

# Status Analysis of Agricultural Disasters in Yunnan Province

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**Abstract**—Yunnan Province is rich in natural resources; however, its geographical environment is complex. The mountains are high and the slopes are steep; the water-holding capacity of the cultivated land is poor; various climates are distributed crossly; and drought and flood disasters are prone to occur frequently. Based on the data of area affected by agricultural disasters and direct economic losses in Yunnan Province from 2006 to 2015, this paper studies the status of agricultural disasters in Yunnan Province, and concludes that drought and flood are main disaster-causing factors of agricultural disasters in Yunnan Province, and damage areas account for over 50% respectively of the total areas affected by agricultural disasters, and the two show a change trend of waning and waxing, with a correlation coefficient of -0.27.

**Keywords**—Agricultural disasters; Status of disasters; Disaster-causing factors; Correlation analysis

## I. INTRODUCTION

Yunnan Province has complex natural environment with high mountains and deep valleys, vertical and horizontal rivers, and a variety of crossly distributed climatic zones. It has obvious three-dimensional climate features and large regional diversity. There are many kinds of natural disasters in Yunnan, among which the meteorological disasters caused by drought, flood, cold damage and frozen injury, frost, hail, etc. are the most serious. Derived disasters related to meteorological factors occur at the same time, such as landslide, debris flow, forest fire, forest pest and disease, crop pest and disease, which posing great threats to agricultural production and social economy, and seriously affecting people's normal production and life.

Yunnan is one of the provinces with serious agricultural disasters in China. From 2009 to 2014, the abnormal climate of the province lasted for five years with frequent occurrence of drought, flood, hail, cold damage and frozen injury and so on. Its wide scope, long duration, deep degree and great loss are rare in the history of Yunnan Province. In 2010, the damage area of crops in the province was as high as 52.428 million mu, and the average damage area in the next few years was about 20 million mu, and the direct economic losses was as high as 52.819 billion yuan.

## II. RESEARCH STATUS OF AGRICULTURAL DISASTER LOSSES

The losses of agricultural disasters are often huge and heavy. Therefore, since the 1970s, with the research purpose of strengthening agricultural disaster early warning and prevention, reducing disaster losses, and establishing an

efficient and reliable agricultural disaster loss assessment system, relevant research on disaster losses related to providing guidance and suggestions for the government's disaster prevention and relief work, the improvement of the capital market's compensation means for disaster losses and the material reserves in various regions has attracted increasing attention from domestic and foreign scholars, and has achieved many results. The research on agricultural disaster losses mainly focuses on the two aspects of agricultural disaster risk assessment research and agricultural disaster loss measurement.

### A. Research on agricultural disaster risk assessment

The research on agricultural drought risk analysis and assessment at home and abroad mainly focuses on agricultural information analysis and natural disaster science and so on. As a hot research direction of agricultural economic management, the significance of agricultural risk assessment has become increasingly important, the three agricultural risk assessment theories and models based on risk factors, risk losses and risk mechanism have been gradually formed, and a series of research results have been produced. At present, the assessment theory and method based on risk factors is mainly the Disaster Risk Index (DRI) [1] cooperatively developed by the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the Global Resource Information Database (GRID). Since the 1980s, many domestic scholars have begun to pay attention to the research in the field of natural disaster risk, and agricultural risk assessment has been placed in an important position to study [2]. Based on modern risk analysis and assessment theory, Lei XU[3] constructed a basic framework for agricultural catastrophe risk assessment, and used numerical analysis methods such as quantile regression, Monte Carlo simulation, over-threshold model and risk value. He also used the quantile regression model to analyze the impact of extreme climate on crop yields, and constructed an extreme value statistical model of the probability distribution of agricultural catastrophe losses for the prediction of agricultural catastrophe disasters and the application research on agricultural catastrophe insurance rate determination. With the historical precipitation data, disaster data and socio-economic data of the southwest, Xinchuang XU et al.[4] made development and improvement based on the drought assessment index which takes the existing prefecture-level cities as the assessment units. In combination with different response of crops at different growth stages, they designed a set of calculation method based on probability measurement for the determination of drought grade loss rate of different crops, and constructed the numerical

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model of agricultural drought risk loss assessment to effectively evaluate the drought grade of unit crops.

#### B. Research on agricultural disaster loss measurement

The assessment of the direct economic losses of agricultural disasters includes estimating the size of the yield loss and the probability of loss occurring. Generally speaking, people are more concerned about the latter. In recent years, some scholars have begun to try to use the modern probabilistic method to study the probability distribution of agricultural extreme weather events in China (such as continuous drought, rainfall, sustained high wind, and hail). Typically, Xuyan DONG et al.[5] used the regression model to study the temporal variation characteristics and spatial distribution characteristics of the precipitation in Yunnan Province from 2000 to 2014, and found that the spatial fluctuation of precipitation is positively correlated with the distribution of water resources by calculating the correlation between water resources and precipitation; according to the snowfall data from October 2009 to March 2010 in Altay, Xinjiang, Zhongfeng TIAN et al.[6] used the Gumbel distribution to fit the temporal and spatial distribution characteristics of snowfall; Cuihua LU [7] used the maximum wind speed data from 1971 to 2008 in Zaozhuang City, Shandong Province for statistical analysis, and the results showed that the Gumbel distribution could well fit the extreme value distribution characteristics of the maximum wind speed in the region; Zhaohui CHEN et al.[8] used the annual maximum wind speed extremes data of Chongqing from 1990 to 1999 for statistical analysis, which showed that the Weibull distribution is the optimal extreme value distribution of the maximum wind speed in the region, expanding the data fitting distribution for the absence of long-term wind speed observation data. The mathematical statistics method has obvious advantages in fitting agricultural disaster events.

Therefore, the extreme value statistical method can be used to obtain the probability distribution model of agricultural disaster losses.

### III. ANALYSIS OF AGRICULTURAL DISASTER LOSSES IN YUNNAN PROVINCE

The land area of Yunnan Province is 394 thousand square kilometers, accounting for only 4.1% of the total area of the country. However, there are a huge variety of biological resources. This is due to Yunnan's complex topography and landform, with vertical and horizontal mountains and hills and dams and lakes spread all over the place. It belongs to the region with a wide distribution of karst landform in China. It has both volcanic hot springs and modern glaciers, as well as the climates of the three climatic zones of frigid zone, temperate zone and torrid zone, with prominent three-dimensional climate characteristics. It provides unique natural conditions for the growth and reproduction of a wide variety of animals and plants, creating the superior agricultural resources of Yunnan. With the implementation of major strategies such as "building a green and strong economic province, a strong national culture province and a bridgehead that China opens to the southwest", Yunnan will become the frontier of China's opening to the southwest. Although the agriculture proportion has continued to decline with the acceleration of economic development, the basic nature of agriculture in Yunnan Province's national economic development has not changed.

Crop disaster data from 2006 to 2015 (source: Yunnan Province Disaster Reduction Yearbook) are chosen in this paper to analyze the damage area of crops, the disaster-causing factors and the direct economic losses.

#### A. Agricultural damage area and direct economic losses

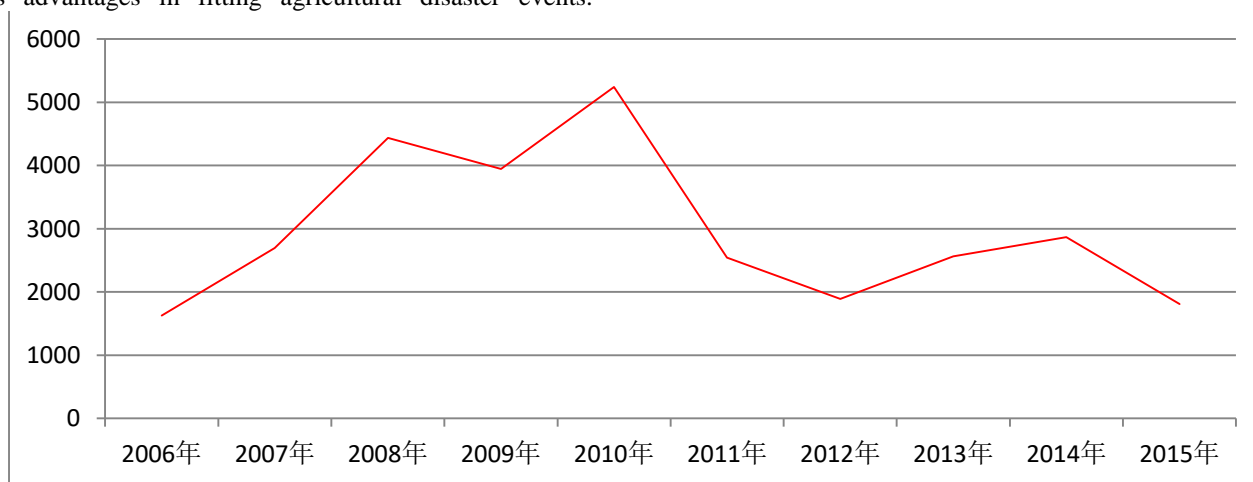


Fig. 1 Crop damage area of Yunnan Province from 2006 to 2015 (10 thousand mu)

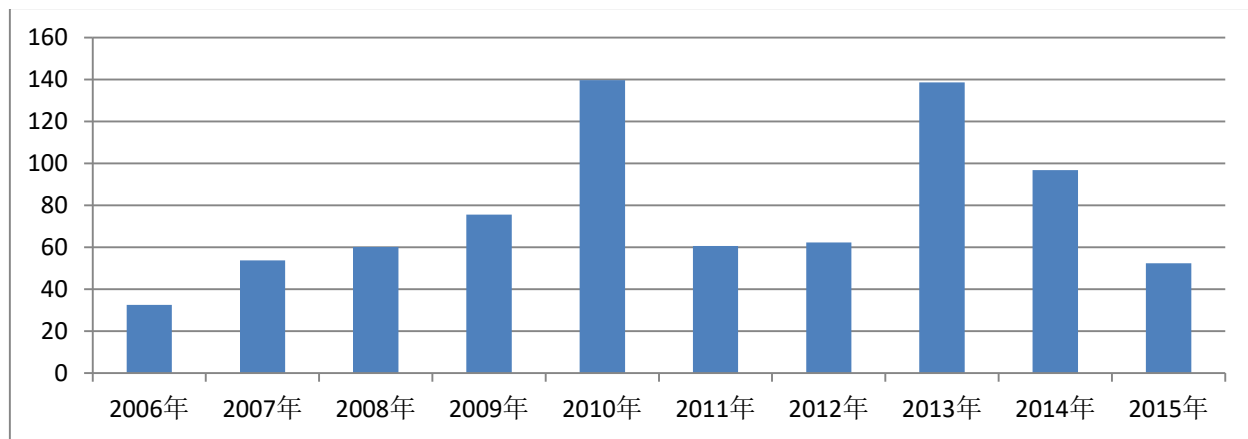


Fig. 2 Direct economic losses of agricultural disasters in Yunnan Province from 2006 to 2015 (100 million yuan)

It can be learned from Figure 1 and Figure 2 that the annual damage area of crops in Yunnan Province is over 15 million mu. The damage area is wide, especially in 2009, reaching 52.482 million mu; and the direct economic losses is as high as 13.97 billion yuan. The development trend of the agricultural natural disasters in Yunnan Province is increasingly serious and there are more than 280 counties have different types of agricultural disasters per year on the average. Agricultural disaster risk has become one of the major factors that affect the sustainable development of agricultural economy in Yunnan Province. Meanwhile, it often affects other industries of the national economy and the vital interests of the people.

#### B. Main disaster-causing factors of agricultural disasters in Yunnan Province

The soil of the cultivated land in Yunnan Province is mainly of mountain soil and the mountain land accounts for 94% of the total area, showing a step-like downward trend of high northwest and low southeast. The mountains with the slope over 25° accounts for 39.3% of the total cultivated land in the

province, among which, the proportion of sloping fields in northwestern Yunnan and northeastern Yunnan is as high as 60% to 90%. The forest coverage rate accounts for about 21.8%. And the central Yunnan and the eastern areas are of the well-known karst landforms in the country with complex geological structures and small water retention capacity. The whole province is located in the transition zone between the eastern monsoon region of China and the Qinghai-Tibet high and cold zone, and it is a transitional zone influenced by the circulation of various monsoons (East Asian monsoon, South Asian monsoon, and plateau monsoon) with distinct dry and wet seasons. In the dry season (from November to April), the precipitation is scarce and it is not easy for the shallow soil layer to store water. The winter drought and spring drought are easy to be formed and in severe cases, the continuous drought from winter to summer may occur. In the rainy season (from May to October), the precipitation is concentrated and influenced by topography and other factors, there are heavy rain in short times and disasters such as flood, landslide, and debris flow are prone to occur.

TABLE I PROPORTION OF THE DAMAGE AREA CAUSED BY THE DROUGHT AND FLOOD DISASTERS IN THE AGRICULTURAL DAMAGE AREA IN YUNNAN PROVINCE FROM 2006 TO 2015

	2006	2007	2008	2009	2010
Proportion of drought disasters	43.17%	25.90%	32.06%	57.34%	93.43%
Proportion of flood disasters	13.80%	50.30%	27.34%	24.70%	2.92%
Total proportion	56.97%	76.20%	59.40%	82.04%	96.35%
	2011	2012	2013	2014	2015
Proportion of drought disasters	64.70%	68.50%	47.11%	32.70%	54.95%
Proportion of flood disasters	4.38%	18.63%	10.03%	24.80%	18.40%
Total proportion	69.08%	87.13%	57.14%	57.50%	73.35%

From Table 1, it can be learned that in the past ten years from 2006 to 2015, the drought and flood disasters accounted for the majority in the total damage area of the agricultural disasters in Yunnan Province, with the average annual

proportion of over 50% respectively. And in 2010, it even was as high as 96.35%. It can be learned that drought and flood have become the main disaster-causing factors.

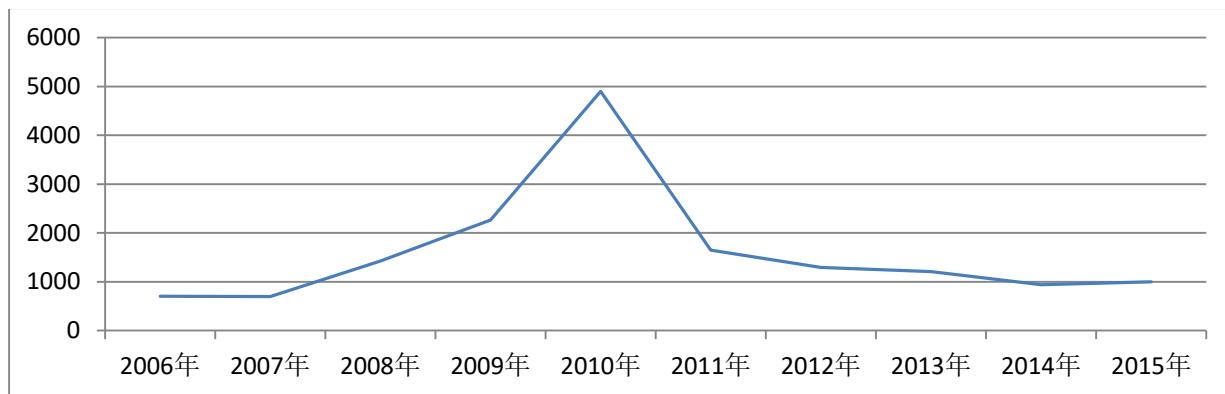


Fig. 3 Drought disaster damage area of Yunnan Province from 2006 to 2015 (10 thousand mu)

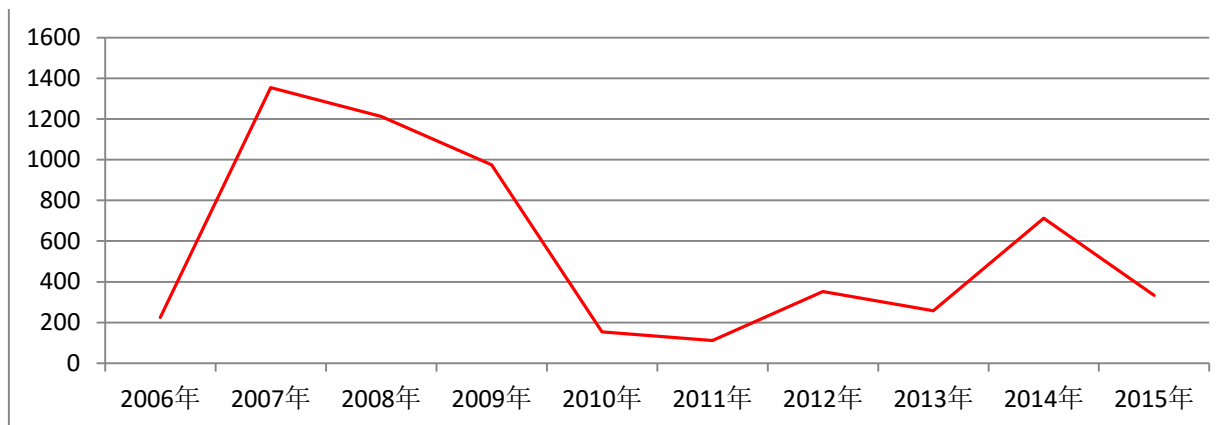


Fig. 4 Flood disaster damage area of Yunnan Province from 2006 to 2015 (10 thousand mu)

It can be learned from Figure 3 and Figure 4 that from 2006 to 2015, the person correlation coefficient of the damage area of the agricultural disasters caused by drought and flood was -0.27, which showed a change trend of waning and waxing. Thus, it can be seen that natural disasters have posed a very serious threat to the agricultural development of Yunnan Province. The traditional agricultural characteristics of Yunnan Province are strong and the agriculture scale and modernization level are low, and the agriculture main producing areas are strongly dependent on the natural environment, which are the main reasons for the frequent occurrence of natural disasters.

#### IV. CONCLUSIONS

In short, the causes of agricultural natural disasters in Yunnan Province are complex, the damage area is wide and the direct economic losses are large, which have seriously affected the healthy development of the national economy. Agriculture is the most important material basis for human survival and development and the basic industry of national economy. The stable and harmonious development of agriculture is not only related to the stability and improvement of farmers' income, but also the foundation of the social and economic development. It is an important source of information and labor force for other industries. Stable and effective agricultural development has solved the worries behind of the development of related industries. In recent years, the country has paid more attention and given more support to agriculture and the

allocations of government finance for agriculture, rural areas and farmers each year is no less than 3 trillion per year. At the same time, relevant national policy orientation and the development route of agriculture, rural areas and farmers are closely related to China's agricultural development trend. The strategic position of agriculture in China's social and economic development is constantly improving.

From the research analysis of this paper, it can be learned that the main disaster-causing factors of the agricultural disasters in Yunnan Province are drought and flood disasters and from 2006 to 2015, the average annual crop damage area is over 29 million mu, and the average annual direct economic losses were as high as 7 billion yuan. Relevant issues caused by agricultural natural disaster risk have also attracted the attention of top leaders in China.

In 2013, Changbin HAN, Minister of Ministry of Agriculture and Rural Affairs of the People's Republic of China emphasized at the rural work conference the necessity to respond to agricultural disasters, and improve our abilities to scientifically prevent, resist and reduce disasters. At the 2015 central rural work conference, Premier Keqiang LI pointed out that at present, the sustainable development of China's agriculture faces unprecedented challenges, and agriculture faces serious ecological and environmental damage. And issues of the shortage of resources such as cultivated lands and fresh water. And he emphasized that we must ensure the increase of agricultural investment regardless of fiscal restraint. It can be

seen that the response to the agricultural natural disaster risk has become a strategic issue at the country level. On December 25, 2015, People's Daily issued a document stressing that agriculture is still a shortcoming of the "synchronization of the four-zation". In order to cope with various difficulties and risks in agricultural production, the responsibility requirements of "priority among priorities" in the "agriculture, rural areas and farmers" work should be strictly implemented and in order to achieve the sustainable development of agriculture, people must respect nature, conform to nature, and protect nature. Agricultural disaster prevention measures should be actively established, early warning system for agricultural disasters should be perfected to improve disaster prediction accuracy and timeliness, and agricultural catastrophe insurance funds, and catastrophe reinsurance systems should be established to effectively cope with various agricultural natural disasters such as drought, flood, and cold damage and frozen injury. Specific emergency response management plans for agricultural production areas should be made according to the spatial and temporal distribution characteristics of agricultural disasters in Yunnan Province to meet the requirements of comprehensively improving the overall agricultural disaster relief efficiency.

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