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RESEARCHER AGRICULTURAL ADAPTATION TO CLIMATE SECRETE YOU NEVER KNOW

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Abstract

The deepening of temperature change research, more attention has been paid to vulnerability to global climate change. Compared with water resources, forests, and other natural ecosystems, agriculture is more prone to global climate change, thereby scientifically assessing agricultural vulnerability to global climate change is of great during this paper, the authors provides a comprehensive review of the research from the attitude of the definition of global climate change temperature change} vulnerability and agricultural vulnerability to climate change, research topics, and evaluation methodologies.

Keywords

Climate change; Vulnerability; Agriculture; Evaluation methodologies.

Introduction

Global climate change has become a serious environmental problem affecting the long run survival and also the development of mankind and it's attracted the widespread attention of governmental organizations and also the academic community within the world. Agriculture is one among the sectors most sensitive to temperature change, and any degree of global climate change will bring potential or significant impact to agricultural production and related processes. Temperature change has impacted the agriculture of China significantly, and it'll inevitably have an enormous impact on agricultural production within the future. Although the impact will vary by location, as a whole, it'll be mainly adverse [ECCNARCC, 2007]. At present, the assessment of global climate change vulnerability continues to be a comparatively new field of study. Although IPCC developed an infatuated research program specifically for the as-

sessment of temperature change research, research work to this point indicates feasible methods to gauge.

The impact of global climate change temperature change} on agriculture and therefore the agricultural vulnerability to climate change in several regions, it's of great significance for proactively adapting to global climate change, developing effective adaptation measures and ensuring sustainable agricultural development, and also for providing a scientific basis for decision-making.

Additionally, scientific and reasonable evaluation of the vulnerability will provide meaningful results for risk analysis of temperature change. Therefore, the evaluation of agricultural vulnerability to global climate change temperature change} isn't only necessary but is also a crucial a part of the research of climate change impact and adaptation. Through reflecting on current knowledge and progress within the research of global climate change temperature change} vulnerability and agricultural vulnerability to climate change issues round the world, the authors hope to supply a meaningful reference for re- related studies within the future. 2 Vulnerability to temperature change Definition of vulnerability to global climate change The term vulnerability is widely utilized in different disciplines, thanks to the differences in their study objects and knowledge background, the understanding- ing, and definition of vulnerability can very different. A vulnerability was originally utilized in the sector of disaster studies to represent the extent of the injury. Later, with the growing influence of global climate change issues, the concept was introduced to the sector of climate science, and also the IPCC First Assessment Report provided a preliminary elaboration of it. In 1996, the IPCC Second Assessment Report defined sensitivity and vulnerability. In 2001, the IPCC Third Assessment Report clearly defined the connection between global climate change sensitivity and adaptation and vulnerability with Eq.

(1). Vulnerability = f(Exposure, Sensitivity, Adaptive capacity)

(1) Exposure refers to the extent and therefore the characteristics of a system exposed to significant climate variability; sensitivity refers to the degree of influence as a system

stimulated by climate-related factors, including the adverse and beneficial effects; adaptive capacity refers to the power to create a profit and avoiding loss because the natural and man-made system littered with ac- actual or expected climatic stimuli and their impacts. This definition has been generally accepted by the educational community [EC-CNARCC, 2007]. In 2007, the IPCC Fourth Assessment Report still used the definition within the Third Report, and provided a comprehensive description of the most recent knowledge of global climate change vulnerability and mitigation acquired by the international scientific community. The meaning of vulnerability to global climate change continues to be evolving and marching toward perfection. Research progress in vulnerability to temperature change The study of vulnerability started early abroad, general conceptual models for vulnerability have emerged within the field of global climate change studies [Kelly and Adger, 2000; Downing, 2001; Turner et al., 2003; Yohe et al., 2003]. Adger [2006] summarized the method within the vulnerability research (Table 1). Smit et al. the livelihood vulnerability index to assess vulnerability to temperature change in some regions of Mozambique. The assessment of vulnerability to temperature change in China started later than abroad, and therefore the studies have focused on areas like natural ecosystems, agriculture (crop) production, and water resources [Tang et al., 2000; Yin and Wang, 2004; Li et al., 2005; Pan.

Table 1 Research process of vulnerability

Vulnerability approach	Objectives
Vulnerability to famine and food insecurity	developed to explain vulnerability to famine in the absence of Shortages of food or production failures. Described vulnerability as a failure of entitlements and shortage of capabilities
Vulnerability to hazards	Identification and prediction of vulnerable groups, critical regions through likelihood and consequence of hazard. Applications in climate change impacts
Human ecology	Structural analysis of underlying causes of vulnerability to natural hazards
Pressure and release	further developed human ecology model to link discrete risks with political economy of resources, and normative disaster management and intervention
Vulnerability to climate change and variability	Explaining present social, physical or ecological system vulnerability to (primarily) future risks, using wide range of methods and research traditions
Sustainable livelihoods and vulnerability to poverty	Explains why populations become or stay poor based on analysis of economic factors and social relations
Vulnerability of social-ecological systems	explaining the vulnerability of coupled human environment systems

In recent years, many scholars have done plenty of labor in sorting knowledge of vulnerability and as- assessment research. As an example, Fang et al. [2009] gave a comprehensive review of the research progress of vulnerability to global climate change abroad.

3 .Agricultural vulnerability to temperature change Definition of agricultural vulnerability to global climate change Agricultural vulnerability to global climate change has not been clearly defined. The U.S. Department of Agriculture defined vulnerability because the potential for negative consequences that are difficult to alleviate through adaptive measures given the range of possible climate changes which will occur in certain areas of a part, which is that the concept of inter-regional comparison [Reilly, 1996]. According to the definition of vulnerability to temperature change given by the IPCC assessment report, agriculture vulnerability to temperature change is that the manifestation of the agricultural sensitivity and adaptive capacity to climate changes [Wang, 2003], and it

changes with the situation, time, and socio-economic and environmental situations. Agricultural vulnerability to temperature change is that the function of characteristics of climate variability, magnitude, and rate of variation within the agricultural system, and also the system's sensitivity and adaptive capacity, and it's the degree to which the agricultural system is prone to, or unable to address adverse effects of temperature change including climate variability and extreme events [Hou and Liu, 2003]. It's worth noting that in literature both climate vulnerability and temperature change vulnerability have basically the identical meaning, which should be differentiated from the vulnerability of agricultural systems themselves. Research progress of agricultural vulnerability to temperature change Research add the quantitative assessment of agricultural vulnerability to global climate change started early outside China. Such study has had three stages: the primary stage was studying the vulnerability of crop yield, growth period among other indicators to temperature, precipitation, and other climate factors [Iglesias et al., 2000; Alexandrov and Hoogen- boom, 2000]; the second stage was mainly on the difference capability, focused on the exploration of adaptation and response measures [Burton et al., 2002; Fischer et al., 2002]; and also the third stage not only proscribed the sensitivity of agriculture to global climate change and adaptableness, but it also took into consideration the power of global climate change mitigation [Zheng et al., 2009]. As an example, there was a regional case study exploring the ways and means of quantitative evaluation of the vulnerability to global climate change [Luers et al., 2003]. International Institute for Applied analytic thinking (IIASA) used Agro-Ecological Zones-Basic Linked System (AEZ-BLS) model for comprehensive evaluation of the world's food vulnerability to global climate change.

At first, many used the indicator system methods [Liu and Lei, 2002; Liu, 2002], because there have been many factors and their relationships were complicated, only some main factors may well be used with the indicator system method, and also the designed evaluation method was relatively simple. In recent years, the applying of models has provided a brand new way for the evaluation of vulnerability to temperature change. For example, the employment of regional climate models, socio-economic models, crop models, and GIS technology has played a crucial

role within the comprehensive study of vulnerability to temperature change. Many scholars [Luo and Wu, 2010; Cai and Smit, 1996] summarized agricultural vulnerability studies from different perspectives, including these three main aspects: sensitivity area classification, regional vulnerability, and therefore the vulnerability analysis of major crops. Supported this, Chinese scientists are assessing agricultural vulnerability to global climate change through an integrated approach, for instance, Adaption to global {climate change temperature change} in China (ACCC) may be a program attempting to comprehensively evaluate the agricultural vulnerability to climate change in China. Main methods that Chinese scholars employed in recent years to gauge agricultural vulnerability to global climate change.

The statistical analysis method is represented by employing a series of observation (statistics) indices combined with functions, and setting a counter range for every vulnerability index by comparing it to historical statistics. In conducting vulnerability assessments, if the observation value is within the counter range, then the systems is taken into account stable or of low vulnerability even no vulnerability; and the other way around. The disadvantage of this method is that one can only perform vulnerability analysis for one index every time, which is able to evoke inconsistencies within the system for a posh agricultural system [Tang, 2007]. The indicator system method establishes an affordable index system by comprehensively considering the factors impacting agricultural vulnerability to temperature change, and assigning weight consistent with the importance of every factor, then obtaining agricultural vulnerability to temperature change by the weighted sum of things. This method is that the most ordinarily used evaluation method, but there's an enormous problem in establishing an affordable evaluation index system and scientifically setting the burden of every index. Comprehensive evaluation method will consider the combined effect of the biophysical and socio-economic factors to judge the agricultural vulnerability to global climate change, which is to require into consideration sensitive factors to global climate change in agriculture and also the factors of its adaptation capacity. during this way, it can more comprehensively and objectively analyze the extent of agricultural vulnerability to temperature change and eliminate the shortcomings of the primary two methods, which is that the direction

of the event of as- assessment methods for agricultural vulnerability to global climate change within the future [Tang, 2007; Tang et al., 2010].

4. The research prospects of agricultural vulnerability to global climate change Although the assessment study of agricultural vulnerability to temperature change made some findings, research methods and tools are under rapid development, thus far no widely accepted method has been found. Major problems within the existing studies and therefore the directions of the event are as follows.

1) Currently, the indicator system method was widely wont to study vulnerability problems, due to the complex relationship among affecting factors and multiple facs- tors involved and other reasons, a way to scientifically construct an affordable indicator system and determine the index weight (such as expert analysis, AHP, and artificial neural network method, all have obvious ad- vantages and disadvantages) become the bottleneck of the indicator system method [Liu and Lei, 2002; Tang et al., 2010]. More research add building targets, determining weights, and mutual relations of indices is required within the future.

2) the variation capacity is an im- important aspect of vulnerability, quantitative research of adaptation capacity remains scarce nowadays, which should be strengthened within the future.

3) The analysis and assessment of vulnerability are two aspects of vulnerability research. The vulnerability of agricultural systems and agricultural vulnerability to global climate change should be scientifically identified and distinguished in research, and therefore the problem of uncertainty should be considered within the evaluation process [Patt et al., 2005].

4) within the assessment of future agricultural vulnerability to global climate change, lack of socio-economic scenario data and comparatively simple climate scenarios cur-

rently applied must be studied, besides, attention should be paid to the supply and reliability of knowledge and data. With deepening research on temperature change, the methods and tools for vulnerability assessment are innovated and developed. the main target of the research are moving from the natural ecosystem to a coupled system [Li et al., 2008] (human-environment coupling system, social-ecological system, human-land system, etc.). the size and level of evaluation will still change, and also the uncertainties in researches are going to be constantly identified and reduced.

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