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### DEVELOPMENT OF IRRIGATION SYSTEMS AND PROCESSES OF LAND RECLAMATION IN CENTRAL FERGANA: A HISTORICAL AND SCIENTIFIC ANALYSIS

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#### Abstract

The article examines the historical development of irrigation systems in the Fergana Valley, the expansion of irrigated lands, and the economic and environmental consequences of agrarian policy based on scientific sources. The author comprehensively highlights the formation of irrigation infrastructure, the role of the Great Fergana Canal in regional development, the characteristics of Soviet agrarian policy, and its environmental consequences. The research findings are of significant scientific importance for the rational use of water resources and the improvement of agrarian policy under modern conditions.

**Keywords:** Fergana Valley, irrigation policy, water management, agrarian reforms, land development, cotton growing, ecological balance, Aral Sea, meliorative condition, hydraulic structures.

#### Introduction

In the context of contemporary globalization processes and the intensification of climate change, ensuring the sustainable development of the agricultural sector and the rational use of water resources has become one of the priority strategic directions at the global level. In particular, increasing the efficiency of agricultural production in regions with limited water resources, introducing

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scientifically grounded mechanisms for the use of land and water resources, and maintaining ecological balance have emerged as important areas of modern scientific research. In this regard, the comprehensive study of issues related to the improvement of irrigation systems, enhancement of meliorative conditions, and efficient utilization of agricultural lands acquires special scientific and practical significance.

From this perspective, the historical and scientific investigation of the processes of irrigation system formation and the reclamation of new lands in the Central Fergana region represents one of the urgent research issues. This region is distinguished by its unique natural-geographical conditions, specific characteristics of water supply, and specialization in agricultural production. Consequently, the irrigation measures, meliorative activities, and agrarian transformations implemented in this territory have exerted a significant influence not only on regional development processes but also on the socio-economic advancement of the republic as a whole.

Within the framework of this research, it is necessary to conduct a comprehensive scientific analysis of the stages of irrigation infrastructure formation in the Central Fergana region, the mechanisms for integrating lands into agricultural circulation, as well as the economic efficiency and ecological consequences of irrigation processes. At the same time, studying the development of the water management system, the dynamics of land and water resource utilization, and the regional characteristics of agrarian policy is essential for identifying existing problems and developing scientific approaches aimed at their elimination.

The results of this research will provide an opportunity to formulate theoretical conclusions and practical recommendations aimed at improving the water resource management system, increasing land-use efficiency, and advancing agrarian reforms on a scientific basis under modern conditions. Furthermore, the study serves as an important methodological foundation for addressing scientific and practical issues related to the modernization of irrigation systems, ensuring

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ecological sustainability, and enhancing the long-term efficiency of agricultural production.

### Research Methods

In the process of conducting this research, a number of modern and traditional methods of scientific inquiry were applied in a comprehensive manner. In particular, the historical-analytical method was employed to examine the stages of formation and development of irrigation systems in the Central Fergana region within the broader context of historical processes. Through source analysis, the scientific reliability and content of archival documents, statistical materials, scholarly literature, and data published in periodicals were critically evaluated. Furthermore, based on the system-oriented approach, the interrelationship between irrigation infrastructure, water resources, and agrarian relations was comprehensively investigated. By means of the comparative analysis method, irrigation policies implemented in different historical periods, land reclamation processes, and their regional characteristics were comparatively examined. In addition, the socio-economic analysis method made it possible to scientifically assess the impact of irrigation systems on agricultural production, population employment, and the economic development of the region.

### Literature Review

The analysis of scholarly literature related to the topic demonstrates that the study of the history of irrigation in the Fergana Valley was initially associated with the activities of Russian researchers, whose scientific works extensively covered the geographical distribution of irrigation systems, their hydrotechnical characteristics, and economic significance. These studies scientifically described the formation processes of irrigation networks and the organizational aspects of water resource utilization.

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Subsequent scientific investigations provided a deeper analysis of issues related to the hydrological structure of irrigation systems, mechanisms of water resource distribution, and agrarian policy. In particular, scholarly perspectives concerning water management, the enhancement of irrigation efficiency, and the improvement of meliorative conditions constitute the methodological foundation of research in this field.

Scientific works conducted by local researchers mainly focused on the processes of reclaiming new lands in the Central Fergana region, the development of collective and state farms, as well as socio-economic transformations associated with the expansion of irrigation infrastructure. These studies paid special attention to the enlargement of irrigated land areas and the intensive development of agrarian production.

Foreign studies, in turn, have primarily assessed the ecological consequences of irrigation policy as one of the central objects of research. In particular, extensive scientific analyses have been devoted to problems related to the Aral Sea crisis, the reduction of water resources, the intensification of soil salinization, and the disruption of ecological balance. At the same time, scientific concepts concerning the sustainable use of water resources, the provision of ecological security, and the modernization of irrigation systems have been recognized as priority directions in contemporary research.

### Results and Discussion

The history of irrigation in the Fergana Valley was initially studied systematically and on a scientific basis by Russian researchers, whose early investigations focused on the region's natural-geographical conditions, hydrological characteristics, traditions of water resource utilization, and the stages of irrigation infrastructure formation. These scholarly studies serve as important theoretical and methodological sources for identifying the historical patterns of irrigation system development, assessing the regional characteristics of the water

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management system, and scientifically substantiating the processes of agrarian relations formation.

In particular, the studies conducted by V. Zaorskaya-Aleksandrova and I. Aleksandrov comprehensively analyzed the formation process of irrigation systems in the Fergana Valley, their geographical distribution, economic significance, and role in agricultural production [1; p. 145]. The researchers scientifically examined the territorial distribution of irrigation networks, the level of water resource utilization, and the close interrelationship between the irrigation system and agrarian production. These studies possess significant methodological importance for evaluating the economic efficiency of irrigation infrastructure and determining the role of the water management system in regional development. In his research, N. Prokhorov classified the irrigation system of Fergana into two principal groups according to the level of water supply, while scientifically substantiating its hydrological structure, relationship with water sources, and functional characteristics [2; p. 320]. This approach enabled the classification of irrigation systems according to the degree of provision with natural resources and served as an important theoretical foundation for subsequent scientific research. At the same time, this scholarly perspective has methodological significance in identifying the regional differentiation of irrigation systems and evaluating the efficiency of water resource utilization.

In the history of irrigation in the Fergana Valley, the Great Fergana Canal occupies a significant place as a major hydraulic engineering structure of strategic importance. The canal emerged as one of the key factors in the development of irrigated agriculture in the region, the centralized management of water resources, and the incorporation of new lands into agricultural circulation. Therefore, its construction and operation are regarded as one of the most important stages in the history of the irrigation system.

In his research, El-Registan particularly emphasizes that the Great Fergana Canal was constructed within an exceptionally short period through large-scale labor

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mobilization and organizational measures implemented at the state level [3; pp. 25–39]. The study scientifically substantiates the canal's role in the agricultural development of the region, especially its strategic importance in expanding irrigated farming and increasing the scale of agrarian production. According to the author, the construction of this hydraulic engineering structure significantly influenced the pace of economic development in the Fergana Valley.

M. Kuzmin, in his scholarly research, analyzed the subsequent stages in the development of the Great Fergana Canal, with particular emphasis on its reconstruction processes, technical modernization, and role in the rational distribution of water resources across different territories [4; p. 210]. The study scientifically substantiates the canal's functional significance within the irrigation system, its contribution to ensuring the stability of water supply, and its impact on the development of agrarian infrastructure. Furthermore, the author specifically highlights the strategic importance of the canal's operation in increasing the efficiency of agricultural production and ensuring regional economic development.

Thus, the existing scholarly studies devoted to the history of irrigation in the Fergana Valley constitute an important scientific source for understanding the formation of irrigation systems, their stages of development, and their interrelationship with agrarian production. In particular, research concerning the Great Fergana Canal makes it possible to evaluate this structure not merely as a hydraulic engineering facility, but also as a strategic resource ensuring the socio-economic development of the region. This, in turn, demonstrates the necessity of a comprehensive approach to the study of irrigation system history.

The processes of reclaiming new lands in the Central Fergana region have been extensively covered in scientific research as one of the important and actual directions of study. These processes primarily encompassed a complex system of measures aimed at incorporating desert and semi-desert territories into agricultural circulation, ensuring the efficient use of water resources, developing

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irrigation infrastructure, and increasing the volume of agrarian production. Therefore, the issue of land reclamation has been investigated not only in relation to the development of the agrarian sector, but also in close connection with ensuring the socio-economic advancement of the region.

In particular, the scholarly works of K. Narinsky comprehensively analyze the participation of the local population in the reclamation of the Central Fergana deserts, the mechanisms for organizing and effectively utilizing labor resources, as well as the economic expenditures and principal directions of investment policy associated with this process [5; pp. 45–60]. Alongside evaluating the economic efficiency of land reclamation, the author pays special attention to the significance of human resources and organizational management factors in the implementation of these processes. These studies constitute an important scientific source that enables a comprehensive assessment of the social and economic dimensions of land reclamation.

In the studies conducted by A. G'ofurov, the land reclamation activities implemented within the framework of the collective and state farm system, the gradual expansion of irrigation infrastructure, and the institutional foundations for organizing and managing agrarian production are scientifically examined [6; p. 180]. The research extensively analyzes the mechanisms of land and water resource utilization under the conditions of the Soviet planned economy, the influence of the state administrative system on the agrarian sector, and the forms of labor organization. At the same time, the author demonstrates through scientific evidence that the expansion of the irrigation system contributed to the intensive development of agricultural production. These works possess important source-based and methodological significance for the study of practical processes implemented within the framework of Soviet agrarian policy.

In his studies, M. Kuzmin also provided a detailed analysis of the later stages in the development of the Great Fergana Canal, particularly the processes associated with its reconstruction and technical modernization [4; p. 210]. The author

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scientifically substantiates the role of this hydraulic engineering structure in the optimal distribution of water resources across territories, its significance in ensuring the stability of water supply, and its multifaceted influence on the development of the irrigation system. The study highlights not only the canal's function as a technical infrastructure facility, but also its strategic importance in ensuring the economic development of the region and implementing agrarian policy. From this perspective, the Great Fergana Canal is evaluated as an important strategic resource ensuring the long-term socio-economic development of the region.

The essence of Soviet agrarian policy and its influence on the irrigation system also occupies a significant place in scholarly research. In particular, H. Ziyoev, in his scientific works, analyzes the process of the specialization of the Turkestan region in cotton production and emphasizes that the development of the irrigation system primarily served the implementation of this economic policy [7; p. 200]. According to the author, the management of water resources and the expansion of irrigation infrastructure were directly connected with the strategic objectives aimed at developing cotton cultivation. This demonstrates that irrigation policy was largely shaped on the basis of economic priorities.

A. Abdullaev, in turn, scientifically analyzes how the Soviet policy of cotton monoculture led to one-sided specialization within the agricultural sector [8; p. 256]. According to the researcher, this policy negatively affected the structural balance of the agrarian sector, intensified problems related to food security, and undermined economic stability. At the same time, the author notes that the development of the irrigation system in accordance with the demands of cotton cultivation adversely affected the balance of natural resource utilization. This approach possesses significant scientific importance for assessing the long-term economic and ecological consequences of Soviet agrarian policy.

In general, scholarly studies devoted to the reclamation of new lands, the development of irrigation infrastructure, and the study of Soviet agrarian policy

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in the Central Fergana region provide an opportunity for a comprehensive analysis of the region's socio-economic development processes. These studies serve as an important theoretical and methodological foundation for scientifically evaluating the formation of irrigation systems, the mechanisms of water resource utilization, and the economic as well as ecological consequences of agrarian policy.

The issue of the ecological consequences of the irrigation system and agrarian policy has also been extensively and profoundly examined by foreign researchers. These studies are aimed at analyzing the ecological problems that emerged as a result of the irrational use of natural resources in the Central Asian region. Within these scientific investigations, the long-term ecological, economic, and social consequences of irrigation policy are examined through a comprehensive approach, while the problems associated with water resource management systems and their influence on regional development are scientifically substantiated.

In particular, F. Micklin, in his studies, analyzes the process of the desiccation of the Aral Sea and identifies the excessive and uncontrolled use of water resources for irrigation needs as one of the principal causes of this ecological crisis [9; p. 280]. According to the author, the insufficient consideration of ecological factors in the implementation of irrigation policy led to the disruption of natural balance, the reduction of water bodies, and the deterioration of ecological stability in the region. The study scientifically substantiates the long-term negative consequences of these processes and demonstrates the direct interrelationship between ecological security issues and irrigation policy.

Furthermore, I. Kurtoglu and other researchers comprehensively analyze the ecological consequences of agrarian policy implemented in Central Asia, emphasizing that it contributed to the disruption of natural balance, land degradation, deterioration of water quality, and the emergence of large-scale ecological problems [10; pp. 47–72]. These studies thoroughly examine the

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impact of irrigation system expansion and intensive agrarian policy on the natural environment, while scientifically substantiating the necessity of ensuring a balance between agrarian development and ecological sustainability. These scholarly perspectives possess important theoretical significance for understanding the interrelationship between agrarian policy and ecological processes.

In the studies conducted by K. Bishel, issues related to water resource management in Central Asia, particularly the political, economic, and institutional aspects of transboundary water relations, are analyzed through a comprehensive approach [11; pp. 88–102]. The author pays particular attention to interstate cooperation in water resource utilization, mechanisms of water distribution, and the effectiveness of management systems. The study scientifically highlights the close interrelationship between the use of transboundary water resources, regional security, and economic stability.

In the studies conducted by D. Kandiyoti, the process of the expansion of irrigated areas in Uzbekistan, the economic outcomes of agrarian policy, and the impact of these processes on the living standards of the population are comprehensively analyzed [12; p. 240]. While acknowledging that the development of the irrigation system contributed to the increase in agricultural production volumes, the author also scientifically substantiates the influence of agrarian policy on regional socio-economic processes. The study particularly highlights the interrelationship between the expansion of irrigation infrastructure and the welfare of the population.

M. Spoor, in turn, analyzed the transformation of the agrarian sector in Central Asian states, the transition to market relations, and the socio-economic consequences of these reforms [13; p. 95]. The author scientifically examines the processes associated with structural changes in the agrarian system in the post-Soviet region, the transformation of forms of ownership, and the introduction of market economy principles. These studies are regarded as an important source for

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understanding the dynamics of agrarian relations development in the post-Soviet space.

K. Griffin and other researchers scientifically analyzed the policy of reclaiming new lands, its socio-economic impact, and its influence on employment, income levels, and the living standards of the population [14; p. 310]. The studies comprehensively evaluate the role of land reclamation processes in societal development, the efficiency of labor resource utilization, and the social outcomes of agrarian reforms. These scholarly perspectives provide an opportunity for a deeper understanding of the economic and social essence of land reclamation policy.

In the studies conducted by N. Ochilov, the processes of reclaiming new lands in Central Fergana are analyzed on the basis of archival sources, while the historical stages of these processes, their implementation mechanisms, organizational and economic aspects, and achieved results are scientifically substantiated [15; p. 190]. Drawing upon archival documents and statistical data, the author objectively and systematically examines the development of irrigation infrastructure, the processes of incorporating new lands into agricultural circulation, and their influence on regional development. The source-based nature of this research makes it possible to study the topic in depth and to objectively evaluate historical processes.

In general, foreign and local studies devoted to irrigation systems, agrarian policy, and their ecological as well as socio-economic consequences serve as an important scientific and theoretical foundation for the comprehensive study of water resource utilization, agrarian development, and ecological sustainability in Central Asia. These scholarly investigations possess significant methodological importance for assessing the long-term consequences of irrigation policy, improving water resource management systems, and developing scientific approaches aimed at ensuring ecological security.

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### Conclusion

The processes of developing irrigation systems and reclaiming new lands in the Central Fergana region have been comprehensively and systematically studied by both local and foreign researchers. These scholarly investigations provide an opportunity for an in-depth analysis of irrigation policy, agrarian relations, and the utilization of land and water resources in the region. Studies devoted to this subject scientifically examine the stages of irrigation infrastructure formation, the expansion of irrigation systems, the mechanisms for incorporating new lands into agricultural circulation, and the economic, social, and ecological consequences of these processes.

The analyses demonstrate that the development of irrigation infrastructure and the expansion of irrigated land areas contributed significantly to the intensification of agricultural production, particularly to the increase in the cultivation of export-oriented agricultural crops. The improvement of irrigation systems created opportunities for the reclamation of new territories, the expansion of production volumes, and the strengthening of the economic potential of the agrarian sector. From this perspective, the irrigation system emerges as one of the key factors ensuring the economic development of the region.

However, the analysis of scholarly literature indicates that these processes were often implemented within the framework of centralized and one-sided agrarian policies, as a result of which the principles of rational use of natural resources were not adequately taken into account. Consequently, a number of negative outcomes emerged, including excessive consumption of water resources, soil salinization, disruption of ecological balance, and the intensification of environmental degradation in certain areas. In particular, the development of irrigation systems primarily directed toward the needs of cotton cultivation had a serious negative impact on ecological sustainability. This demonstrates the necessity of considering ecological factors alongside economic interests in the implementation of agrarian policy.

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From this point of view, the historical and scientific study of irrigation and land reclamation processes carried out in the Central Fergana region, the objective evaluation of their positive and negative aspects, and the formulation of scientifically grounded conclusions based on existing experience possess important scientific and practical significance. Such an approach makes it possible to develop theoretical and practical recommendations aimed at the effective management of water resources, the rational use of land, and the improvement of agrarian policy under contemporary conditions.

Furthermore, the fact that the research was conducted on the basis of archival sources, statistical materials, and scholarly literature provides an opportunity to examine the topic objectively and comprehensively. This serves as an important methodological foundation for scientifically assessing the irrigation systems and land reclamation processes in the Central Fergana region within the dynamics of historical development, identifying existing problems, and developing scientific approaches aimed at their resolution.

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