

# Chapter 79

## Research on Coordination Mechanism and Low- Carbon Technology Strategy for Agricultural Product Supply Chain

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### **ABSTRACT**

*As the future orientation of economic and agricultural development, low-carbon agriculture is devoted to reducing the energy inputs and greenhouse gas emissions during the agriculture production. So, it's urgent to take some actions to transit from the current high carbon economy to a low-carbon and high resource efficient economy. This paper examines a two-echelon agricultural product supply chain with a producer and a processor and the market demand is influenced by the retail price and the level of low-carbon technology. The optimal solutions in the decentralized and centralized agricultural product supply chain with or without low-carbon technology are studied. To make the decentralized agricultural product supply chain perform as well as the centralized agricultural product supply chain, the coordination mechanism of the low-carbon supply chain that few of papers focused explicitly on is designed. Finally, extensive numerical experiments are conducted to study the behaviors of supply chain members.*

### **INTRODUCTION**

Global mean surface air temperatures have increased quickly over the last 100 years, which is mainly caused by human activities (International Panel on Climate Change, 2007). The climate change will bring about a series of negative influences, e.g., the rising of the sea level and increased frequency of extreme climatic events including intense storms, heavy rainfall events and droughts, which will increase the frequency of climate-related hazards and result in the loss of life, social disruption and economic

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hardships (Samuel et al., 2014). Stern (2007) described the climate change as “the greatest market failure ever seen” and suggested that the potential global costs of unmitigated climate change was equivalent to a loss in average world economic output of between 5 and 20 per cent per year. Therefore, it's urgent to take some actions to transit from the current high carbon economy to a low carbon and high resource availability economy.

It's often recognized that agriculture is one of the largest anthropogenic sources of greenhouse gas emissions within the scientific community. Consequently, agricultural activities must be responsible for the release of significant amounts of carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ), and nitrous oxide ( $\text{N}_2\text{O}$ ) into the atmosphere, which have a long-term influence on the global climate because of the nature of chemical stability and long existence. Meanwhile, the agricultural production is expected to meet the increasing food demands of the large population. Therefore, reductions in emissions of the agriculture are- expected, since agricultural sector is responsible for approximately 10-12% of global greenhouse emissions and 50% of  $\text{CH}_4$  and 60% of  $\text{N}_2\text{O}$  from anthropogenic sources (Crosson et al., 2011). There is no doubt low-carbon technology should be adopted in the agriculture to decrease the impacts on climate change.

As the future orientation of economic and agricultural development, low-carbon agriculture is devoted to reducing the energy inputs and GHG emissions during the agriculture production, which improves the environmental sustainability. In this paper, optimization models are formulated for the agricultural product supply chain and the optimal decisions of the supply chain members are studied. This paper contributes to our understanding of the optimal decisions especially the choice of low-carbon technology strategy. To raise the low-carbon technology, the coordination mechanism is designed to improve the performance of the agricultural product supply chain.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literatures. Section 3 presents the main symbols and assumptions. Section 4 and 5 analyzes the optimal decisions in the decentralized and centralized agricultural product supply chain, respectively. Section 6 designs the coordination contract to improve the performance of decentralized agricultural product supply chain. Section 7 focuses on numerical studies. Section 8 concludes and highlights our research findings, managerial implications and provides possible future research directions.

## **LITERATURE REVIEW**

This paper study a supply chain coordination management on agricultural product supply chain considering low-carbon technology and is related to three topics, e.g., low-carbon agriculture, agricultural product supply chain and supply chain coordination management. In the following, we will review the three topics and find some differences between our paper and previous.

The low-carbon agriculture is one of the research hotspots in recent years. Smith et al. (2007) explored the constraints and barriers to implementation important for GHG mitigation in agriculture and examined how climate and non-climate policy in different regions of the world has affected agricultural GHG emissions and the links between mitigation, adaptation and drives for sustainable development and the potential for agricultural GHG mitigation in the future. Norse (2012) presented the case for greater national and international efforts to move on to a lower carbon agricultural growth path and assessed the main strategy and policy options for achieving such growth. Audsley and Wilkinson (2014) explored the potential for reducing GHG in systems used to produce twelve crop and seven livestock commodities

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