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IMPACTS OF CLIMATE CHANGE

Climate Change Impacts and Adaptation Strategies in Northwest China

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Abstract

Climate change resulted in changes in crop growth duration and planting structure, northward movement of planting region, and more severe plant diseases and insect pests in Northwest China. It caused earlier seeding for spring crop, later seeding for autumn crop, accelerated crop growth, and reduced mortality for winter crop. To adapt to climate change, measures such as optimization of agricultural arrangement, adjustment of planting structure, expansion of thermophilic crops, and development of water-saving agriculture have been taken. Damaging consequences of imbalance between grassland and livestock were enhanced. The deterioration trend of grassland was intensified; both grass quantity and quality declined. With overgrazing, proportions of inferior grass, weeds and poisonous weeds increased in plateau pastoral areas. Returning farmland to grazing, returning grazing to grassland, fence enclosure and artificial grassland construction have been implemented to restore the grassland vegetation, to increase the grassland coverage, to reasonably control the livestock carrying capacity, to prevent overgrazing, to keep balance between grassland and livestock, and to develop the ecological animal husbandry. In Northwest China, because the amount of regional water resources had an overall decreasing trend, there was a continuous expansion in the regional land desertification, and soil erosion was very serious. A series of measures, such as development of artificial precipitation (snow), water resources control, regional water diversion, water storage project and so on, were used effectively to respond to water deficit. It had played a certain role in controlling soil erosion by natural forest protection and returning farmland to forest and grassland. In the early 21st century, noticeable achievements had been made in prevention and control of desertification in Northwest China. The regional ecological environment has been improved obviously, and the desertification trend has shown sign of under control.

Keywords: Northwest China; climate change; impact and adaptation

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1 Introduction

The Working Group II Report of the IPCC Fourth Assessment Report (AR4) [*IPCC*, 2007b] stated that global climate warming has had discernible impacts on many physical and biological systems, and will has long-term impacts on future natural ecology and socio-economic development. To rely on policy measures of both adaptation and mitigation could reduce the risk of climate change.

Northwest China is located in China's inland, far away from the ocean, with drought and a scarcity of rain; its vulnerable ecological environment is sensitive and vulnerable to climate change. In the context of global warming, the regional annual mean temperature has markedly increased in Northwest China, which would inevitably affect the social and economic life in the region. Impacts of climate change on agriculture, animal husbandry, water resources, ecology and energy and other fields in Northwest China (including 4 provinces of Shaanxi, Gansu, Ningxia, and Qinghai) and strategies to adapt to climate change have been elaborated, mainly to provide scientific and technological support for adaptation to climate change for government and related industries in the region.

2 Major impacts of climate change

2.1 *Impacts on agriculture*

Climate change led to changes in crop growth duration and planting structure, northward movement of planting region, and more serious plant diseases and insect pests. Climate warming caused earlier seeding for spring crop, later seeding for autumn crop, accelerated crop growth, and reduced mortality for winter crop. The growth duration of wheat, corn and other determinate growth habit crops was shortened, while that of cotton, potato and other indeterminate growth habit crops was prolonged [*Yao et al.*, 2006; *Deng et al.*, 2008a; 2008b; *Deng and Zhang*, 2010]. For example, the growth duration of winter wheat in Shaanxi was reduced by an average of 5 d, the whole growth duration of corn in dry-farming areas in southeastern Gansu was shortened by 6 d, and the whole growth duration of cotton in Hexi Corridor was prolonged by 14–18 d [*Deng et al.*, 2008b; *Deng and Zhang*, 2010; *Pu et al.*, 2007]. Climate change also altered the regional crop planting structure. The planting pattern of predominant spring wheat changed into that of corn and cotton predominance in arid irrigated areas in Hexi Corridor. The planting pattern of spring wheat predominance changed into that of predominant winter wheat, spring wheat and potatoes in the semi-arid dry-farming areas in central Gansu. The suitable planting area for apple was expanded, but the fruit set percentage decreased due to high temperature events [*Pu et al.*, 2009; *Yang et al.*, 2010]. Climate warming was conducive to improving the climatic yields of cotton, rice and other thermophilic crops [*Sang et al.*, 2006], but not for the yields of spring wheat, potatoes and other cryophilic crops. The suitable planting areas for crop were expanded northward and to high altitudes. The northern boundary of winter wheat extended 50–100 km northward, and the altitude increased by around 200 m in the eastern part of Northwest China, especially in the mountain areas of southern Ningxia by 600–800 m. The kind of crop pests increased, which affected wider area and caused more severe damages [*IPCC*, 2007a; 2007b; 2007c].

2.2 *Impacts on animal husbandry*

Damaging consequences of imbalance between grassland and livestock were enhanced. The deterioration trend of grassland was intensified; both grass quantity and quality declined; with overgrazing, proportions of inferior grass, weeds and poisonous weeds increased in the plateau pastoral areas [*Li et al.*, 2008; *Yao et al.*, 2007]. The growth duration of grass was prolonged, and the livestock death rate showed obvious decrease. Grasslands in Qinghai province showed an overall degradation trend from 1951 to 2000. By 2000, the moderate or severe degraded grassland areas accounted for 51.7% of the total available areas. About 50%–60% of the grassland in the Three River Source Region has shown different degradation since the 1980s. Compared with the 1950s, the yield (kg hm^{-2}) decreased by 30%–50%, and poisonous weeds increased by 20%–30% in the 1990s [*Chen*, 2007]. Vegetation coverage, grass height and productivity repre-