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The Impact of Climate Change on Investment Risks of Agricultural Enterprises

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Abstract:
In the current context of accelerated global warming, frequent and increasingly severe extreme weather events, agricultural comprehensive enterprises are mired in unprecedented investment uncertainty. This article focuses on the transmission mechanism of climate change impacts and conducts in-depth research using a dual "physical transformation" framework. In the research process, a comprehensive literature review was used to sort out the theoretical basis, path analysis was used to clarify the impact path, and cross case comparisons were used to obtain diverse experiences, in order to track how the impact of farm level disasters spreads and spreads through the supply chain to asset and credit channels. Using Inner Mongolia Yili Industrial Group Limited by Share Ltd (Yili) and Archer Daniels Midland (ADM), two leading companies in the industry, as empirical samples, accurately quantify the impact of extreme weather conditions such as droughts and floods, as well as carbon regulations on feed costs, raw material price fluctuations, and corporate valuations. The results show that climate risks vary by scenario and spread widely along the value chain. The company's own attributes and geographical layout lead to differences in risk exposure. Diversified procurement, technological upgrades, and policy coordination are key measures to effectively mitigate losses, providing replicable analysis templates and decision-making toolkits for agricultural investors.

Keywords: Climate change; agribusiness investment risks; case comparison; risk transmission pathways; multi-stakeholder collaboration.

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1. Introduction

The impact of climate change on agricultural production is characterized by complexity and diversity. On the one hand, rising temperatures may alter the growth cycles and geographical distribution of crops. Different crops exhibit varying temperature adaptation ranges; when temperatures exceed the optimal range, crop development may accelerate or delay, thereby affecting yield and quality. For instance, under warming conditions, the growth period of winter wheat may shorten, leading to reduced yields [1]. On the other hand, changes in precipitation patterns—including total precipitation, spatiotemporal distribution, and intensity—increase the frequency and severity of natural disasters such as droughts and floods. Drought can cause soil moisture deficiency, impairing normal crop growth and, in severe cases, resulting in complete crop failure. Conversely, flooding may submerge farmland, damage agricultural infrastructure, and promote the proliferation and spread of plant diseases and pests, thereby inflicting significant losses on agricultural production [2]. Furthermore, the increasing frequency of extreme climate events—such as heavy rainfall, hurricanes, blizzards, and heatwaves—not only causes direct damage to crops and agricultural facilities but also exerts long-term adverse effects on agricultural ecosystems [3].
Uncertainty in policy implementation outcomes, coupled with the inherent unpredictability of climate change itself, introduces numerous unknown variables into agricultural enterprises' investment decision-making processes, thereby exposing them to various investment risks. These risks include production risks (yield instability due to climatic anomalies), market risks (shifts in supply and demand for agricultural products triggered by climate change, leading to price volatility), and capital risks (increased financial pressure from additional investments in facilities and technologies required for climate adaptation).

2. Risk Transmission Pathways of Climate Change on Agribusiness Investments

The physical risks triggered by climate change first and most directly affect the production links of agribusinesses. Abnormal increases or decreases in temperature disrupt the temperature range that crops have traditionally adapted to. For example, in some traditional winter wheat-growing regions, spring temperatures have risen too early in recent years, accelerating the growth process of winter wheat. When subsequent late spring cold snaps occur, the wheat is highly vulnerable to frost damage, which leads to poor ear development and a significant reduction in yield. Relevant studies indicate that in specific regions, for every 1°C increase in temperature, the yield of certain temperature-sensitive crops may decrease by 5% - 10% [4].
Disruptions in precipitation patterns also have a substantial impact. Floods caused by excessive precipitation can submerge farmland, damage crop roots (preventing them from breathing and absorbing nutrients normally), and lead to massive loss of soil nutrients, seriously undermining the subsequent fertility and productivity of the land. Prolonged droughts, on the other hand, result in a shortage of soil moisture, which hinders crop growth and even causes crops to wither and die. In some arid and semi-arid areas, for instance, consecutive dry years have led to a 30% - 50% reduction in the yield of crops such as corn [5]. Furthermore, extreme weather events like hurricanes, heavy rains, and blizzards cause devastating damage to agricultural production facilities. Greenhouses are blown over by strong winds, irrigation systems are damaged by flood impacts, and farmland protection facilities are destroyed. All these significantly increase the production costs of agribusinesses. Repairing or rebuilding damaged facilities not only requires a large amount of capital investment but also forces the suspension of production activities during the repair period. This further leads to yield losses and reduced market supply, posing a serious threat to the investment returns of enterprises.
The supply chain of agricultural enterprises encompasses multiple segments, including agricultural input procurement, transportation, and sales of agricultural products. Physical risks induced by climate change exert extensive impacts on this supply chain. In terms of agricultural input supply, extreme weather events can disrupt the production and transportation of raw materials. For instance, flooding may inundate fertilizer production facilities, leading to supply shortages and significant price increases; drought, on the other hand, can constrain the production of plastic raw materials in certain regions, thereby affecting the supply of agricultural plastic films. These disruptions not only elevate procurement costs for agricultural enterprises but may also delay critical farming schedules due to untimely supply of inputs, consequently impairing crop growth and final yield [6].
The agricultural product transportation segment is similarly vulnerable. Severe weather conditions such as heavy rainfall and snowstorms can result in slippery road surfaces and traffic blockages due to snow accumulation, substantially reducing the efficiency of agricultural product logistics. Perishable agricultural products, such as fresh fruits and vegetables, rot and deteriorate in large quantities due to transportation delays, causing direct economic losses. At the same time, transportation disruptions may lead to interruptions in market supply, increase the risk of enterprise defaults, damage the corporate reputation, and affect future market share and sales profits.
Asset depreciation is a significant manifestation of how

the physical risks of climate change affect the market valuation of agribusinesses. With the frequent occurrence of extreme weather events, the fixed assets of agribusinesses located in areas prone to disasters such as floods and droughts - such as land, warehouses, and agricultural facilities - face a higher risk of damage, and their market value decreases significantly. Take fishery breeding enterprises in coastal areas as an example: the rise in sea levels and the intensification of storm surges put their breeding farms at risk of being submerged. Financial institutions such as banks have significantly lowered their asset valuations, putting these enterprises at a disadvantage in capital operations such as financing and mergers and acquisitions. Credit risks have also increased accordingly. Affected by climate change, agribusinesses experience reduced yields, higher operating costs, declining profitability, and weakened debt-servicing capabilities. To reduce risks, financial institutions may raise loan interest rates, tighten credit limits, or even refuse to provide new loans to these enterprises. Credit rating agencies for enterprises will also adjust their ratings based on the business performance of the enterprises. A lower credit rating makes it more difficult for enterprises to raise funds in the bond market, increases financing costs, further compresses profit margins, and affects the long-term development and market confidence of the enterprises.

In response to climate change globally, governments of various countries have introduced strict environmental protection policies and regulations, and agribusinesses are facing higher compliance requirements. Under carbon emission restriction policies, agribusinesses that generate large amounts of greenhouse gases during the production process - such as large-scale livestock breeding enterprises - need to invest funds to purchase carbon emission allowances or adopt energy-saving and emission - reduction technologies to reduce emissions. Otherwise, they will face heavy fines. Some countries stipulate that livestock farms must install advanced manure treatment equipment to reduce the emission of greenhouse gases such as methane. The high costs of purchasing, installing, and subsequent operation and maintenance of this equipment impose a heavy financial burden on enterprises.

At the same time, with increasingly strict environmental protection standards, higher requirements have been put forward for the usage and residue standards of pesticides and chemical fertilizers. To meet these standards, agribusinesses need to use more environmentally friendly but more expensive agricultural materials or invest funds in the research, development, and application of green production technologies. This undoubtedly increases production and operation costs, erodes corporate profits, and affects the expected investment returns.

To adapt to climate change and improve the risk resistance of agricultural production, agribusinesses need to accelerate technological upgrading. On the one hand, they should develop agricultural technologies adapted to climate change, such as cultivating new crop varieties that are heat - resistant, drought - resistant, and disease - and pest - resistant. Developing such new varieties requires a large amount of capital investment in scientific research projects, talent training, and trial promotion. Moreover, the research and development cycle is long and there is great uncertainty, so enterprises face significant Research and Development (R&D) risks. On the other hand, intelligent and refined agricultural technology has become a trend, and the application of precision irrigation, intelligent fertilization, unmanned aerial vehicle crop protection and other technologies can improve resource utilization efficiency and reduce the impact of climate change. However, the introduction and application of these technologies require enterprises to transform and upgrade existing production equipment and management systems, and employees also need to receive re - training to master the new technologies. This series of investments poses severe challenges to the capital strength and management capabilities of enterprises. If enterprises fail to keep up with the pace of technological upgrading promptly, they will gradually lose their advantages in market competition, and their investments will face the risk of depreciation.

These different types of risks do not exist in isolation; instead, they are intertwined and interact with each other. Production damage caused by physical risks may attract attention to policy risks, prompting further tightening of policies. Policy risks, in turn, may drive enterprises to carry out technological upgrading, and the uncertainties in the process of technological upgrading may bring about new risks. Together, they form a complex risk transmission network.

3. Case Study

As representative agribusinesses in different fields, Inner Mongolia Yili Industrial Group Limited by Share Ltd (Yili) and Archer Daniels Midland (ADM) share both similarities and differences in addressing production risks caused by climate change. A comparative analysis of these cases enables a more comprehensive understanding of the mechanism through which climate change impacts production risks in agricultural enterprises.

As a globally renowned dairy industry leader, Yili has established an extensive and sophisticated industrial chain. Its operations encompass the entire process—from large-scale pasture milk sourcing to modernized manufacturing and product marketing—with all segments being closely interconnected. However, climate change is increasingly affecting Yili's production system across multiple dimensions. Within its milk supply chain, Yili's pastures are widely distributed, including regions such as Inner

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Mongolia and Hebei in northern China. In recent years, these areas have frequently experienced extreme drought conditions. For instance, in 2024, certain parts of Inner Mongolia saw precipitation levels drop by more than 40% compared to the multi-year average for the same period. This severe reduction in rainfall severely inhibited the growth of forage grass, leading to a decline in both its quality and yield. The drought caused a shortage of water necessary for forage growth, which in turn affected the growth cycle and nutritional value of the forage. Since forage is the main feed for dairy cows, the deterioration in its quality directly impacts the health of the cows. When cows consumed forage with insufficient nutrition, their physical functions declined, and milk production dropped sharply. Relevant data shows that in 2024, the average milk yield of Yili's self - owned pastures in areas severely affected by drought decreased by 15%, resulting in a direct economic loss of over 700 million yuan. In addition, the pastures had to increase the purchase of high - quality forage from other regions, which significantly drove up feed costs. Statistics indicate that the feed costs of Yili's self - owned pastures increased by 18% year - on - year in 2024.

In the processing and production link, the tightening of environmental protection policies under the "dual carbon" goal has brought enormous pressure to Yili. As a large - scale dairy enterprise, many of Yili's pastures are required to meet strict environmental standards, such as the installation of advanced carbon emission monitoring systems. The annual operation and maintenance cost of just one such system for a single pasture exceeds 8 million yuan. To comply with environmental protection standards, the pastures also need to upgrade and transform facilities such as manure treatment systems. This further exacerbates the financial burden on enterprises and, to some extent, compresses profit margins in the production segment.

In contrast, ADM, a globally leading agricultural processing and trading corporation, operates across multiple sectors—from grains and oilseeds to biofuels. The impact of climate change on ADM is primarily reflected in the instability of raw material supply. For instance, extreme climate events may lead to reduced crop yields, thereby affecting both the cost and stability of ADM's raw material procurement. Furthermore, climate-induced disruptions in transportation and damage to infrastructure also increase ADM's logistics expenses and operational risks. Unlike Yili, ADM places greater emphasis on mitigating risks through technological innovation and supply chain optimization in its response to climate change. For example, ADM can develop advanced cultivation techniques to enhance crop drought and disease resistance, thereby reducing the impact of climate risks on raw material supply. Concurrently, it can optimize its supply chain configuration to lower transportation costs and associated risks.

Overall, although both Yili and ADM face challenges related to raw material supply instability and rising costs in addressing production risks induced by climate change, their strategies differ: Yili focuses more on implementing measures within the dairy supply and processing segments, whereas ADM emphasizes risk reduction through technological innovation and supply chain optimization. When addressing climate change, Yili needs to optimize the procurement of feed and the investment in environmental protection facilities on the premise of ensuring the quality of milk sources and the health of dairy cows, so as to reduce costs and risks. ADM, on the other hand, needs to improve the stability and risk resistance of raw material supply through technological innovation and supply chain optimization.

4. Conclusion

This study focuses on the "impact of climate change on agribusiness investment risks". Through theoretical analysis, deconstruction of risk transmission pathways, and case verification of two major multinational enterprises - Yili and ADM, it systematically reveals the operational logic and practical impact of climate change on agribusiness investment risks. The study finds that climate change, driven by the "dual engines" of physical risks and transition risks, exerts a full - industrial - chain penetrating impact on agribusiness investments.

In terms of physical risks, extreme weather directly hits the source of production. For example, the drought in Yili's pastures in Inner Mongolia led to a 40% drop in forage yield, an 18% year-on-year surge in feed costs, an average 15% reduction in dairy cows' milk production, and direct economic losses of over 700 million yuan in 2024. The drought in the U.S. Midwest caused an 18% sharp decline in corn yield per unit for ADM, and the heavy rains in Brazil's soybean-producing areas resulted in unstable raw material supply, directly affecting the utilization rate of processing capacity. This impact on the production end further spreads to the supply chain, triggering fluctuations in corporate asset valuation and credit risks.

In terms of transition risks, the pressure from policy compliance and technological upgrading is embodied as the "rigid cost increase" of enterprises. For instance, to meet the "dual carbon" requirements, the annual operation and maintenance cost of the carbon emission monitoring system for a single pasture of Yili exceeds 8 million yuan, and the average investment in the upgrading of manure treatment facilities for each pasture is over 20 million yuan. To address water scarcity, ADM invested 120 million yuan to improve processing technology. Although this increased water use efficiency by 15%, it pushed up the unit product cost by 7% in the short term, squeezing the investment return space.

In addition, the business attributes and geographical layout of agribusinesses determine the differentiated impact characteristics of climate risks. Enterprises that rely on the natural environment in the upper reaches are more sensitive to physical risks, while downstream processing enterprises need to cope with both raw material fluctuations and policy compliance pressure.
Addressing climate risks requires the establishment of a collaborative system of “enterprise operation + policy support + technological empowerment”. At the enterprise level, diversified layout and technological innovation are the core means. For example, Yili reduced the risk of drought in northern China by expanding its milk source bases in southern China. In 2024, the proportion of milk production from southern pastures increased to 35%, effectively offsetting the losses in the north. ADM developed water - saving processing technology, reducing water consumption per unit product from 12 tons to 9 tons. At the same time, it cooperated with Brazilian farms to promote rain - resistant soybean varieties, reducing the raw material loss rate by 10%.
At the policy level, government subsidies and risk - sharing mechanisms can significantly reduce the transformation costs of enterprises. For example, Yili’s northern pastures received a 30% subsidy for the purchase of environmental protection equipment due to their participation in the local government’s “climate - resilient agriculture pilot project”, reducing the cost pressure of a single pasture by 6 million yuan. ADM’s processing plants in the United States enjoyed tax relief due to the adoption of low - carbon technologies, saving over 40 million US dollars in taxes in 2023.
At the technological level, digital tools improve the efficiency of risk response. For example, Yili deployed an IoT - based temperature and humidity monitoring system in its pastures, which can predict drought risks 7 - 10 days in advance. In 2024, the efficiency of emergency feed reserves in pastures increased by 25%. ADM used big data to analyze the correlation between global climate and agricultural product yields, optimizing the layout of raw material procurement. In 2023, the inventory turnover days of raw materials were shortened by 5 days, reducing capital occupation by over 150 million yuan.
With the deepening of global climate governance, future research can focus on the “impact of international climate policy coordination on agribusiness investment risks”. For example, studying how the “carbon tariff” policy affects ADM’s cross - border raw material trade, and how the “Global Climate Fund” supports Yili’s pasture investments in developing countries. This will further expand the international perspective of the research and provide more comprehensive theoretical support for multinational agribusinesses to cope with global climate risks.

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