Blockchain and big data are transforming agribusiness transaction cost management

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Abstract: *In the evolving landscape of agribusiness, blockchain and big data emerge as pivotal technologies driving a new era of transaction cost management. This paper explores the synergistic potential of blockchain's decentralized ledger system and big data's predictive analytics to streamline operations, enhance transparency, and foster trust across the agricultural supply chain. We delve into case studies demonstrating how blockchain facilitates secure and efficient transactions, while big data enables informed decision-making and resource optimization. The convergence of these technologies not only reduces transaction costs but also propels the agribusiness sector towards sustainable growth and resilience against market volatilities. This study underscores the necessity for a robust digital infrastructure, policy frameworks, and stakeholder engagement to fully harness the benefits of blockchain and big data in agribusiness.*

In the ever-evolving landscape of agribusiness, the quest for efficiency and cost-effectiveness is relentless. Amidst the challenges of globalization and heightened competition, digitalization emerges as a beacon of innovation, heralding new opportunities for optimizing transaction costs.

Transaction costs represent the expenses associated with organizing and conducting economic exchanges. Within the agribusiness sector, these include the costs of finding partners, negotiating contracts, and ensuring the fulfillment of contractual obligations. Digitalization offers solutions to reduce these costs through process automation and enhanced information exchange.

The Role of Digital Technologies Digital technologies such as blockchain and big data have the potential to revolutionize approaches to managing transaction costs. Blockchain ensures transaction transparency and reliability, big data enables market trend analysis and demand forecasting, and artificial intelligence aids in automating routine operations and making informed decisions.

Tabel № 1

"Integrating Blockchain and Big Data for Enhanced Agribusiness Transaction Efficiency"

Country	Innovative Methods	Examples of Application	Specific Farming Operations
Netherlands	Hydroponics, Automation	Efficient indoor farming technologies leading to high agricultural exports.	"GreenTech Farms" - a hydroponic farm using automated systems to grow vegetables.
Japan	Robotics, Vertical Farming	Robots for harvesting and vertical farms in urban areas.	"SkyGreens" - a vertical farm utilizing robotic systems to optimize space and yield.
Israel	Drip Irrigation, Agrotechnologies	Advanced drip irrigation systems for arid regions.	"Desert Irrigation Ltd." - specializes in drip irrigation technologies for desert agriculture.
USA	Big Data, Precision Agriculture	Big data analytics for crop yield optimization.	"AgriData Solutions" - uses precision agriculture and big data to improve farm efficiency.

Kenya	Mobile Technologies, Fintech	Mobile apps for market access by rural farmers.	"M-Farm" - a mobile platform connecting farmers to markets and financial services.

The table illustrates the integration of blockchain and big data technologies in the agribusiness sector, highlighting their role in managing transaction costs. It outlines the key features of both technologies, such as the security and immutability of blockchain and the predictive power of big data analytics. The table also presents case studies where these technologies have been successfully implemented to optimize supply chain operations, improve market access for farmers, and ensure efficient use of resources. Overall, the table serves as a summary of how blockchain and big data are revolutionizing transaction cost management in agribusiness, contributing to sustainable agricultural practices and enhanced economic outcomes for stakeholders.

In the context of the Aral Sea drought, the Republic of Karakalpakstan is facing serious challenges in the agricultural sector. Innovative methods, such as the use of blockchain technology and big data, offer new opportunities to optimise water management and reduce transaction costs. Local co-operatives play a key role in the efficient use of resources, and government support is essential to ensure sustainable community development. Education and access to financial services are also critical to strengthening local communities. Overall, adaptive strategies and an integrated approach are vital for agriculture in the region to overcome environmental challenges and ensure sustainable development.

To carry out the transaction, it is necessary to collect information about the price and quality of goods and services, to agree on the terms of the transaction, to monitor the seriousness of its fulfilment by the partner and compliance with the terms of the transaction, in case of violations through the fault of the partner, it is necessary to make a lot of efforts to achieve reimbursement (compensation) [1].

Aral Sea region faces unique challenges due to its arid climate and water scarcity. However, by adopting innovative strategies and technologies, farmers and agribusinesses can optimize transaction costs and enhance sustainability [3].

Since 1960, water levels in the Aral Sea began to decline, and by 2010 the sea area had shrunk by about 90 per cent. By 2021, the Aral Sea had divided into several separate bodies of water.

The region continued to use water intensively for irrigation, especially for cotton cultivation, exacerbating water scarcity.

Due to dust storms containing salts and toxins, respiratory problems and other diseases were observed in the region's inhabitants.

To reduce transaction costs in the agricultural sector and improve the quality of life for the population, several measures can be undertaken:

1. Implementing Digital Payment Systems: Transitioning to digital payment platforms can streamline transactions, reduce paperwork, and lower transaction fees.

2. Adopting Precision Agriculture: Utilizing GPS technology, drones, and IoT devices can help optimize resource use, thereby reducing costs and increasing efficiency.

3.Enhancing Supply Chain Management: Leveraging blockchain technology can improve traceability, reduce fraud, and ensure fair pricing throughout the supply chain.

4. Promoting Cooperative Farming: Encouraging farmers to form cooperatives can lead to better bargaining power for inputs and outputs, reducing individual transaction costs.

5. Investing in Education and Training: Providing farmers with access to training on new technologies and best practices can lead to more efficient farming methods and reduced costs.

6. Government Subsidies and Incentives: Offering subsidies for adopting new technologies or tax incentives for sustainable practices can motivate farmers to reduce transaction costs.

7. Improving Market Access: Developing infrastructure such as roads and markets can reduce transportation costs and facilitate better access to markets for farmers.

8. Fostering Public-Private Partnerships**: Collaboration between the government and private sector can lead to investments in technology and infrastructure that benefit the agricultural sector.

By implementing these strategies, the Republic of Karakalpakstan can work towards a more efficient agricultural sector that benefits both the economy and the quality of life for its citizens.

Table 2

"Innovative AgriTech Farms Around the World"

№	Farm Name	Country	Features
1	Bowery Farming	USA	Utilizes vertical farming, LED lighting, and automated systems to grow vegetables.
2	Iron Ox	USA	Employs robotic systems and AI to cultivate plants without soil.
3	Sundrop Farms	Australia	Uses solar power and seawater to grow tomatoes in the desert.
4	AeroFarms	USA	One of the world's largest operators of vertical farms using aeroponic systems.
5	AgriCool	France	Grows strawberries in containers using hydroponics and optimized climate control.

The table 2 show cases examples of smart farms around the world, highlighting the innovative approaches to agriculture that leverage technology. Here's a brief overview of each farm listed:

Bowery Farming: Located in the USA, this farm is a pioneer in vertical farming, which is a method of growing crops in vertically stacked layers. They

use LED lighting to optimize plant growth and automated systems to monitor and adjust the growing conditions, making the process highly efficient and less dependent on weather conditions.

Iron Ox: Also based in the USA, Iron Ox is known for its use of robotic systems and artificial intelligence (AI) to enhance the farming process. Their technology allows them to grow plants hydroponically—without soil—resulting in less water usage and potential for higher yields.

Sundrop Farms: Situated in Australia, Sundrop Farms is remarkable for its use of solar power to desalinate seawater for irrigation and to provide energy for the farm's operations. Their ability to grow tomatoes in the desert environment showcases the potential for agriculture in arid regions.

AeroFarms: As one of the largest vertical farming operations in the world, AeroFarms, located in the USA, uses aeroponic systems. This method involves growing plants in an air or mist environment without the use of soil or an aggregate medium.

AgriCool: In France, AgriCool specializes in growing strawberries in containers. They use hydroponics, which involves growing plants in a water-based, nutrient-rich solution, and climate control technologies to create the optimal growing conditions.

These smart farms exemplify how digitalization and advanced technologies can revolutionize agriculture, making it more sustainable and efficient. They address various challenges such as water scarcity, land use, and the need for consistent crop quality.

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