

American Journal of Economics and Business Management

Vol. 9 Issue 10 | **pp.** 432-440 | **ISSN:** 2576-5973
Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

Organizational-Economic Mechanism of a Regional Primary Vegetable Processing Center in Tashkent Region

Djamalova Asal Sayduvaliyevna[1]

1. PhD Student at the International Strategic Center for Agri-Food Development, 1a Labzak Street, Shaykhantakhur District, Tashkent, Uzbekistan

Abstract: Vegetable production in Tashkent region is characterized by a fragmented production structure, significant post-harvest losses and a low producer share in the final price of products. The aim of this study is to substantiate ways of improving the efficiency of the vegetable value chain by strengthening coordination among its participants and developing regional centers for the collection, storage and primary processing of produce. The study applies institutional and comparative analysis, analysis of the regulatory framework, the computational-constructive method and the labor output standards method. As a result, a three-level organizational and economic mechanism of hybrid contractual-cooperative coordination is proposed, providing for the establishment of a regional center in the form of a service cooperative. Calculations for two farms in Buka district showed that profitability can be increased from 27.3% to 55.0% and from 24.0% to 40.7%, gross value added can be raised by a factor of 1.2-1.4, and the producer share in the final price can reach 46-48%. It is substantiated that the development of regional centers creates conditions for reducing post-harvest losses to 7-10% and increasing the share of value added retained by primary producers.

Keywords: Value chain, vegetable production, organizational and economic mechanism, coordination, service cooperative, regional center, post-harvest losses, producer share in the final price, Tashkent region.

Citation: Sayduvaliyevna D. A. Organizational-Economic Mechanism of a Regional Primary Vegetable Processing Center in Tashkent Region. American Journal of Economics and Business Management 2026, 9(10), 432-440.

Received: 10th Jul 2026
Revised: 11th Aug 2026
Accepted: 11th Sep 2026
Published: 13th Oct 2026

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1. Introduction

The efficiency of a value chain is determined not only by the performance of its individual links but also by the degree of interaction between them. In Tashkent region, vegetables are produced mainly by a large number of small farm enterprises and dehkan farms, which complicates their integration with processing, storage and marketing enterprises. As a result, a considerable share of vegetables is sold without further processing, which limits the potential for generating higher value added [1].

Post-harvest handling and storage consistently remain the least efficient link in the chain: this is where the bulk of physical and value losses is concentrated. According to estimates of the Food and Agriculture Organization of the United Nations, post-harvest losses of vegetables under a fragmented marketing infrastructure reach 25-30% of the gross harvest and, in some seasons, approach 40% for perishable crops. At the same time, primary producers receive on average only about a quarter of the retail value of the produce, while most of the value added accumulates in the intermediary and trade links. Consequently, the key reserve for increasing the profitability of vegetable production in the region lies not in the field stage of the cycle but in the post-production stage, namely

in building modern infrastructure for the consolidation, sorting, storage and primary processing of produce [2] .

The aim of this article is to substantiate an organizational and economic mechanism for coordinating participants in the vegetable value chain in Tashkent region and a model of regional centers for the collection, storage and primary processing of vegetables as its core element [3].

2. Methods

The methodological basis of the study is O. Williamson's theory of transaction costs and hybrid forms of governance [2]. Methods of institutional and comparative analysis were used, together with an analysis of the regulatory framework of the Republic of Uzbekistan in the field of fruit and vegetable production and agricultural cooperation. The efficiency of the proposed solutions was assessed using the computational-constructive method based on 2025 survey data from two farm enterprises in Buka district of Tashkent region; the staffing requirements of the regional center were determined using the labor output standards method.

3. Results

For vegetable production in Tashkent region, relying exclusively on either a market or a hierarchical model of coordination does not fully ensure effective interaction among value chain participants. Under the market model, based on one-off transactions, producers remain highly dependent on price fluctuations, sales channels are unstable and transaction costs are high. The hierarchical model, which implies rigid vertical integration, restricts producers' autonomy and shifts the bulk of value added to the integrating structure. Therefore, the proposed mechanism is based on a hybrid contractual-cooperative model of coordination, which involves the voluntary participation of farm enterprises and dehkan farms in service cooperatives and the development of long-term contractual relations with processing and trading companies. This approach preserves producers' economic independence, makes their incomes more predictable and, at the same time, reduces transaction costs [4].

The mechanism performs a number of interrelated functions: it aggregates the output of numerous small farms into homogeneous commodity lots that meet the requirements of processors, retail chains and export markets; it ensures the application of uniform requirements for sorting, packaging, labeling and traceability; it provides for the exchange of information on demand, prices, quality requirements and delivery volumes; and it helps reduce production and market risks by coordinating delivery schedules, concluding long-term contracts and reserving storage and processing capacity [5].

The mechanism operates on the principles of voluntariness, subsidiarity, open access, economic self-sufficiency and legal compliance. The principle of subsidiarity means that production remains the responsibility of farms, the consolidation, sorting and standardization of produce are carried out at the meso level, and regulation and state support fall within the competence of the macro level. Under the principle of self-sufficiency, current operating costs should be covered by income from the services provided, whereas state support should be directed primarily at creating and upgrading infrastructure.

The mechanism provides for vertical, horizontal and interagency coordination. Vertical coordination ensures interaction between successive links of the chain on the basis of contractual relations, uniform product quality requirements, and agreed delivery volumes and schedules. Horizontal coordination concerns interaction between regional centers and service cooperatives: agreeing on service areas and uniform sorting and packaging requirements, and achieving fuller utilization of storage and processing capacity. Interagency coordination ensures concerted action by government bodies, financial institutions, and certification and standardization organizations [6].

The fundamental principle of the mechanism is a fairer distribution of value added among chain participants. It is implemented by transferring to service cooperatives the functions of collecting, sorting, storing, packaging and preparing produce for sale, which were previously performed mainly by intermediaries. The mechanism also ensures a rational allocation of risks: seasonal risks are partly offset by regional collection, storage and processing centers; price risks, by long-term contractual relations and the diversification of sales channels; and quality-related risks, by uniform requirements for the sorting and standardization of produce. The correspondence between coordination levels and their actors, functions and types of interaction is presented in Table 1.

Table 1. Levels, actors, functions and types of links in the organizational and economic coordination mechanism

Coordination level	Actors	Function in the mechanism	Type of coordination link
Macro level (sectoral regulation)	Ministry of Agriculture, Agency for Agro-Industrial Development under the Ministry of Agriculture, regional and district hokimiyats, Chamber of Commerce and Industry	Setting norms and standards, subsidies, program and methodological support	Hierarchical-regulatory (normative)
Meso level (regional coordination)	Regional centers (service cooperatives), second-tier cooperatives, unified digital platform, organized sales channels	Consolidation, grading, storage, logistics; harmonization of service areas and standards; marketing of produce	Cooperative-contractual (vertical and horizontal)
Micro level (primary link)	Farm enterprises, dehkan farms, household plots	Production and supply of produce, participation in the cooperative, provision of data	Contractual-market (membership / contract)
Feedback loop	Digital platform operator, cooperative board, regional coordination council	Collection and analysis of KPIs, adjustment of service terms, coverage areas and delivery schedules	Information and management (feedback)

Source: compiled by the author.

The sustainability of the mechanism is ensured by a monitoring and feedback system based on a limited set of indicators: the share of produce sold through organized sales channels, the producer share in the final price, the level of post-harvest losses, the share of produce sold under contracts, and the share of exports. The key element of the meso level that enables the practical implementation of the mechanism is the regional center for the collection, storage and primary processing of vegetables.

The organizational and economic mechanism of a regional center comprises six circuits (Fig. 1): institutional regulation (I); the functional and operational core (II), which includes the blocks of consolidation, grading according to quality standards (Premium, Grade 1, Grade 2), packaging and labeling, controlled atmosphere storage, primary processing, and a digital accounting platform; suppliers (III), which do not include agro-clusters; sales channels (IV); the financial and investment circuit (V); and socio-economic effects (VI).

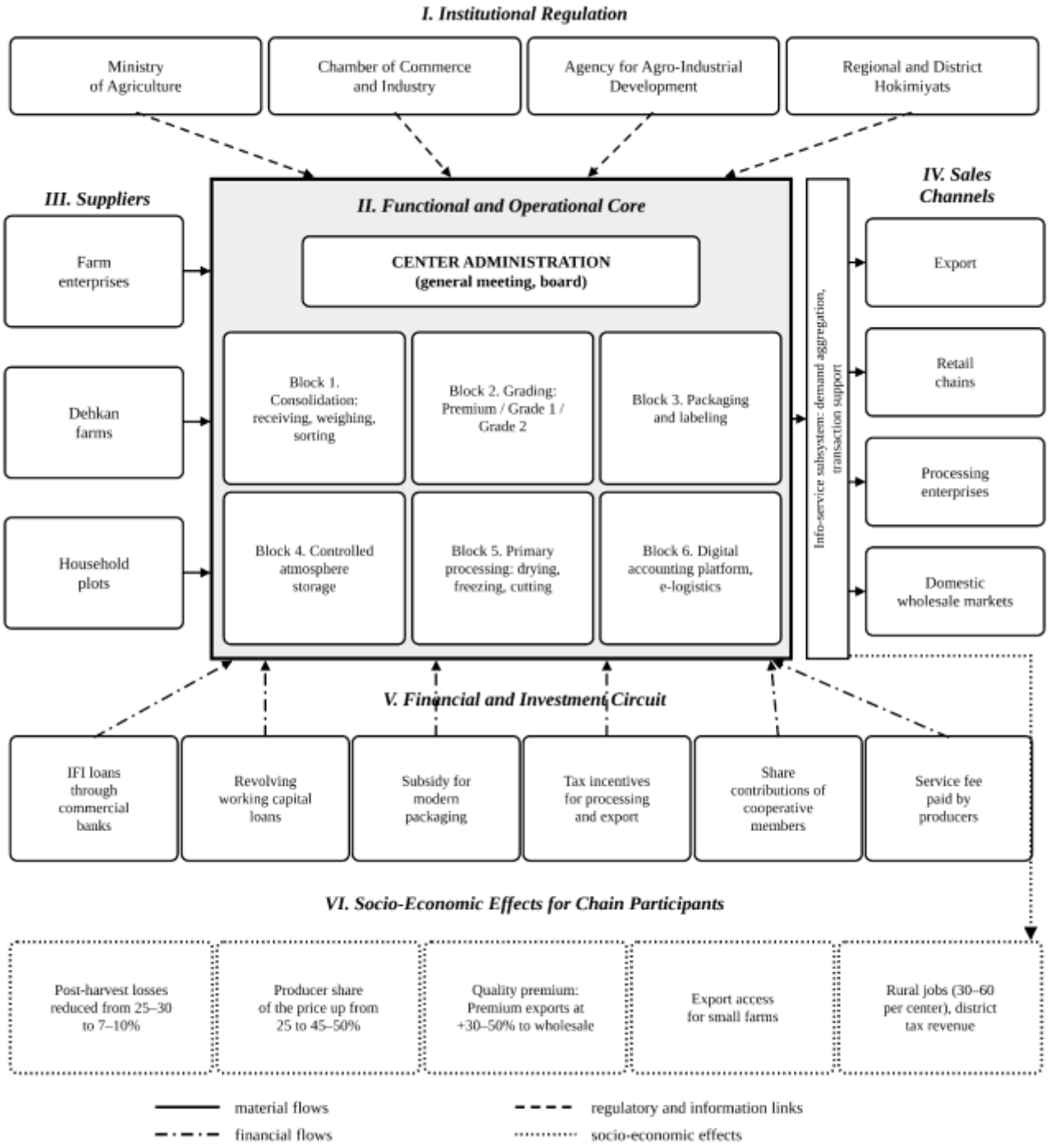


Figure 1. Organizational and economic mechanism of a regional center for primary processing of vegetables

Source: developed by the author.

The internal logic of value creation at the center is shown in Fig. 2. At the grading stage, produce is divided into three quality categories, while rejects and organic residues are not written off as losses but are used for feed and composting, which reduces total post-harvest losses from 25-30% to 7-10%.

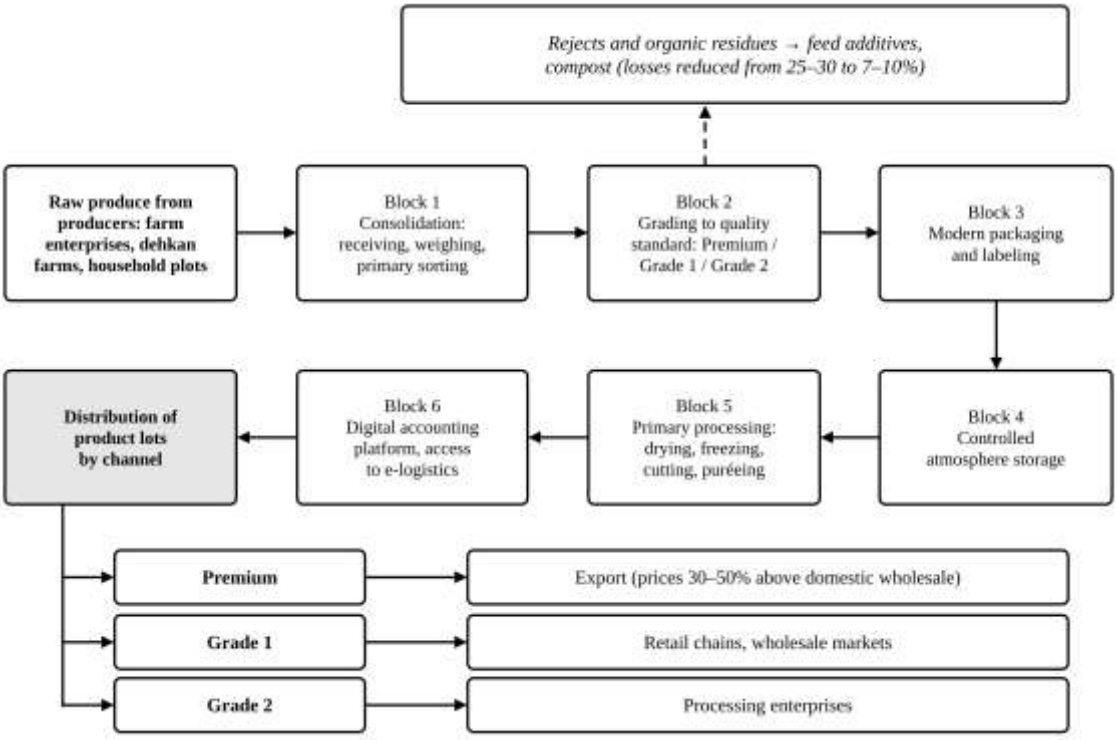


Figure 2. Technological sequence of vegetable flow through the regional center and distribution across sales channels

Source: developed by the author.

A service agricultural cooperative is proposed as the legal form of the center, established on the basis of a public-private partnership: capital-intensive infrastructure is built with the participation of the state and/or a private operator and then transferred to the producers' cooperative for management. Basic technological services are provided to all producers; the produce remains their property, and the center sells it on behalf and in the interests of the producer, retaining a service fee [7]. For cooperative members, the fee is set at about 6%, and at the end of the year they receive a patronage payment in proportion to the volume of produce delivered; for other producers, the fee is about 11%. Capital expenditures are financed through loans from international financial institutions and members' share contributions, while current operations are funded by the service fee, packaging subsidies and tax incentives [8].

To verify the efficiency of the mechanism quantitatively, a comparative calculation was performed for two tomato-growing farm enterprises in Buka district: Azizmukhammad is considered a member of the service cooperative, and Buston SS a producer that uses the center's services without joining the cooperative. In the "via the center" scenario, losses fall to 8%, produce is segmented by quality (Premium 30% with a price coefficient of 1.5; Grade 1 50% - 1.2; Grade 2 20% - 0.5 relative to the base price), and the service fee is charged at the applicable rate (Table 2).

Table 2. Comparative calculation of indicators for two farms in Buka district operating without and via the center, 2025

Indicator	Farm enterprise "Azizmukhammad"		Farm enterprise "Buston SS"	
	without the center	via the center	without the center	via the center
Area, ha	1	1	1	1
Gross harvest, t	29.5	29.5	24	24

Indicator	Farm enterprise "Azizmukhammad"		Farm enterprise "Buston SS"	
	without the center	via the center	without the center	via the center
Post-harvest losses, %	14	8	17	8
Marketable volume sold, t	25.4	27.1	19.9	22.1
Average selling price, thousand UZS/t	6,000	6,900	4,500	5,175
Gross sales revenue, UZS million	152.2	187.3	89.6	114.3
Center service fee, UZS million	–	11.2	–	12.6
Patronage payment to member, UZS million	–	9.4	–	–
Net farm revenue, UZS million	152.2	185.4	89.6	101.7
Production costs, UZS million	119.6	119.6	72.3	72.3
Profit, UZS million	32.6	65.8	17.4	29.4
Profitability, %	27.3	55.0	24.0	40.7
Gross value added of the farm, UZS million	85.6	119.6	49.9	61.9
Producer share in the final price, %	25	48	25	46

Source: compiled by the author based on survey data.

Passing produce through the center increases the profitability of Azizmukhammad from 27.3% to 55.0% and its gross value added from Uzbek soums (UZS) 85.6 million to UZS 119.6 million per hectare, i.e., by a factor of 1.4. For Buston SS, profitability rises from 24.0% to 40.7%, and gross value added from UZS 49.9 million to UZS 61.9 million per hectare, i.e., by a factor of 1.2 [9].

The center's staffing requirements were determined using the labor output standards method for each functional block (Table 3). A permanent staff of about 39 people ensures the year-round operation of the center, and during the mass harvest an additional 13-16 seasonal workers are engaged, mainly in sorting, grading and packaging [10].

Table 3. Calculation of the regional center's staffing requirements by functional block (design capacity of 10,000 t/year)

Functional block	Operation volume, t/year	Output standard, t per worker per year	Headcount, persons
Receiving, weighing, primary sorting	10,000	2,000	5
Grading to quality standard (Premium/Grade 1/Grade 2)	10,000	1,000	10
Packaging and labeling	10,000	1,200	8
Controlled atmosphere storage maintenance	3,500	800	4
Primary processing (drying, freezing) – 15% of volume	1,500	700	2
Digital accounting platform and logistics	–	–	2
Administration and management (board, accounting, sales)	–	–	4
Transport and loading staff	–	–	4
Total permanent staff			39

Functional block	Operation volume, t/year	Output standard, t per worker per year	Headcount, persons
Seasonal workers (peak harvest period, 2-3 months)			13-16
Total in peak season			52-55

Source: compiled by the author based on statistical data.

4. Discussion

The results obtained make it possible to discuss the specific features of the proposed model in comparison with existing organizational forms, its consistency with current state policy, and the conditions for its implementation.

The proposed regional center should be distinguished from a fruit and vegetable cluster, since the two are opposite in the way they appropriate the value created. A cluster is a vertically integrated operator that independently carries out the entire technological cycle "seeds – seedlings (saplings) – cultivation – procurement – storage – processing – transportation – delivery to market"; the value added of the post-harvest stages accumulates with the integrator [11]. The regional center, by contrast, functions as a shared service and infrastructure platform for collective use, managed by the independent producers themselves, who retain ownership of the produce at all stages of its passage through the center. Whereas a cluster centralizes ownership and value with the integrator, in the center only the infrastructure is shared, while ownership and value remain with the producer [12]. This model is consistent with international practice: the Federal Agricultural Marketing Authority of Malaysia (FAMA) operates a network of collection, sorting, packing and consolidation points for small farmers' produce without depriving producers of ownership of their output; a similar logic is followed by cooperative marketing associations in the Republic of Korea, Japan and a number of European Union countries [13].

In the traditional chain, produce passes successively through middlemen, wholesale markets and retailers, and the producer retains about 25% of the final price. In the integrated chain, the center organizationally replaces the functions of the local procurer and the wholesale intermediary, so that the producer share in the final price rises to 45-50%, while losses decline and an export channel opens up.

Owing to the reduced fee rate and the patronage payment, a cooperative member receives a higher share of the final price, which creates a sustainable incentive to cooperate without resorting to coercion. Importantly, in both cases the increase in value added is achieved not at the expense of other links in the chain, but through lower losses, higher quality and the elimination of excessive intermediary mark-ups [14].

The legal basis for establishing such centers comprises Decree of the President of the Republic of Uzbekistan No. DP-5388 dated March 29, 2018, "On additional measures for the accelerated development of horticulture in the Republic of Uzbekistan", which established the principle of building a "from seed to market" technological chain; Resolution of the President of the Republic of Uzbekistan No. RP-4549 dated December 11, 2019, "On additional measures for the further development of horticulture and viticulture and the creation of a value chain in the sector"; the Strategy for the Development of Agriculture for 2020–2030, which provides for the reduction of post-harvest losses; Resolution of the President of the Republic of Uzbekistan No. RP-52 dated December 15, 2021, "On measures for state support of the horticulture sector and the further development of the cluster and cooperation system in the industry", which institutionalizes cooperation and the provision of paid agricultural services; Law of the Republic of Uzbekistan No. LRU-995 dated November 8, 2024, "On agricultural

cooperatives"; and Resolution of the President of the Republic of Uzbekistan No. RP-136 dated April 8, 2025, "On additional measures to increase the export potential of agricultural products and to develop the processing chain", which provides for subsidies for modern packaging and tax incentives [15]. Taken together, these acts confirm that the proposed mechanism does not contradict but rather develops current state policy [16].

The mechanism should be implemented in stages. The initial stage involves forming service cooperatives and regional centers and implementing pilot projects in districts with high vegetable output; the next stage involves expanding the network of centers and developing interaction among them; and the final stage involves integrating the regional coordination system with the national logistics infrastructure and export sales channels. A phased approach makes it possible to take into account persisting institutional constraints: insufficient trust among producers, unstable contractual relations, and differences in the digital literacy of rural producers [17].

The operation of a regional center also requires a unified information system. In Tashkent region, priority should be given to IoT monitoring of the cold chain and a digital sales platform: monitoring storage and transportation conditions will reduce post-harvest losses, while the digital platform will make it possible to shorten intermediary chains and increase the producer share in the final price [18]. A traceability system should be introduced at the initial stage, linked to the receiving and sorting of produce. The use of artificial intelligence to forecast demand and prices should be regarded as the next stage of digitalization, once a sufficient body of data on production, prices and demand has been accumulated [19].

5. Conclusion

The organizational and economic mechanism for coordinating participants in the vegetable value chain is a three-level system in which the regional center serves as the core element of the meso level. Hybrid contractual-cooperative coordination ensures the alignment of interests and the allocation of risks without concentrating value with an integrator, while the feedback loop makes the system manageable.

Unlike the cluster model, which concentrates value with the integrator, a regional center organized as a service cooperative pools infrastructure while leaving ownership and the value added it creates with the primary producer. Its introduction makes it possible to reduce post-harvest losses from 25-30% to 7-10% and to raise the producer share in the final price from 25% to 45-50%; calculations for farms in Buka district showed an increase in profitability from 27.3% to 55.0% and from 24.0% to 40.7%.

The mechanism should be introduced in stages, starting with pilot projects in districts with high vegetable output and using existing state support instruments. At the initial stage, the center's digital platform should be equipped with traceability and cold chain monitoring functions, to be supplemented later with AI-based predictive analytics tools.

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