

# *Evolution Evaluation and Optimization of Industrial Structure in Ecologically-sensitive and Contiguous Severely Poverty-stricken Areas in West China*

—A case study of the Three Parallel Rivers of Yunnan Protected Area

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**Abstract**—Concentrated and contiguous severely poverty-stricken areas are the key areas which restrict the construction of the comprehensive well-off society in our country. As China's typical ecologically-sensitive and underdeveloped region, the Three Parallel Rivers of Yunnan protected area has obviously improper industrial structure. By means of diversification ratio and location quotient (LQ), an overall evaluation on evolution of the industrial structure in the area is concluded: unrealistically advanced evolution, lack of diversification and low specialization. Poverty alleviation development of this region through industrial structure optimization requires the acceleration of applying agriculture with plateau characteristics in ecological production, implementation of new-mode industrialization tolerable to the region and reinforcement of the strategies of playing the role of a tourist industry cluster in cultivation and driving the development.

**Keywords**—contiguous severely poverty-stricken areas, poverty alleviation and development, industrial structure, Three Parallel Rivers

The imbalance of regional economic development in China has long been prominent, and some poor areas have become a major restriction to the overall development of our economy. In 2011, the State Council defined 14 concentrated and contiguous severely poverty-stricken areas as the main battlefield of China's poverty alleviation development for the next 10 years to come in the China Rural Poverty Alleviation Development Program (2011-2020) based on the data of per capita GDP, per capita budgetary income and per capita net income for farmers of county level in the past 3 years or so and on the enhanced efforts for poverty alleviation in the former revolutionary base areas, areas inhabited by minority nationalities, remote and poverty-stricken region.[1]

The 14 areas include Liupan Mountain area, Qinba Mountain area, Wuling Mountain area, south area of the Great Xing' an Mountain, Wumeng Mountain area, rocky desertification area of Yunnan, Guangxi and Guizhou, mountainous area in the border of west Yunnan, Yanshan-Taihang Mountain areas, Luliang Mountain area, Dabie Mountain area, Luoxiao Mountain area, Three South Xinjiang

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districts, areas inhabited by Tibetans in Qinghai, Sichuan, Yunnan and Gansu and Tibet. On the whole, concentrated and contiguous extraordinarily poverty-stricken areas share the main features of old revolutionary areas, areas inhabited by minority nationalities and mountainous areas in the borders. Preliminary statistics show per capita net income for farmers in those areas were less than 3500 Yuan in 2011, almost half of the national average [2] Therefore, these regions have been the biggest bottleneck to achieving the overall balanced development of our economy in the future, especially to the collective construction of a better-off society.

## I. INTRODUCTION OF THE SUBJECT AREA

Three Parallel Rivers, located in northwest Yunnan, originating from Nujiang River, Lancang River, Jinsha River in Qinghai and Tibetan Plateaus, run 170 kilometers in parallel north-south through Dandanlika Mountains, Gaoligong Mountains, Mount Fury, Yunling Mountains and other mountains. Hence the name "Three Parallel Rivers". Three Parallel Rivers areas cover Lijiang Yunnan, Dêqên Tibetan Autonomous Prefecture, Nujiang Lisu Autonomous Prefecture with an area of 41,000 square kilometers. The unique geographical location where the three major plates of East Asia, South Asia and Qinghai-Tibet Plateau meet and long-term evolution of the Earth have created a distinctive natural landscape and rich biodiversity in this region. In 2003, UNESCO added the Three Parallel Rivers area on the World Heritage List which is our country's largest world heritage site. For a long time, the area has lagged behind nationwide on the list of economic development due to its geographical environment and backward infrastructure. In 2012, per capita net income for farmers in the region was 4168 Yuan, much lower than the provincial average of 5417 Yuan and almost half of the national average of 7917 Yuan. The 14 concentrated and contiguous extraordinarily poverty-stricken areas include 10 of 12 counties and districts in the Three Parallel Rivers area except the ancient city district and Huaping County, Lijiang. 7 counties of 10 in Nujiang prefecture and Lijiang City belong to the mountainous area in the border of west Yunnan while Dêqên prefecture is part of areas inhabited by Tibetans. As

China's typical ecologically-sensitive and underdeveloped region, the area has obviously improper industrial structure. Domestic and foreign development experience shows that a proper industrial structure has a direct bearing on the level of regional productivity and affects the speed and quality of regional economic growth and thus the overall living standards of the local people. Only by constructing a proper and orderly industrial structure, will the regional economic development

advance in the optimal direction [3]. Based on the current situation of industrial development in the contiguous and severely poverty-stricken Three Parallel Rivers area, this paper is designed to discuss industrial structural characteristics of the ecologically-sensitive and underdeveloped region and propose industrial development policies for regional poverty alleviation and sustainable development through industrial structure optimization.

TABLE I. COMPARISON OF MAJOR MACROECONOMIC DATA BETWEEN THE SUBJECT AREAS, THE NATIONAL AND YUNNAN PROVINCE IN 2013

Area \ Category	Per capital household savings (Yuan)	Per Capita net income of rural residents (Yuan)	Urbanization rate(%)	Incidence of poverty under 2010 poverty standard (%)	Per capita budgetary income (Yuan)
The Three Parallel Rivers area	12481	4212	27.52%	42.3%	2321
Yunnan Province	16623	5417	39.31%	21.6%	2871
The National	29542	7917	52.57%	10.2%	4659

## II. THE CHARACTERISTICS OF CURRENT ECONOMIC AND SOCIAL DEVELOPMENT IN THE THREE PARALLEL RIVERS AREAS

### A. Bad regional natural and geographical environment

The Three Parallel Rivers areas, located in Hengduan Mountain Valley in the southern portions of the Qinghai-Tibet Plateau, are covered with mountains and valleys with an average altitude of 2600 meters. 97.1% of the region are mountains and plateaus with an uneven terrain. Plains among those mountains is the main available form of local land use, the populated place and the center for economic development with an approximate area of 1300 square kilometers, occupying 2.9% of the region. The bad geographical condition leads to small regional scale of urbanization and scarce urban land and arable land. In the case of Nujiang prefecture, available land resources are 236.07 km<sup>2</sup>, accounting for 1.61% of the total. Arable land with the slope of greater than 25° accounts for 75% of the total area of the prefecture. 80% of Dêqên prefecture in the north of the Three Parallel Rivers areas is located at an altitude of more than 3000 meters. Due to cold climate and low air temperature, crop growth is slow, production of most cash crops and crops are low and agriculture is heavily dependent on weather in a primitive way.

### B. Backward infrastructure and low-level economic development

The Three Parallel Rivers area which stands in the southwest frontier of China, far away from economically developed areas and main traffic routes possesses bad location conditions both provincially and nationally. As of 2012, there was even no one kilometer expressway. Its present road class is low and about 60% of roads are rated class four or below with weak road capacity in the rainy season. With poor highway network levels, major towns and cities in the region fail to be connected by a convenient traffic network. For example, the straight-line distance between Fuliuku, Nujiang prefecture to Lijiang measures 180 kilometers. Because there is no through highway between the two places, it is necessary to make a detour of 410 kilometers around Dali. Considering the low-

class roads, the whole journey takes 9 hours. Backward traffic hinders interconnected development between the two places.

The 2013 government revenue of the Three Parallel Rivers areas reported 8.395 billion Yuan, accounting for 3.1% of the provincial total. The urbanization rate was 27.52%, far lower than 52.5% of the national's and 39.3% of Yunnan's. The poverty-stricken area and the number of poor population are large. According to the 2012 poverty standard of 2300-Yuan household net income per capita, the incidence of poverty of Nujiang prefecture reached up to 54%. Nearly 61% of the population lives in high-altitude mountainous areas and mid-levels. The geographical environment causes sparse distribution of the people, which makes joint development difficult. Some portions of Nujiang and Dêqên prefectures disclose a certain degree of concentrated distribution of the poor population—it is common that the whole township and county are stricken by poverty.

### C. Highly-sensitive ecological environment

Due to its unique geographical location and geological structure, the Three Parallel Rivers region has been known as one of the most biologically diverse areas in China, ranking first among 17 "key regions" for biodiversity conservation. As the world's important bio-gene pool and China's largest world natural heritage site and scenic spot, the Three Parallel Rivers area boasts 3 national and 10 provincial nature reserves. Accounting for 0.6% of the national land area, the region possesses more than 1/3 of national higher plants and animal species, thus constituting one of most the productive regions in global landscape type, ecosystem type and biological species. As the important ecological functions result in high sensitivity of its ecological environment, both inadvertent human activities and economic development may cause devastating damage to the regional ecology. Therefore, the region is sensitive and critical to industrial choice and layout and development intensity in economic development. In China's latest division of main function areas, the Three Parallel Rivers area has been included under the category of limited and forbidden development areas as an important ecological function area in China.

*D. Prominent non-institutional factor of poverty restriction in regions inhabited by ethnic minorities*

Institutional poverty has been regarded as the source of poverty in most of China's backward regions. Poverty in the Three Parallel Rivers area is dependent on non-institutional factors in addition to institutional ones. 16 ethnic minorities reside in the area which is one of the main regions inhabited by ethnic minorities. Under the influence of their own traditional culture, ethnic minorities have developed unique views towards production, consumption and investment, which are an obstacle to their getting rid of poverty and becoming better off to a certain extent. Their traditional views are indicated in little knowledge on the market, obviously irrational consumption, heavy on righteousness while light on interest, reluctance to leave the hometown and resignation of themselves to his/her fate. According to the author's study, poverty in the Three Parallel Rivers area has been closely connected to non-institutional and traditional cultures and values in addition to the poor natural geographical environment. The most striking expression of non-institutional factors is prevalent extravagant consumption beyond the family's affordability. Extravagant weddings and funerals, guest invitation and gift giving are all prevalent in the whole region. Households and villages pay attention to eating and drinking. The Yi and Lisu nationalities spend 40%—50% of the family's annual income on weddings, funerals, sacrifices and entertainment of guests. In Dêqên prefecture, cattle and other livestock are regarded as a symbol of family wealth and the number of them is used to measure affluence of a family. Therefore, many local families rarely sell livestock products but leave them for food, thus making it difficult to translate wealth into economic benefits.

III. EVALUATION ON EVOLUTION CHARACTERISTICS OF INDUSTRIAL STRUCTURE IN THE THREE PARALLEL RIVERS AREA

*A. Unrealistically advanced industrial structure*

The properness of the industrial structure determines quality and benefit of economic development of a region or country. British economist William Petty is the first to point out those countries or regions were placed in different stages of national income and economic development because of the disparity in the industrial structure [4]. Clark divided three industries and at the same time, talked in the Conditions for Economic Progress that labor force concentrates in the primary

industry in the early days of social development; with the progress of social economy, it gradually migrates to the secondary industry; and when economy came along to a higher stage, labor force will concentrate in the third industry [5]. H.B.Chenery revealed the change tendency of the industrial structure by constructing a standard industrial structure model—As economic development advances, the industrial focus shifts from the first to secondary industry, and then from the secondary to the tertiary industry, the conversion representing the general trend of industrial structure evolution. In view of the world's experience of economic development, advanced industrial structure has been the main goal of industrial development in many countries and regions [6].

As the Three Parallel Rivers area is located far away from the developed eastern regions of China, the 30 years after the reform and opening-up has witnessed its slow economic development with weak industrial foundation, slow industrialization and the dominance of agriculture. As of 1997, agriculture had remained the primary industry with an industrial structure of “primary, tertiary and second” industry in sequence. From 1998 to 2001, an industrial structure of “tertiary, primary or second” formed thanks to the rapid rise of the tertiary industry. Since 2002, “tertiary, second and primary” industrial pattern has been developed with the accelerated growth of industry overtaking the primary industry (see table 1). The industrial structure in the Three Parallel Rivers area is at the advanced stage in view of the structural evolution. However, advancement does not represent properness of the industrial structure in the region. The advanced but improper industrial structure is unrealistically advanced. The region is still categorized under the underdeveloped regions and in the early stage of industrialization in terms of both local industrial development indicators and of per capita income for residents and other factors. But why the industrial structure has evolved into such an advanced stage of “tertiary, second, primary”? The root cause is that the region has been vigorously expanding its tourism by virtue of its world-renowned tourist resources and brand. As a result, while the industry development is at the start-up stage, the tertiary industry has gained its strong growth momentum and risen to the biggest industry driven by tourism supporting economic development in the whole region. Obviously, such an industrial structure is unreasonable because what behind the advanced industrial structure is weak industry and overly reliance of the tertiary industry on tourism in. The Three Parallel Rivers area has a long way to go in industrial optimization and upgrading for the next few years to come.

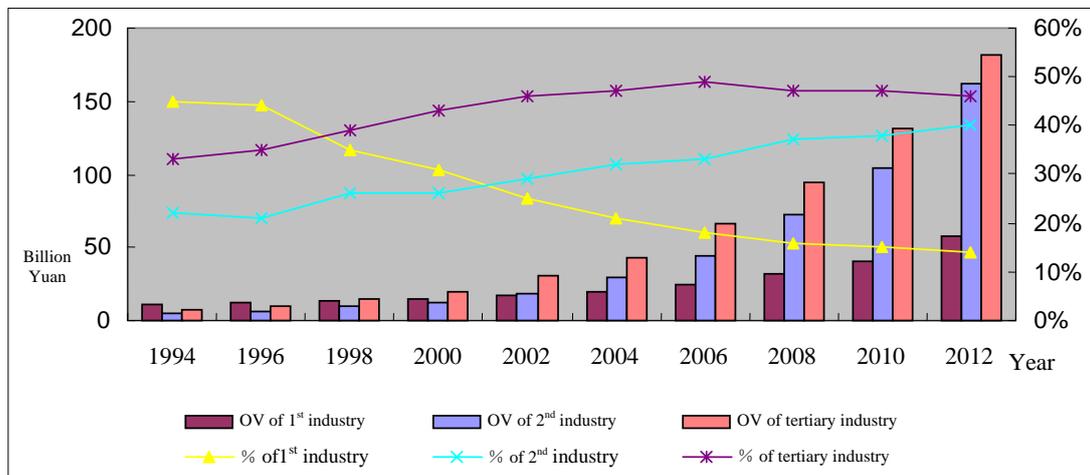


Fig. 1. Three changes of industrial structure evolution in the three parallel rivers area

B. Lack of diversified industrial structure

$$ESD = \sum (P/P, S/P, T/P)$$

The experience of industrial development from all over the world shows that advances of industrial structure are characterized by diversification. How diversified an industrial structure indicates the maturity of industrial development in a region or a country. Diversification coefficient of industrial structure, with the first industry of national or regional economy as the baseline value, evaluates the outputs of the second and the tertiary industries and then summarizes the evaluation results. The basic formula is expressed as:

$$ESD = \sum (P/P, S/P, T/P)$$

In the formula, ESD represents diversification coefficient of industrial structure; P, output of the primary industry; S, output of the secondary industry; and T, output of the tertiary industry. Industrial structure diversification ranges from 1 to infinity. The larger the coefficient is, the more reasonable the regional industrial base becomes. In the early days of industrialization, the industrial base is just established and therefore, industry remains subordinate to the long-established agricultural production[7]. For instance, the diversification coefficients of industrial structure for the United Kingdom, France and the United States were less than 1.8 in the early 19th century (in 1800) and for China, 1.4 in 1950. With rapid progresses of manufacturing and business services in the past 200 years, the diversification coefficients of industrial structure in developed countries are increasingly larger, exceeding 60 for Japan, the United States, Germany and other developed countries[8]. And the coefficients were 81 for Germany and 79.4 for the United States in 2012 whereas the number is 6.9 for the Three Parallel Rivers area, lower than the national average of 9.91. The main reasons for that are as follows. First, the proportion of agriculture in the gross output is still big, the ratio of the three industries in 2012 being 14:40:46. The higher percentage of the primary industry in regional GDP indicates relatively lagging regional economy and industry. Second cause is the low

industrialization level. The region's GDP accounted for 3.9% of the total of the province in 2012 while the ratio of its total industrial output to that of Yunnan was only 3.3%, indicating that the secondary industry failed to play a leading role in local economic development. And weak industrial development remains the most crucial factor that restricts local economic development.

C. Low specialization of industrial structure

Industrial specialization is usually used to measure the specialized sectors and the degree of specialization in the regional industrial structure. In order to obtain a more comprehensive understanding of the specialization level of industrial structure and the degree of industrial agglomeration in the Three Parallel Rivers area, this paper introduced location quotient to evaluate the specialization level in the subject area. Location quotient, also termed specialization rate was first proposed and applied in location analysis by P. Haggett and is usually used to judge whether an industry comprises regionally specialized sectors in regional economics. In order to better reflect the specialization level of industrial structure in the region, this article evaluates the specialization level of the subject area in terms of the location quotients of output value of and labor force in a certain industry.[9] The formula is:

Location quotient of output value:  $Q = (A_0/A_1) / (B_0/B_1)$

In the formula, A0 and A1 represent the net output value of a certain industry while B0 and B1, net output value of all industries in the subject region (prefecture, city) and a region of one-level higher than the obvious (province) respectively. And Q represents the location quotient of output value.

Location quotient of employment:  $Z = (J_0/J_1) / (C_0/C_1)$

In the formula, J0 and J1 represent labor force of a certain industry while C1 and C2, the number of employed persons in the subject region (prefecture, city) and a region of one-level higher than the obvious (province) respectively. And Z represents the location quotient of employment. By formula, the location quotient of the Three Parallel Rivers area relative to the national and Yunnan in 2012 is calculated (Table 2).

TABLE II. LOCATION QUOTIENT OF THE THREE PARALLEL RIVERS AREA RELATIVE TO THE NATIONAL AND YUNNAN

Industry	Location quotient of output value			Location quotient of employment		
	Primary industry	Second industry	Tertiary industry	Primary industry	Second industry	Tertiary industry
National	1.21	0.61	1.38	1.18	0.56	0.98
Yunnan	1.08	0.85	1.24	1.02	0.79	0.94

If the location quotient is greater than 1, the industry is usually considered as a specialized sector in the region; and the bigger the location quotient is, the higher the specialization becomes. If the quotient is less than or equal to 1, the industry does not have the comparative advantage in the region; and the smaller the value is, the worse the specialized development becomes. The study of the location quotient shows that: the location quotient of output value and location quotient of employment of the primary industry in the Three Parallel Rivers area relative to the national and Yunnan are 1.21, 1.08 and 1.18, 1.02 respectively, all greater than 1. And the quotients for the second industry are all less than at 0.61, 0.85 and 0.56, 0.79 respectively. But the location quotient of output value and location quotient of employment relative to the national and Yunnan for the tertiary industry are divergent with the former greater than 1 at 1.38 and 1.24 while the latter, less than 1 at 0.98 and 0.94.

It is safely to say the primary industry in the Three Parallel Rivers area has a certain degree of specialization which is at a low level. The main cause is that agriculture has been an integral part in the local economy for a long time as the main economic source of local rural residents. The second industry

with the small location quotient failed to develop into a specialized sector in the area and the industrial development gap between the region and the whole country and Yunnan is significant, which constitutes another major reason for the overall economic underdevelopment in the Three Parallel Rivers area. The tertiary industry takes an advantage in specialization over the national and Yunnan, which mainly stems from its advanced development of the tourism industry stimulating the overall specialization of the tertiary industry. But the proportion of primary industry employment hovers at a high level (Table 2). In 2012, the employment ratio of the three industries in the region was 55.9 :15.0:29.1 in sequence, reflecting a noticeable difference from that of the national (33.6:30.3:36.1). By the ratio, more than half of the population still relied on agriculture for a living, the second industry was far from playing its role in stimulating employment and the tertiary industry with high-level specialization had not attracted most of labor force, which reflects that tourism only contributes to the tertiary industry in output value rather than playing its part in stimulating employment and promoting all-round social development and that the region's economic development relies too much on tourism to cause abnormal development to some extent; (Fig. 3).

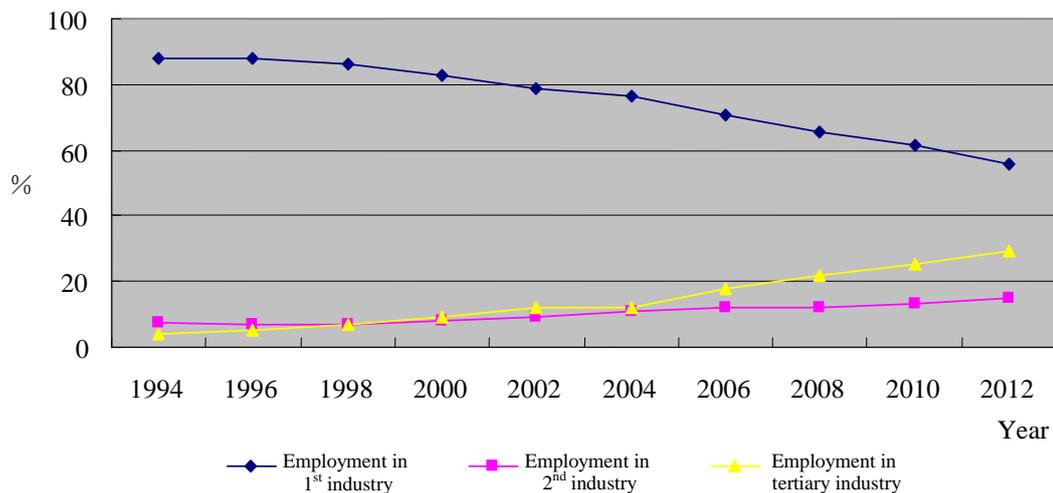


Fig. 2. Evolution of employment proportion of three industrial structures in the Three Parallel Rivers area

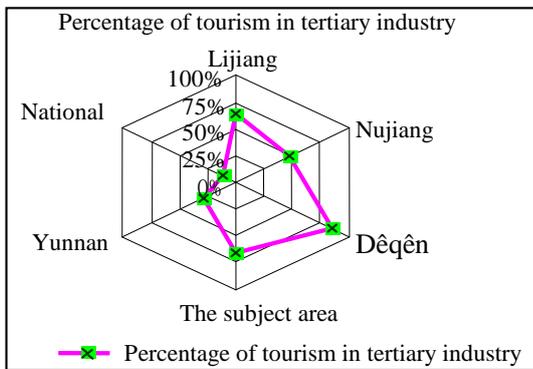


Fig. 3. Comparative study on the proportion of tourism to the tertiary industry in the subject area, the national and Yunnan

#### IV. COORDINATION AND OPTIMIZATION STRATEGY OF INDUSTRIAL STRUCTURE IN THE THREE PARALLEL RIVERS AREA BASED ON POVERTY ALLEVIATION AND DEVELOPMENT

##### A. Industrialization and Ecologization of agriculture with plateau characteristics

Primary industry development in the Three Parallel Rivers area is still at a relatively backward stage, mainly characterized by low agricultural productivity, outdated management ideas, inadequate agricultural scale, short industrial chain and low added value. Compared with most parts of the country, natural geography and climate in the Three Parallel Rivers area hinders its development of large-scale and mechanical modern agricultural management mode. But based on the regional agricultural background, the area is expected to develop its own distinctive agricultural industry with certain competitive advantages, depending on the unique plateau geographical environment: First, the area is abundant in resources of biological medicinal materials with high-valued brand and big development potentials, such as *Spirulina*, *Lepidium meyenii*, *cordyceps sinensis* and the other which all have gained some brand influence; second, the development basis for animal husbandry is promising as the yak, pien niu, black goat, wild boar and other species with plateau characteristics have a broad prospect; third, the food processing industry of such as wild fungi, *tricholoma matsutake*, preserved fruit and yukimomo is provided with higher added value.

Despite great advantages of characteristics resources, traditional household decentralized farming management impedes the formation of a large-scale centralized farming at present. In most portions of the region, characteristic agricultural products are marked by low production rate, backward farming technology and reliance on the weather, which hinder the establishment of modern agricultural production and management systems. At present, development of regional agricultural industry should strive to build a high value-added industrial chain with the market as the main body, aimed at the cultivation of large leading enterprises, relying on brand effect, based on the agricultural industrialization management model of “leading enterprises + farming base + farmers” so that a community of shared interest and risk between the farmers and enterprises is developed and

agricultural industrialization brings direct incomes and wealth to the farmers.

##### B. New-mode industrialization tolerable to the region

According to the national classification of main function areas, the Three Parallel Rivers area is generally defined as a restricted development region, which mainly serves as an important national ecological safeguard to provide ecological products. Restricted development areas are clearly defined as where large-scale and high-intensity industrialization and urbanization are restricted. For the moment, in view of existing weak industrial base, it is impossible to strengthen the industrial base and upgrade the overall industrial level in the region. Realistically, industrialized development of the area is unlikely to follow the path of other parts of the country and is required to take a road of new-mode industrialization based on the carrying capacities of the regional resources and environment. In the process of advancing the new-mode industrialization, the following challenged should be properly handled.

###### 1) Selective acceptance of industrial transfer to construct a regionally characteristic industrial system

Underdeveloped areas need to introduce into a large number of enterprises to expand themselves in the process of industrialization because of their poor development bases. Against the backdrop of international and domestic industrial transfer, some energy-intensive and highly-polluting enterprises are easily transferred into the region and therefore, supervision over the transfer industry should be enhanced. Starting from the region's own resource advantages and location characteristics, low-pollution, high-tech and potential industries should be selected with the aim of developing regional characteristic industry.

###### 2) Avoidance of development at the expense of resources

Such underdeveloped areas as the Three Parallel Rivers area are very likely to expand GDP at the expense of high consumption of resources by taking irrational strategies because of slow start-up of the industrial base and low-level development with the efforts to go after developed areas and achieve a well-off society at the pace of the national, resulting in a huge waste of resources and ultimately, failure of regional sustainable development. Considering the background condition of regional resources, mineral resources and hydropower are the leading industries of industrial development in the Three Parallel Rivers area. Mineral resources development should deal with the relationship between environmental restraint and development demand, and strictly implement the EIA system and project admittance system of mineral exploitation. With regard to hydropower development, current installed capacity of the new hydropower station in area reaches up to 20.58 million KW, which accounts for 5% of the exploitable capacity in the country. Controversy over the impact of hydropower development on the ecological environment in area persists and the backlash against the construction of hydropower stations on the upper reaches of Nujiang River is particularly strong. Therefore, the central and local governments should widely listen to the opinions of all parties before making the decision over development, strictly conduct the auditing over the environmental assessment of

hydropower construction and prohibit all development activities in the core area of highly-sensitive Three Parallel Rivers Heritage site.

### 3) Reinforcement of cultivation and stimulation of the tourist industry

At present, integration of the tourist industry with other industries has become an important breakthrough in the cultivation of a tourist industry cluster. Especially the integration with the leisure industry has brought a new wave of industrial development, including tourism, vacation, health preservation, cultural life experience, ecological endowment, housing and service industry associated with modern agriculture, all together constituting a pan-tourism industry cluster. The comprehensive and closely associated industry cluster involves and penetrated into many relevant sectors and industries, such as agriculture, industry, science and technology, medicine, education, environment, architecture, finance, etc. Therefore, the cultivation of pan-tourism industry cluster will play an important role in stimulating development of related industries, expanding employment and facilitating a proper industrial structure.

## V. CONCLUSION

It is safely to say that poverty in the Three Parallel Rivers area is related to its bad regional geographical environment to some extent. But from the perspective of current international economic development, a proper regional industrial structure is important guarantee to the realization of sustained growth of regional economy and improvement of people's income. The industrial structure in the Three Parallel Rivers area is characterized by unrealistic advancement and inadequate diversification and specialization. In the context of its backward industrial base, advance development of tourism leads to the rise of the tertiary industry but fails to optimize effective allocation of production factors among the industries and thus promote the sustained take-off of the regional economy. Liu Wei and some domestic scholars revealed that the main impetus of economic growth comes from the second industry in the early stage of industrialization, whose structural

expansion is of primary significance to regional GDP growth, progress of science and technology and expansion of employment. Therefore, the focus of the people's getting rid of poverty and becoming better off in the Three Parallel Rivers area is to boost the secondary industry and take the road of new-mode low-carbon industrialization tolerable to the region. The key mission of the advantageous and dominant tourist industry is to promote its interconnected development to maximally improve the people's income and employment in the region. The cultivation of the tourist industry cluster should start from creation and extension of industrial chain so as to benefit more farmer participants in the upper reaches.

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