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Kazakhstan: Optimization of state management of investments in agriculture

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Abstract

In the context of increasing global competition, climate challenges, and the need for food security, improving mechanisms for state regulation of investment activities in the agricultural sector is of particular importance. This study aims to develop an optimization model for managing agricultural investments in the Republic of Kazakhstan. The work contains a systematic analysis of existing support instruments, identifies key institutional and infrastructural barriers, and studies international experience. A five-level adaptive model is proposed, including strategy, normative, economic, institutional, and information-analytical subsystems. KPI/KQI indicators have been developed to assess efficiency, and a logical matrix (logFrame) with elements of scenario modeling has been introduced. A conclusion has been reached about the need to move from fragmented subsidies to a flexible, digital, and results-oriented system of state stimulation of agricultural investments. The presented model can serve as a tool for transforming investment policy and increasing the sustainability of the agricultural sector.

Keywords: Adaptive model, Agro-investments, Government regulation, Institutional policy, Kazakhstan, Management optimization, Subsidies, Sustainable development.

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1. Introduction

Kazakhstan's agricultural sector has significant potential to ensure both domestic food security and an export orientation. However, in recent years, there has been a discrepancy between this potential and the actual pace of agricultural development. One of the key reasons remains the insufficient level of investment, including in technological

re-equipment, digitalization, and infrastructure development. Moreover, the existing mechanisms of state regulation of investment activities do not ensure sustainable investment growth, especially in the small and medium-sized agribusiness segments.

In the context of increasing global competition and the need to transition to sustainable agricultural production, the task of improving the instruments of state influence on investment processes in agriculture is becoming urgent. This requires not only financial but also institutional modernization of approaches to agricultural investments.

Today, Kazakhstan's agricultural sector is experiencing a number of positive changes, such as increased food exports, the development of individual agro-parks, and the introduction of elements of digital farming. However, investment activity remains volatile. According to the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (BNS ASPIR RK), the share of investment in fixed capital in agriculture is only approximately 2% of the total investment in the economy as of March 2025 (Figure 1).

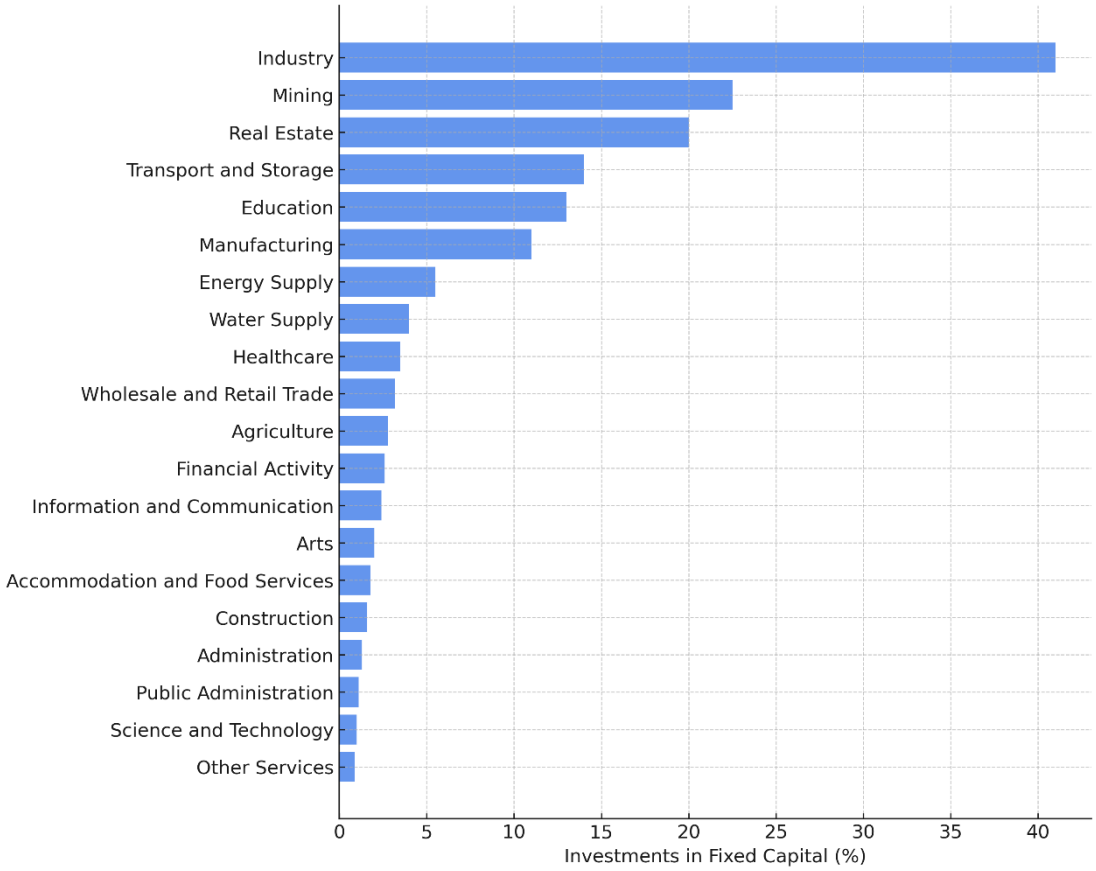

Figure 1.
Investments in fixed capital by areas of use (as of 17.03.2025, according to BNS ASPIR RK).

The deficit of long-term, “smart” investments in sustainable technologies, processing and logistics is particularly acute. It is also possible to note the fundamental difference in investments in the agricultural sector by region (Figure 2). This also causes a disproportion in the development of the agricultural sector on a national scale.

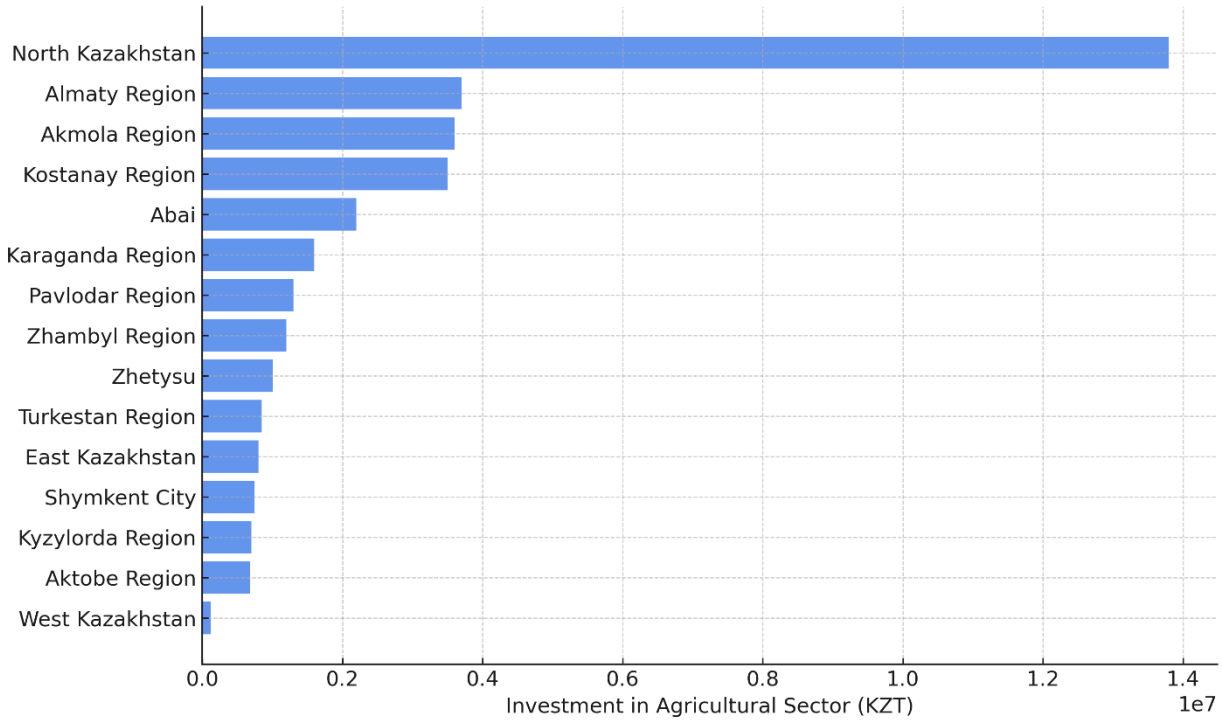

Figure 2.
Regional distribution of investments in the agricultural sector (as of 17.03.2025, according to BNS ASPIR RK).

We identify the following main barriers that limit investment.

- High level of investment risk.
- Limited access of agricultural producers to credit resources.

Lack of systematic support for investment projects.

- complexity and opacity of state support mechanisms.

From the analysis of the current instruments of state regulation, we note several problems that reduce the effectiveness of the impact on investment processes.

- Fragmentation of support, when there are many subsidies, programs and grants, but they are rarely synchronized with each other and do not form a unified system.
- Lack of access to financing when the banking system is extremely cautious about lending to the agricultural sector, especially in regions with low solvency.
- The lack of a project approach when investments are often distributed without taking into account strategic priorities and real potential.
- Low level of digitalization, when the lack of unified digital platforms and investment attractiveness maps hinders quick decision-making.

Compared with foreign practices, we note in some of them successful cases of creating targeted, innovative and flexible mechanisms for attracting investments:

The Netherlands has the Impact Clusters[1]grant program. This initiative supports Dutch companies seeking long-term investments in developing countries, promoting private sector development and sustainable growth. Notably, Agrofoodcluster[2] brings together agri-food companies to stimulate knowledge, innovation and business in open field production.

The Raven Venture Capital Fund Created in Canada Indigenous Impact Fund II[3] invests in innovative businesses led by indigenous people to improve the well-being of these communities. The New Acres Food & Ag Fund[4], a venture capital fund focused on the agriculture and food sectors and supported innovation and development in these areas.

In Brazil, the Moderfrota Program provides financing for the modernization of agricultural machinery, increasing the productivity and efficiency of the agricultural sector. Additionally, the Brazilian bank BNDES[5] actively supports investment in agriculture by providing loans for the purchase of machinery and equipment, which contributes to the intensification of agricultural activities.

These examples illustrate successful approaches by different countries to stimulating investment in the agricultural sector through clusters, specialized funds and economic zones.

[1] https://english.rvo.nl/subsidies-financing/impact-clusters-ic?utm_source=chatgpt.com.
[2]https://agrofoodcluster.com/.
[3]https://www.fcc-fac.ca/en/financing/capital/fund-investments?utm_source=chatgpt.com.
[4]https://www.bdc.ca/en/bdc-capital/venture-capital/portfolio.
[5]https://www.climatepolicyinitiative.org/.

Through comparative analysis, we note that developed countries actively use "smart subsidies," venture mechanisms, and monitoring platforms with a high level of digitalization in the context of state regulation of agricultural investments. In these countries, the state focuses on the project approach, co-investment, and clustering, which ensure higher investment efficiency and attract private and other capital to the agricultural sector.

We believe that Kazakhstan also needs to move from the "budget injection" model to a system of flexible instruments + digital transparency + institutional support.

This concerns the need to implement a rating model of subsidies, in which the amount of support depends on the transparency, efficiency, and sustainability of the project. Additionally, flexible subsidies that adapt to the stage of implementation of the investment project (pre-project, initial, scaling, expansion) are used. It is also necessary to develop guarantee instruments through state and quasi-state institutions.

In general, a comprehensive improvement in the mechanisms of state regulation of agricultural investments will allow.

- Significantly increases the volume of private investment in agriculture.
- Stimulate the transition to sustainable, environmentally friendly and innovative agricultural production.
- Reduces investment risk and increases investor confidence.
- Ensuring transparency and efficiency in the distribution of budget funds.

Thus, modern challenges require Kazakhstan to move from fragmented and reactive approaches in agricultural policy to systemic and proactive support mechanisms. Effective state regulation of investment activities should be based on the principles of comprehensiveness, strategicity, openness to investors, digitalization, and the use of data. The creation of institutional and digital infrastructure, integration with the innovation agenda, and sustainable practices will provide an impetus for the modernization of the agricultural sector, ensuring its contribution to the development of the national economy.

In this context, state regulation of investment activities needs to be improved, taking into account the modern challenges and priorities of agricultural policy.

Accordingly, in this paper, we propose a new optimized model of mechanisms for the state regulation of investments in the agricultural sector of Kazakhstan.

The new optimized model is postulated as a detailed and complete scheme of events and actions to significantly improve the investment climate in Kazakhstan through the optimization of state policy in the field of agricultural investment.

2. Literature Review

The Republic of Kazakhstan has achieved significant results in the agricultural sector: there is a constant growth of production based on market relations, labor productivity and productivity are increasing, fixed assets and infrastructure of the industry are being updated, self-sufficiency in basic food products has been achieved [1, 2]. Kazakhstan is especially characterized by significant potential for the development of organic agriculture [3].

In general, it can be said that the investment climate in Kazakhstan is quite attractive.

The investment attractiveness of the Kazakhstan market is ensured by a combination of access to natural resources, the size of the market, the strategic location of Kazakhstan and some other factors [4].

But this attractiveness, especially in the field of agricultural enterprises, must be motivated by new and rational approaches to state regulation in the field of agricultural investments [5].

Each country, one way or another, found itself in a rather difficult situation related to investment activities [6] especially in a key area such as the economy. These problems particularly affect the countries of the post-Soviet space [7].

Today, Kazakhstan is experiencing similar difficulties. All this requires special attention and new approaches to the system of investment regulation by the state. Here, an optimal balance is needed between state policy and the institutional conditions of society in the context of economic relations.

Increased attention has been given to the clarification and justification of new instruments and mechanisms of the system of regulation and stimulation of investment activity at the present stage of economic development [8]. In particular, to optimize and intensify the state's economic and institutional regulation of investment processes, it is proposed to interpret and implement the principle of competitiveness [9].

In general, investments in the agricultural sector are considered strategic tools for ensuring food security, sustainable development and economic diversification, especially for countries with high agricultural potential, such as Kazakhstan. Issues of state regulation of investment activities in the agricultural sector are actively studied within the framework of institutional, neoclassical and sustainable economic theories.

In the Republic of Kazakhstan, the agricultural sector plays a key role in sustainable development strategies. However, analysts note significant barriers: the inefficiency of existing subsidies, fragmentation of support, weak regional involvement, limited access to financing, and insufficient digitalization [10].

Research by Gabdualiyeva et al. [11] showed that the institutional environment for investors in agro-industrial complexes remains unstable, especially in terms of land rights, legal security and long-term partnership mechanisms. Significant regional disparities in the volume of investment activity have also been identified [11].

Theoretically, this study is based on the principles of institutional economics, in particular, the classic works of D. North, who emphasized the role of institutions in reducing transaction costs and ensuring the predictability of investor behavior [12].

The concepts of adaptive regulation and program-targeted management in agriculture are being developed in the works of modern researchers, where the need for policy flexibility in the face of climatic and economic uncertainty is emphasized.

Attracting investment in the agro-industrial complex is a multifaceted task covering the entire range of possible financial, economic, legal and organizational resources [13]. The heterogeneity of economic development and investment space in Kazakhstan actualizes the problem of smoothing out interregional disparities. Which is impossible without attracting investments to each region, developing an investment strategy taking into account local characteristics [14].

It is extremely important to ensure an increase in the volume of investments in the modernization of fixed assets of agriculture [15].

It is especially necessary to note the importance of investments in digital technologies in the agricultural sector. Digital technologies can significantly increase the profitability of the agricultural sector through targeted cost optimization and more efficient distribution of funds [16].

In general, a necessary condition for attracting investments, including foreign ones, is the formation and implementation of the investment attractiveness of the economic system, which should be understood as its ability to accept significant investments [13, 17].

3. Research Methodology

Methodology was based on the synthesis of qualitative and quantitative methods of analysis, with the integration of concepts of institutional economics, the theory of government regulation, project management, and a comparative analysis of foreign experience.

The study is based on the following working hypotheses.

Hypothesis 1: The existing mechanisms of state regulation of investments in the agricultural sector of Kazakhstan are fragmented, insufficiently adaptive and do not ensure sustainable investment growth.

Hypothesis 2: It is possible to build an optimization model of state regulation based on the principles of adaptability, targeting, co-investment, and digital transparency.

Hypothesis 3: The implementation of such a model will increase the efficiency of budget expenditures, the investment attractiveness of the agricultural sector and the sustainability of its development.

A comprehensive analysis of current regulatory legal acts, strategies, and state programs regulating investment activities in the agro-industrial complex of the Republic of Kazakhstan was conducted.

A comparison of Kazakhstani instruments of state support with successful foreign practices was carried out according to the following criteria.

A conceptual model is constructed from five interconnected subsystems (strategic, normative, economic, institutional and information-analytical), each of which is assessed according to functional blocks, tasks and performance indicators.

The mechanism for adaptive distribution of investment subsidies and rating assessment of projects was developed using the following elements:

To evaluate the implementation of the model in a real environment, a logical matrix (logframe) and scenario analysis were utilized.

However, this study does not cover the behavioral and psychological aspects of agro-investors or the specific risks associated with land use rights. Additionally, quantitative modeling using regression or agent-based analysis was not carried out, which could be the subject of future work.

4. Results

4.1. Contours of the Optimization Model

We postulate and analyze a new model of state regulation of investment activity in the agricultural sector of the economy as a paradigm of optimal management.

There is no doubt that investment activity in the agricultural sector, in the context of new global "tariff wars" initiated by the USA, has a high level of risk, institutional inertia, and extreme dependence on environmental and climatic factors. This is especially true in the context of extreme climate dynamics in recent years and in future prospects.

Therefore, we can assert that optimal public administration should be based primarily not on stimulation but on the principles of adaptive optimization. Notably, we do not exclude stimulation as an important component of state regulation. However, we make it secondary in relation to adaptive optimization.

The implemented principle of adaptive optimization, as we see it, will maximize the sustainable (permanent) accumulation of investments in the agricultural sector, increase their efficiency, minimize transaction costs and ensure a balance between the interests of the state, investors and agricultural enterprises.

The optimization model should be oriented toward maximum efficiency under the conditions of the mentioned uncertainties and rather limited resources. That is, the model should integrate the maximum number of possibilities and actual potential of the state management and regulation system.

Thus, we have outlined the general picture in the context of which an optimal model of state regulation of investments in the agricultural sector should be formed.

4.2. Optimization Goals

It is preferable to select the following components as the target guidelines of our model (Figure 3).

1. *Synergy - maximizing the integral effect of investments*

That is, not only the effectiveness of investments in the agricultural sector but also the cumulative effect of these investments (agricultural society, standard of living of workers in the agricultural sector, social infrastructure, sustainability, and so on).

2. *"Green corridors" - minimization of investment barriers*

This goal concerns the creation of regional “green corridors” for all types of investments in the agricultural sector, including the elimination or minimization of regulatory, informational, infrastructural and organizational barriers.

3. Multivector - optimization of resource distribution,

This goal concerns the optimization of the distribution of resources across all regions, industries and types of agricultural producers and related industries.

4. *"Procrustean bed" - reduction of regulatory inefficiency*

This goal concerns the radical optimization of subsidies and public spending in the agricultural sector.

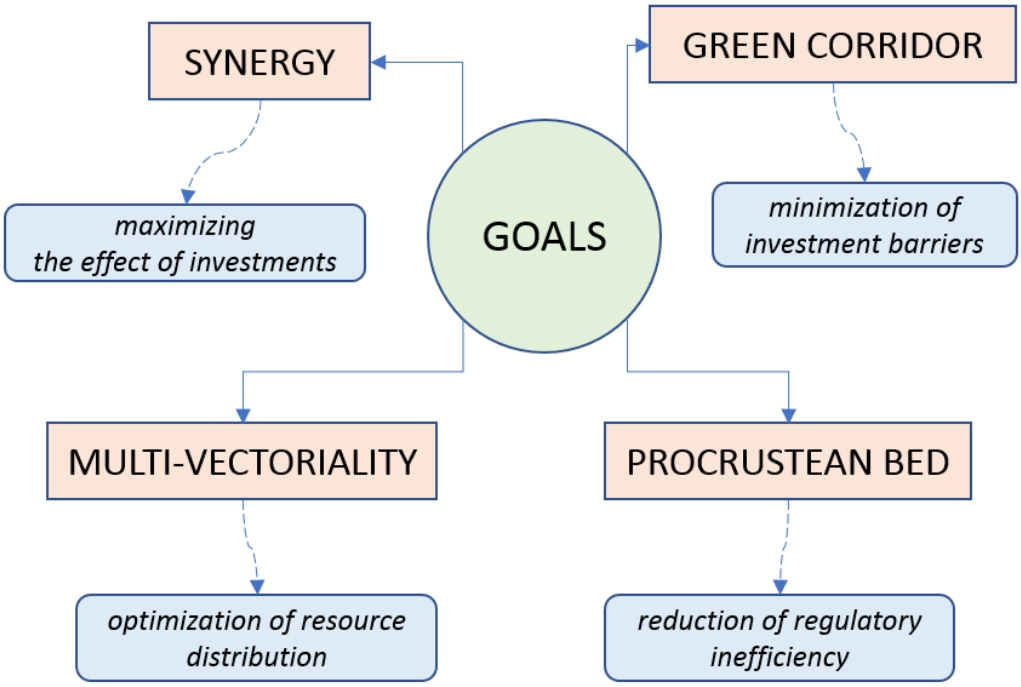

Figure 3.
Optimization model objectives.

4.3. Structure of the Optimization Model

The optimization model includes five key optimization subsystems (Figure 4), which operate in synchronous mode:

1. *Strategic subsystem (navigation of goals)*

Here, priorities are formed. What exactly needs to be supported - export-oriented products, processing, logistics, organic farming, etc. Here, scenario planning of investment policy is interpreted, and target indicators (KPIs) are introduced for assessing investment programs, projects and initiatives.

Tasks of the strategy subsystem:

- Identification of priority areas (processing, logistics, organic farming, etc.).
- Coordinating regional programs with the national strategy.
- Preventive identification of investment bottlenecks.

2. *Normative subsystem (reducing participation costs).*

Here, regulatory requirements are optimized, and access to support is simplified. Legal guarantees for investors (including protection of private property and nondiscriminatory conditions of access) are also introduced, and transparent procedures and full digitalization of control and execution are ensured.

Tasks of the regulatory subsystem:

- Forgiving administrative procedures.
- Protection of investors’ rights (Including land, contract, and arbitration).
- To manage a regulatory "sandbox" for innovative models (for example, agrotech startups).

3. *Economic subsystem (resource provision)*

Here, budgets are allocated on the basis of a multilevel analysis of efficiency. Mechanisms for priority subsidies for the most efficient and innovative projects are also introduced. In addition, the participation of private investors is stimulated (including through guarantees, agricultural bonds and funds).

Tasks of the economic subsystem:

- In the implementation of the rating system of subsidies (KPI approach).
- support for agricultural bonds, credit guarantees, and venture funds.

- Differentiation of forms of support depending on the type and scale of the project.

4. *Institutional subsystem (regulatory and supporting structures)*

Here, coordination between levels of government (central–regional–local) is ensured, and investment agencies and "one-stop" platforms in the agro-industrial complex are created. An institutional environment for agro-innovative development (clusters, agro-parks, and technology parks) has also formed.

Tasks of the institutional subsystem:

- Establishment of an agro-investment agency or a one-stop-shop platform.
- Development of regional investment support institutions.
- Support for agricultural clusters, agroparks and logistics hubs.

5. *Information and analytical subsystem (feedback and adaptation)*

Here, the effectiveness of the programs being implemented is monitored. Digital analytics and a system for predictive assessment of the investment climate are being built. A register of investment projects and open databases for investors are also supported.

Tasks of the information and analytical subsystem:

- Creation of a digital map of the investment attractiveness of regions.
- In the implementation of automated project evaluation systems (AI platforms).
- Publication of open data and investment registers.

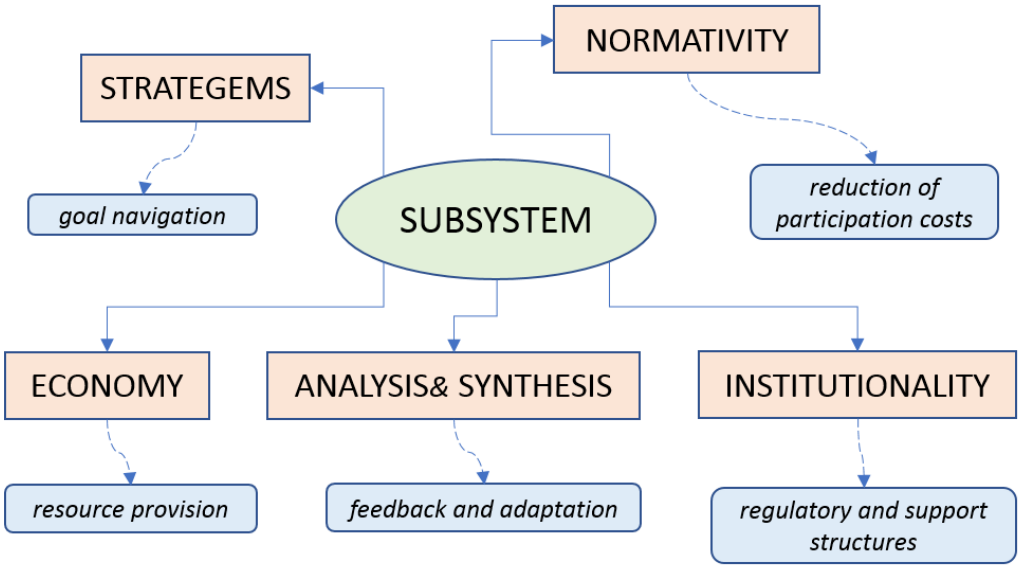

Figure 4.
Structure of the optimization model.

4.4. Optimization Principles

The optimization model is based on the following principles of optimal government intervention (Figure 5).

1. Targeting

Assistance is provided only to those projects that meet strategic goals and have high potential for a multiplier effect,

2. Adaptability

The mechanisms are regulated on the basis of feedback, monitoring and predictive analysis.

3. Differentiation

Conditions and tools are adapted to the types of entities (Small, medium, and large farms).

4. Transparency and accountability

Digital interfaces, open evaluation algorithms, independent performance audit.

5. Partnership and coinvestment

Participation of the state not as the sole donor but as a catalyst for private and other investments in the agricultural sector.

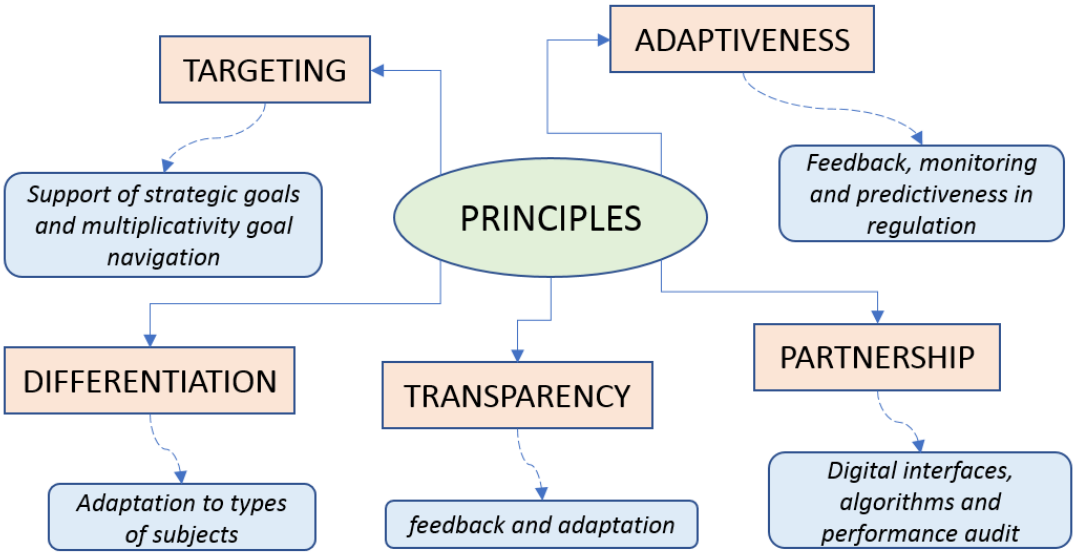

Figure 5.
Principles of the optimization model.

4.5. Optimization Tools

The instruments for optimizing the state regulation of agricultural investments (Figure 6) are formed on the basis of the following components.

1. Investment priorities and ratings

In the management of a system of ratings for investment projects according to the following criteria: technological innovation, sustainability, export potential, and employment. Using ratings to assess the amount of support.

2. Distribution mechanism

The use of a point system (or index ranking) instead of a uniform or historical distribution of funds. Introduction of restrictions on the concentration of support (Antigopolization).

3. Adaptive subsidies

Flexible support models: Transformable subsidies, results-oriented grants, "growth" subsidies (escalation upon achievement of goals),

4. Economic filters

Automatic filtering of ineffective projects through requirements for co-financing, investment plans, and the validity of the agricultural business model.

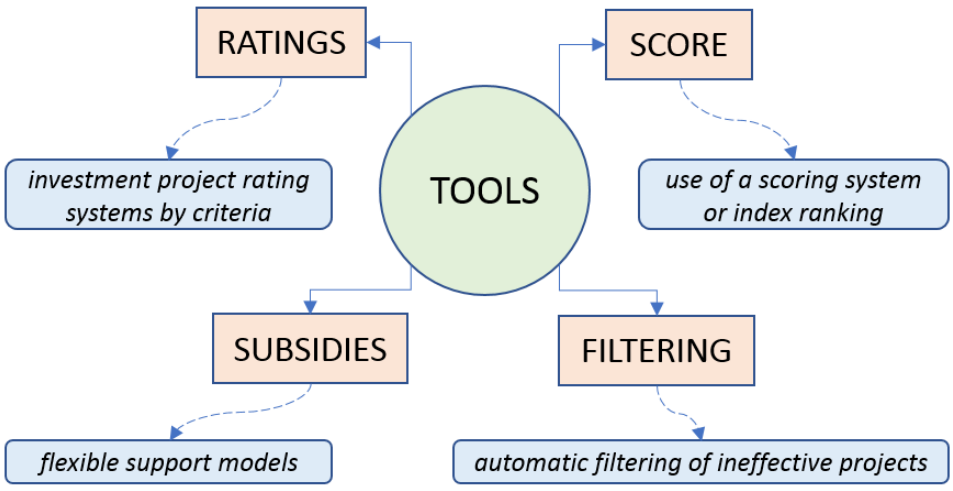

Figure 6.
Tools for implementing the optimization model.

Thus, the implementation of the goals, structure, principles, and instruments, as we believe, will have specific effects on the implementation of the optimization model. We interpret these effects through an increase in the effectiveness of public spending due to targeting, an increase in investor confidence due to the predictability and institutional sustainability of mechanisms, stimulation of innovation and technological modernization of the agricultural sector, and improvement of macroeconomic indicators. In particular, this is due to sectoral growth in GDP, export earnings, and employment in the agricultural sector.

We can highlight the key results of the model's implementation.

- *Growth of investment activity in the agricultural sector.*
- *Increasing the efficiency of budget expenditures.*
- *Strengthening the confidence of investors and financial institutions.*
- *Development of an innovative and sustainable agricultural economy.*

In general, our optimization model of state regulation of agricultural investments is not a static system of subsidies and general support. Our model is a dynamic, adaptive and strategically oriented management mechanism.

The optimization model requires rethinking the role of the state in the sphere of control and regulation of the investment system in the agricultural sector. In particular, the general investment policy, from the distributor of resources to the architect of the investment agricultural environment, should be considered. Optimal and effective conditions are created for long-term sustainable development and the attraction of private capital and other forms of capital to agriculture.

To implement the optimization model, it is necessary to introduce an adaptive system of control, regulation and management at all levels of government structures participating in investment processing.

Such an adaptive system ensures the connection between subsystems and goals, constantly adjusts mechanisms on the basis of results and maintains a balance between sustainability and flexibility of regulation.

4.6. Indicators and Assessments of the Effectiveness of Implementation

There is no doubt that the implementation of the model in practice must be accompanied by an authentic and adequate system of indicators and assessments of all management processing.

Therefore, in our context, it is necessary to form indicators for assessing the effectiveness of the implementation of the optimization model of state regulation of investment activities in the agricultural sector. which can be grouped by the corresponding subsystems.

When forming the indicator system, we proceed from similar systems and general ideas about indicative parameters. In accordance with this, we divide the indicators into KPIs and qualitative KQIs, with a focus on their applicability for monitoring, management audits and strategic correction.

On this basis, the system of indicators for the subsystems we have considered will be interpreted in the following form.

Table 1.
Performance indicators for the strategy subsystem.

Type	Indicator	Unit of measurement	Target value
KPI	The share of investment in the agro-industrial complex from the total volume of investment in the economy	%	> 5%
KPI	Level of achievement of strategic KPIs in the agricultural sector (by priorities)	% Completion	≥ 90%
KQI	Degree of coherence between regional and national strategies	expert scale (1-5)	≥ 4

Hereafter, we provide a priori quantitative indicators. Specifically, the optimization model is implemented, and its parameters are adjusted. That is, the full technical passport of the assessments is a dynamic process that becomes relevant after the model is checked for verifiability and falsifiability (in Karl Popper's notation).

Table 2.
Performance indicators for the regulatory subsystem.

Type	Indicator	Unit of measurement	Target value
KPI	Average time to obtain a subsidy/permit for a project	days	≤ 30
KPI	Number of new legal acts simplifying investment activities	things	≥ 10 per year
KQI	Investment Confidence Index (based on business surveys)	points (0-10)	≥ 7

Table 3.
Performance indicators for the economic subsystem

Type	Indicator	Unit of measurement	Target value
KPI	Ratio of private and public investment in the agro-industrial complex	coefficient	≥ 2:1
KPI	Share of projects with positive ROI after 3 years	%	≥ 70%
KPI	Specific efficiency of budget expenditures (tenge of return per 1 tenge of support)	tenge	≥ 3

Table 4.
Performance indicators for the economic subsystem.

Type	Indicator	Unit of measurement	Target value
KPI	Number of active investment offices/support platforms	units	≥ 10
KQI	Level of coordination between government agencies and investors	expert scale (1-5)	≥ 4
KPI	Number of PPP projects in the agro-industrial complex	things	≥ 15 per year

Table 5.
Performance indicators for the information and analytical subsystems.

Type	Indicator	Unit of measurement	Target value
KPI	Availability of a digital investment card of the agro-industrial complex	fact (yes/no)	Yes
KPI	Share of projects with digital support and monitoring	%	≥ 80%
KQI	Degree of transparency and availability of investment data	index (0–100)	≥ 85

Therefore, we have specified the units of measurement and target indicators as precisely as possible. This is necessary to demonstrate the maximum practicality and authenticity of the model, which can be more quickly and effectively implemented in the system of state regulation of investments in the agricultural sector.

The system of internal indicators, naturally, must be supplemented with general indicators that characterize the optimization model as a whole, integrally.

Accordingly, we introduce integral indicators in the following interpretation (Table 6).

Table 6.
Integral (summary) indicators of the optimization model.

Type	Indicator	Unit of measurement	Target value
KPI	Gross value added growth in the agricultural sector	% per year	≥ 5%
KPI	Index of investment attractiveness of the agricultural sector	scores (according to the World Bank/UNCTAD scale)	in the top 50 countries
KPI	Employment level in agriculture and processing	thousand people	growth of ≥ 5% annually
KQI	Investor confidence in the regulatory system (based on surveys)	points (0-10)	≥ 8

Naturally, the indicator model we developed and presented must be provided with the necessary resources and organizational measures. In particular, this concerns the information part. That is, the methods of collecting and evaluating data for the quantitative and qualitative determination of indicators. In this context, it is possible to use national statistical reports, annual reports, online platforms for subsidies and project monitoring, surveys of entrepreneurs, and independent audits.

4.7. Logic Matrix (Logframe)

We have considered what assessments and indicators an optimization model should provide after implementation or during the implementation process.

However, we only present and propose an optimization model in the context of an innovative solution. Therefore, it is necessary to additionally assess the effectiveness of the implementation of the optimization model itself in the real-state environment—in the system and in the structures. That is, it is necessary to set a kind of vector for the rational and effective implementation of the model.

These are tasks, first, of observing the logical sequence of all stages of implementation. Accordingly, such a system for assessing the effectiveness of implementation should be based on logical tools, that is, in a single space of logic.

We interpret this toolkit as a logic matrix (LogFrame).

Accordingly, we will form and create a logical structure matrix (logarithm) to assess the effectiveness of the implementation of the optimization model of state regulation of investment activities in the agricultural sector of the Republic of Kazakhstan. This matrix should include a hierarchy of goals, objectively verifiable indicators, and key assumptions. We can postulate the hierarchy of goals in the form of four components: the overall goal (Impact), the project goal (Outcome), the results (Outputs), and the activities (Activities).

Table 7 (matrix) of the logical structure of the implementation of the optimization model that we have compiled is interpreted as follows.

Table 7.
Logframe matrix of the optimization model.

Hierarchy of goals	Indicators (OVI)	Key assumptions and risks
Common Goal (Impact)	Sustainable development of the agricultural sector through increased investment	Political stability and long-term priority of the agricultural sector
	Growth of gross value added (GVA) in the agro-industrial complex ≥ 5% per year	Maintaining climate resilience and favorable export conditions
	Growth of employment in agriculture and agro-processing ≥ 5% per year	No dramatic demographic or migration shifts
Project Goal (Outcome)	Improving the efficiency of state regulation of investment activity in the agricultural sector	Timely budget financing and political will for reforms
	The index of investment attractiveness of the agricultural sector is among the top 50 countries in the world	International assessment methods do not undergo any fundamental changes
	The share of private investment in the agro-industrial complex will double by 2030	Private investor confidence not undermined by external shocks
Results (Outputs)	The model has been implemented into the national investment policy	Support for the initiative at the level of central and regional authorities
	Agroinvestment center/single window for investors created	Resources and personnel for institutional implementation are available
	Digital assessment and monitoring tools have been developed	Digital infrastructure and integration with regional systems are being successfully implemented
	Rating and KPI mechanisms for distributing subsidies have been introduced	Industry associations back new rules
	Monitoring and public reporting system launched	Support from the Accounts Committee and the civil sector
Activities	Carrying out regulatory reform in subsidies	Political will at all levels of government
	Development of KPI and rating assessment methodology	Expertise and data for development are available
	Creation of a digital platform for an investment portal	IT competencies, government orders and integration with platforms are possible
	Training of regional operators of the model	Readiness of regions for implementation and coordination with the center
	Conducting investor confidence and information campaigns	Support from business communities and the media

The OVI parameter (objectively verifiable indicators) in this table is quantitative or qualitative and is clearly verifiable. The assumptions parameter refers to the external conditions on which success depends but which are not directly controlled.

In this context, it is necessary to supplement the optimization model with risk and scenario assessments (Table 8). Failure to implement the optimization model of state regulation of investment activities in the agricultural sector. This is a relevant addition to the logical matrix. In addition, it is necessary to ensure anti-crisis management, scenario planning and adaptive correction of the model.

Table 8.
Risk assessment and scenarios in the case of implementation failure.

Risk category	Risk indicator	Anxiety threshold	Failure scenario
Political and administrative risks	No regulatory changes on time	Regulatory acts have not been adopted within 12 months.	Introduce temporary regulations within the pilot regions, initiate an interdepartmental agreement
	Sabotage or passive resistance from the regions	More than 30% of regions have not implemented elements of the model	Designate "pilot" regions with increased support, introduce KPIs for akimats
Financial risks	Underfunding of key instruments of the model	More than 25% reduction from planned budget	Reallocate resources, temporarily suspend lower priority projects
	Refusal of private investors to participate in coinvestment mechanisms	Investor participation below 40% in target projects	Introduce guarantees, tax preferences, organize direct dialog with business
Institutional risks	Lack of competence in agro-investment centers and administrations	Less than 50% of specialists have completed training	Launch emergency trainings, bring in external experts, delegate functions to growth centers
	Conflict between regulatory and service functions	Complaints from businesses, growing bureaucracy	Reorganize the institutional architecture, separate control and service functions
Technological risks	Unsuccessful implementation of the digital platform	Low utilization (<30% of planned)	Restart with new IT contractor, transition to modular architecture
	Incompatibility with other state information systems	Integration errors, database duplication	Creation of API bridges and data hubs, connection via the Unified Electronic Document Management System and the Smart Data Ukimet platform
Social risks	Low confidence of agribusiness in new mechanisms	Refusals to participate in competitions and platforms	Conducting an information campaign, participation of business associations in the development of mechanisms
	Negative media coverage over 'lack of transparency'	More than 5 negative media publications/discontents	Public audit, publication of all criteria and subsidies in the public domain
Exogenous risks	Weather/climate shocks, epidemics, sanctions	Force majeure ≥ 2 regions	Temporary focus on anti-crisis investments (processing, storage, sustainable technologies)
	Market destabilization/inflation	Significant increase in the cost of resources	Adjustment of investment standards, introduction of a dynamic price index when evaluating projects

As risk management tools, we highlight the following:

- A risk register that is updated quarterly.
- With an early warning system such as digital analytics based on deviations from target indicators.
- A crisis management plan that can be approved at the government level and includes powers for accelerated response.

This scheme can be interpreted by specific rapid response mechanisms that can be implemented within the framework of scenario modeling (Table 9).

Table 9.
Scenario modeling.

Scenario	Description	Countermeasure
Base	Planned implementation, moderate deviations	Support, monitoring, minimal adjustments
Moderately negative	Slow implementation, 1-2 risks active simultaneously	Strengthening feedback, connecting additional resources
Critical	Simultaneous activation of ≥ 3 risks, missed deadlines, resistance	Mobilization of anti-crisis mechanisms, political intervention
Optimistic	Outperformance, increased confidence, foreign investor interest	Scaling, consolidation of best practices, replication

5. Discussion

Thus, the results of the conducted research and the proposed optimization model of state regulation of investment activity in the agricultural sector of Kazakhstan definitely allow us to go beyond the traditional discourse on subsidies and move to a systemic, strategically sound approach.

Discussion of these results clearly requires interpretation from the standpoint of modern institutional theory, principles of sustainable development, and analysis of international experience and practical applicability in Kazakhstan's realities.

Notably, the proposed concept of adaptive optimization as a fundamental principle of the new model of state regulation opposes the existing practice of predominantly directive and fragmented subsidization. Adaptability in this context is not only the ability to respond to external and internal changes but also the mechanism of learning and constant calibration of regulation parameters on the basis of predictive analytics and KPI monitoring built into the model.

We emphasize that the proposed structure of the model, which is divided into five subsystems (strategic, normative, economic, institutional and information-analytical), is conceptually close to systemic management in the field of public administration.

This allows for a functional connection between goal setting, resource provision, institutional implementation and feedback mechanisms. The information and analytical subsystem is especially significant, acting as the "nervous system" of the model, without which adaptability and predictability are impossible.

The typology of goals (Synergy, "green corridors", multiple vectors, and a reduction in regulatory inefficiency) reflects the desire for multilevel efficiency. From macroeconomic indicators to specific convenience indicators for agricultural investors. This reflects a departure from traditional vertical management and a transition to the network interaction of stakeholders, including agricultural associations, the private sector and international partners.

The key factor is also the mechanism of co-investment and the differentiation of subsidies depending on the stage and results of projects. This solution opens the way to the use of project financing instruments, venture models, and the integration of criteria into agricultural investments. Thus, the optimization model is not only functional but also strategically sustainable since it contributes to the formation of new motivational contours from state subsidies to investor initiatives and market partnerships.

A comparison with international cases shows that successful models of agro-investment are based on three pillars: Institutional clarity, financial flexibility and digital transparency. The proposed RK model logically moves in the same direction, offering its own interpretation through adaptive integration rather than direct imitation of foreign solutions.

It should be noted that successful implementation of the model is impossible without meeting key conditions: political will, digital maturity, interdepartmental coordination and qualified personnel. Additionally, the risks of resistance at the regional level, technical failure during digitalization, and social distrust require a well-established change management system. In this context, the proposed model and the use of the log-frame logical matrix are valuable management tools for reducing uncertainty and scenario planning.

In our opinion, the proposed system of KPI/KQI indicators, covering all levels and subsystems of the model, deserves attention. Its presence ensures not only control and audit but also the potential possibility of integrating it into state platforms for assessing the effectiveness of policies. This clearly and directly transforms the model from a project initiative into a component of the national sustainable development strategy.

Thus, the proposed optimization model is not only a tool for modernizing the investment climate in the agricultural sector but also the architecture of a new type of state regulation that combines systematicity, flexibility, and digitalization and focuses on results.

The model can be considered a universal prototype for the transformation of other industries with a high degree of risk and low investment attractiveness from ecology to infrastructure.

6. Conclusion

The agricultural sector of Kazakhstan is undergoing a phase of active transformation, and the success of this transformation largely depends on the effectiveness of the mechanisms of state regulation of investments. Based on the above, we can draw the following fundamental and key conclusions.

1. The need to strengthen the state regulation of investments is confirmed by objective factors. Without an active role of the state, the agricultural sector, characterized by high risks and relatively low profitability, will not be able to attract

sufficient investment for modernization. The experience of Kazakhstan and other countries shows that a competent state investment policy is a prerequisite for the sustainable development of the agro-industrial complex.

2. In Kazakhstan, a basis for a system of support for investments in the agro-industrial complex has been created, including subsidies, preferential lending, special institutions, and national development programs. These measures have contributed to the growth of production and investment in recent years. However, significant shortcomings have been identified: episodic debt on subsidies, weak insurance, limited bank lending, not always targeted spending of funds, and infrastructure and institutional gaps.
3. Global experience confirms that comprehensive support, from subsidies to agrobanks and insurance, can significantly increase investment activity. It would be advisable for Kazakhstan to adopt best practices: stable and predictable financing of the agricultural sector, development of specialized financial institutions, insurance mechanisms, and clear long-term planning.
4. The priority areas for improving the mechanisms of state regulation of investments in the agricultural sector of Kazakhstan are strengthening the financial infrastructure; increasing the volume and improving the reliability of subsidies (with transparent monitoring); developing a system of agricultural insurance with state participation; improving regulatory conditions for investors (land relations, taxes, and stability guarantees); stimulating private investment through PPP, guarantee and venture mechanisms; and investing in market infrastructure (storage, logistics, and export promotion) and, most importantly, human capital (education, knowledge intensity, consulting).
5. The integrated model of state investment stimulation proposed in this work assumes the coordinated actions of all stakeholders: central and regional authorities, financial institutions, farmer associations, and businesses. The key elements of the model are strategic planning and monitoring (government), accessible financing, risk management (insurance, guarantees), motivation for innovation (linking support with the introduction of technologies), and feedback (dialogue with farmers). This model ensures a synergistic effect. When state investments are multiplied many times, private investments lead to qualitative growth in the industry.
6. The implementation of the recommended measures will require political will, interdepartmental coordination and, possibly, significant resources. However, the socioeconomic return from the development of the agricultural sector, in the form of increased food security, employment, and export potential, justifies such investments. In the context of global changes (tariff, geopolitical and climatic), Kazakhstan has a chance to become one of the leading players in the global food market if it can effectively mobilize investments in its agricultural sector.

Thus, improving the mechanisms of state regulation of investment activities in the agro-industrial complex of the Republic of Kazakhstan should follow the path of a more comprehensive, targeted and sustainable approach.

A transition from the quantitative growth of support to increasing its qualitative effectiveness is needed. The optimization model we have presented can serve as a basis for developing new programs and regulatory decisions. Its implementation will contribute to the formation of a competitive, innovative, and sustainable agro-industrial complex of Kazakhstan, fully realizing its potential and making a significant contribution to the economic development of the country.

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