4. Line the site; 5. Sowing; 6. Management (Thinning, ridging); 7. Grow seedlings in the woodland.
4	Transplanting	1. Site selection; 2. Prepare the site in the mountain; 3. Scaffolding shade (forest shade); 4. Ridging the site; 5. Shovel mud and smoke the soil; 6. Digging shed soil; 7. Ditching; 8. Base fertilizer; 9. Seedlings transplanted.
5	Field management	1. Shelter edge; 2. Fill gaps with seedlings and weeding, loosen soil; 3. Top-dressing; 4. Refurbish shed and brighten shed; 5. Pick flowers.



Figure 7
Important steps in nursing seedlings of Coptis at Shizhu (photographed by Qian TIAN)

Table 2
Processing procedures of Coptis in Shizhu

Steps	Processes	Methods
1	Equipment	Heatable baking bed (Kang in Chinese pin yin); 2. Trough cage (Bamboo-made); 3. Wood-based-panels
2	Drying	Bake the raw roots of Coptis; 2. Bake in different categories
3	Hair removal processing	1. Fill the cage; 2. Lift the cage; 3. Seal the cage; 4. Sieve and filter



Figure 8
Baking the raw roots of Coptis at Shizhu County (photographed by Qian TIAN)



Figure 9
Caging and filtering Coptis at Shizhu County (photographed by Qian TIAN)

Some farmers might use the machine to dig up land if Coptis was to be planted on certain flat terrain, but only a relatively small portion of them would do that. Although the machine can even reduce the workload as well as avoid a lot of labor costs (i.e. weeding and other more relaxed work-eighty RMB a day, scaffolding and other heavy work-150-200 RMB per day). However, that means of cultivating Coptis with machines could not produce high quality Coptis, as machines dig the shallow soil and made it easier to be compacted with rain, which would be detrimental to the roots of Coptis. Given those soil factors described in previous sub-section, Shizhu Coptis traditional production system was preserved and inherited with its advantages.

5. DISCUSSION

It is evident from this study that Coptis traditional production system as a designated China-NIAHS system is of great value historically, culturally and ecologically, which is the illustration of an interplay of the nature and its people during the civilization in the Dragon River watershed. Its complicated and strict process of cultivating and selecting Coptis seedlings, roots explicates the diligence and hard work of generations at Shizhu, which reflects the ‘bitter’ culture, or mostly interpreted as hardworking and diligent culture, embedded in traditional Chinese culture.

5.1 Shizhu CTPS in the “Bitter Culture”

“Bitter industry” produces “bitter culture”. “Bitter” as one of the five flavors, refers to the taste of Coptis or the bile, which is in contrast with “sweet”. The ancient poetry “Poetry Tang style and Cai Ling” depicts that the beauty lies in the bitter wild vegetables, which grow in the mountains. Coptis, when boiled, becomes the yellow soup, which is called the “yellow water.” Since ancient times, there are some Coptis-related idioms which describe its bitterness, such as the saying that ‘nothing could be more bitter than Coptis’, and ‘people who are dumb cannot tell how bitter they are after they eat Coptis’. People

also use Coptis as a synonym to “bitterness”. Given that Coptis lives and grows in the tough environment and harsh weather, it is conceptualized as a symbol of “bitterness”, which generates the bitter culture at Shizhu. Residents, particularly those Coptis farmers planted Coptis in a severe conditional and they worked diligently and persistently with qualities, strong will and resilience. Besides, “bitter culture” is China’s traditional inspirational culture, interpreted as one of the elements in the core values of the eastern culture to be hard working. There is a very deep-rooted value in Chinese culture that people need to endure hardship before they eventually achieve. One saying states that suffering more and more bitterness would make a human stand out. The value of pursuing achievement through hardships best reflects the important symbol of the cultural characteristics of China.

In traditional Chinese culture, the “bitterness” is not of the taste but reflects a cultural element. Literally, the word “bitter” can be used as a noun, an adjective, a verb, etc. in Chinese rhetoric; it is very complicated in meaning with various connotations, such as “uncomfortable”, “diligence”, “grit”, “earnestness”, “endeavor”, “poverty”, “urgent,” “very “, and so on, more than twenty unique meanings. There are more than 3000 poems involving bitter or bitter feelings in China before the modern era, and numerous cultural interpretations of “bitterness” in ancient and modern poetry, literature, academic books and folklore in China, forming a unique “bitter culture” with rich connotation, which shapes, and has a great impact on, people’s world view, mindset, values, ethics and philosophical perspectives. The qualities embedded in the Chinese traditional culture, such as hard work, kindness, honesty, dignity, courage, are also the manifestation of the influence of “bitter culture”.

Given the political contexts, globalization and cultural diversity in the world, China has developed a lot since the opening-up and reform policy. The “bitter” culture, as an indispensable element of Chinese traditional culture, serves as a “glue” to connect the old hardworking people in the critical situations with the gradually developed life to work harder for the future development. Besides, it would support the farmers spiritually and psychologically at Shizhu to be more confident to improve their living conditions in the deprived areas. To analyze this complicated “bitter culture”, three dimensions would be focused: 1) ontological meaning of “bitter” in Chinese traditional culture; 2) “bitter-sweet idea” which is built upon dialectical philosophy and psychology; 3) methodological systems to appreciate the beauty of success from bitter, then to happiness. With a long history and a large population, China is a developing country that has worked hard and would continue to work hard to improve. The traditional culture of bitterness would serve as a leverage to work together toward the dream. In Shizhu, it is the indigenous culture that connects the

residents and the Coptis together, which makes this agriculture heritage system unique and significant.

5.2 Shizhu CTPS Development Approaches in the Watershed

With the implementation of the national strategy on precise poverty alleviation, the economy of Shizhu County is also developing continuously. However, overall, it is still categorized as a deprived county at a national-level and requires to seize the opportunity to fully integrate various resources such as industrial, landscape, ecological and cultural resources. It is timely to manage this China-NIAHS appropriately and thoroughly to promote it to be a GIAHS system, which would develop Shizhu CTPS sustainably.

Shizhu Coptis Traditional Production System (CTPS) is a farming cultural ecosystem created by the Tujia ethnic minority group, and is the main support on their livelihood and development at Shizhu County, which build a profound humanistic foundation. As a living legacy preserved till today, Shizhu CTPS still plays an important role in modern life, and it has been nominated by the UN Food and Agriculture Organization as a candidate project of GIAHS. It has rich value with regards to economic crop diversity and cultural diversity. Drawing on its cultural, ecological history and significance and the complexity of such a system in the “watershed” framework, the following section discusses the possible approaches and strategies to sustain this important agricultural heritage system.

The proposed approaches to the development of Shizhu CTPS can be summarized as “one pool and one demonstration area”, “two bases” and “three centers”, which is demonstrated in Figure 9 through the interplay and interdependence of four systems, drawing upon Brofenbrenner’s research. “One pool” refers to the China Coptis gene resource pool, which was initiate by Shizhu County Committee and supported by the national government to develop Coptis medicinal resources in China. It focuses upon collecting the resources of the Coptis species and establishing a base for the preservation of Coptis germplasm resources in Huangshui County, Shizhu County to preserve the Coptis gene resources. The importance and value of this gene pool would not be anticipated without the government’s strategic planning. Shizhu government, in the meso-system serves as the performer of the national government, which locates in the macro-system in figure 9, and also the executive body of the particular strategies in the national level. Besides, the designated budget from the local government would contribute to the management of CTPS.

“A demonstration area” refers to building a model eco-tourism centred area related to Coptis. Given the agreeable weather and quality air at Shizhu with its specialty in CTPS, a concept of green tourism is more likely to be established with the contribution of local residents as the micro-system (Figure 9) and Shizhu government and its community as the meso-system. A special eco-

friendly resort could be designated, to promote Coptis traditional production system, as well as the create more job opportunities for the local labour. Furthermore, the exo-system of the soil, weather and the development of technologies would also impact on the management of this traditional system, which would be reflected on Coptis yields and its quality.

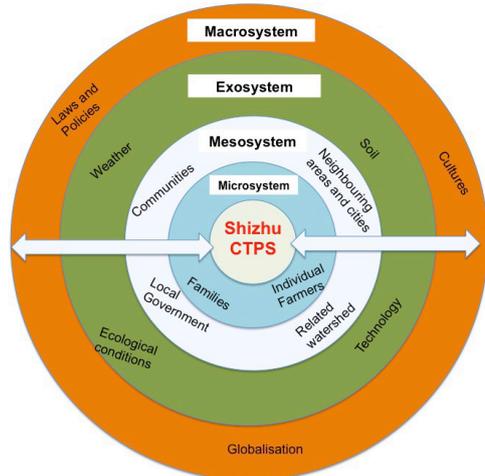


Figure 9
The possible working system of conserving and managing Shizhu CTPS

“Two bases” include the ecological protection base and Coptis medicinal material processing base. The construction of the ecological protection base shall stabilize the area planted with Coptis and develop its cultural elements of CTPS. The construction of the Coptis processing base shall encourage the external capitals to enter into the industry of Coptis through the planning, guidance and policy support in the macro-level so as to enhance the competitiveness of the brand of Shizhu Coptis in China. The “three centers” refer to China Coptis Seedling & Breeding Center, China Coptis Trading and Logistics Center, China Coptis Engineering Technology Research Center. With the facilitation of three centers working collaboratively, the use of modern management methods and scientific research innovation would prompt to integrate the Coptis industry. Through the above-mentioned approaches, with the framework of the standardization of important agricultural cultural heritage in the world, Shizhu CTPS is more likely to fully realize the green, ecological and sustainable development and effectively promote the construction of the Dragon River watershed ecological reserve with Shizhu County as its core.

6. CONCLUSIONS

Shizhu Coptis traditional production system in Chongqing, China is a farming culture ecosystem created by indigenous people in the Dragon River watershed. As a living legacy preserved till today, the cultivation, processing and marketing of Shizhu CTPS still plays

an important role in people’s life in modern era. Shizhu Coptis Traditional Production System is an agricultural heritage project that has the multiple layered values of promoting the development of local agricultural economy and preserving the inheritance of regional culture. It has been acknowledged as an important agricultural cultural heritage in China. However, several factors might affect its future management. Firstly, the lack of farmers, particularly farmer experts in CTPS because of the urbanization and migration at Shizhu County, would bring difficulties to the labor force in cultivating Coptis. Second, deforestation in the watershed would deteriorate the soil, which would be less likely to produce quality Coptis. Thirdly, the insufficient knowledge of the value of Coptis by the local residents and the people in the wider communities would destroy the core cultural element of CTPS, as well as its yield. It implies that more endeavor from various bodies and levels in the working system (Figure 9) would be connected to ensure the sustainable development of CTPS, and promote the construction of ecological civilization (Li, 2013). To address the importance and urgency of this agriculturally, socially and culturally system, further research on its values and impact factors could be conducted in interdisciplinary areas by means of a mixed methods approach. In the analytical framework of the watershed in this study, the complexity of Shizhu CTPS was explicated, which would shed light on an anthropological perspective of studying the agricultural heritage systems in China and globally. With its unique medical contribution, CTPS is differentiated from the other agricultural heritage systems whilst sharing similarities with them with regards to its values and importance in human development and civilization. Confronted with the potential risks in the development of CTPS, how could the interdependent systems in figure 9 could work effectively, and the extent to which the various levels of contributions from social groups, organizations and enterprises would be attracted to work collaboratively would be on the agenda of future research to sustain CTPS development.

REFERENCES

- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.
- Casti, J. (1944). *Complexification: Explaining a Paradoxical World Through the Science of Surprise*. HarperCollins, New York.
- Chen, H., Deng, C., Nie, H., Fan, G., & He, Y. (2017). Transcriptome analyses provide insights into the difference of alkaloids biosynthesis in the Chinese Goldthread (Coptis chinensis Franch.) from different biotopes, *PeerJ*, 5, e3303.
- Cui, L, Liu, M, Chang, X., & Sun, K., (2016). The inhibiting effect of the Coptis chinensis polysac-charide on the type II diabetic mice. *Biomedicine & Pharmacotherapy*, 81, 111-119.

- Friedemann, T., Ying, Y., Wang, W., Kramer, E. R., Schumacher, U., Fei, J., & Schröder, S., (2016). Neuroprotective effect of *Coptis Chinensis* in MPP+ and MPTP-induced Parkinson's disease models. *The American Journal of Chinese Medicine*, 44(05), 907-925.
- Fuller, T., & Min, Q. (2013). Understanding agricultural heritage sites and complex adaptive systems: The challenge of complexity. *J. Resour. Ecol.*, 4, 195-201.
- Fuller, A. M., Min, Q., Jiao, W., & Bai, Y. (2015). Globally Important Agricultural Heritage Systems (GIAHS) of China: The challenge of complexity in research. *Ecosystem Health and Sustainability*, 1(2), 1-6.
- Hou, Y., & Wang, J. (2017). Study on agricultural cultural heritage from the perspective of ethnic regional development - "Traditional Production System of *Coptis* in Chongqing. *Journal of Agronomy*, 7(11), 80-85. (In Chinese)
- Kaboli, P. J., Rahmat, A., Ismail, P., & Ling, K. H., (2014). Targets and mechanisms of berberine, a natural drug with potential to treat cancer with special focus on breast cancer. *European Journal of Pharmacology*, 740, 584-595.
- Jiao, W., Fuller, A. M., Xu, S., Min, Q., & Wu, M. (2016). Socio-ecological adaptation of agricultural heritage systems in modern China: Three cases in Qingtian County, Zhejiang Province. *Sustainability*, 8(12), 1260.
- Jiao, W., & Min, Q. (2017). Reviewing the progress in the identification, conservation and management of China-Nationally Important Agricultural Heritage Systems (China-NIAHS). *Sustainability*, 9(10), 1698.
- Kauffman, S. A. (1990). The sciences of complexity and origins of order. In *PSA: Proceedings of the biennial meeting of the philosophy of science association* (No.2, pp.299-322). Philosophy of Science Association.
- Kauffman, S. A. (1992). The origins of order: Self-organization and selection in evolution. In *Spin glasses and biology* (pp. 61-100).
- Kamath, S., Skeels, M., & Pai, A. (2009). Significant differences in alkaloid content of *Coptis chinensis* (Huanglian), from its related American species. *Chinese Medicine*, 4, 1-17
- Li, W. (2013). *The significance of conservation of agricultural cultural heritage* [EB/OL]. <http://cpc.people.com.cn/n/2013/0118/c64387-20252130.html>, 2013-01-18. Accessed on 15 September 2020. (In Chinese)
- Li, W., Min, Q., & Sun, Y. (2006). Discussion on several problems in the study of natural and cultural heritage protection. *Geographical Research*, 25(4), 561-569. (In Chinese)
- Manson, S. M. (2001). Simplifying complexity: a review of complexity theory. *Geography Forum*, 32(3), 405-14.
- McCulloch, W. S., & Pitts, W. (1943). A logical calculus of the ideas immanent in nervous activity. *The Bulletin of Mathematical Biophysics*, 5(4), 115-33.
- Min, Q. (2006). The world's major agricultural heritage - a new type of world heritage. *Resource Science*, 28(4), 206-208. (In Chinese)
- Min, Q. (2011). The characteristics and conservation of agricultural heritage systems. *World Environment*, 1, 18-19. (In Chinese)
- Tjong, Y, Ip, S., Lao, L., Fong, H. H., Sung, J. J., Berman, B. & Che, C. (2011). Analgesic effect of *Coptis Chinensis* rhizomes (*Coptidis Rhizoma*) extract on rat model of irritable bowel syndrome. *Journal of Ethnopharmacology*, 135, 754-761.
- Whitehead, A. N. (2011). *Science and the modern world*. Cambridge University Press.
- Wiener, N. (1961). *Cybernetics: Or, control and communication in the animal and the machine*. MIT Press, Cambridge, MA.
- Xiang, K.L., Wu, S. D., Yu, S. X., Liu, Y., Jabbour, F., Erst, A. S., Zhao, L., Wang, W., & Chen, Z. D. (2016). The first comprehensive phylogeny of *Coptis* (Ranunculaceae) and its implications for character evolution and classification. *PLoS One*, 11(4), p.e0153127.
- Zhou, X., & Peng, F. Z. (2012). Shizhu *Coptis* Ethnobotany. *Hubei Agricultural Sciences*, 51(2), 221-227. (In Chinese)