

THE MINISTRY OF EDUCATION OF THE REPUBLIC OF AZERBAIJAN

AZERBAIJAN STATE UNIVERSITY OF ECONOMICS

INTERNATIONAL CENTER OF GRADUATE EDUCATION

MASTER DISSERTATION

on the topic

**“THE PERSPECTIVE OF IMPLEMENTATION OF AGRICULTURE
INNOVATION SYSTEM APPROACH TO ECONOMIC DEVELOPMENT IN
KARABAKH REGION”**

Minaya Mammadova Heybat

BAKU – 2022

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KARABAKH REGION”**

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Elm andı

Mən, Məmmədova Minayə Heybət qızı and içirəm ki, “The perspective of implementation of Agriculture Innovation System approach to economic development in Karabakh region” mövzusunda magistr dissertasiyasını elmi əxlaq normalarına və istinad qaydalarına tam riayət etməklə və istifadə etdiyim bütün mənbələri ədəbiyyat siyahısında əks etdirməklə yazmışam.

QARABAĞ REGIONUNUN İQTİSADI İNKİŞAFINA KƏND TƏSƏRRÜFATI İNNOVASİYA SİSTEMİ YANAŞMASININ TƏTBİQİ PERSPEKTİVİ

XÜLASƏ

Tədqiqatın aktualığı: Tədqiqatın aktualığı ondan ibarətdir ki, günü-gündən yenilənən texnologiyaların və sistemlərin kənd təsərrüfatında tətbiqi olduqca vacibdir. Qarabağ regionunun işğaldan azad edilməsindən sonra onun bütün sahələrində infrastrukturun yenidən qurulması üçün də yeni sistemlərə ehtiyac vardır. Xüsusilə regionun kənd təsərrüfatında yeni sistem yanaşmasının tətbiqi həm kənd təsərrüfatı, həm də iqtisadiyyatı üçün əhəmiyyətlidir. Buna görə də hazırkı vəziyyətdə yeni sistemin tətbiqinin yaradacağı prespektivlərinin öyrənilməsi aktual bir mövzudur.

Tədqiqatın məqsədi: Tədqiqatın məqsədi Qarabağ regionunun kənd təsərrüfatı sahəsini bərpa etmək və yenidən dirçəltmək üçün dünyada geniş tətbiq olunan yeni sistem yanaşmasını regionun kənd təsərrüfatında tətbiq etmək, onun yaradacağı imkanları araşdırmaq və bu imkanlar daxilində müəyyən təkliflər hazırlamaqdır.

İstifadə olunmuş tədqiqat metodları: Tədqiqat işinin hazırlanmasında keyfiyyət və ikinci dərəcəli tədqiqat metodları tətbiq edilmiş, mövzu ətrafında araşdırmalar aparmış müxtəlif yerli və xarici yazarların elmi əsərlərindən və məqalələrindən, həmçinin rəsmi qurumların məlumat bazalarından istifadə edilmişdir.

Tədqiqatın informasiya bazası: Tədqiqatın informasiya bazası yerli və xarici iqtisadçıların mövzu ətrafında hazırladıqları əsərlərdən, məqalələrdən, rəsmi təşkilatların hazırladıqları hesabatlardan və digər rəsmi internet sahifələrinin dərc etdikləri məlumatlardan ibarətdir.

Tədqiqatın məhdudiyyətləri: Əsas məhdudiyyətlər yerli ədəbiyyatda yeni sistem yanaşmasına aid məlumat çatışmazlığı və bu sahədə praktiki təcrübənin olmamasıdır.

Tədqiqatın elmi yeniliyi və praktiki nəticələri: Tədqiqat işindən əldə edilən nəticələr və təkliflər Qarabağ regionunun yenidən bərpasına, onun iqtisadiyyatının sürətli inkişafına və 30 illik boşluğun tez bir zamanda müsbət dəyişikliklər ilə doldurulmasına kömək edəcəkdir.

Nəticələrin istifadə oluna biləcəyi sahələr: Tədqiqat işində dünya ölkələrinin bu sahədə praktiki təcrübələrini nəzərə alaraq hazırlanmış təkliflər kənd təsərrüfatı sahəsində istifadə oluna, həmçinin iqtisadiyyatın bir çox sahələrində konseptual baza rolunu oynaya bilər.

Açar sözlər: Qarabağ, kənd təsərrüfatı, innovasiya, Kənd Təsərrüfatı İnnovasiya Sistemi (KTİS)

THE PERSPECTIVE OF IMPLEMENTATION OF AGRICULTURE INNOVATION SYSTEM APPROACH TO ECONOMIC DEVELOPMENT IN KARABAKH REGION

SUMMARY

The actuality of the subject: The relevance of the research is that the application of daily updated technologies and systems in agriculture is very important. After the liberation of the Karabakh region, new systems are needed to rebuild infrastructure in all its areas. The application of a new systemic approach to agriculture in the region is especially important for both agriculture and the economy. Therefore, in the current situation, the study of the prospects for the implementation of the new system is a topical issue.

Purpose and tasks of the research: The aim of the study is to apply a new system approach to agriculture in the region to restore and revitalize the agricultural sector of the Karabakh region, to study the opportunities it will create and to develop certain proposals within these opportunities.

Used research methods: Qualitative and secondary research methods were used in the preparation of the research work, scientific works and articles of various local and foreign authors who conducted research on the topic, as well as databases of official bodies were used.

The information base of the research: The research database consists of works and articles prepared by local and foreign economists on the topic, reports prepared by official organizations and information published on other official websites.

Restrictions of research: The main limitations are the lack of information on the new system approach in the local literature and the lack of practical experience in this area.

The novelty and practical results of investigation: The results and recommendations of the study will help to revitalize the Karabakh region, the rapid development of its economy and quickly fill the 30-year gap with positive changes.

Scientific-practical significance of results: The proposals developed in the research, considering the practical experience of countries in this field, can be used in agriculture, as well as play a conceptual basis in many sectors of the economy.

Keywords: Karabakh, agriculture, innovation, Agriculture Innovation System (AIS)

ABBREVIATIONS

AI	Artificial Intelligence
AIS	Agriculture Innovation System
AKIS	Agricultural Knowledge and Information Systems
ANAMA	Azerbaijan National Agency for Mine Action
EU	European Union
FAO	Food and Agriculture Organization
FCC	Farm Credit Canada
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IICA	Inter-American Institute for Cooperation on Agriculture
IDPs	Internally Displaced Persons
IFAD	International Fund for Agricultural Development
NEPAD	New Partnership for Africa's Development
MoA	Ministry of Agriculture
MoE	Ministry of Economics
MoES	Ministry of Education and Science
OECD	Organization for Economic Co-operation and Development
PPPs	Public and Private Partnerships
P4P	Purchase for Progress
RFID	Radio-frequency identification
R&D	Research and Development
UAVs	Unmanned Aerial Vehicles
UN	United Nations
VFM	Virtual Farmers' Market
WB	World Bank
WFP	World Food Program

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INTRODUCTION

Relevance of the research topic: The use of new systems and technologies created in recent years in the field of agriculture has created conditions for the development and more productivity of this sector. Although a new agricultural system has been developed and approved in many developed countries, it is still in its infancy in other developing countries. Thus, the difficulty of creating or applying a new systemic approach to agriculture in many developing countries has been one of the most pressing issues facing those countries. There are several reasons for this problem. One of the main reasons is the sharp changes in the climate. Due to these changes, there are problems in the implementation of the new system or inconsistencies between the climatic conditions of the country where the system will be applied and the system. As a result, system failures occur. Another reason is the lack of resources and budgets in developing countries. Due to this problem in many countries, investment in the creation or implementation of a new system is reduced, or the new system approach cannot be applied due to the lack of sufficient resources in the country to implement the new system. Another reason is the lack of education in developing countries and the increase in brain flow over time. For this reason, there is no process of proposing new ideas in the country and creating a new system due to these ideas. The fact that agriculture is one of the risky areas also leads to a decrease in interest in this area, as a result of which a new system is not created and the sector lags in development.

An Agriculture Innovation System (AIS) is widespread in most countries, which allows solving many problems in the field of agriculture. Of course, in many countries, agricultural machinery and technologies have been developed in advance and their application to agriculture has always existed. However, the parameters of this technological equipment and systems did not always meet the requirements of modern times. For this reason, new techniques that meet the requirements of modern times began to be created, and these technologies began to form the basis of the modern system.

Many countries and, most importantly, countries with developed agricultural systems have been using the AIS for several years, and thanks to this approach, they have been able to increase their productivity. It is the foreign experience that proves that the development of this system in Azerbaijan, and especially the application of this system in the liberated Karabakh region, will make new contributions to the revival and development of destroyed agriculture in this region for many years. Also, the Karabakh region differs from some regions of the country by its fertile lands, which is why the revival of agriculture in this region as a country will reduce dependence on imports, and this policy makes it necessary to prioritize the application of the AIS in Karabakh.

In addition, it is known that the application of this new system to the Karabakh region will create several difficulties, as the agricultural sector in the Karabakh region has been in a state of bankruptcy for 30 years due to occupation, as well as almost no database in this area is one of the main reasons for its emergence.

Experience shows that the AIS not only revives the agriculture of the country where it is applied but also plays a major role in the economic development of the country. The same goals are set for the Karabakh region, and the innovations created by this new system will have a positive impact on both the development of agriculture and economic development in the region.

The role of the AIS in ensuring the economic development of the Karabakh region and the analysis of the prospects that will arise with the application of this system will be examined and presented in the presented research work.

The urgency of the problems that arose as a result of 30 years of occupation and the obstacles that arose in solving these problems led to the choice of the research topic, the definition of its goals and objectives, as well as the object of the dissertation.

Statement of the problem and learning level: There have always been favorable natural conditions for the development of agriculture in the Karabakh region. That is why the Karabakh region has always been at the forefront of Azerbaijan's agriculture. Unfortunately, as a result of the aggressive policy of the Armenian government, the

Karabakh region was enslaved and as a result of 30 years of occupation, the development of both the structure and individual spheres of the region was limited. However, the liberation of the Karabakh region from the occupation in 2020 and the start of its structural reconstruction laid the foundation for a new stage. Thus, with the beginning of this new stage, the study of problems in the economic development of the region and, in particular, the conduct of new scientific research on the development of agriculture, which is the basis of economic development, came to the fore.

Numerous researches have been conducted on modern systems applied in the field of agriculture, as well as scientific articles and works have been published. Thus, foreign scientists G.Anita, S.Lakhwinder, H.Campos, N.De Roo, R.Hawkins, M.Schut, M.Salomons, T.Beshah, S.Staal, S.Kassam, and others in the field of agriculture researched the application of new systems. In Azerbaijan, the study of agriculture was among the research objects of H. Eynalov, Y. Guliyev, T. Sadigov, T. Temel, F. Karimov, and others.

Thus, for the last year, agricultural research for the liberated Karabakh region has led to the choice of the research topic.

Purposes and objectives of the research: The purpose of the study is to identify patterns in the application of the AIS to ensure economic development in the Karabakh region and to develop new priorities using the approaches of countries around the world to implement this system.

The following objectives have been identified to achieve the objectives of the study:

- Defining the concept of the AIS approach and researching its essence;
- Study of the working principle of the AIS using the experience of different countries;
- To study the general overview of the agricultural sector of Azerbaijan and to determine the role of the Karabakh region in this field;

- Identification of obstacles and barriers to the agricultural system of the Karabakh region;
- Analysis of opportunities created as a result of the application of the AIS in the Karabakh region;
- Analysis of the relationship between the implementation of the AIS in the Karabakh region and the economic development of the region;
- Creating better agricultural systems for the Karabakh region by developing new proposals;

The object of research is the agricultural system of the Karabakh region as a whole, the application of the AIS for the development of this sector, and the prospects and opportunities that this application will create in the economic development of the region.

Object and subject of the research: The object of research is the perspectives of the application of the AIS approach in the Karabakh region. The subject of the research is the study of the theoretical and practical activities of the AIS approach.

Research methods: This research paper will be based on two research methods. Qualitative and desk research methodologies will be applied to this research paper to get the whole picture of the research topic. Firstly, as a qualitative research method, I will analyze various case studies of different countries and then apply, compare, and contrast these studies with Azerbaijan's current situation. And finally, in the desk research stage, I will collect data and analyze reports of various literature. Generally, available literature reviews and other sources will be introduced during the research study. The database of this research topic forms of various reports of Organization for Economic Co-operation and Development (OECD), Food and Agriculture Organization (FAO), agricultural and different materials of the State Statistical Committee of the Republic of Azerbaijan, books, and articles by some local and foreign scientists and research groups.

Research database: The research is based on scientific works and articles of local and foreign scientists on the subject, reports of local and foreign organizations, and information on other Internet sites.

“The perspective of implementation of AIS approach to economic development in Karabakh region” focuses on the nuances and ideas taken into account in the works and articles of local and foreign scholars. During the research, the provisions and results from local scientists and writers S.Məmmədova., Eynalov.H., Guliyev.Y., Zeynalov.K, and from foreign writers Aksoy.U., Boz.I., De Roo.N., Hawkins.R., Schut.M., Salomons.M., Anita.G., Lakhwinder.S and other authors were trusted by the author of this study. As well as materials and reports of the FAO, OECD, Economic Research Center under the Ministry of Agriculture (MoA) of Azerbaijan, and also information of the State Statistics Committee.

Research limitations: The main limitation of the research on "The perspective of implementation of AIS approach to economic development in Karabakh region" is the lack of research on agriculture in the Karabakh region during the 30-year war and the limited number of literatures in the Azerbaijani language.

Scientific novelty of the research: The scientific novelty of the research is that the introduction of a new agricultural system in the Karabakh region will create great opportunities in a number of areas. It will have a positive impact on development in both agriculture and the economy as a whole, the acceleration of the reconstruction process, new job opportunities and regional revival in general.

Scientific and practical significance of the results: The scientific and practical significance of the research is the prospects that the approach of the AIS to be applied in the Karabakh region will create for its economic development. The results obtained are of particular importance. The scientific and practical significance of the research is that it can be used as a subject of training and education.

CHAPTER I. UNDERSTANDING THE CONCEPT OF THE INNOVATION SYSTEM APPROACH

1.1. Agriculture Innovation System Approach

According to statistics for January 2021, the world's population has already reached 7.8 billion people, and therefore the world's attention continues to focus on sustainable farming and new agricultural technologies. Today, it is impossible to imagine agriculture without innovation and technology. Innovations in agriculture unite farmers with new farming research, and innovations are now more necessary for modern agriculture than ever before. The ever-changing nature of global food and agricultural systems is forcing people to rethink the need for innovation to contribute to the countries' agriculture. Although scientific and technological changes in agriculture have helped increase productivity and reduce poverty, their contributions are incomplete without proportional changes in the broad system of which they are part (Kelemework D and Spielman D., 2009).

Today, global food and agricultural systems are undergoing rapid change compared to the previous period (Kelemework D and Spielman D., 2009). It's clear that the source of progress is innovation and without it, livelihoods, and prosperity decline. Innovations in medicine help prevent disease and cure it, while in the agricultural and food sectors, it increases production and productivity, as well as reduces environmental impacts to deliver greater value to consumers. There is a greater need for innovation in these sectors than ever before. More than 800 million people worldwide are chronically malnourished, and about two million people suffer from micronutrient deficiencies. Climate and weather change, which have a negative impact on agriculture, also have a large-scale impact on water, land, and forests. Most of the world's population lives in rural areas and relies on agriculture and natural resources for both employment and livelihoods. That's why food and agricultural markets are undergoing rapid change for two main reasons. Firstly, increasing consumer demand for quality and convenience,

and then changes in the scale and coverage economy in procurement, processing, wholesale, and retail. These changes shape the technology frontier, require appropriate decision-making support systems for farmers and others in the value chain and open prospects for new input and output features for products. For this reason, agricultural and food innovation systems are called upon to respond adequately to such changes (Campos H., 2020). Low agricultural productivity in developing countries is often associated with a lack of innovation systems and low or no adoption of improved agricultural technologies. The adoption of agricultural technology has identified many factors that affect farmers' decision-making regarding adoption. Some studies have found that households' forms, characteristics, ownership assets, and access to services and infrastructure also have a significant impact on their adoption decision. Also, access to technology by farmers and the availability of technology are important nuances.

First of all, when we want to apply any innovation to agriculture, we need to show why we need this innovation. There are many answers to this question. Some of these are as follows:

- Boosting productivity in agriculture
- Supporting the small farms and family farmers
- Increasing the productivity and profitability of small farms and family farmers
- Increasing incomes and farmers
- Reducing poverty
- Improving rural development
- Feeding the growing population
- Facing the challenge of climate change
- Creating global solutions

Burning challenges in the modern world put agriculture under many pressures: population growth, climate change, the need to reduce greenhouse gas emissions in

agriculture, the rapid development of emerging economies, and growing instability due to land, water, and energy shortages. This scenario increases the critical role of innovation in making agriculture more competitive and sustainable. Innovation, in general terms, is the process by which something new is realized in a particular context. It serves as a driver of economic growth and competitiveness in countries. The innovation process takes place mainly within "innovation systems" of organizations and private and public stakeholders, which are interconnected in different ways and have the technical, commercial, and financial skills necessary for innovation. Some key elements can help you better understand the scope of the concept of innovation: its definition, types of innovation, the people who implement them, and their goals. According to the OECD, innovation is the implementation of something new or improved (technically or otherwise) in products (goods or services), processes, marketing, or organizational methods. In other words, according to the Inter-American Institute for Cooperation on Agriculture (IICA) it is the application of ideas, knowledge, or experiences that are new to a particular context in order to create a positive change that will provide a way to meet needs, cope with challenges, or seize opportunities (IICA., 2014). Innovation is a complicated process in which many actors play various roles, says the FAO. Governments and other key stakeholders, including civil society, farmers' organizations, research institutions, and the private sector, have a role to play in creating an environment conducive to the flourishing of innovation and solutions in agriculture. Success depends on combining drivers that influence the perception of innovation (FAO., 2018).

The origin of the innovation system approach is based on Friedrich List (1842) (Anita G and Lakhwinder S., 2019). The innovation system can be defined as a network of organizations, enterprises, and individuals aimed at attracting new products, new processes, and new forms of organization to economic use, along with the institutions and policies that affect the behavior and operation of the system. Innovation systems help to create knowledge, provide access to knowledge, share knowledge and learn.

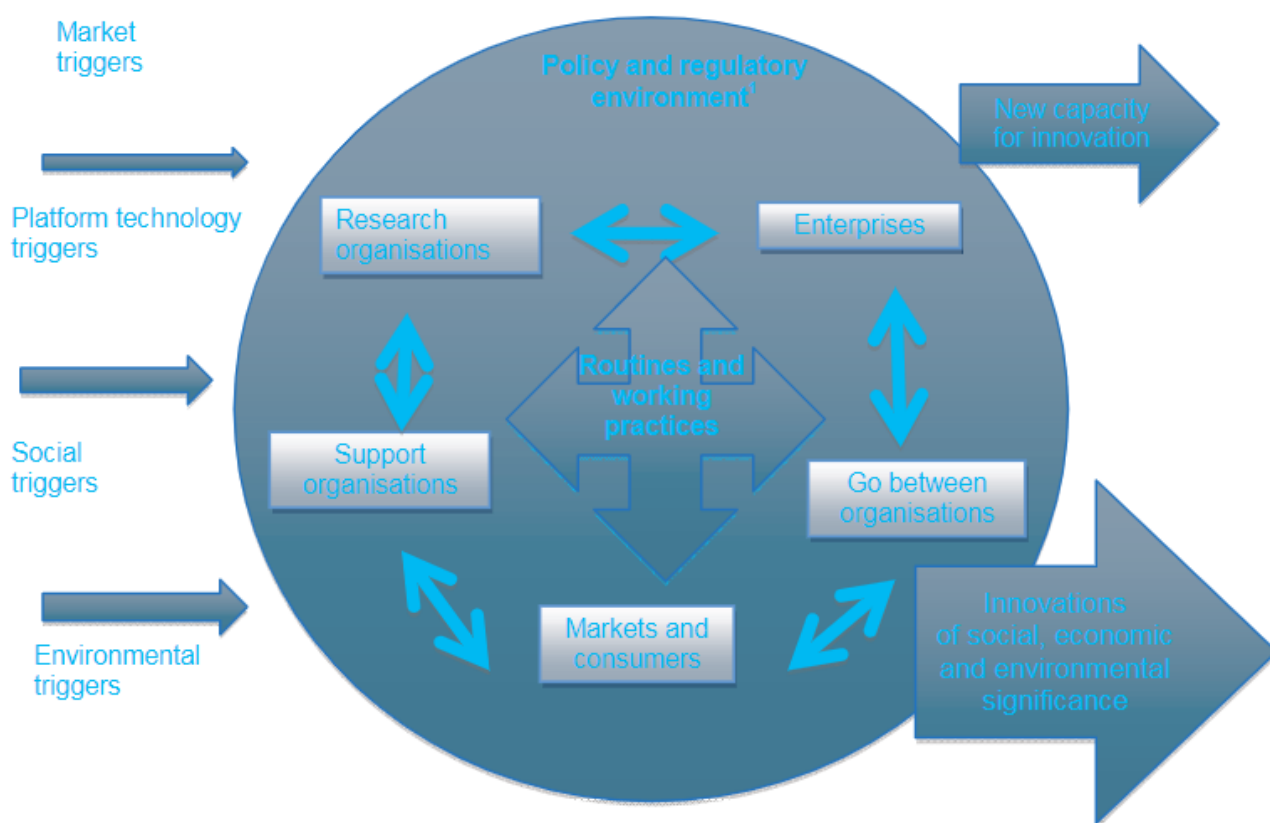
The concept of innovation systems stems from direct observation of countries and sectors with strong innovation records. The concept is mainly used to explain examples of past economic indicators in developed countries. It has only recently been applied to agriculture in developing countries, but it offers interesting opportunities to understand how the country's agricultural sector can make better use of new knowledge. For the past 40 years, humanity has witnessed a fundamental debate on innovation in science and technology. The first scientific research that emerged was considered to be the main driving force of innovation. Research has created new knowledge and technology that can be transferred and adapted to different situations, and this view is commonly referred to as the “linear” or “technology transfer” model. The second and subsequent revisions were called the Agricultural Knowledge and Information Systems (AKIS) concept and more recently the AIS concept in the 1990s. While acknowledging the importance of research and technology transfer, the second view clearly sees innovation as an interactive process. Innovation involves the interaction of organizations and individuals with different types of knowledge in a particular social, political, economic, and institutional context (Rajalahti R., Janssen W. and Pehu E, 2008). In one way or another, agriculture is an integral part of the physical and economic survival of every human being. The United Nations (UN) anticipate that the world's population will exceed 9 billion by 2050. That’s why food production will have to increase by 70 percent to feed everyone and this is also possible through AIS. While it is difficult in itself to help farmers and fishermen around the world achieve this goal, agriculture, in addition to providing food, provides significant support to the economies of most countries, especially developing ones. Agricultural development requires and depends on innovation and innovation systems. According to the World Bank (WB) innovation is widely recognized as a key source of productivity, competitiveness, and economic growth in developed and developing economies. Innovation also plays an important role in creating jobs, increasing profitability, eradicating poverty, and accelerating social development (WB., 2012).

AIS is complex, multi-layered, and often difficult to identify and analyze. But what exactly is the AIS? AIS represent a dynamic network of interactions between people, organizations, and institutions that enable or limit innovation in the agricultural sector. By its nature, AIS is a complicated system, many different factors are related to each other, boundaries are blurred, different actors have different perceptions of these relationships or boundaries, and different groups of actors do not always react to the same or similar interventions in the same way. Therefore, AIS is difficult to capture or measure (De Roo N. and others, 2017). The perspective of AIS recognizes that agricultural innovation is a process that involves many different actors and factors and can only be launched if it meets the needs of key users. AIS is a grouping of people, organizations, and businesses in the agricultural and associated sectors, as well as continuing to support institutions and policies, that supply existing or new commodities, procedures, and organizational forms for social and economic use. The way these actors interact, generate, share, and use information, as well as collaborative learning, is shaped by policies and institutions (both formal and informal) (FAO., 2018).

AIS is characterized by two main factors: the combination of participants and the dynamic interaction between them. Key stakeholders include farmers and farmers' associations, providers of new products or technical and financial services, those who increase the adoption and development of new knowledge, those who promote knowledge exchange, those who add value to production, and those who facilitate market access. Research and technology development organizations operate as a part of the AIS, as well as public and private extension services that play an important role in facilitating access to knowledge and building capacity. If the work of AIS can be developed through better coordination among its participants, then it will create a large amount of productivity to meet the innovations and opportunities that arise day by day. It also encourages the private sector to invest in the creation and implementation of innovation. The diagram in Picture 1 shows the systematic interactions between all public and private, civil society and academic participants in AIS to create, disseminate,

adapt, study, and use knowledge to improve their ability to innovate in all links in the agricultural value chain (IICA., 2014). For example, private and public research centers, higher education institutions, and private companies create coded knowledge and skills, and farmers and agricultural producers in agriculture and enterprises are considered users of this knowledge and skills. Consumers belonging to Demand organizations, local and international markets influence research priorities, consumer decisions, innovation adoption, Support organizations help to invest physical and human capital in creating and adopting innovation, while Go-between organizations help to farmers and other agricultural enterprises in order to apply innovation to agriculture (OECD., 2013).

Picture 1: Innovation system's dynamics



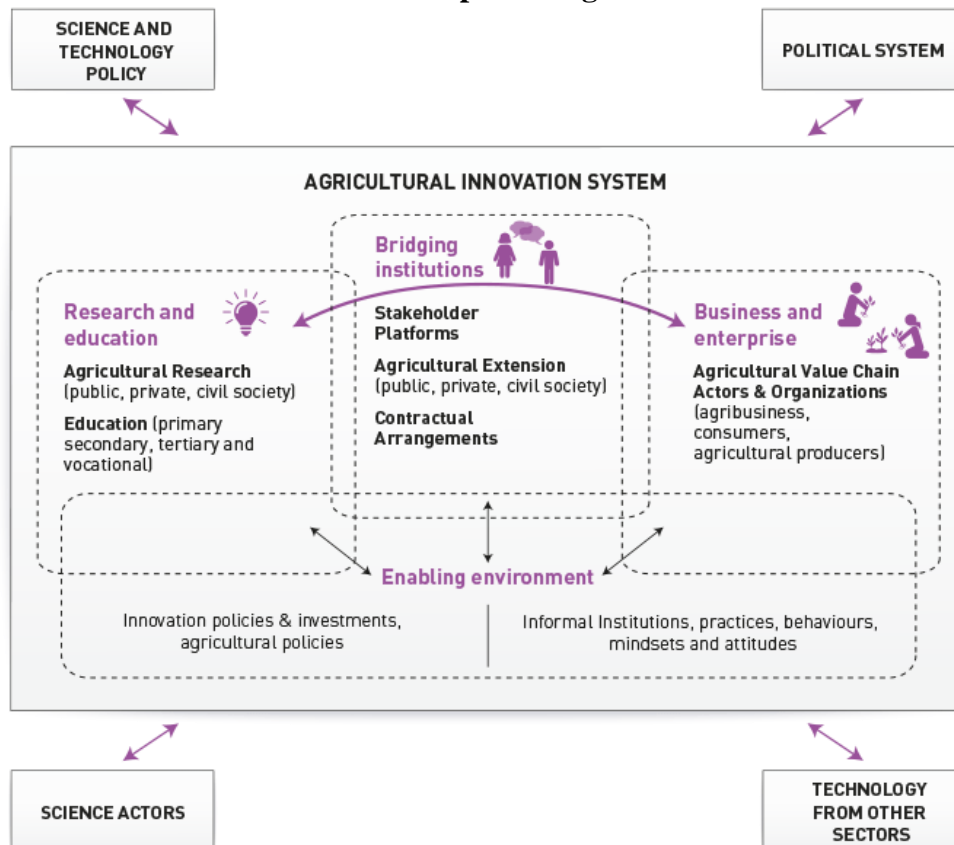
Source: OECD., 2013 https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-innovation-systems/overview-of-agricultural-innovation-system-developments_9789264200593-4-en

As with all systems, AIS has its strengths and limitations. If we talk about the strengths of the system, we can say that this concept offers a unified way to strengthen the ability to use, create and disseminate knowledge, which is widely tested in the industrial sector. In addition to knowledge and skills, the development of skills includes a variety of attitudes and experiences that affect the way these organizations engage in knowledge, learning, and innovation, as well as an example of the interactions and relationships that exist between different organizations (WB., 2006). Also, AIS emphasizes the existence and significance of various forms of innovation processes, as well as the significance of institutional and policy reforms that support innovation. As for the limits of the system, we can say that this system has not yet been widely tested in the agricultural sector. Based on the analysis of published data sources, it is difficult to determine the interrelationships and institutional dimensions of innovation potential. In addition, less attention is paid to education in this area (WB., 2006). Within AIS, there are almost no skills needed to facilitate interaction between different actors, and many financiers who want to invest in this approach are reluctant to invest in the development of such intangible potential in the medium or long term. Also, in general, AIS implementers in some cases lack operational skills in facilitating, building relationships, brokerage, etc., and there are very few professionals who want to apply, learn, and test the AIS approach and also train AIS implementers.

1.2. Elements of Agriculture Innovation System

In recent years, many countries have revised their agricultural knowledge systems and moved away from supply-based innovation to a more interactive, demand-based AIS approach. There are several reasons for this: gaps in the adoption of innovations by farmers, the potential of AIS to respond to emerging and pressing challenges, budget constraints, issues related to innovation adopted by consumers and civil society, etc (Wambura R.M. and others, 2015). According to the concept of AIS, the AIS comprises four elements: research and education; bridging institutions; business and enterprise; and the enabling environment (<https://tapipedia.org/framework/conceptual-diagram-agricultural-innovation-system>, 2012). Picture 2 represents all elements of AIS. Within each element, there are different actors.

Picture 2: Conceptual diagram of AIS



Source: Tropical Agriculture Platform., 2012 <https://tapipedia.org/framework/conceptual-diagram-agricultural-innovation-system>

The first one is **Bridging Institutions**. It acts as a bridge between "research and education" and "business and enterprises" elements. It has three types of actors:

- **Stakeholder Platforms** - When a particular issue or problem arises, it contributes to the working principle of AIS by bringing together actors with direct or indirect interests in these issues.

- **Agricultural Extension** - These types of actors can play an important role by organizing knowledge among farmers and other actors, such as creating new technology or expertise available to other actors or farmers, supporting, or networking producers, and facilitating accessing inputs, outputs, and credit services so on. For example, public, private and civil society.

- **Contractual arrangements** - can be used to facilitate connections between suitable actors, such as contracts between research and farming organizations, buyers, and producers.

The second one is **Research and Education**. This element also has two actors related to the research and education sectors. The first one is **Education institutes**. Potential roles of the Education institutes include:

- Developing the general level of education of all actors
- Conducting professional training and education in the field of agriculture
- Further developing of knowledge and skills of farmers and other actors
- Facilitating investment in human resources for product and overall process development

- Development of experienced and multiplayer learning methods and approaches

The second one is **Agricultural Research institutions**, and they play the following actions, among others:

- Development of technologies, practices, and processes in accordance with the local/regional/national context

- Testing of local advanced technologies and processes
- Documenting innovative ways to access agricultural research efforts and policy decisions, and adopt new practices and technologies
 - Collaborate with researchers from other disciplines/sectors and/or other countries/international organizations

The next element is **Business and Enterprise**, and they are the main element in AIS that the actors in it play various roles. The first one is **Farmer or Farm family**, and they play the following activities:

- Create, adopt, and test new technologies for the production of food, feed, etc., and to use this knowledge to adapt to field conditions
- Offer and apply new products and practices to increase market access and agricultural productivity.

The second one is **Farmer Organizations**, and they represent the following roles:

- Represent different farmers, interests, needs, and opportunities in political arenas, societies, and value chains
- Organize knowledge and technology among farmers and other actors
- Facilitate access to agricultural products, loans, and markets
- Help organize the value chain
- Enhance specific innovations through organized logistics support and collaborative research

The next one is **Agro-dealers**, and their activities include:

- Provide new agricultural products or input markets
- Identify, test, and direct new market opportunities
- Determine the quality standards of agricultural products
- Develop product and process facilitating the investment in physical and human resources
 - Connect agricultural actors with the rest of the market

The last one is **Consumer organizations**, and they engage the following actions:

- Influence innovative practices and research priorities
- Implement a process to facilitate consumer acceptance
- Facilitate and organize information about new products and processes

The last element of AIS is **Enabling Environment**. The enabling environment for AIS consists of a number of factors that affect agriculture and is managed by organizational structures that manage, regulate and develop policies in addition to those that directly affect agricultural innovation. The concept of an enabling environment is a very broad concept that includes both intangible components such as social habits, values and beliefs, rules of conduct and social conventions, as well as "tangible" components like political aspects, formal rules and regulations, and material aspects related to formal governance structures. The enabling environment creates opportunities for all actors in the system to work together, share knowledge and interact. Thus, all these elements are involved in the creation and implementation of AIS.

1.3. How Agriculture Innovation System Works

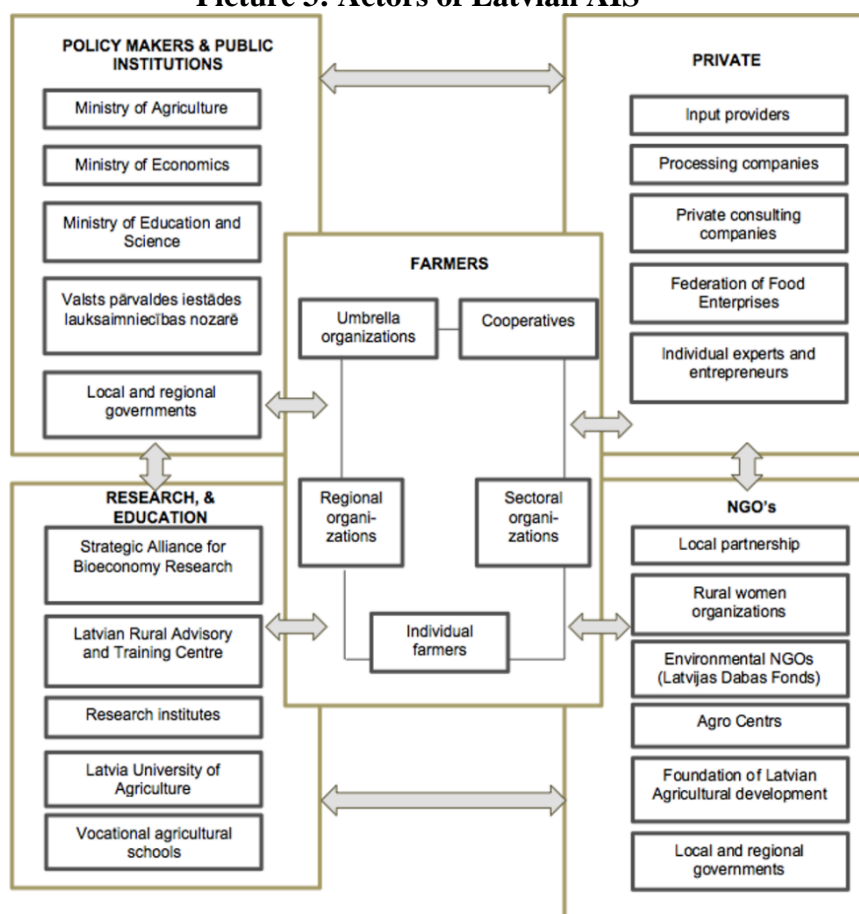
The AIS is becoming more widely recognized as a helpful tool for assessing innovation capability, planning investments, and coordinating initiatives which seems to magnify innovation related to agriculture and equitable growth. The AIS concept can be used at multiple levels, including country, sector, and project/intervention. The majority of the critical processes in using the AIS approach, however, remain the same. Actors play a crucial part in the AIS implementation process. Its actors are divided into numerous categories. The first group is Innovation. It includes family farmers, small-scale farmers, large-scale commercial farmers, fisherfolk, pastoralists, landless (honey, butterfly larvae producers, etc.) and their role is to develop and share new ideas, as well as supply agricultural advising services, agricultural research, and education. The second group is Private group actors. They are agro-processors, input dealers, distributors, traders, exporters, large corporations, and their roles include assessing,

demanding, providing inputs, distributing inputs, purchasing, processing, trading, and exporting produce, as well as educating and advising. The next group actors are Producer organizations, and they also include family farmers, small-scale farmers, large-scale commercial farmers, fisherfolk, pastoralists, landless (honey, butterfly larvae producers, etc.). Their roles are the same as the Innovation group. The next group is Financial service suppliers. They are banks, microfinance institutions, microcredit, credit agencies, and their function are to give loans and credit to producers, as well as to advise them. The next one is the Agricultural education system. They are universities, schools (primary, secondary), colleges, training institutions, on-the-job training within institutions, informal education, vocational training. Education, consultancy services, researching, innovation, and sharing ideas are all part of their job description. The next group of actors is Input and service suppliers. They include agrochemical retailers (fertilizers, pesticides), machinery manufacturers, mechanics, retailers, seed suppliers, and their job is to provide products and services. The next one is the Agricultural research system, and which includes government actors, private sector actors, producers organizations. They educate farmers, the private industry, actors, and agricultural consulting services, as well as invent and share technologies, gauge demand, perform and communicate knowledge, and assist producers. The next group is Agricultural advisory services, and they include national governments, regional and local governments, non-governmental organizations, producer organizations, private sector. Their job description is to connect farmers with other players in the AIS, exchange information, educate farmers, broker, encourage, advise, invent, and share new inventions, and gauge demand. The next one is Government policy and regulatory framework and they include is regulating agencies, parliamentarians, heads of departments, senior managers, ministers, global or regional agencies. For example, the FAO of the UN, the WB, International Fund for Agricultural Development (IFAD), New Partnership for Africa's Development (NEPAD), African Union, European Union (EU). Their responsibilities include regulation, standard-setting, policy debate, policy

formulation, and the establishment of codes and standards inside organizations. The last group of actors is Consumer demands and they are in charge of purchasing things, creating demand, and influencing policy (<https://www.g-fras.org/en/good-practice-notes/agricultural-innovation-systems.html?showall=1>, 2015).

So, the AIS process takes place through these actors. Agricultural innovation is usually the result of a dynamic interaction between the many actors involved in growing, manufacturing, packing, distributing, and consuming, or even using agricultural commodities (WB., 2012). For example, traditional suppliers of research, development, and educational organizations are included in the Latvian AIS, which is regulated and controlled by agriculture, science, and educational regulations (OECD., 2019). Picture 3 depicts the actors participating in Latvian AIS and the various organizations are included in each of the actors.

Picture 3: Actors of Latvian AIS



Source: OECD., 2019 <https://www.oecd.org/latvia/innovation-agricultural-productivity-and-sustainability-in-latvia-9789264312524-en.htm>

But in Sweden agricultural workers and agro-based businesses are the primary users of information and innovations generated in the AIS of Sweden; the government is involved in the AIS management and investment and knowledge generators in the AIS comprises research institutes, government entities, universities, and businesses. Universities are the primary actors in public research in Sweden (OECD., 2018).

Also, the funding system plays an important role in the working process of AIS. Generally, the AIS investment takes two funding forms: private and public funding. For instance, Latvian research is heavily reliant on government financing. In Latvia, three main ministries are directly responsible for the management of agricultural science. They are the Ministry of Education and Science (MoES), the Ministry of Economics (MoE), and the MoA. There are a variety of mechanisms available, one of the most prominent of which are basic research financing, national awards and projects, and the EU structural funds (OECD., 2019). In Canada, whether conducted by public or private entities, the public sector remains a primary source of funding for agricultural research and development (R&D). Various financing mechanisms are used. This includes direct government spending on researchers' salaries or projects, public and private partnerships (PPPs), and different forms of taxes incentives. Market demand often drives business investment in R&D, but governments also give various types of incentives. Some, such as R&D tax incentives, are applicable to the entire economy, while others are exclusive to agriculture. R&D financing is also provided by agricultural producers and other non-governmental organizations. The government of Canada uses a range of tools to support and encourage private investment in agricultural R&D, it includes credits, tax provisions, and competitive awards. Farm Credit Canada (FCC), for instance, is Canada's largest farm lender, with the mission of "boosting the business of agriculture." It offers small and medium-sized firms in the farming industry specialized and personalized financial and business services. Farmers, agribusinesses, such as providers and manufacturers, and agri-food companies can also benefit from insurance, technology, learning programs, and other business services. The FCC also

helps and supports farm businesses in developing and strengthening their appropriate business plans. This includes a list of any intellectual property and patents owned by farmers, as well as future R&D efforts (OECD., 2015).

Table 1 shows OECD summaries of a number of countries on innovation, sustainability, and agricultural productivity. As can be seen from the table, despite the increase in project research contracts and competitive research grants, the share of project-based funding in total funding for agricultural R&D in Argentina, Brazil, China, Korea, and Japan remains one of the lowest (OECD., 2019).

Table 1: Percentage share of spendings of countries on agricultural R&D

Percentage share of spendings	Countries
0-20 %	Argentina, Brazil, China, Korea, Japan
20-40 %	Canada, Latvia, Turkey
40-60 %	Australia, Sweden
60-80 %	Columbia, Estonia, United States
80-100 %	Netherlands

Source: OECD., 2019 <https://www.oecd.org/publications/innovation-agricultural-productivity-and-sustainability-in-japan-92b8dff7-en.htm>

The innovation process starts with the creation of a new idea or concept, which is subsequently turned into a tangible service, process, or product that may be commercialized to satisfy technological, economic, or societal demands and problems. But first and foremost, the agricultural systems of the various countries should be thoroughly investigated. But on the other hand, innovation processes cannot be divided down into separate steps that occur in a particular order. AIS works through various actors and elements, various public and private investments, as well as various agricultural research and AIS is adapted to the agricultural sector of each country in which it is applied and aims to develop the area in which it is adapted. So, when AIS is applied, the national characteristics of each country are taken into account and the system adapts to these areas. Some examples of AIS work will help us understand it more clearly. The first example is about **Sweden's reindeer herding farming**. In

Sweden, reindeer herding has been subjected to great technological development. Major changes include communications and transport. However, towards the end of the 1970s, mass production of snowmobiles began, which significantly reduced labor costs. In the 1980s, the use of motorcycles and helicopters became outstanding. In modern times, old and new technologies are still used together. This is because the new technology requires a lot of money and expense. Many new technologies (satellites, information technology, etc.) are currently being tested, although deer herders still suffer from insufficient communication infrastructure (low quality and lack of broadband, etc.) (OECD., 2018). But nowadays the government is still trying to invest as much as possible in the development of this area.

The second example is about **Mimiro digital company**. Mimiro is a large digitalization and technology company based in Norway. The company is owned and operated by Tine, a large Norwegian dairy company, and Felleskjøpet Agri, a major feed company. The company's main goal is to develop an open data platform that collects and shares data, and Mimiro aims to support farmers' decisions and management through this platform. Mimiro's main goal is to combine comprehensive knowledge of agriculture with advanced technology. Based on the analysis and optimization of farmers' data, Mimiro plans to develop solutions that support digital end-to-end decisions, and these digital solutions will not only provide farmers with information but also advice on a specific topic. The most important principle here is that farmers have their information on this platform. The information that farmers want to share anonymously is available to external service providers, and these providers can use this information to provide farmers with even better research services. Mimiro launched its first application in 2019 and launched sophisticated management tools for field operations in 2020, which include support for Artificial Intelligence (AI)-based decision-making from sensor data to machine learning (OECD., 2021).

The next example is about **semi-roofed shelters** or in **Spanish corralon**. The difference between the eastern and western parts of the Andes is primarily climatic.

Altiplano, at an altitude of 3,700 m, divides these mountains into two parts and stretches up to 800 km. Resistant to strong winds, frost, hail, and snow, local farmers take llama camels to pasture every day, which is a major source of food and protein security. Traditionally, llama camels have also been an economic commodity, providing farmers with organic fertilizer, transport, and fiber for textiles. However, the worsening climate in recent years has reduced the number of livestock and created difficulties for farmers. Local farmers are an important group in Bolivia's highlands, and the Bolivian government has approached FAO, which has decided to implement a two-pronged innovation package to increase the sustainability of llamas and farmers' livelihoods. Thus, in an area where llama camels lay in the open, semi-roofed shelters called in Spanish corralon, specially designed for them, began to be used, thus protecting llamas from attacks by cougars and foxes at night, as well as from extreme weather conditions in the Andes. In addition, providing farmers with easy access to mobile veterinary services and pharmacies has led to the treatment of sick livestock and a significant reduction in losses. Corralo's design is based on the position of the sun and wind, as well as the topography of the area. Its size is also in line with the size of the llama herds, as it is considered a maximum of 3 meters. In addition, for future manure production, corralon has a manure deposit, a drainage channel, as well as channels that direct water. Corralons also have the opportunity to raise llama cubs. However, farmers still expect financial support from municipalities, as they are unable to build these shelters at their own expense. They even have difficulty paying for trips to municipal veterinary pharmacies. To solve this problem, high-altitude devices have been installed in areas closer to cattle breeders, and they can communicate with veterinarians through these devices. As a result, farmers say livestock deaths have declined since shelters were built. Farmers also say they earn 18 percent more from llama meat and wool in addition to the live llama trade. In 2016, this practice was observed on 14 farms in Bolivian municipalities (FAO., 2019).

Forth example is about **Fapp platform** in Uganda's agriculture. Known as the pearl of Africa, the fertile lands and favorable climatic conditions of the Republic of Uganda have helped Ugandans succeed in the agricultural sector, where 80 percent of them work. The rise of pests and diseases that have devastated crops in recent years has threatened the food security and livelihoods of Ugandans. Ugandans say they lose 30 to 40 percent of their produce to pests, diseases, or storage, processing, or careless handling. A service consisting of smartphones and drones was offered to prevent such cases. Using this service, both offline and online smartphones and drones can be used to map large areas by identifying areas affected by disease or pests using image recognition devices. Depending on pests and diseases, the service recommends farmers' resistant pesticides and assures that the solution will protect the food integrity of the products and make the products environmentally sound. The service will also alert neighboring farmers to the dangers posed by continuous monitoring of pest and disease agencies and offer them ways to manage risks as well as prevent further infestation. This service covers a platform that unites farmers and buyers, and transparency on the platform ensures the exact origin of products and fair prices. The service is called Fapp, the product of Hansu Mobile Innovations, and was developed as a startup idea by three young Ugandan developers from the Mbale Agricultural Society in eastern Uganda. First, Fapp was tested in neighboring fields in the summer of 2018 to adapt to the real needs of farmers. Innovation had to overcome many limitations, some of which still persist. The lack of financial support and the necessary equipment in the early stages meant that developers had difficulty gathering the information needed to properly teach a machine learning model for disease and pest recognition. To make sure the model was accurate, the team needed an army of drones, agronomists, and pathologists to provide the amount of information needed. Finally, and most importantly, many farmers did not have smartphones to use the service, and this prevented them from using the system. However, despite these obstacles, many farmers in Uganda continue to benefit from this platform (FAO., 2019).

As a final example, we can note that small rural farmers face many problems and obstacles in Africa. They are struggling to enter local and international markets at fair prices for their products, a move that could lift them out of poverty. When small farmers find a buyer, they rarely have the power to negotiate and develop conditions. Africa is the second-fastest-growing mobile market in the world after Asia. Low smartphone prices are revolutionizing the continent and allowing phone users to access the Internet at an unprecedented level. In fact, half of Africa's one billion people already subscribe to mobile services and are increasingly using their mobile phones to engage in banking and agribusiness. For small farmers in Africa, the new technology offers radical opportunities to increase profits, gain access to new markets and increase agricultural production. **The Virtual Farmers' Market (VFM)** is an application-type e-commerce platform where farmers' growths and buyers' demands or needs for products are advertised and traded. VFM is based on the leadership of the UN World Food Program (WFP) and provides support to the agricultural market for small farmers around the world. Thus, WFP's Purchase for Progress (P4P) program connects small farmers to markets. The application works with the same logic as popular exchange programs like eBay and Airbnb and connects small farmers with buyers and other stakeholders. The application also provides a transparent, open, and reliable space for small farmers and buyers for fair prices and deals. In 2016, the WFP Innovation Accelerator provided seed funding to develop and test a prototype of the VFM platform with small farmers from rural areas in three regions of Zambia. Until May 2017, testing of the application began in Zambia under the name Maano, which means intelligence in Tonga. Price visibility and lack of trust between small farmers and buyers outside their community have always been major problems preventing them from doing business. Through VFM, WFP has helped to overcome such problems by maintaining and mediating buyers' payments until the product is collected and inspected and assured that buyers will pay the agreed price and provide the agreed quantity and quality to farmers. Trust is built on feedback from both buyers and sellers collected in the application, allowing farmers

and traders to use the program to build a reputation for reliability. By reducing transaction costs both for buyers and sellers, VFM aims to create efficiencies in supply chains, formal markets, and food systems. In addition, the project sets out to contribute to improved nutrition, promote gender equality and women's empowerment, and ensure that benefits reach the poorest people in the community and that no one is left behind. Promoting gender equality and women's empowerment is challenging in communities with deep-rooted gender norms that discriminate against women and girls. During the pilot, the Zambia country office project team prioritized women when selecting ambassador farmers and 40 percent of ambassadors were women. By lowering transportation costs for all sellers and buyers, VFM strives to increase efficiency in food systems, formal markets, and supply chains. Furthermore, the project intends to enhance nutrition, gender equality, and women's empowerment, as well as to ensure that benefits reach the lowest members of society and that no one is left behind. In countries where deep-seated gender norms discriminate against women and girls, reducing inequalities and women's empowerment is a struggle. During the trial phase, the Zambian country office's project staff prioritized women when selecting ambassador farmers, and women accounted for 40 percent of the ambassadors (FAO., 2019).

Innovations' potential benefits can only be realized if they are implemented correctly and effectively (OECD., 2018). So. the above examples also show how AIS works, who finances it, who implements it, is always effective, etc.

The agricultural system has long been one of the key issues for global development because the rural population of developing countries is fully or partially dependent on agriculture. This area is very important for economic development, integration into the world, nutrition, and so on. AIS is one of the important factors for the development of agriculture (Saravanan R and Suchiradipta B., 2017). But since agriculture is a risky area, there may be some issues in the application of AIS and these issues relate to the challenges in countries' agriculture. For example, challenges in Cambodian agriculture.

The Royal Government of Cambodia has adopted an agricultural modernization program as a key strategic path for transforming Cambodian agriculture towards a more efficient and profitable sector. However, various hurdles in agriculture can cause problems with the application of this strategy, often known as AIS. The following are some of Cambodia's challenges (FAO., 2021):

- Interactions between various systems – linkages between research and expansion with weak or non-market systems, or between interrelated institutions.
- Functional and technical potential – key institutions' individual and institutional capacity remain poor.
- Size of farms - Farmland areas are still tiny and scattered.
- Sustainable application of smart agricultural practices – the assimilation and adoption of such practices is still low at the national level.
- Crop and livestock output productivity continue to be low.
- Production costs – Production costs are a complicated topic that entails a slew of interconnected issues and challenges. These concerns include high agricultural product costs (seeds, fertilizers, etc.), a restricted number of local services, expensive electricity, gasoline, and transportation costs, and complex logistics issues.
- Infrastructure – Irrigation and drainage systems have yet to be installed in all of the country's agricultural areas. For crop production, most places still depend significantly on rainwater. As a result of this problem, the country's agricultural productivity is extremely vulnerable to natural disasters such as droughts and floods. Rural areas also have a restricted number of rural roadways, as well as storage and post-harvest handling.
- Development of agricultural technology and research – the number of researchers is still limited due to weak financial support (30 people per million population). The research does not cover or weakly covers most of the problems facing the country's agricultural sector. In addition, investment in agricultural growth and education is low.

- Crime – deforestation, destruction of fishing, illegal export and import of agricultural products, including vegetables, rice, and poultry, still exist in Cambodia. Clearing of forested areas and flooded forest lands is still a matter of concern.

Thus, due to such problems in the agriculture of the countries, AIS is not able to fully implement its goals and objectives, and as a result, the implementation of the system fails. Thus, in order to avoid such problems, the agricultural sector of the country to be applied, its strengths and weaknesses should be thoroughly studied before applying AIS.

CHAPTER II. OVERVIEW OF AGRICULTURAL SECTOR OF AZERBAIJAN IN CASE OF KARABAKH REGION

2.1. Overview of Agricultural Sector of Azerbaijan

Hunger elimination is one of the great issues of the twenty-first century. This issue is ranked first in the Millennium Declaration of the UN. Agriculture must always play a key role in addressing this widely known issue. Growing population, global climate change, a decline in cropland per capita, an absence of agricultural irrigation, continually increasing prices for raw tools and components, a lack of qualified agricultural professionals, and low labor productivity, to name a few factors, all make it difficult to fix the issues once more. Unfortunately, agriculture will not have an immediate good impact because investors are currently more interested in the oil and gas industry than in inefficient agribusiness. Following the disintegration of the Soviet Union, Azerbaijan gradually found its own path and developed a new plan to integrate into the global economy. The initial approach was to concentrate on the oil business. It was the only option for a rapid recovery. A new development idea about future of Azerbaijan was approved in 2012. This new idea defines the current economic policy, the primary vectors of economic division, and the high growth temp in the non-oil sector, regardless of the country's oil revenues and export capacity (Mammadova S., 2019).

Agriculture is crucial to Azerbaijan, providing a significant share of employment, rural lives, food security, and agricultural development. Unfortunately, the sector is extremely vulnerable to climate change, and climate change could result in negative temperature changes, rainfall, and the frequency of extreme events (such as plagues, heat waves, and flooding) (WB., 2012). After the construction and oil industries, agriculture is the third-largest sector contributing to Azerbaijan's economy. 5.9 percent of the total Gross Domestic Product (GDP) falls on agriculture (<https://www.stat.gov.az/news/index.php?id=4795>, 2021). 88 percent of agricultural farms are

private farms, of which 82.5 percent are family farms and 5.5 percent are other forms of agricultural farms (<https://www.stat.gov.az/source/agriculture/?lang=en>, 2022).

In terms of social and economic impact, agriculture is also one of the most essential industries in Azerbaijan. According to 2021 statistics, about 47 percent of the total population (10.1 million) live in rural areas, and they live their daily lives through agriculture, forestry, and fishing. Approximately 4,780.1 square kilometers of the country's territory is cultivated and used for agriculture. According to 2020 data, about 36.3 percent of the total population works in agriculture. According to 2020 statistics, 7594.4 million manats of the gross agricultural output fell to private owners, family farms, and households. Also, 4004.3 million manats of this gross output fell to livestock and 3590.1 million manats to crop production. 1243 hectares of arable land in Azerbaijan are irrigated (<https://www.stat.gov.az/source/agriculture/?lang=en>, 2022). The available resources for the future development of agriculture in Azerbaijan have not yet been exhausted, and the current soil and climatic situation may allow for an increase in irrigated areas in Azerbaijan to 3-3.5 million hectares. However, the shortage of water resources may not allow it. Since 1970, the total irrigated area and their distribution have remained stable. Azerbaijan's water reserves are 32.2 billion cubic meters. 31.9 percent of water resources are concentrated in the country, but the rest comes from neighboring areas, mainly Armenia and Georgia. Other Caucasian countries have richer water resources than Azerbaijan. In addition, it should be noted that the rate of water evaporation is 2.5 times higher than the total precipitation in Azerbaijan. Water resources in Azerbaijan are main rivers, springs, waterfalls, lakes, and reservoirs. The share of groundwater resources in total water resources is about 0.4 percent. The main water users in Azerbaijan are those working in agriculture and industry, and these areas are more water demanding. In agriculture, the main water consumption is irrigation and cleaning of saline soils. The main problem is that water losses in irrigation due to infrastructure (Aksoy.U. and others, 2017).

Azerbaijan can be divided into four agricultural zones in terms of temperature, irrigation, arable land, pastures, altitude, rainfall, and livestock density. These zones differ greatly in terms of precipitation, temperature, altitude, topography, and humidity. Thus, these four zones consist of irrigated areas, subtropical areas, high rainfall areas, and low rainfall areas. Most of the northern and western parts of Azerbaijan are considered to be areas of high rainfall. The central part of the country is irrigated, the southern part is subtropical, and the eastern part is low rainfall. The Nakhchivan zone is considered to be a high rainfall and irrigated area (WB., 2012).

Thus, the diversity of the environment in Azerbaijan creates different opportunities for production from subtropical to temperate climates. The basis of Azerbaijan's agriculture is divided into two broad parts: crop and livestock (Aliyev R., 2019). So, in order to look at the general overview of agriculture in Azerbaijan, it is necessary to study the agriculture of its economic regions. By the decree issued by the President of the Republic of Azerbaijan Ilham Aliyev in 2021, a new division of the country's economic regions was created. According to this new division Azerbaijan has 14 economic regions now. They include Baku, Absheron-Khizi, Ganja-Dashkasan, Shaki-Zagatala, Lankaran-Astara, Quba-Khachmaz, Central Aran, Karabakh, Eastern Zangazur, Mountainous Shirvan, Nakhchivan, Qazakh-Tovuz, Mil-Mugan, and Shirvan-Salyan.

In the Absheron-Khizi and Baku economic regions, the basis of agriculture is mainly a suburban economic complex. This includes livestock, sheep, poultry, horticulture, floriculture, viticulture, vegetables, and dry subtropical fruit growing. In Absheron and surrounding districts around Baku, mainly vegetables are produced and sold for the local market. The climatic conditions of these economic regions also allow the production of saffron, olives, pistachios, and other agricultural products. The basis of agriculture of Ganja-Dashkesan and Gazakh-Tovuz economic regions is various products. Thus, 13-14 percent of the country's agricultural products fall to the region, which includes 80-85 percent of potato production, 28 percent of grape production, and

15 percent of livestock production. Agriculture in these two economic regions specializes mainly in potato and wheat production, as well as viticulture. There are many greenhouses in Shamkir region, where off-season vegetables are grown and exported to Russia. Ganja region is also one of the most productive regions and mainly cotton and fruits are grown here. In addition, Gadabay region is one of the leading regions in the production of potatoes and honey. In parallel, Tovuz and Shamkir regions are also engaged in potato production. Goranboy region is also famous for its cotton and wheat production. Agstafa, Shamkir, Samukh, and Gazakh districts specialize in viticulture. In addition, these economic regions also specialize in horticulture and fruit growing. The economy of the Sheki-Zagatala economic region is based on agriculture. In the economic region, mulberry growing, wheat production, fruit growing, tobacco growing, and viticulture, and in the livestock sector, meat, dairy, and wool sheep breeding have developed. Thus, 17 percent of the country's wheat, 35 percent of mulberry, 75 percent of tobacco, and about 2 percent of green tea leaves fall to this economic region. The supply of livestock products in the Sheki-Zagatala region is more than 10 percent of the country's total supply. In the Lankaran-Astara economic region, the agrarian business industry is more developed than in other areas. The region's fertile lands, sufficient labor force, humid subtropical climate, and rich water resources offer great opportunities for agricultural development. The agricultural structure of the region consists mainly of tea growing, wheat production, viticulture, and vegetable growing. The region accounts for 27 percent of vegetables, 99 percent of tea, 15 percent of wheat, 24 percent of potatoes, 13 percent of grapes, and 10 percent of fruit produced in the country. Lankaran, Masalli, and Astara districts specialize in horticulture and tea growing. Lankaran region has also developed in the production of grain and grapes, vegetables, and citrus fruits. Jalilabad region specializes in viticulture. The basis of agriculture in Lerik and Yardimli districts is tobacco and wheat production, as well as livestock. Fishing is better developed in coastal areas. Lankaran-Astara economic region is the most important region in the country in terms of citrus production. The

basis of the Guba-Khachmaz economic region is agriculture. The region's agriculture specializes mainly in the production of fruits and vegetables. In Khachmaz, Siyazan, and Shabran regions, viticulture is predominant, and in Gusar region, potato production is predominant. Wheat is grown in almost every part of the population of the economic region. Meat and dairy cattle predominate in the lowlands of the region, but sheep breeding is the main occupation in the highlands of the region. Poultry farms operate in Shabran and Siyazan districts. Along with its developed industries, Mil-Mugan, Shirvan-Salyan, and Central Aran economic regions are the main agricultural regions of Azerbaijan. Irrigated agriculture dominates in the agriculture of the regions. In addition, these economic regions specialize in cotton, viticulture, horticulture, wheat, and dry subtropical fruit growing. These regions account for more than 90 percent of cotton production in Azerbaijan. The production of sugar cane and potatoes has also developed. The basis of the economy of the Karabakh economic region is agriculture. The main agricultural sectors in the region are tobacco and fruit production, viticulture, and wheat production. In addition, this region is distinguished from other regions by the productivity of viticulture. Meat and wool cattle predominate in the highlands, while meat and dairy cattle predominate in other parts of the region. Mulberry and beekeeping have also developed in the region. Thus, the industry of the Karabakh economic region is based on the processing of local agricultural products. The economy of the East Zangazur region is based on the development of agriculture and animal husbandry. Livestock, beekeeping, and sheep breeding are the main areas of animal husbandry. For almost 30 years, the occupation has affected the agriculture of both the Karabakh region and the East Zangazur region, and these areas have lagged behind in development. Another economic region, the Mountainous Shirvan region, specializes in various areas of agriculture. These include viticulture, animal husbandry, agriculture, and winemaking. In the field of agriculture, wheat production is more developed than others. Other agricultural lands are used to meet the local consumption of the economic region. Sheep-breeding and cattle-breeding are the most developed branches of animal

husbandry. The diversity of climatic conditions of the Nakhchivan economic region has led to the specialization of the agricultural sector of the region in different directions. It has been possible to develop agriculture in the region using an artificial irrigation system. The main agricultural areas include tobacco, fruit, and wheat production, as well as viticulture. The Nakhchivan economic region is the second-largest tobacco-producing region in the country. In addition, henna, flowers, vegetables, and sugar cane are grown in the economic region. Beekeeping, meat, and dairy and wool sheep breeding, as well as meat and dairy cattle breeding, are the most developed among the livestock industries (<https://e-qanun.az/framework/4797>, 2022).

If we take a general look at the livestock sector of the country, we can see that fishing, cattle breeding, sheep breeding, and poultry farming are the most developed areas. The livestock sector provides the country's population with milk, wool, fur, meat, and chicken. The largest source of income in the livestock sector is cattle breeding. Sheep, cows, and goats make up the majority of livestock. The buffalo industry is also widespread in the country and is mostly used for milk production. It also accounts for 20 percent of total livestock. It can be said that sheep breeding is more prevalent in mountainous regions. Poultry farming is more important for the production of eggs, meat, and feathers, and as a result, their profitability and productivity are increasing day by day.

Thus, agriculture is one of the traditional areas of Azerbaijan, and the country's territory has always been the main settlement of agriculture and livestock. Archaeological excavations show that in 6-8 millennia BC, sericulture, fruit-growing, and viticulture were developed in the lands of present-day Azerbaijan, and grain crops were grown. Since most of the country's territory is mountainous, livestock has been one of the most important areas in the life of the country's population.

2.2. The Role of Karabakh Region in the Agricultural Sector of Azerbaijan

Karabakh is one of the most ancient and historical places in Azerbaijan and is also considered an integral part of the country. Every nation in the world has had both happy and painful years. In 2020, a new historical stage of our country began, and this new stage is called the stage of victory. Over the past years, the creation of foreign exchange reserves in the country, the significant strengthening of the economy, the provision of our Army with new equipment and technologies, as well as successes in diplomacy have all led to the victory of the Azerbaijani Army. As a result, victory was achieved, and Azerbaijan began to rebuild the infrastructure of Karabakh and develop the districts of this region. Currently, the process of clearing the occupied territories of mines and other explosives and devices has begun, and this process is still ongoing. President Ilham Aliyev has outlined the scope of reconstruction of infrastructure in the liberated regions after the war. Development of the liberated regions of Azerbaijan, their reconstruction, humanitarian activities with the collaboration of international development organizations and investors, in addition, cooperation between the public and private sectors, repatriation of displaced persons and refugees in their native lands, development of social capital, etc. all these activities can be carried out by special state programs (Zeynalov K., 2021).

The political and economic situation in Azerbaijan has been aggravated by internal conflicts in the past, the Armenian government's unfounded territorial claims against Azerbaijani lands, as well as incompetence in the management of forces coming to power, and so on. Thus, the occupation of more than 20 percent of our territory and the displacement of millions of people have seriously damaged the country's agriculture, especially in the Karabakh region, resulting in a sharp decline in agricultural production, weakened material and technical base and significant market access was severely damaged. Thus, during 1990-1993, the imbalance between the prices of agricultural and industrial products in the country intensified, and a difficult situation arose in the development of social and economic infrastructure in the region. During

this period, certain problems arose in providing the agricultural and industrial sectors with the necessary equipment, and the depreciation of the country's fixed assets accelerated. In addition, the application of the achievements of scientific and technological progress in production processes was limited at that time, which turned our country from a food exporter to a food importer. At times, there was even a great need for help from foreign countries and international organizations. The facts also prove that the volume of agricultural production decreased by 58 percent between 1990 and 1995. However, despite the fact that the territory of Azerbaijan has been under occupation for about 30 years, the production of agricultural products in 1995-2019 increased significantly compared to 1995. This can be seen visually in the Table 2 below (İbrahimov R., 2021).

Table 2: Agriculture production in Azerbaijan before and after the occupation (thousand tons)

Products	Over the years				
	1990	1995	2000	2010	2019
Grain	1413	921.4	1540.2	2000.5	3538.5
Cotton	542.9	274.1	91.5	38.2	295.3
Tobacco	53.3	8.5	17.3	3.2	6.0
Potato	185	155.5	469	953.7	1004.2
Vegetable	856.2	424.1	780.8	1189.5	1714.7
Fruit	320	324.2	477	729.5	1099.7
Grape	1196	308.7	76.9	129.5	201.8
Tea	30.7	9.4	1.1	0.5	0.9
Meat (live weight)	294.2	135	195.8	425.9	573.3
Milk	970.4	826.5	1031.1	1535.8	2129.4
Wool (physical weight)	11.1	9.0	10.9	15.6	16.1
Egg (mln. pieces)	985.3	455.8	542.6	1178.6	1827.1
Cocoon	4.9	1.1	0.1	6.0	6.4

Source: Agricultural Economics Research Center., 2020
<https://agroeconomics.az/az/article/34/sgaldan-azad-olunan-erazilerimizde-kend-teserrufa/>

After the occupation of the ancient and ancient historical lands of Azerbaijan by the Armenian occupiers in 1990-1993, the use of neither natural nor other potential resources of these territories became impossible until the liberation of those territories from occupation. The agricultural lands of these areas, which include arable land,

perennial crops, etc., have not been used for agricultural production for a long time. Studies show that it has not been possible to produce billions of manats worth of agricultural products every year in destroyed and completely unusable areas (İbrahimov R., 2021).

Karabakh has always been an integral part of Azerbaijan for centuries. Both the climate and natural resources, as well as the favorable nature, have always played an irreplaceable role in the development of agriculture. Before the Armenian occupation, 199.000 hectares of the region were used for agriculture (İbrahimov R., 2021). Vineyards and grain fields, as well as large and small cattle dominated here. Along with the restoration of traditional arable lands in the territory of Karabakh, vegetables, melons and fodder crops, potatoes, etc. can be widely grown here. The favorable geographical location of the Karabakh region, its nature, climatic conditions, and landscape of the lands, as well as the availability of favorable water supply, have always provided great opportunities for the development of agriculture in this region. Potatoes, pomegranates, wheat, peas, corn, grapes, as well as farm and legumes are grown in the Karabakh region have always been diversified. The region is also known for its valuable selection of farm animals and cultivated plants created by the local population over the centuries. Thus, the liberation of the Karabakh region from occupation will increase the role of this region for the development of Azerbaijan's economy and, most importantly, agriculture. As a result of the liberation of our lands from occupation, the Karabakh war created a historical opportunity to study the development and reorganization of agricultural production, the favorable use, protection, restoration of water and land resources, biodiversity in the region, etc (<https://science.gov.az/az/news/open/15228>, 2020).

Due to the Armenian occupation, the Karabakh region has suffered a lot. According to statistics, about 600 agricultural and industrial enterprises were destroyed in the occupied Karabakh region. In addition, more than 1 million hectares of agricultural land were destroyed and withdrawn from circulation, including 35,000 hectares of orchards and vineyards and 128,000 hectares of irrigated land. Prior to the

occupation, the country accounted for 24 percent of GDP, 46 percent of potato production, 34 percent of milk production, 18 percent of meat production, and 41 percent of grape production. Thus, the occupation also rendered the country's water resources unusable. The economic potential of the liberated territories is diverse and covers tourism, agriculture, and industry. The protected lands have excellent opportunities for tobacco growing, cotton-growing, viticulture, cocoons, melons, livestock, and fruits and vegetables. In the pre-occupation period, Agdam and Fuzuli regions had excellent opportunities for cotton-growing, viticulture and grain growing, and these regions were among the leading regions of the country at that time. For the Karabakh region, both peas and corn are among the crops. Gubadli, Jabrayil, and Zangilan districts also differed in terms of viticulture development. In addition, Gubadli, Lachin, Kalbajar, and Zangilan districts developed in the direction of animal husbandry (Zeynalov K., 2021).

At present, our main task as the people of Azerbaijan is to restore and develop agriculture in our liberated territories. Also, certain action plans have already been developed for the implementation of this policy in these regions, and the implementation process has already begun. The President has already instructed the government on these development plans (Fikrətzadə F. and Hacıyeva S., 2020).

During conflicts and wars, activities such as large-scale migration or displacement, extensive damage to agricultural infrastructure, damage to crops, pastures, livestock, extensive use of mines and other explosive devices, etc. have long-term implications for food security can cause problems. Thus, in order to overcome such problems, it is possible to rehabilitate agricultural infrastructure in the post-war period, clear the damaged areas of mines, temporarily evacuate soldiers who took part in the fighting, and rehabilitate roads and irrigation systems. Studies show that wars drastically reduce agricultural production, which in turn leads to hunger and human migration. After the recent conflicts in the Middle East, this example can be observed in Iraq, Syria, and other countries (Teodosijević S.B., 2003). Wars cause serious damage

to agriculture, reduce incomes of households, damage soils, destroy plant genetics and resources, and cause the death and migration of agricultural specialists (Bahn R., Zurayk R. and Woertz B, 2018). The Consultative Group on International Agricultural Research has conducted some research and observed that agriculture has been restored after wars in a number of countries in Asia, Latin America, and Africa due to wars and other conflicts over the last 30 years or so. These are (Varma S. and Winslow M., 2005):

- Establishment of scientific and experimental centers in the field of agriculture
- Rehabilitation of systems of supply and seed production centers
- Agrobiodiversity restoration and protection
- Restoration of human potential
- Increasing resilience to disease, future war, and other activities
- Increasing the efficiency of aid groups

The liberation of Karabakh from the system of occupation has a great role in the economy of Azerbaijan, especially for agriculture. According to the region's land balance, more than 200,000 hectares of liberated areas can be used for agriculture after the restoration of agricultural land, and 9,000 hectares of these areas are mainly backyards. Getting information on quality measures based on agrochemical research is a crucial issue in terms of improving agriculture in the freed territories and selecting priority areas, in addition to quantitative land measurement. Although public conflicts now claim that the liberated regions have more water resources than other regions, research shows that sugar cane has been grown in these areas in previous years. In addition, the creation and development of irrigation systems in these areas, as well as the assessment of the irrigation potential of these systems is one of the most important issues for the country's agriculture. In other words, although the current discussions emphasize that these areas have more water resources than other regions, historical facts prove that dry farming prevailed in these areas. After assessing the water and land resources in the liberated areas, the main task is to carry out land reform in these areas,

and there are a number of positive developments in this direction. Thus, for the first time in 1996, only land reform was allowed in Azerbaijan among the CIS countries, and this practice can serve as a conceptual basis in the liberated regions today. However, due to the lack of accurate inventory in the land reforms carried out in 1996, an electronic accounting system is now expected to be established to accurately carry out land reforms in the liberated regions (Fikrətzadə F. and Hacıyeva S., 2020).

After the restoration of the liberated lands and a number of land reforms, the main goal and stage is the establishment of livestock facilities or farms in these areas. At present, the establishment of a number of such farms and the provision of these farms with productive animals is one of the urgent issues. It is also important to provide such farms with means of production. Facilitating farmers' access to fertilizers, seeds, etc. in these liberated regions is one of these issues. In addition, the provision of consultation hours and information services to farmers living in these areas is an important factor in terms of agricultural recovery and development in the region. Prior to the occupation, the region's indigenous population was registered in the liberated areas, but during the occupation, they were displaced from their homes, and as the years went by, they also moved away from agricultural activities. Also, the new generation born and raised in cities or towns after the occupation has almost no experience in agriculture. In addition to all this, modern agricultural technologies have been updated, and more advanced forms of agriculture have been created. For these reasons, one of the most important nuances is the creation of consulting or modular vocational training and information services that provide training for agriculture in these areas. Given the development of fruit, cocoon, viticulture, and dairy farming in the liberated areas, it is important to establish processing enterprises in these areas. Once these farms are operational and the above action plans are in place, logistics infrastructure and supply chains must be established for their sustainable operation. The logistics infrastructure established in these areas should first cover the rehabilitation of roads and easy access to vehicles, as well as the transportation of manufactured and stored products. Taking into account the

re-development of tobacco and cocoons in the region, the establishment of receiving points for these products is one of the important issues. In addition, the establishment of flour mills in accordance with the development of grain growing, the establishment of leather processing and feed production enterprises in accordance with the development of animal husbandry are among the priority issues (Fikrətzadə F. and Hacıyeva S., 2020).

According to the official data of the State Statistics Committee, in 1980, there were 139,800 hectares of arable land in the Karabakh region, and these fields were dominated by vineyards and grain fields. 35 percent of these arable lands were vineyards and 55 percent were grain fields. Based on the statistics of the 1980s and the unoccupied territories of Fuzuli and Agdam regions, it is projected that there will be 232.800 hectares of arable land in those areas for the long term. In addition, the development of fruits and vegetables in the liberated areas, as well as fodder crops in terms of livestock. The focus is also on planting apple, pomegranate, cherry, date, pear, and plum orchards, as well as cocoon and grape orchards to rehabilitate perennial crops, taking into account soil and climatic characteristics. In the 1980s, grain and dairy farming were predominant in the Karabakh region. At that time, Karabakh and surrounding areas accounted for 13.9 percent of the country's grain production and 25.5 percent of grape production. In addition, it is planned to restore and develop tobacco production in Kalbajar, Gubadli, and Zangilan districts. Along with the restoration of traditional areas, these areas have excellent opportunities for the development and expansion of melons and fodder crops, as well as potatoes and vegetables. Special attention is expected to be paid to the development of fruit growing in these areas in terms of raw materials and exports (Fikrətzadə F. and Hacıyeva S., 2020).

Giving more attention to the development of the livestock sector in the region, along with the restoration of the above-mentioned traditional and prospective directions of the agricultural sector, is considered to be more beneficial in terms of natural-climatic and relief qualities. This is due to the predominance of pastures and meadows

in these locations, as well as the fact that the economic traditions in these areas have historically been mostly in this direction. In the 1980s, the region had 321,000 head of cattle and 1.1 million head of small cattle, according to the State Statistics Committee. This amount has the potential to grow to 430,000 head of cattle and 1.6 million head of small cattle in the long run. When the number structure of animals is compared to the total number of animals in the country, taking into account the return of IDPs to liberated areas as well as farms, it is estimated that cattle will account for 14.7 percent of the total number of cattle and 17.5 percent of the total number of small cattle. This ratio was 16.2 percent in the number of cattle and 19.3 percent in the number of tiny cattle in the 1980s. (Fikrətzadə F. and Hacıyeva S., 2020). According to the research, the number of animals in agriculture in the pre-occupation and post-occupation years of the Karabakh region was compared, and the forecasts for the post-occupation years are shown in Table 3.

Table 3: Number of animals (thousand heads)

	1980s			Perspective period		
	Large horned animals (total)	Cows and buffaloes of them	Small horned animals	Large horned animals (total)	Cows and buffaloes of them	Small horned animals
Karabakh	95.6	30.7	264.3	127.9	41.0	376.6
Agdam	44.4	16.4	191.8	59.4	22.0	273.2
Jabrayil	26.4	8.9	114.2	35.3	11.8	162.7
Fuzuli	37.8	13.4	149.0	50.5	18.0	212.3
Kalbajar	31.9	11.0	97.4	42.6	14.6	155.3
Gubadli	22.8	8.3	30.6	30.5	11.1	43.6
Lachin	43.0	14.8	224.8	57.5	19.8	320.3
Zangilan	19.1	6.8	34.6	25.6	9.1	49.2
Total number of animals	321.0	110.3	1106.7	429.3	147.4	1593.2
Ratio to the total number of animals in the country, %	16.2	14.8	19.3	14.7	10.9	17.5

Source: Agricultural Economics Research Center., 2020
<https://agroeconomics.az/az/article/34/isgaldan-azad-olunan-erazilerimizde-kend-teserrufa/>

In terms of providing meat and dairy products to the country, the development of the livestock sector is critical. As a result, the region is predicted to generate around 45,000 tons of meat and 240,000 tons of milk, demonstrating the region's relevance in terms of import substitution and food security. (Fikrətzadə F. and Hacıyeva S., 2020). Again, the research on dairy and meat products for the prospective period is shown in Table 4.

Table 4: Production of basic livestock products (thousand heads)

	1980s			Perspective period		
	Meat	Milk	Eggs (million units)	Meat	Milk	Eggs (million units)
Karabakh	10.9	53.9	31.7	17.9	66.1	51.2
Agdam	3.8	24.4	19.2	6.3	42.5	31.0
Jabrayil	2.3	14.0	11.4	3.7	21.0	18.4
Fuzuli	2.8	20.0	11.8	4.6	31.2	19.0
Kalbajar	2.0	16.3	8.1	3.3	20.9	31.1
Gubadli	1.3	12.1	4.4	2.2	18.3	7.1
Lachin	3.3	13.9	4.1	5.4	23.9	6.7
Zangilan	1.1	9.2	3.6	1.9	14.3	5.8
Total production	27.5	163.8	94.3	45.3	238.2	152.3
The ratio of total production in the country, %	14.9	15.4	8.8	12.2	10.5	7.9

Source: Agricultural Economics Research Center., 2020
<https://agroeconomics.az/az/article/34/isgaldan-azad-olunan-erazilerimizde-kend-teserrufa/>

Along with meat and dairy livestock, equestrianism and the revival of the region's historically extant cocoon and beekeeping traditions are other priorities. The directions of agricultural recovery in these areas have been defined, and the potential amount of agricultural output in the region has been anticipated, according to the analysis and assessments carried out in terms of agricultural development prospects in the freed regions. Thus, it is predicted that annual and perennial crops will be planted on around 232.800 hectares in the liberated areas, as well as farms with 430,000 head of cattle and 1.6 million head of small cattle, taking into account the vacant areas of Agdam and Fuzuli in the region. Agricultural output dominated by livestock will continue to dominate in the future, taking into consideration the region's historically existing potential in the field of animal husbandry and natural relief features. In addition to the

availability of pastures and hayfields in the region for fodder supplies, the expansion of grain and fodder crops has significant potential for livestock development. The anticipated level of meat and dairy output is critical, particularly in terms of import substitution. In addition, the region's ancient viticulture, tobacco, cocoon, and beekeeping regions will be restored and extended. Furthermore, the region's expansion of intensive fruit cultivation will become a new trend. The restoration of agricultural production in the region is predicted to improve the country's total agricultural production by more than 8 percent, according to estimates. (Fikrətzadə F. and Hacıyeva S., 2020).

2.3. Obstacles to the Development of Agriculture in Karabakh Region

There have been wars in the lives of all the peoples of the world, and these wars have had a significant impact on agriculture. It usually had a greater impact on arable land and the agricultural sector, but also on agricultural trade. The post-war problems in agriculture do not differ much from the pre-war problems. But, of course, wars create more serious problems in agriculture (Warren G.F., 1998). There can be many types of interactions between war, conflict, and agriculture, and agriculture can also cause conflicts and crises, for example, agriculture can be a source of controversy. Agriculture can also finance military operations, produce commodities, and market them, thus acting as a means of sustaining wars, crises, and conflicts. Thus, both concepts have been in contact with each other since their inception. Wars and conflicts cause serious damage to agriculture, reduce household incomes and assets, cause famine and food shortages, and negatively affect the production system and their exports. Wars and conflicts also have a direct impact on the agricultural system. These include the destruction of agricultural infrastructure, disruption of animal and crop production, loss of agricultural assets, etc. For example, crop production can be damaged either directly or indirectly due to the disruption of irrigation systems. Leaving agricultural land in or near war-torn areas can also reduce crop production. Thus, wars can lead to population

migration and, indirectly, to agricultural employment or livelihoods (Bahn R., Zurayk R. and Woertz B., 2018).

Interruption of agricultural output and food trade, diminished investments, and degeneration of lands or infrastructure are all common effects of socioeconomic shocks, technological disasters, and military conflicts on regional or national agricultural production. Slow changes (e.g., rapid urbanization or economic expansion) or abrupt shocks (e.g., unexpected socioeconomic, ecological, and political upheavals, or armed conflicts) can induce changes to land structures and systems over time. Research findings of armed conflicts have revealed significant land-use changes as a result of migration and land abandonment, resulting in a decrease in cropland and a keep increase in natural vegetation in some situations. For instance, in the Nagorno-Karabakh war between Azerbaijan and Armenia from 1991 to 1994, significantly higher rates of agricultural abandonment were seen. Another aspect of military conflict is the loss of biodiversity, which occurs when protected areas are not continuously guarded and just become parts of the combat zone or are impacted by refugee inflow. On the one hand, military action may result in casualties and exodus from war zones, resulting in decreased agricultural output and land abandonment. Militants, on either hand, may exploit agriculture as a source of money and hence aim to enhance agricultural productivity. Due to a lack of a steady food resource, civilians may expand agriculture productivity (Eklund Lina., and others, 2017).

It is clear that the Nagorno-Karabakh war has caused significant damage to Azerbaijan's agriculture. In general, Azerbaijan was a country that suffered from the effects of both the first Karabakh and the second Karabakh war, because the war was going on in the ancient lands of Azerbaijan. For this reason, not only the country's agriculture but all its sectors were shaken by the consequences of the war. Especially as a result of the war, there were some obstacles to the future development of agriculture. The following obstacles are clear examples of this.

1. **War's explosive remnants** - According to assessments at the end of 2019, landmine contamination within Azerbaijan, which includes anti-personnel and other sorts of explosives, covered 10.4 km², with the most contamination concentrated along the country's borders. During the 2020 battle, this is expected to have escalated, and contamination is expected to have spread further away from the Locative. The existence of explosive remains of war raises serious safety issues, particularly in villages along of the Locative., where contamination is common. Contamination makes it difficult for locals also for other people to work, stay and live within those places, as well as access marketplaces, land, and basic amenities (Assessment Capacities Project., 2020). Explosives are especially dangerous for agriculture and create certain obstacles to the development of this sector. This problem can create difficulties for both agriculture and livestock. In agriculture, it can create obstacles for people to use the land as they wish, and the sudden explosion of these explosives can endanger human health and lives. In the livestock sector, it can be a major threat to the lives and health of both humans and livestock. Contamination from the latest and previous conflicts is projected to encompass an area of 350 km² to 830 km² in the transferred lands, with 50,000–100,000 landmines. In 2019, contamination was expected to cover 7.75 km² in Nagorno-Karabakh. Following the 2020 war, contamination is anticipated to have intensified. Demining operations are said to have begun in the Fuzuli, Agdjabadi, Jabrail, Khocavand, Agdam, and Tartar districts, despite the fact that previous to the 2020 war, Azerbaijani national demining services were prohibited from working inside 2 kilometers of the Azerbaijan-Armenian frontier. At least 750 unexploded rockets and missiles, 4,500 anti-personnel explosives and mines, and 2,000 anti-tank mines have been discovered and detonated by the Azerbaijan National Agency for Mine Action (ANAMA) from September 27. The agency claimed to detect 800,000 items of explosive material after clearing a 50,000-hectare region (Assessment Capacities Project., 2020). According to ANAMA, 21 Azerbaijani citizens have been killed by landmines since the liberation of the occupied territories (<https://www.bbc.com/azeri/azerbaijan->

[57361973](#), 2021). Because many places in the transferred lands are contaminated with landmines, displaced people will have to wait until coming back. According to the Azerbaijani demining officials, clearing Agdam district will take 3 to 5 years before it is safe for people, and clearing the other 7 transferred territories will take 10 - 15 years. Former villages, on the other hand, are being given preference for clearing and will most likely be available to resettlement in the coming years, regardless of the fact that the nearby lands may be severely contaminated and off bounds (Assessment Capacities Project., 2020).

2. **Changes in land usage** - Socioeconomic shocks can alter future land-use pathways. Land-use systems can experience periods of quick and extreme change as a result of socio-economic shocks, and these changes can determine future trajectories of land-use systems. Land-use changes are generally produced either through slow (e.g., demographic shifts or urbanization) or rapid (e.g., revolutions, economic crisis) forces of change. Military action and combat, in particular, are severe socioeconomic shocks that have a wide range of effects on people's lives and livelihoods. Military wars are a particularly severe type of socioeconomic shock. In the combat zone, high farming land abandoning rates of more than 60 percent predominate local land-use shifts. Agricultural operations were also displaced into neighboring Azerbaijani territory, most likely as a result of refugee flows (more than 30 percent including all abandoned land in the warzone was balanced by new agricultural lands on Azerbaijani territory). About 17 percent of the abandoned lands were re-cultivated after the military conflict ended, showing that the land-use pattern had changed dramatically. Our findings revealed that military action can have a significant influence on land use. Military conflict has the capacity to alter the landscape for decades or even centuries, but such consequences can be complicated, necessitating the examination of various spatial and temporal aspects in the case of land usage. In terms of geographic parameters, the most urgent land-use changes usually take place inside the actual conflict zone (hence referred to as "local effects"). Due to a lack of implementation by local officials, local effects are tied

directly to the war and can lead to either expanding or lowering pressure on land use, such as illicit logging, mining, and illegal hunting. Forest areas may be destroyed across wide areas in extreme cases, such as when defoliating chemicals are utilized, as in the Vietnam conflict. Land-use operations, on the other hand, might decline in battle areas when people are fighting or fleeing, resulting in high percentages of farmland abandonment, settlement demolition, or decreased logging. Military actions have far-reaching implications on land use that are not limited to the immediate vicinity of the conflict. Abandonment levels, for example, are lower at long distances from the battle zone. Land-use operations, on the other hand, might decline in battle areas when people are fighting or fleeing, resulting in high percentages of farmland abandonment, settlement demolition, or decreased logging. Refugees fleeing warzones frequently travel long distances inside their country or even across international borders. As they do so, their demand for natural resources grows. This may result in increased land-use tension at the location, depending on the density of population and economic activity. In regard to the transient dimension, it's unknown if land-use changes resulting from military conflict last after the conflict ends. To put it another way, does a conflict indicate a socioeconomic shock occurrence where a land system rebounds to its pre-conflict state, or does it shift toward a new state? If refugees return once the fighting stops, the system of land will most likely recover, agricultural areas will be re-cultivated, and forest resource utilization will continue. However, there are occasions when a comeback is highly unlikely. After the fighting has ended, territorial borders may still be challenged, causing concerns about land ownership, making it difficult to reinvest in farming, and leaving abandoned fields uncontrolled. Similarly, when the need for certain agricultural goods declines, as in the example of date palm damage in Iraq in the 1990s, land-use tension can stay low. Anti-personnel explosives and unexploded materials, which are sadly common in conflicts, can stay on the battlefield for years, severely limiting land use (Baumann M., and others, 2014). Thus, changes in land use are moving away from the already arable nature of the land, which poses a

significant risk to agriculture. The return of the soil to its former state takes some time to form its previous habits.

3. **Labor shortage** - One of the most serious obstacles to agricultural development is a labor shortage. In war-torn, combat, and liberated countries, this is especially true of the agricultural sector. Agriculture's development, the introduction of innovations, expansion, risk reduction, and other activities are all hampered by a lack of labor. There are several reasons for the workforce scarcity, particularly in war-torn places. The fear of a new war, the presence of explosives buried in the war-torn lands, and the degradation of the lands all contribute to migration from the war zone, the return of just a percentage of the people after years of war, the fear of a new war, and the degradation of the lands. The concern of losing fertility, the fact that young people today, unlike earlier generations, are more technology-oriented and less interested in agriculture, and so on. As a result of these factors, there is a labor shortage, which has a negative influence on agriculture. As a result of the inability of settling in Karabakh in a short period of time, a shortage of labor in the agricultural sector may initially cause major challenges, limiting the use of agricultural potential to a reduced extent.

4. **Decreased or forgotten habits** - The efficient deployment of labor is one of the primary issues in the settlement of the population in the liberated regions and the development of the agricultural sector. Because the majority of these families have migrated to cities or urban-type settlements in the last about 30 years, some of them work in the service, construction, or transportation industries, as well as in industry. Such labor potential will not be able to work in the agriculture industry in the regions right away. Youngsters who were forcibly removed from the region as children are now teenagers and almost all of them grew up in cities and have no experience of agriculture. As a result, their lack of agricultural knowledge impedes the sector's growth.

5. **Ecological status** - The ecological status in the Karabakh region has been severely harmed as a result of Armenia's 30-year aggressive strategy. In addition to the economic context, illegal activities and natural resource exploitation in the occupied

territories have resulted in a number of environmental issues. The ecological balance in the region has been disrupted as a result of deforestation and burning, pollution of water supplies, destruction of flora and wildlife, and robbery of the subsoil. In all of Azerbaijan's formerly occupied areas, there were around 260,000 hectares of forest, although forest cover has been quickly declining over the last 30 years. Furthermore, deliberate fires were set regularly during Armenia's 30-year occupation of Azerbaijani provinces, resulting in the total destruction of land and forests. All living organisms, including topsoil, grass, and bushes, are killed by the fire. In addition, the majority of the rivers that flow through Azerbaijan's territory originate in Armenia or Karabakh. These water sources are contaminated with garbage from a variety of sources. According to the Republic of Azerbaijan's Ministry of Ecology and Natural Resources, long-term contamination of the Araz River has resulted in the extinction of valuable fish species. As a result of Armenia's 30-year occupation, the ecological situation in Karabakh has deteriorated, posing major challenges to the region's agricultural growth (<https://story.karabakh.center/az/qarabagda-ekosid>, 2021). According to the official data of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, as a result of the Armenian occupation, 265.3 billion dollars was damaged to the nature and natural resources of the Karabakh region (Azərbaycan Respublikası Ekologiya və Təbii Sərvətlər Nazirliyi., 2019).

Thus, all these nuances create obstacles to the development of agriculture in the Karabakh region and slow down the process of revival of the sector. At present, our country is making full use of all opportunities and is trying to overcome the obstacles facing agriculture. The liberated areas' and villages' challenges are nearly the same in character. It is critical to make the most of the area's demographic potential. The major goal is to establish well-founded ideas, projects, and programs to organize agricultural and livestock production on a scientific foundation, accomplish development and put in place a variety of methods that make efficient use of land, water, labor, and financial resources. It has the potential to help the country's agriculture expand further, increase

food security, diversify its economy, and promote industries in a dynamic and balanced manner.

CHAPTER III. THE PERSPECTIVE OF IMPLEMENTATION AGRICULTURE INNOVATION SYSTEM IN KARABAKH REGION

3.1. Implementation of Agriculture Innovation System in Karabakh Region of Azerbaijan

Agricultural science has always been one of the most difficult sciences to study. This is because the environment and nature in which we live are constantly changing, and it takes some time for us to adapt to this process. It should also be noted that there are many factors that cause changes in the environment and nature. For example, wars, global warming, testing of various weapons, etc. The nature of the Karabakh region has changed radically due to the war. For this reason, a detailed study of the nature and agriculture of Karabakh is important for the introduction and operation of a new system in agriculture.

As noted in the first chapter, the AIS is a combination of a number of organizations, actors, and individuals applying an existing or newly created product or process to agriculture. In other words, an AIS is a collection of agents who contribute to the invention, dissemination, and the use of new technologies, and who impact the process of technical change in agriculture, either directly or indirectly (Temel T., Jenssen W., and Karimov F., 2002). Agricultural innovation is becoming increasingly reliant on regional innovation, because of advances in ICT, nanotechnology, and biotechnology. A robust innovation portfolio will assure that overall and specific information from other fields (necessary for developing and implementing agriculture innovation) is available, as well as that economic players and society as a whole share an innovation culture (OECD., 2015).

In order to implement the AIS in a region, the nature and agriculture of the region must first be studied in detail and also young scientists must be trained and research centers must be opened. After this stage, sufficient information should be collected about the system to be applied, and it should be taken into account that this information

is sufficient for the region where the system will be applied. The Karabakh region has been under occupation for about 30 years and remains at war. For this reason, a number of changes have taken place in its nature and agriculture. A clear example of these changes is the lands destroyed and polluted by the war. That is why the introduction of a new system in the region's agriculture is one of the most difficult issues, both in terms of a 30-year lack of information about the region and the war-torn nature of the region. Examples of AIS applications in modern agriculture include Precision Farming applications, Smart Agriculture Methods, Drones and Unmanned Aerial Vehicles (UAVs), Smart Irrigation Systems, Smart Fertilization Systems, Smart Greenhouses, Radio-frequency identification (RFID) barcodes and earrings, Cattle step and Location tracking applications, Smart Poultry System (<https://www.btk.gov.tr/uploads/pages/arastirma-raporlari/akilli-tarim.pdf>, 2021). Thus, the application of these methods in the newly liberated territories can create ample opportunities for agricultural development.

Firstly, one of the main projects to be implemented in the Karabakh region within the framework of the AIS is **Precision Farming applications**. In fact, the Precision Farming method originated in the 1990s as Agriculture 3.0 and is still in use today. This method is mainly based on the use of GPS signals by humans. However, this method is still accepted in modern times as a type of AIS. Precision Farming is an agricultural method that targets high returns with lower costs and variable inputs (<https://apelasyon.com/yazi/39/tarimda-hassas-miyiz/1>, 2017). This method also emphasizes the protection of the environment. The Precision Farming method provides detailed information through agricultural tools and areas surrounded by sensors to agricultural producers and farmers with weather conditions, which areas will be best planted, what type of fertilizer to use, the number of minerals and water plants need, soil condition, harvest on which times are more accurate, identifying diseases and pests and which drugs will be more effective for those diseases and pests, what dose should be used and in what weather conditions these drugs are used and targets maximum efficiency level. Thanks to this method, agricultural producers and farmers will be able to get better

quality and more products by minimizing human labor power and production costs. They can also use smart technology devices to manage and monitor the entire planting area. With the Precision Farming method, every share of the cropland or every animal in the herd is monitored specifically and if there is a problem, it is always found. The application of this type of technological method in agriculture is one of the most important nuances. Due to the fact that the Karabakh region is a mountainous area, and the weather conditions change sharply in the winter months compared to other lowland regions of the country, the application of Precision Farming is important here. For example, if pre-treatment is planned for a field and it is not clear when the time is right for this process, the process can be time-consuming, costly, and cause other major problems. Thus, if the weather changes and it rains after the spraying process, the drugs on the surface of these plants may be washed away, and in addition, the drugs may mix with the soil and damage its composition. Examples of Precision Farming technology include a number of irrigation and treatment systems. For example, the CropX software system, which is used in Israeli agriculture. This system is placed in the fields with the activation of the GPS system and transmits updates on the state of the soil to smartphones through special sensors.

Another method known as the AIS is the **Smart Agriculture method**. Tractors, combines and other agricultural vehicles have been used in agriculture for many years. However, in modern times, these vehicles, combined with innovation and technology, are already known as smart machines. These smart vehicles operate on a more complex system than conventional tractors or combines, but still reduce the workload of farmers and save time. Through these mechanisms, each part of the arable land is worked out in detail, for example, if the soil needs medicine, it is possible to determine what part of the soil is needed or how much treatment is needed through sensors installed in these mechanisms. These systems are controlled by farmers via a tablet or smartphone, and thus a large area can be managed with just one touch. Examples of such smart machines are Driverless Tractors or Automatic Farming Vehicles. These tools work without

human support, simply through a navigation and navigation system. These computer-controlled devices are able to work even at night, without being affected by the weather and without interruption. According to some academic studies, it is possible to save 10 percent in total cost, 9 percent in fuel, and 17 percent in time with automatic steering. Given the fact that the lands of the Karabakh region are damaged by explosives (mines or other unexploded ordnance), which are the sharp remnants of the war, the use of such smart machines in the region is very important. Because no matter how much the region's lands are cleared of explosives, a full cleanup will be possible in about a few years. For this reason, the use of Driverless Tractors and other vehicles in agriculture is also important for human life. Robotic technology has already begun to enter the farms. One of the Smart Agricultural methods is to milk cattle on farms using robotic techniques. This technology digitizes the amount of fat and protein in animals' milk, the feed they eat, and what diseases they have, and it is possible to control it.

One of the indispensable innovations used in modern agriculture is **Drones and UAVs**. With the help of these tools, it is possible to see the fields from the air, the amount of moisture in the soil, and when it will be irrigated, monitor and evaluate the products, diagnose diseases, and, in this connection, treat them. In addition, Drones can be used to map soils for pre-analysis, so that the timing of planting, irrigation, and nitrogen application can be determined in advance. According to global marketing analysis, the sale of Drones is projected to earn 1 billion dollars by 2024 (<https://apelasyon.com/yazi/53/tarimda-ilaclamalar-artik-drone-ile-yapilacak>, 2018). Thus, as mentioned above, the continuous destruction of the region with explosives during the war and occupation creates a great basis for the application of these technologies in the area.

Azerbaijan ranks last among the Caucasus countries in terms of water resources. Only 31.9 percent of water resources are concentrated in the country, and the rest comes from neighboring countries. Therefore, the attentive construction of the irrigation system and attentive use of water resources in Azerbaijan is one of the most important

nuances. It is through **Smart Irrigation Systems** that it is possible to approach this issue in particular. The Smart Irrigation System is an application that keeps the roots of the plant moist and is able to provide as much water as each plant needs in a certain amount. In addition, this application prevents the overuse of water, which is considered a scarce source, and also eliminates the problem of drainage, which, of course, is an excellent application for our country, which has weak water resources. For example, the Drip Irrigation System, known as the Smart Irrigation System, completely eliminates the problem of water being wasted under or above the soil by constantly keeping the root zone of the plant at an optimal level of moisture. Through this system, which is also used in greenhouses, it is also possible to provide feed for plants and medicines for weeds. The application of this system is widespread in Israel, which provides a large number of agricultural products for its population. There is even one of the world's leading companies in the country, Netafim drip irrigation company, which was the first to introduce a modern Drip Irrigation System to the world. Thus, given the reasons for Azerbaijan's backwardness in terms of water resources, and especially the continuous pollution of rivers and other water sources by Armenians during the 30-year occupation of the Karabakh region, the deliberate drying of transit rivers in the country, the introduction of the Smart Irrigation Systems can create great opportunities for disposal and saving water resources.

Another system is the **Smart Fertilization Systems**. Through this system, each plant root can receive the required amount of fertilizer. This system was created taking into account the high losses during the fertilization process in agriculture. The use of nutrients in the fertilization process varies between 20 and 40 percent, meaning that only 200 to 400 kilograms of each ton of fertilizer applied are used by the plant, while the rest mixes with the soil, damaging its composition and costing it financially. It is through the intelligent system that the use of nutrients by plants can increase by 46-65 percent. In France, for example, a very simple sensor operation in the cultivation of cereals has increased protein and productivity, and even less fertilizer has been used to

produce an average of 70 euros per hectare. The same operation applies to water, medicine, and seeds. For example, the treatment used to destroy herbicides in corn yields an average of 42 euros per hectare. Thus, given the damage to the lands of the Karabakh region during the occupation, as well as the high cost of infrastructure in the region, the application of the Smart Fertilization System in the area can prevent both additional costs resulting in excess fertilizer loss and further destruction of damaged lands by over-fertilization.

As the climate of the Karabakh region changes dramatically in the winter months, the use of **Smart Greenhouses** in the region's agriculture may be one of the important experiences. Thus, all conditions have been created for plants growing in such greenhouses to feel in their natural environment. It is even possible to control the air inside Smart Greenhouses, to ensure that the weather conditions are optimal for the plant, provide constant ventilation, as well as to set the radiation and carbon dioxide at a level that does not harm plant growth. It is also possible to use Smart Irrigation, Smart Fertilization, and Drainage Systems within these types of greenhouses. The smart automation system in greenhouses monitors and reports the situation inside the greenhouse and operates to optimize product performance and operating costs. Given the harsh winter in the Karabakh region, growing crops with the greenhouse effect and even other conditions within smart greenhouses can help meet the region's demand for agricultural products during the winter months.

Of course, the agricultural system of the Karabakh region does not consist only of agriculture. Livestock also plays an important role in the region's agriculture. It is also possible to see smart applications related to animal husbandry in the AIS. **RFID barcodes** and **earrings**, one of the animal tracking devices used in agriculture, are used to more effectively track cattle and small ruminants and work with radiofrequency. Thus, RFID earrings contain all the information about the animal, such as the date of birth of the animal, vaccines, reproductive characteristics, blood relationships, etc. All this information is recorded on a computer, making it both easier and faster to track and

report on them. Mini labels placed under the skin of animals, worn on the ears, or hung around the necks are also used for the tracking process. Through these electronic labels, farmers can easily track, archive, and report on the processes of animal feeding, reproduction, disease detection, gestation, wool management, weight determination, etc. In addition, **Cattle Step** and **Location Tracking** applications are used to track animals. These devices are mainly attached to the legs of animals, such as pedometers. Through these applications, the number of steps of the animals, their location, the feed they eat, their productivity, and the quality of the product they give can be determined. For example, a reduction in the amount of milk an animal produces as a result of a reduction in the number of steps can also be identified as a decrease in the quality of the milk, and the necessary interventions can be made for the animal. In addition, medical information such as the animal's body temperature and pulse can be used to determine if an animal is sick. Thus, given the location of the Karabakh region in the mountains, the application of these systems for livestock can create great opportunities for farmers. Such remote access to information about animals transferred to mountainous areas for feeding can facilitate farmers' work, manage animals, and diagnose animals more quickly if they have any health problems.

In addition to livestock, a system is designed to monitor poultry farms. The most important issue for poultry houses is the regulation of moisture and heat. Birds are unable to maintain normal body functions under extreme heat. For this reason, the regulation of heat and moisture content in **Smart Poultry Systems** is one of the most important issues. Activities such as control and monitoring of poultry houses both inside and outside, information on empty feed and water containers, heating condition of water containers, sound system on closing the door of the poultry house, etc. within the Smart Poultry System can be controlled remotely only with a smartphone. In this case, the condition of poultry houses can be monitored, and inspections of poultry houses can be carried out without visiting poultry houses. With the Poultry House Tracking System, it is possible to get information about feed, water, vaccines,

electricity, etc., and even instantly track the income from the sale of eggs (Koçak F.N., 2018). Given the growing development of livestock and sheep breeding among livestock farms in the Karabakh region and the fact that poultry farming is a traditional area of employment only in backyards, this new system can be applied in the region to facilitate the work of the region's population and to further develop the poultry industry to the level of other areas of animal husbandry.

Thus, given that the Karabakh region has just emerged from a difficult period, the revival of the region's agricultural system is one of the first priorities. This is also due to the fact that the agricultural system is at the forefront of the economic development of the world. This theory is equally valid for the Karabakh region. The AIS, which is a system to be used to revive the region's agriculture, is also designed for this purpose. With the application of this system, new prospects for the economic development of the Karabakh region may arise, and this will be the beginning of a new era for our country as a whole.

3.2. The Agriculture Innovation System's Role in the Economic Development of the Karabakh Region

Over time, agriculture is becoming more important for the world and its development. The reason is clear, because the world's population is constantly growing, and this leads to a further increase in consumption and a decrease in resources. For these reasons, the countries of the world are trying to further develop agriculture as much as possible and create new innovations and systems in this sector. Agricultural innovation has played a vital role in economic progress across the whole of history and in every country around the world by boosting agricultural production, raising the incomes of poor agricultural producers, and making food more widely accessible and cost-effective for consumers, all while minimizing the needs on natural resource shares (Alston J.M and Pardey P.G., 2021). The agricultural sector helps to increase incomes and reduce poverty among the population in developing countries, as well as to sell products at more affordable prices in rural areas and increase employment among the population. Agriculture is crucially significant in low-income states, where it employs over 60 percent of the working population and contributes to 25 percent of GDP (however, just 9 percent of middle-income states and 1 percent of high-income states are affected). Developing countries have a world population of 5.5 billion, 3 billion of whom reside mainly in rural regions, and the agricultural sector is the primary source of food for 86 percent of the entire rural population. 75 percent of the poor populations still reside in rural regions and rely on the agriculture sector and allied industries for the majority of their income. The agricultural sector also provides food, earnings, and employment, and therefore may be a key growth driver in agrarian developing states as well as a useful method for poverty reduction in developing states in transition (Dethier J.J and Effenberger A., 2012).

The agricultural sector also leads to economic development by establishing key consumption and production links. For example, agriculture can supply non-agricultural industries with raw resources or consume inputs from the industrial sector.

On the consumer side, increased agricultural productivity can raise rural population revenue, boosting the need for domestically made manufactured products. Such connection impacts can improve the chances of getting a job in the non-farm business of rural areas, resulting in indirect rural income generation. In addition, it is possible to increase foreign exchange reserves by exporting agricultural products to foreign countries, which will serve as a kind of budget for the import of capital products (Dethier J.J and Effenberger.A., 2012).

The liberation of Karabakh and Azerbaijan's victory in this area have set new priorities and commitments for the country. One of them, of course, is to revive Karabakh and bring its economic development to the fore. It is clear that economic development is possible in many ways and by bringing many areas to the forefront and introducing a new system in these areas. For this reason, agriculture is one of the priority areas for the economic development of Karabakh. The introduction of a new system in this area and the positive effects of this system on the region's economy will show how important innovation is today. National economies have made innovation and technology one of their main objectives. Governments attempt to promote innovation activities in the hopes of increasing economic expansion, national competition power, and social welfare. Frequently, policymakers create innovation strategies that simply repeat the successful innovation process without taking into account the various structures and different characteristics of the systems. The more scientifically based and sophisticated knowledge is, the further innovation is expected to be encouraged (Hristov M., 2011).

Economic development is a very broad term and covers not only the economic sphere but also the social, political, and cultural spheres. In other words, the positive changes observed in other areas of a country indicate that there is progress in the economic development of that country. Agriculture has a substantial contribution to the economic expansion process. In developing countries, the agricultural economy is the most important. The agriculture industry is critical to economic prosperity and

development. Agriculture is vital because it influences productivity expansion, increases the living standards of the generally low-income section of the agricultural workforce, provides input to many other industries, and stimulates a desire for these industries. Agriculture makes a bigger contribution to economic development, especially in developing states, because it employs so many people. The widely held belief in the international community is that there is a considerable beneficial connection between advanced technology output, economic expansion, and development (Akbash G.G and Bagci A., 2021).

Thus, if the AIS is applied in Karabakh, along with agriculture in the region, its economic development can also benefit from this system. The role of the AIS in the economic development of the region is as follows:

1. Employment – Agricultural sector is the world's poorest people's primary source of employment. In Sub-Saharan Africa, the agricultural sector employs 60 percent of the workforce (Meijerink G. and Pim R., 2007). It is known that the level of employment in the Karabakh region is lower than in other regions. Therefore, one of the current priorities is to increase employment in the region. Thanks to the AIS applied in the region's agriculture, the level of employment in the Karabakh region can be expected to increase. Thus, for the implementation of this new system, first of all, it is important to have experienced professionals, and this will lead to the creation of new jobs. The introduction of the new system will, of course, facilitate the work of agricultural producers and farmers and reduce many manual jobs, that is, technology, not people, will do it, but for these technologies to work, specialists in this field will be needed. Thus, there will still be a need to create new jobs. In addition, the population of this region has been away from home for almost 30 years and, most importantly, they have little knowledge in the field of agriculture, so the organization of training for them and their specialization in the new system is one of the important nuances for the new system. Smart farming has the ability to increase young participation in agriculture too. These developing technological advances can show the young generation that

agriculture can be a successful and competitive commercial option, increasing the attractiveness of agricultural-related careers. By involving the young generation in the agricultural sector, they will be able to contribute an imaginative and tech-savvy viewpoint to addressing some of the agricultural sector's most challenging problems (Siti F.P and Khairul H.B., 2022). In 1994, the number of refugees from Armenia to Azerbaijan was 243,682, as well as 611,293 people were forced to leave Karabakh as a result of Armenia's occupation of 20 percent of Azerbaijani lands. So, more than 900,000 Internally Displaced Persons (IDPs) and refugees have not been able to operate economically for a long time (İbrahimov R., 2021). After the great victory, the main task of the Azerbaijani government is to relocate these people who were separated from their homes as a result of the occupation, and the introduction of the new system will contribute to solving the problem of employment of returnees. Thus, the AIS plays an important role in increasing labor productivity and, in parallel, in raising employment.

2. Productivity - Agriculture farmers may be able to enhance output while also effectively managing natural resources thanks to technology and innovation. It contributes to long-term sustainability as well as minimizes production's adverse effects on the environment, like pollution and waste. The new innovation system applied to agriculture can make agriculture more productive and sustainable by reducing costs and resource inputs. The 30-year occupation of the Karabakh region and the contamination of its lands with various explosives have significantly reduced the productivity of its lands. Furthermore, there are other causes for the agrarian sector's low production, technical advancement is among the most important components in dealing with the situation. Improved productivity can be achieved by technological advancements in the process of agricultural production including cultivation of crops, watering crops, fertilization of crops, application of pesticides, harvesting of crops, and storage of final crops (Akbash G.G and Bağcı A., 2021). As we know, the Nagorna-Karabakh region and seven neighboring districts are one of the leading regions of Azerbaijan in terms of natural resources. The liberation of these territories will also help strengthen

Azerbaijan's economy and increase people's well-being. As a result of the Armenian occupation, 647,900 hectares of Azerbaijan's fertile lands were ruined, and majority of these lands are suitable for cultivating different agricultural products. Prior to the occupation, 199,000 hectares were cultivated. In general, 1.7 million hectares were occupied by Armenia. At present, as a result of the return of these territories to Azerbaijan as a result of the Second Karabakh War, it will be possible to process and produce agricultural and industrial products in those territories. Thus, it will create new jobs for people returning to their homes. It is a fact that during the occupation of these territories, the Armenian side carried out illegal activities in these territories and exploited these territories for agricultural purposes (İbrahimov R., 2021). On 1 December of the year 2020, President of Azerbaijan İlham Aliyev announced the fact that Armenia was engaged in wheat production on 10,000 hectares in Agdam, Zangilan, Fuzuli and Jabrayil regions and annually produced 90,000 tons of wheat in the occupied territories, and only wheat produced a considerable amount of production on its territory, a total of 100,000 tons in just one year (<https://president.az/az/articles/view/48205> , 2020). So, this fact proves how productive the Karabakh region is. Thus, it is the application of the AIS in the region that can increase the productivity of the region's lands and increase the productivity of the products grown here.

3. Income growth and poverty reduction – The introduction of new systems and technologies in agriculture will not only increase productivity in this area but also increase income and profitability. That is, there is a correlation between productivity and income, that is if more products are grown and sold, then the income of agriculturists increases. The increase in income from innovations in agriculture will also increase the level of social welfare and reduce poverty among the population. Most people displaced by the war lived in poverty in the early years, but the government provided various assistance to improve the living conditions of IDPs. During 1993-2018, the government spent 7.1 billion manat to address the social problems of IDPs, and during these years the shelter conditions of approximately 300,000 IDPs improved.

Thus, as a result of assistance provided by the Azerbaijani government to IDPs, the poverty rate among IDPs has dropped from 75 percent to 12 percent (Zeynalova Z., 2020). Even after the great victory, the return of these people to their lands and the introduction of various innovation systems in agriculture will further reduce this level of poverty. Thus, an increase in the level of welfare and a reduction in poverty will lead to an increase in the living standards of the population, which in turn will lead to an increase in demand for industrial goods.

4. Industrial expansion - The rise of the agricultural sector resulted in the industrial sector expanding as well. It's known that agriculture is a large industry. It has the potential to enhance the growth of the industrial economy so that major industries rely on agricultural raw materials. Agricultural and industrial sectors have a strong connection in the expansion and growth procedure. It has assisted in the process of industrialization in developed states by accumulating wealth, manpower, and raw materials through previous agricultural development. The introduction of the AIS in the Karabakh region will also lead to the expansion and further development of agriculture, which will increase the production of raw materials, which in turn will allow the opening, development, and further expansion of key industries in Karabakh. As we know, tobacco, viticulture, fruit growing and silkworm breeding, which are the main fields of agriculture in the Karabakh region, are very widespread. Therefore, the development of tobacco, juice, wine and clothing industries in the region will be beneficial for the region. The development of livestock in the direction of wool can also create conditions for the development and growth of carpet-weaving. When farmers also have money saved up, they can purchase consumer products and invest in businesses. As a consequence, the industrial sector expands indirectly. Attracting private investment to the region as a result of agricultural development will also play a role in the development and expansion of various industries.

5. Attracting foreign direct investment (FDI) - The introduction of new technologies and innovations in the region and, as a result, the development observed

in the field of agriculture can attract not only local but also foreign investors and allow foreign investment to flow into the region. In particular, it may be possible to attract investment from countries where AIS is better applied. In any case, the attraction of foreign investment is necessary for the development of the Karabakh region, and this policy can be realized through the introduction of a new system in agriculture in the region. During the occupation, the Armenian government engaged in illegal activities by attracting foreign companies to the region, but after the liberation of the Karabakh region, our country has already been able to carry out this activity legally. According to the State Statistics Committee in 2020, the total amount of foreign investment in the overall economy of Azerbaijan amounted to \$ 6125.4 million (<https://www.stat.gov.az/source/finance/>, 2020). The small share of the agricultural sector here makes it possible to apply the new system in the field. Most of foreign direct investment in Azerbaijan is in the oil and gas sector. Therefore, our main goal in the coming years should be to direct this direction to the non-oil sector, especially agriculture.

6. Foreign exchange supply - Agriculture may make a significant contribution to foreign currency earnings through exporting agricultural products. The application of new technologies and systems in agriculture can increase productivity as well as agricultural exports to foreign countries. The application of the system to the Karabakh region has the ability to provide the local market as a result of the development of agriculture in the region, as well as to export products to world markets, and thus contribute to increasing the country's foreign exchange reserves.

7. Capital formation - The economic development of less developing and developing states necessitates a large quantity of capital. Agriculture provides a substantial source of capital generation in the early phases of economic development. Highways, marketplace facilities, warehousing, transit railroads, postal services, as well as other infrastructures are needed for the development of the agricultural sector, which creates demand for industrial goods and the commercial sector. In addition, the

introduction of a new system in agriculture and the resulting development can accelerate the opening of new industrial enterprises. The opening of new industrial enterprises will, of course, create additional capital for country.

Thus, the application of the AIS in the Karabakh region takes into account the above factors for its economic development. In addition to the above factors, if the AIS is implemented in the Karabakh region, it can benefit from other regions and be provided with more affordable food, as well as the introduction of this new system can create environmentally friendly opportunities for the region. As a result, it is clear from the above explanations in the economic development of the countries and regions of the agricultural system and the new systems applied to it.

3.3. Suggestions for a Better Agricultural Sector of Karabakh Region

For the world to be a better place, some areas need to be given more attention, and those areas need to be at the forefront. These are mainly to protect the environment, develop agriculture, develop education and always be open to innovation and digital technology. The world's population is growing and growing, and by 2050 the world's population is projected to reach 9.7 billion. In addition, more serious problems in the world have recently intensified, such as climate change, soil erosion, over-irrigation, and unbalanced fertilizer application, etc., which reduce agricultural productivity and reduce production. These problems make it difficult to meet the growing food demand of the world's prestige. The reduction of water resources in the world also exacerbates these problems. For this reason, the process of digitization and innovation in agriculture must be further strengthened.

Applications and methods used in countries around the world, such as Smart Agriculture, Smart Irrigation, Smart Fertilization, E-Agriculture, the AI applied to agriculture, etc., show that in countries where these applications and methods are implemented, the digitalization of agriculture and special attention is paid to the gradual transition of everything to an automatic system. This process is faster and more

implemented in developed countries. In developing countries, this process began after the first decades of the 21st century. The application of this system in Azerbaijan, especially in the Karabakh region, can be considered more important. Thus, the application of this system can be considered in the Karabakh region for the current period. New innovation systems must be created and implemented in the region to fill the gap that has been created for almost 30 years in all sectors, including the agricultural sector of the Karabakh region. One of the best ways to implement the AIS approach to the revival of agriculture in the Karabakh region may be to rely on the experience of world countries, that have developed the agricultural sector. However, in the Karabakh region, as in any other country and region, certain aspects and proposals must be taken into account before implementing the AIS.

A number of proposals need to be considered before implementing the AIS for a better agricultural sector in the Karabakh region.

1. The establishment of the Agricultural Innovation Center by state for the implementation of the AIS in the Karabakh region may be one of the main priorities. For the establishment of AIS in the country, the state must form an infrastructure, and this center must act as an institution for the implementation of AIS in our country. This body should analyze the proposed applications and create an environment for the application of AIS accordingly. The center can also provide some assistance to agricultural producers and farmers to develop and expand their businesses. For this purpose, the Agricultural Innovation Center will be divided into certain small service offices. These service offices will provide the following services.

- *Financial advisory services* - The Center may provide financial advisory services to farmers and agricultural producers for the development, expansion, and recognition of their business in the local and foreign markets (such as advertising costs). For these services, the Center will have specialists with specialized financial knowledge. For example, an agricultural producer with 100 hectares of arable land can use this service to find out whether the product he will get about 2 weeks before harvest

will bring more profit from the local or foreign market, and as a result, the center's specialists will make forecasts to the manufacturer by searching for and obtaining information on prices, advantages and disadvantages of foreign or local markets.

- *R&D services* - Through these services, farmers and agricultural producers can anticipate a new system or application that they will apply to their businesses (such as crop fields or livestock businesses). Of course, the center will have its own small experiments, and the applications submitted to the center for research will be able to make predictions about the applications submitted in these small experiments, or in other words, what other nuances should be considered in the development of the application. A team of specialists in the field of agriculture will work to conduct the experiments.

- *Legal services* - Agricultural producers and farmers can solve legal issues of their business through experienced legal experts. This includes the documentation process, court, and customs issues (only parts of documentation).

- *Logistics services* - Through logistics services, agricultural producers and farmers will be able to export their products to foreign countries more quickly and conveniently. It should play the role of the number one logistics service office in the region, which exports quickly and easily to foreign countries.

2. Young scientists should be trained, and research centers should be established. These are one of the main conditions for better agriculture in the Karabakh region. Nationwide, purely agricultural and technology educational institutions and research centers should be established. Existing educational institutions should open exclusively in agricultural specialties, and even vocational schools should increase their activities in this area. In addition, vocational schools should be provided with new modern equipment and the number of practical classes should be increased. Syllabuses of new agricultural specialties created in universities should be prepared by taking samples from the syllabuses of universities developed in this field. The establishment of Karabakh University in the region should also serve this purpose. Special strategies

and policies should be developed to increase the enthusiasm of young scientists in our country, as well as the interest and enthusiasm of young people for research in agriculture, science, and technology. For example, incentive programs may be provided such as sending to foreign countries for training for a certain period of time, participation in international online courses (free or with special discounts), paid internship programs in foreign companies, membership fee for global scientific conferences or international scientific journals, visa support for vacations, annual awards based on performance indicators, etc. As a result of the occupation of 20 percent of Azerbaijan's lands by the Armenian state, 850 educational institutions were left in the Karabakh region (Valiyev J., 2008). For this reason, this policy should be given more attention, especially in the Karabakh region. For example, the UK's recent commitment to agriculture and innovation systems projects is due to its support for research, education, and training in agriculture, science, and technology. The government of the UK spent 450 million euros on research in the agricultural and food sectors in 2011-2012 alone. In addition, the UK has the N8 Agrifood platform, created by a combination of the country's eight leading universities (including Lancaster, Durham, York, Leeds, Manchester, Liverpool, Sheffield, and Newcastle). The platform employs more than 450 researchers and more than 150 students and has a budget of 269 million pounds.

3. Financial support for new innovation systems or imported systems is essential for the development of agriculture. In order to have financial support, a certain budget must first be allocated for the system to be implemented. This budget system may also be possible through certain investments or funds. Financial support should be given not only to agriculture but also to the development of science and technology. Because it is in this area that innovations can be applied to agriculture due to growth and innovation. For example, financing of foreign credit organizations operating in the country, allocations from the state budget, SOFAZ's budget, private investments, donations and grants can be used as financial support to the Karabakh region. It's fact that after the victory, the interest of foreign investors in the Karabakh

region has increased, and it can be seen that foreign countries, international organizations, as well as representatives of large and medium-sized businesses are interested in participating in post-conflict building (<https://ereforms.gov.az> , 2020). Thus, 2.2 billion manat has been allocated from the 2022 budget to rehabilitate the region. Let's take an example from around the world, a 2016 report by DEFRA, one of the UK's leading organizations, said the country spent 250 million pounds on agricultural technology in 2015. Due to these costs, the yield per hectare of wheat production in the country increased from 7 to 8 tons. In addition, the state must provide financial support to agricultural producers and farmers. These include various types of subsidies, exemptions from certain types of taxes, the fact that certain types of services are free for agricultural producers, various benefits, etc. In the United States, for example, the government provides various support (training, free aid, etc.) to agricultural producers so that they can use agricultural technology.

4. Different regional agricultural growth strategies need to be applied in different regions. The main purpose of such regional growth strategies is to increase productivity and further develop the agricultural sector. As we know, only 11 out of 14 districts in the Karabakh region were occupied by Armenians, and some parts of Fuzuli and Agdam districts were occupied. Thirty years later, those districts were liberated with a great victory. For example, since some Fuzuli and Agdam districts are occupied, they should be treated differently from other districts, or different growth strategies should be applied to them, taking into account soil fertility, distance from other regions of the country, levels of military waste pollution, mountainous and lowland areas, etc. Also, as noted in the study, the Armenians exploited the occupied territories in various ways, using the territories of Aghdam, Jabrayil, Fuzuli and Zangilan regions for wheat production. This fact raises the issue of different regional development strategies in such liberated regions. In Morocco, for example, the growth strategies are based on soil fertility, market proximity, and irrigation systems, and there are more small and

medium-sized businesses and agribusinesses in these areas than in areas with poor roads, low fertility, and remote areas.

5. Access to foreign and international markets and constant access to technology and innovation should be among the primary goals for better agriculture. Access to foreign and international markets allows it to be recognized both by the sale of products and finance, as well as by working in a foreign market under one brand, for example, “Made in Karabakh” and “Made in Azerbaijan”. The fact that the Karabakh region borders Iran and has access to Turkey through the Zangazur corridor and to the European space through the Turkish market promises great opportunities for the region's agriculture. As a result, the country's and the region's agriculture is further developed. With the help of these accesses, we can both increase the export potential of agricultural products, as well as become aware of the new technologies applied by foreign countries in agriculture and apply these practices in the region. Being open to technology and innovation allows us to keep up with the times, apply the latest systems and technologies in agriculture, and as a result increase productivity and facilitate the work of some farmers. Thus, the Karabakh region can be a gateway for our country's easy access to Europe.

Thus, as can be seen from the above suggestions, in order to bring the agricultural system of a region or country to a better place, it is necessary to start with the development of education, science, and technology within it. Of course, the availability of certain financial support in this area will help speed up the process. Establishing certain growth strategies, as well as market access and openness to innovation, will help the agricultural sector to further develop and keep pace with the global world. In addition to the AIS, the application of the above-mentioned aspects in order to revive the agriculture and, at the same time, the economy of the liberated Karabakh region will open a new page in the life of the region.

CONCLUSIONS AND RECOMMENDATIONS

The liberation of the Karabakh region from occupation after 30 years has set a number of goals for our state as a country. According to him, the restoration of agriculture and the reconstruction of infrastructure in the region are among the main goals. According to the results of the research, the introduction of a new system in the field of agriculture in the Karabakh region and the prospects that this application will create play an important role in the agriculture of the region, as well as in the development and revival of the economy. Based on the results of the study, we can say that a number of nuances need to be taken into account for the application of the AIS approach in the Karabakh region as a developing country.

- The Karabakh region has been under occupation for 30 years and its agricultural infrastructure has been completely destroyed. Therefore, in order to apply a new system approach to agriculture in the region, it is important to analyze in detail its strengths and weaknesses in this area.

- When applying a new system to the Karabakh region, one of the key factors is to have detailed information about the system, such as a detailed analysis of the region's agriculture. That is, just as there are pros and cons to the area in which the system will be applied, there are certain limitations and strengths of the system to be applied. Therefore, a detailed study of the system based on the experience of countries around the world is an important nuance.

- It is one of the main facts that the districts of the Karabakh region have been exploited by Armenians to varying degrees for 30 years. Based on this fact, the creation of a strategy for the analysis of the districts of the region and the application of a new system in accordance with the results of this strategy are among the nuances that must be taken into account.

- The damage inflicted on the territory of the Karabakh region for 30 years must be taken into account in the application of the new system approach. This includes

the contamination of lands with military and explosive ammunition, the complete destruction of vegetation in some areas, the extensive damage to the ecological situation, flora and fauna of the region for 30 years, and so on. can be attributed. Thus, the restoration and development of this entire system is possible only in the long run. Therefore, the application of the new system in the area should be considered in the long run.

- The war in the region for 30 years, as well as the ongoing provocations of Armenians during the ceasefire period, have led to the displacement of the local population as refugees and internally displaced persons. Even after the liberation of the lands, the planning and implementation of a major return by the country is one of the issues to be realized in the long run. In general, human capital is an important factor in the application of a particular system. For this reason, the workforce and the local population are of great importance for the implementation of the new system and its application to the daily economy.

- The occupation of the Karabakh region for 30 years and the displacement of the local population from their homes have led to a decline in their traditional agricultural skills. Also, given that the system to be applied in the region will be the first in the country, the lack of knowledge of the population about this new system is one of the nuances to be taken into account in the application of the AIS approach.

In general, the following proposals should be taken into account for the application of AIS in the Karabakh region:

- A competent body should be established for the implementation of AIS and should work in this direction.
- The theoretical and practical significance of AIS for the application of agriculture in the region should be studied.
- The region and its agriculture must be studied in detail before applying AIS.

- In order to implement the new system, the population must be taught new knowledge and skills, and relevant trainings must be organized in this area.
- Citizens studying abroad in the fields of technology, agriculture, digitalization and innovation, as well as working in these fields should be involved in the country, especially in the Karabakh region, with appropriate incentive programs and a kind of potential should be formed for the application of the new system.
- Before the system can be implemented, its mechanism must be established and tested.
- A special budget should be allocated in this area and appropriate financial support should be provided.

Taking into account all these factors and recommendations, the application of AIS in the Karabakh region and the opportunities and prospects it will create in the economic development of the region will serve as an example not only for other regions of our country, but also worldwide.

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