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Strengthening agricultural extension services in rural Uzbekistan: opportunities and alternatives

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Abstract

The recent set of reforms in Uzbekistan extends the commercial scope of agricultural production, provides more space for farmers to produce crops of their choice, and opens markets for trading. However, agriculture requires knowledge and skillsets from farmers to understand the basic concepts necessary for better productivity; these include water management, entomology, and crop science. Also, advances in machinery have expanded the scale, speed, and productivity of farm equipment, leading to more efficient land cultivation. This requires everyone involved to be well versed in technological advancements and backed up by a sustainable infrastructure.

The current state of extension services in Uzbekistan is not sufficient to support both the increasing production of the sector and address the challenges it will face in the near future. Therefore, fresh approaches are needed, and new types of extension service must be built up, based on both public and private initiatives. The use of innovative methods such as ICT based extension services could help to improve long-term and high performing agricultural extension services. Most farmers usually lack such skills and are prepared to purchase such expertise in the market. Yet, the current agricultural services market does not have a strong extension services component.

In this paper, the authors discuss agricultural extension services, the role of research in the sector, and the current state of research and extension services in Uzbekistan. The authors suggest supporting new alternatives to the currently diverse extension services system. Increasingly digital, commercially driven, supply-based extension services would be more durable and affordable for rural Uzbekistan. Offering incentives and support to the private sector players will bring quicker and more long-term solutions to the development of extension services.

Key words: agriculture, extension services, Uzbekistan

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Introduction

The way in which land and other natural resources are used and how this changes over time pervades society and economies, affecting human wellbeing, the performance of both economic and ecological systems, and food security. Demographic projections suggest that by 2050 there will be 9 billion people on Earth. So the demand for food will increase in the face of not only growing consumption, but also owing to the increasing use of crops for alternative purposes, such as fuel production.

On the supply side of the equation, food production and the agriculture sector overall will be affected by augmenting climate change impacts, dwindling water resources, land and biodiversity degradation, and so forth. Uzbekistan is one of the most vulnerable countries to these challenges owing to its expanding agricultural economy, increasing population, and the growing impact of global warming. Its agriculture sector in particular is more exposed to these challenges; it is vital for decision makers and practitioners of the country to confront them through concrete adaptation measures.

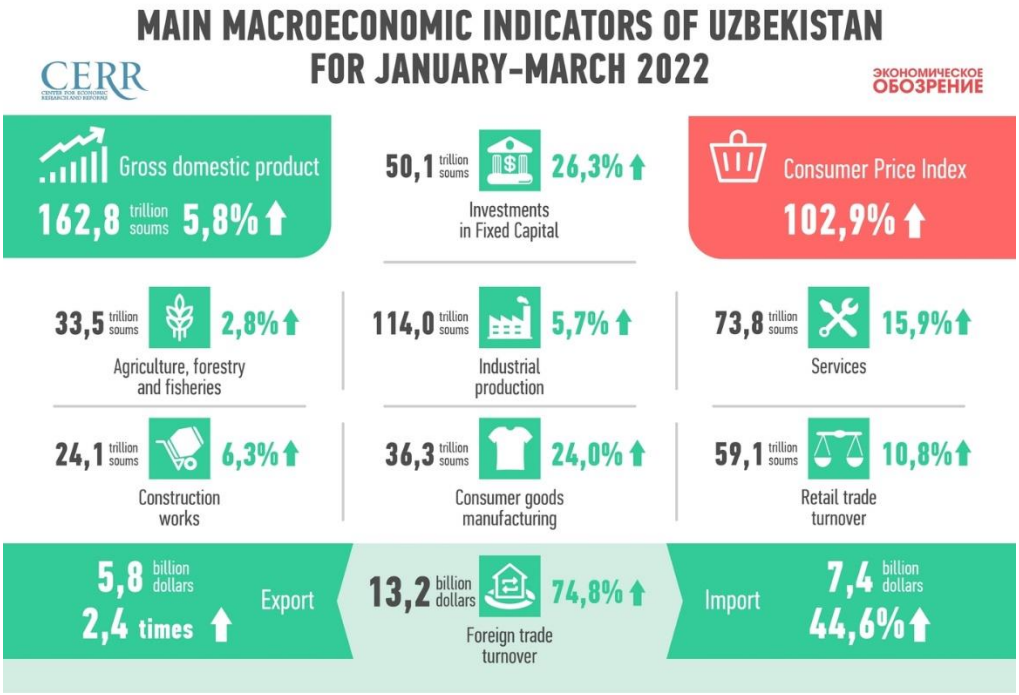
Uzbekistan is the largest country in the Central Asian region (demographically). It has the largest irrigated area of above 4 million hectares and a population of 36 million. Uzbekistan is a downstream country and depends on its upstream neighbors for the release of water in summer months, mainly for irrigation to aid the crop-growing period. The country has a well-established agriculture and water governance and management system, focused on the production of agricultural commodities for both internal and international markets. The country borders with the Central Asian states of the former Soviet Union and Afghanistan (Figure 1).

Figure 1. Map of Uzbekistan

Source: uzbekistan-political-map.jpg (1200×891) (nationsonline.org)

Agriculture and the food industry is an important contributor to and the main driver of Uzbekistan's economy. It provides over 40 percent of GDP and employs over 30 percent (estimated 4.2 million people) of the labor force (Ministry of Agriculture 2020). In the context of the latest reforms, the country is shifting to higher value fruit and vegetables from its longtime main crops—cotton and grain. To continue further the intended reforms in the agriculture sector, Uzbekistan switched to market prices from 1 June 2022, when trading with grain. This was also driven to a large extent by a steep rise in global wheat and food prices this year against the backdrop of geopolitical tensions. Moreover, Uzbekistan has improved most of its macroeconomic indicators during the post-COVID period (Figure 2).

Figure 2. Economic indicators of Uzbekistan



Source: www.cer.uz

Yet, over the past three years, disruptions provoked by political, economic, financial, environmental, and health-related developments caused even greater uncertainty to all parts of the economy, including the agriculture sector. Knowledge-based response measures and capacity building can enhance the resilience of Uzbekistan's agriculture sector to such crises in the future.

Not only during the crisis, but in times of increasing resource scarcity, it is critical that knowledge is disseminated effectively into the communities of practice across all dimensions of the economy. To improve the way in which the agriculture sector functions, knowledge and its practical application is a critical resource to enable farmers and active agricultural businesses to thrive through a challenging period.

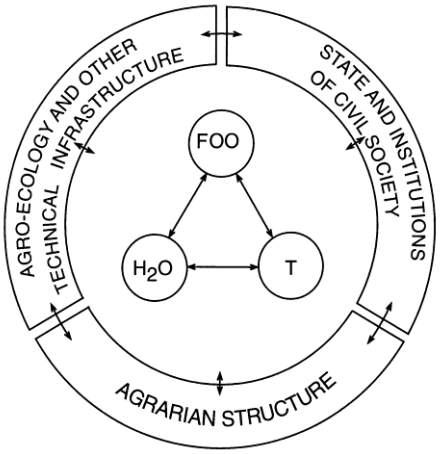
Research findings revealed that knowledge transfer can be successful only by involving the recipients in the generation of research questions and studies, ensuring communication mechanisms are adapted to the absorptive capacity of users, and by developing a trusting relationship with the users (Szulanski 1995). Hence, collaborative engagement between diverse stakeholders in generating and disseminating usable knowledge is important in aiding knowledge transfer. The provision of extension services—for a long time ignored and limited in Uzbekistan—is critical to keep agriculture practitioners abreast of new and innovative developments in the sector.

This study has two main focus areas with several sections and subsections. First, the authors outline agricultural extension services and the role of research in the sector by bringing the best global examples and highlighting the main trends in this regard. Then, the focus turns to the current state of research and extension services in Uzbekistan and the viable options for change, considering the country's economic development indicators and development strategy.

Objective and methodology

The main objective of this research is to analyze and present agriculture extension services in Uzbekistan. The paper shows the major capabilities and capacity gaps in the provision of agricultural extension services and provides potential development options. The paper also discusses the institutional, economic, technological, and social aspects of successful extension services development in Uzbekistan. Moreover, the authors highlight the potential intervention areas for private players in extension services. The paper focuses on three important areas of extension services: the provision of water services, technical services, and financial services. Rural development depends on agro-ecology and technical infrastructure as much as on agrarian structure, the state, and institutions of civil society (Figure 3).

Figure 3. Main factors determining water sector development in irrigated areas



Source: Mollinga 2003

Rural development studies are key areas for major theories and concepts. The theory of transformation investigates four integrated aspects: (i) social reproduction, (ii) gaps and contradictions of reproduction, (iii) trajectories of unintended social change, and (iv) transformative strategies. Social reproduction shows the significance of obstacles to transformation. Gaps and contradictions clarify real possibilities of transformation. The trajectories specify the future of both obstacles and possibilities. The transformative strategies outline how to make changes/transformations.

In this research the authors applied the theory of transformation to understand ongoing changes in agriculture extension services and how they can be transformed into an effective, operational, and sustainable system. The authors reviewed the current system via the analysis of the statistical operational data, through a series of desk reviews, key informant interviews, and case study analysis. A review of research sources, literature, and statistics was conducted to shed light on both the current situation and the future development potential of agriculture extension services in Uzbekistan. A series of analysis of the agriculture research capacities of Uzbekistan was conducted by numerous international organizations (WB 2020, UNDP 2019, and so on). Based on these assessments, the authors developed further analysis of the situation and made recommendations on the future development of the viable extension services in Uzbekistan. A series of single and group interviews were conducted to collect more detailed information from end users and farmers.

In this study, based on the desk review, the authors use a metatype methodology to integrate, collate, and evaluate the pertinent research information from heterogeneous studies and databases. This methodology refers to the collation and integration of the findings of multiple studies and blending a large quantity of data to address the prespecified research intention. The authors employ the relevant data and information from various research institutes, think tanks, and international and

intergovernmental structures, including the World Bank, Asian Development Bank, FAO of the United Nations, UNECE, OECD, and the CAREC Institute.

Evolving role of agricultural extension services: global outlook

The economic development of most industrialized nations started with an agricultural transformation. When economic development takes place in rural areas, where the agriculture sector is critical for wellbeing of people and households, the economic changes can be profound with political, social, and environmental spillovers. **Agricultural transformations can unlock the potential to spur economic growth, poverty reduction, job creation and climate resilience, to name a few of its positive spillovers.** However, transformations are often complex and always need to be *au fait* with the latest research, innovation, and developments in the sector to be successful.

In the context of growing complexities fueled by augmenting climate impact, water scarcity, and exponential population growth, unlocking the full potential of the agriculture sector increasingly depends on the unique proprietary knowledge its stakeholders possess and how they support each other. Navigating the complexity of a transformation is invariably tough for governments themselves, even though they may prioritize agricultural investment and recognize how important it is to get right (McKinsey & Company 2017).

However, current global developments on agriculture and food are full of paradoxical points. Food production is higher than ever before, yet agricultural land is decreasing rapidly; the consumption capacity of the world is increasing at an unprecedented level, forecast to reach 9 billion by 2050. The shortfall between the amount of food produced today and the amount needed to feed everyone at scale tomorrow is growing. The augmenting global climate impact is pouring even more uncertainty into the sector. **Therefore, enhanced agriculture research and extension services is a powerful tool to mitigate the effects of the emerging and increasing challenges to the agriculture sector.**

In fact, advisory services, training, and extension initiatives play an important role in supporting green growth in agriculture and enabling farmers to meet new challenges, such as adopting environmentally sustainable farming practices and improving their competitiveness (OECD 2015). As they are dominant within the agriculture sector, farmers require adequate access to knowledge, information technology, and other necessary services to improve farming and stay abreast of the latest developments for enhancing productivity. It is crucial that they have the required knowledge and services as soon as possible to enable them to deal with existing and future challenges in the sector.

As Anderson & Feder (2004) state, **agriculture extension services are an important tool to transfer knowledge gained from research and the knowledge base to farmers, to advise and educate them about new technology and practices, and to stimulate desirable agricultural developments.** Indeed, agriculture extension services, as both a public and private commodity, help agriculture producers to meet demand and increase exponential growth in production gauged to industry requirements.

Historically, all industrial and technological developments and revolutions have knowledge as a fundamental driver. And, tomorrow's development could well be propelled by knowledge again. The challenges faced by the agriculture sector today will certainly intensify unless substantial countermeasures are put in place. Therefore, farmers need to increase efficiency and to specialize in the market, for which extension services remain a key policy tool. **A continuous wave of investment in agriculture research and extension services could revitalize productivity and unlock more growth, as long as the investment is deployed effectively.**

The World Economic Forum (2012) clearly demonstrates how agriculture is essential for sustainable development and economic growth in its New Vision for Agriculture (Figure 4). In fact, agriculture is an economic development driver and raises productivity, income, and employment, with broad effects across economic sectors.

Figure 4. The concept of new vision for agriculture by World Economic Forum

Source: WEF 2012

International experience of extension services—emerging ICT approaches

Sustainable agriculture production and food security are directly linked to the provision of agricultural extension services to producers; however, this is a costly and challenging process for many reasons. Firstly, users (producers) are scattered over large areas and difficult to reach (Nakasone & Torero 2016). Secondly, in a rural context, most needs or issues are local, therefore specific and tailored solutions are required in each case (Binswanger & Rosenzweig 1986). Moreover, common issues for large-scale initiatives, such as governance problems, also apply to large-scale extension services (Birner & Anderson 2007).

Globally, there are multiple types of agricultural extension service (Nakasone & Torero 2016). Based on this research the authors divided agricultural extension services into three categories: technology transfer, advisory, and facilitation (Table 1).

Table 1. Typologies of extension services worldwide

Technology transfer services Transfer of advice, knowledge, and information.	**Advisory services** Advice to farmers in relation to specific problems faced by them.	**Facilitation services** Support farmers to outline their own problems and develop their own solutions.

Source: Authors' own compilations

In agriculture, as in many other industries, data and connectivity are increasingly becoming a prerequisite to overcome the challenges of production. A wide application of the internet of things (IoT) in the sector could increase yields, improve the efficiency of water and other inputs, and build sustainability and resilience across agricultural value chains. Equally important to note is the potential opportunity to improve extension services to transfer knowledge and advice to farmers through technology.

In China, national TV and radio stations have specific agricultural channels that introduce agricultural technology, agricultural facilities, breeding and cultivation of crops, knowledge about pest control, as well as farming times and conditions in various places, and so on. Moreover, strong enterprises will take out loans to buy large agricultural machinery and equip them with operators; farmers could pay to use that equipment at a certain fee. The companies producing agricultural materials enjoy lower tax rates than the general manufacturing industry and no tax is imposed on agriculture, so farmers are exempt from paying tax. In this way, more capital could be attracted into the field of agriculture. The policy to transfer the right to use a lease for many years without changing property rights helps to form a large area of planting and also to foster intensive capacity. Private companies are given incentives to bring capital into agriculture, for which one does not only need to consider production technology and other issues, but also to establish a proper mechanism for production and marketing. For example, when selling agricultural products, some may be purchased at the state protected price, and the extra parts could be acquired at the (fluctuating) market price to stabilize the expectations when investing in production.

In comparison with traditional approaches, ICT application reduces the cost of delivering services and travel time and provides more regular and timely services to the agricultural producers (Baumüller 2012, Cole & Fernando 2012). ICT-based agricultural extension services include the use of SMS and other messengers, audio and video elements; and focuses on climate-related information, disease outbreaks, general farming advice, and other relevant information, as well as advice on marketing and other types of useful data (Aker et al 2016). Yet, to reap the full potential of ICT application and realize all intended objectives of agricultural transformation and enhancement of extension services, the sector will need to overcome the challenges to deploying advanced technology. This will require significant investment in human and infrastructure capital.

In Sri Lanka, agricultural extension services are organized into commodity sectors by the relevant ministries as well as crop and livestock research and development (R&D) institutes. The system has developed through the introduction of a training and visit system, devolution and fragmentation, an integrated agricultural extension approach, and is continuing to progress (Wanigasundera & Atapattu 2019). Yet, the government's ICT initiatives in agricultural extension services have been constrained by several factors, including poor computer literacy, limited internet access, and lack of support at scale provided by senior officials. Hence, reforms have been redirected on the expansion of agricultural extension human capital.

There is no single agency in Nepal that provides agricultural extension services in response to the needs of farmers. Based on their relevant capacity to deliver, the public sector extension service agency works mainly in association with NGOs, community-based organizations, cooperative societies, and the private sector. The work of NGOs and private sector institutions with government funding is a clear demonstration of the level of pluralism in agricultural extension services in Nepal (Uprety & Shivakoti 2019).

India has succeeded in decentralizing agricultural extension services. However, there is now a strong need for the increased involvement of institutions to monitor the delivery of extension services and hold extension functionaries accountable to the farmer (Babu & Sulaiman 2019).

Overall, recent research findings on the role of ICT in the provision of agricultural extension services highlighted positive trends. For example, weekly weather information helped farmers in Colombia to reduce the risk of crop losses by 7 percent (Camacho & Conover 2011). In Kenya, SMS-based advice on the farming cycle helped farmers increase crop yields by 11 percent (Casaburi et al 2019).

Agricultural research and extension services in Uzbekistan

The agriculture sector is an important pillar in the Uzbek economy. It is critical for ensuring food, social and economic security, and employment in the country (Table 2). Historically, Uzbekistan was home for settled, rural populations whose livelihoods depended on agriculture. The economic development of the ancient cities of Bukhara, Samarkand, Khiva, and many others depended on rural areas for agricultural products and food. This helped maintain self-sufficiency in food and agricultural commodities, eased both delivery and return of the products to rural areas. However, owing to the harsh climate, the regular deficit of water, and limited access to other inputs, the productivity of the agriculture sector was low in many areas of Uzbekistan until the mid-20th century (Abdullaev & Atabaeva 2012).

Table 2. Major economic indicators of the agriculture sector in Uzbekistan

Contribution into GDP	Job provisions	Taxes	Rural population
18-20%	30-35%	20%	54%

After the takeover of the region by Tsarist Russia and later by the communist system, agriculture became more of a production system, oriented to deliver the maximum volume of cotton for the central government. Hence, agriculture development became a major policy of the government, and intensive irrigation development and mechanization of production led to both an increase in production and an improvement of agrotechnical processes. The agriculture sector underwent a series of transformations, ultimately becoming a collective production system. The input delivery, agriculture operations, harvesting, trading, all became part of the state quota system for agriculture commodities (Pomfret 2019).

Agriculture reforms in independent Uzbekistan started in the 1990s, after the collapse of the Soviet system, largely consisting of the transition from a socialist legacy to a market-oriented system. As a result, agriculture reforms transformed the institutional structures of agriculture with new production patterns, including land reform, farm reorganization, irrigation and water management, price reform, and the development of market institutions. Another important change in the sector was reducing the role of the state in setting cropping quotas and regulations, and providing agricultural inputs. In the current economic system, agriculture still plays an important role in economic development and as a source of seasonal jobs; it functions as a social shock absorber, keeping almost 50 percent of Uzbekistan's population in rural settlements and contributing up to 20 percent of taxes (von Cramon-Taubadel & Hasanov 2021).

Global challenges such as the increasing volatility of food markets, the reduced productivity of agriculture owing to climate change, and the growing demand for food makes agriculture an even more important sector for arid (dry) Uzbekistan (CAREC Institute 2022). Therefore, sustainable agriculture development is a cornerstone of economic policy and a development agenda of Uzbekistan (GoUz 2021). In 2021, the Government of Uzbekistan (GoUz 2021) released a strategy of reforms in the agriculture sector, the main aim being to liberalize the production system, and to develop innovative and export-oriented agriculture with the provision of incentives on increased private investment into agriculture.

Historically in Uzbekistan all agriculture-related ministries (Ministries of Agriculture, Melioration and Water Resources) had their own research units, divisions, and separate research institutes. The major

function of these institutions was to equip agricultural producers with knowledge, methodologies, and relevant inputs to run their agricultural systems efficiently.

The recent reforms in the agriculture sector focused on increased productivity, provision of food security, and commercialization of the sector. The removal of almost all bureaucratic interference into the planning and running of agricultural activities resulted in increased crop production and exports. However, the implementation of effective agriculture sector policies also requires a supportive service sector to supply agriculture with all the required inputs, including innovative solutions and technologies. Since independence, the agriculture sector has experienced a lack of such appropriate support services (KPMG 2020).

The current state of agriculture development and challenges requires systematic and modern support systems to provide science-based, innovative, and localized knowledge to agriculture producers. Growing uncertainties both in the economy (price and demand fluctuations, market volatility) and in nature (climate change) makes agriculture a very challenging sector; therefore, decision making will require increased research. Integrated, multilevel, and practical agricultural research could reach both producers, financers, and policy makers in the agriculture sector to help address the challenges of agriculture development. Therefore, setting up an agriculture research system or reorganizing the existing system is the most important step in the further development of agriculture extension systems.

Uzbekistan has a historically developed network of national agricultural research system (NARS). These are numerous research institutes, experimental stations, and universities in the field of agriculture, conducting research on diverse aspects of agriculture development (WB 2020). The World Bank (2020) analyzed the current state of agricultural research in Uzbekistan within its ongoing 'Agriculture Modernization and Competitiveness' project. The findings of this preparatory report demonstrate the assessment of the research capacity of the 13 institutions participating in the project, covering diverse dimensions of agriculture research, as summarized in the SWOT analysis matrix (Table 3a). In spite of the established knowledge creation and management system in place, very little was done to integrate the latest technology and know-how into the sector. The sector suffers from outdated technical skills and limited investment, which overshadowed any opportunities arising while undermining the long history of research foundations in the sector. As shown in the matrix, there are weaknesses across all aspects including people, resources, systems, and procedures.

Table 3a. SWOT analysis of agriculture research in Uzbekistan

Strengths	Weaknesses
• Long history of research and strong research foundations • Suitable environment/broad variety of indigenous crops • Classical knowledge creation and knowledge management • Good cooperation between research, entrepreneur, and farmers • Good classical breeding program • Fertile land to support large production • Strong comparative advantage for horticultural and leguminous crop production • Relatively low labor costs • Established system of seed production (rice, wheat, and cotton) • Fairly good number of varieties released	• Weak cooperation and networking • Outdated technical skills • Insufficient investment for research • Few technical agriculture graduates coming for agriculture education system • Lack of knowledge about new technologies and advances in agriculture research • Inadequate number of trained manpower • Lack of laboratory equipment and consumables • Lack of farm research facilities • Lack of seed processing and storage facilities • Low quality propagation material being produced • Low quality testing of machinery, seeds, and other processed products • No involvement of private sector in research

Opportunities	Threats
• New techniques available to improve breeding, yield, product and process upgradation • Sophisticated laboratory equipment • Improved land preparation technologies • Improved irrigation technologies • Improved seed processing technologies • Improved nutrition management technologies • New pest management technologies • Reduction of post-harvest losses by advance harvesting technologies • Technological developments in subsidiary industries such as food, ICT, logistics • Relatively high share of local population located in rural areas • Improving foreign investments and increasing business environment • Growing local and regional demand • Ownership by the government	• Economic crises in the country • Decrease in donor interest • Little interest of youth in research sector • Political instability • Weather change, unpredictable weather patterns • Unstable/change in agriculture policy

Source: World Bank 2020

Table 3b. SWOT Analysis of agriculture research in Uzbekistan

STRENGTHS	• Long and rich history of agricultural research • Emerging and dynamic private sector in agriculture • Current reforms in higher education and research • High demand from commercial producers for agricultural services, including on extension
WEAKNESSES	• Still highly regulated agricultural systems • Serious disconnection between agricultural research, agricultural production, and markets • Scattered and uncoordinated institutional setting for agricultural research and services
OPPORTUNITIES	• Interest and increasing demand for food and agriculture products of Uzbekistan, Central Asia from potential markets including the EU, China, and Russia
THREATS	• Reduced support to agricultural sector from government, banks, and potential investors • Crisis or conflicts • Downturn of agricultural reforms

Source: Authors' assessment

Existing capacity and systemic issues in the sector can be correlated to the level of public financing for agricultural knowledge and innovations (Table 4). The state budget allocated no financing towards agricultural advisory services from 2017 to 2020. The financing received for agricultural education and agricultural research constitutes a very little share of the overall agricultural public expenditures for those years. Considering the sector's contribution to the economy and the overall GDP of the country, this share could be increased to advance productivity. Increased financing could also improve the functional composition of the overall agricultural public expenditure, defining expense objectives more clearly, which would give more favorable returns.

Table 4. Public expenditure for agricultural knowledge and innovations in Uzbekistan, 2017-2020, (billion soums)

	2017	2018	2019	2020
Agricultural education	401	379	587	269
Agricultural research	47	51	73	91
Agricultural advisory services	0	0	0	0
TOTAL	447	430	660	361
Share of overall agricultural public expenditure (%)	3.35	4.83	5.08	2.97
Share of annual GDP in respective years (%)	0.14	0.10	0.12	0.06

Source: World Bank 2021, https://stat.uz/en/, authors' estimations

Extension services in post-Soviet period in Uzbekistan

Extension services dating from the Soviet period were built around the agricultural economic system as part of the state's function. The network of the numerous research institutes with expertise in areas of agronomy, water, seeds, and other agricultural issues formed the backbone of these extension services. This network was complemented by the state's input provision companies—such as chemicals, fertilizers, and oil—which serviced the collective farms in exchange for the state quota for crops. This system was kept for at least the first decade after independence in almost all Central Asia countries. Uzbekistan has kept this system partially intact, with minimal changes.

Until 2016, Uzbekistan's agricultural policies were semi-state regulated and the provision of inputs and services were part of the state's functions for most agricultural producers (mainly cotton and wheat farming). However, since some of the agricultural producers were private, some services were also commercially available, such as fertilizer, seed, and other inputs.

Following the agricultural reforms during Uzbekistan's years of independence, the previous cooperative units operating on state-owned lands—*kolkhozes* and *sovkhozes*—were translated into individual farmers responsible for managing their own piece of land (Kazbekov & Qureshi 2011). Collective farming and state farming were the main forms of Soviet agriculture production. The collective land was used to produce agriculture products by an organized collective group (*kolkhoz*) or hired staff (*sovkhoz*).

Paradoxically, most of these farmers have diverse educational and professional backgrounds bearing no relation to the agriculture sector. For instance, former schoolteachers, doctors, police officers and so forth have become new farmers with limited knowledge of sustainable and better farming, all of whom desperately need technical advice. If the previous system had its own specialists at their disposal, individual farmers now have no backstop support team with technical insights.

While these difficulties have amplified the existing challenges of productivity and sustainability of the sector, they have also resulted in new issues affecting the state of advisory services for the sector (Kazbekov & Qureshi 2011):

- Decoupling research from practice;
- Limited state support for extension services;
- Farmers have no access to or understanding of donor-driven extension services.

The recent changes in agriculture led to a serious reduction of the government's role in agriculture support, including provision of inputs, technological and mechanical advice, and scientific recommendations. The former state-provided agriculture support systems, located in each district center, disappeared or became bankrupt owing to the stepwise removal of the subsidies. As a result, farming systems started to rely on either self-developed networks or semi-commercial/semi-state or

locally based support systems. However, these systems were poorly developed and insufficient to take care of the growing demand from the newly emerging agriculture producers (Table 5).

Table 5. Typology of agriculture producers in Uzbekistan

Typology	Major indicators	Production system	Need for services
Farmers	Land lease for 49 years, with land sizes from 20-200 ha, major crops are cotton, wheat	Commercial production, major crops, orchards, and livestock farming	Marketing Agricultural Water Crop protection Transport
Dekhkan	Ownership for life with transferable rights	Both for household, commercial production, mostly vegetable and orchard farming, with limited number of livestock farming	Agriculture Water Crop protection
Smallholders, family plots	Owned by families with inheritance and selling rights	Mostly for household consumption and local markets	Crop protection

Agricultural research is the key service for the development of viable and adaptive agriculture. According to the World Bank's recent assessment (WB 2021), investment into R&D in the agricultural sector of Uzbekistan is 0.02 percent on average—much lower than the 1 percent for middle income countries and 2.5 percent for high income countries. Therefore, increasing the financing for R&D, alongside the appropriate market arrangements for agricultural production, is the best way to escalate the demand for extension services and its applications. Uzbekistan is at an early stage of a series of agricultural reforms; these could help to transform agriculture into a well-functioning industry with high output, and a productive and resilient sector. The efforts should focus on the following aims:
(i) availability of quality agricultural services designed to advance on-farm productivity, increasing resilience to climate change, and improving overall output quality; (ii) improve value chains, farm cooperation, and access to necessary financial products; (iii) organization of agricultural trade and marketing through enhanced agro-logistics, with improved phytosanitary capacity and access to market information.

The majority of agricultural R&D in Uzbekistan is carried out by 45 research institutes, research stations, and university research laboratories. New and emerging seed, input, and other agricultural companies in Uzbekistan provide agriculture extension services on a limited scale and scope. An agricultural extension service should offer technical advice, and agronomic techniques and skills to improve agricultural productivity for farmers/clusters and supply the necessary inputs and services to support production. It should provide scientific research and data-analyzed information to farmers and convey new ideas developed by agricultural research stations.

Illustration of selected extension needs

Soil quality plays a key role in successful farming, which is affected by water and essential nutrients to crops. The combination of healthy soil with the appropriate amount of water and sunlight is an important productivity factor in meeting yield quotas for the season. Enhanced soil management protects and enhances soil performance, by reducing input costs, preventing its pollution, and improving overall crop quality. Soil has to be checked for quality before planting, as its physical condition affects the root growth of the crop, which in turn determines whether the crop growth will be rapid and successful. Even through each crop has different soil requirements, there are a few common practices that can encourage healthy soil biology.

Soil is characterized as an organic matter consisting of all small living soil organisms and the previously living organisms in their various degrees of decomposition, fresh plant residues, decomposing (active) organic matter, and stable organic matter (humus) as its primary parts. Soil organic matter content has to be tested in a laboratory in order to adjust fertilizer recommendations and provide estimates for nitrogen, phosphorus and sulfur mineralized levels available for crop production. As there is a strong link between soil organic matter and soil quality, soil organic matter is an important factor in maintaining sustainable agriculture practices. To maintain good practices for sustainable soil management, it is essential that farmers regularly conduct soil analysis. By testing soil, farmers can see the exact amount of nutrients, the humus content, and its pH value. As per the analysis of the content of nutrients in the soil and the crop requirements, it is possible to determine the necessary amount of fertilizer to achieve higher yields and better fruit or vegetable quality.

In the analysis, soil tillage is the first important activity. As this has a direct impact on the quality and final yield, proper tillage has to be carried out in the first place. The preparation of soil for crop growing starts with a soil tillage plan. During the crop production process, farmers perform several types of soil tillage, including plowing, disking, and rolling. The application of these depends on the product type, the condition of the soil, the crop to be planted, and the farm practices. Throughout the process, good soil drainage, aeration, and optimum humidity for plants have to be ensured in order to achieve the best effect. Limited drainage may cause the accumulation of higher amounts of water in the soil than needed, negatively affecting plant growth. In areas where water is limited, placing irrigation equipment is crucial. Immediately after planting and during the first stages of crop growth, irrigation is an important farm practice. By following these practices, farmers can adjust the water levels according to the crop requirements. The extension entomologist can take samples of insects from the field, review the crop condition, and give the farmers/clusters useful and practical recommendations to control insects.

Water is one of the crucial and most limited resources for the agricultural sector in Uzbekistan. Almost 95 percent of agricultural output is produced in irrigated areas of the country. Therefore, a proper water supply and services are key for sustainable agriculture development. Currently, Uzbekistan uses around $47km^3$-$52km^3$ of water for the irrigation sector. Uzbekistan is a highly water dependent country from transboundary water resources that are highly vulnerable to climate impacts. According to the CAREC Institute (2022), water resources of the region will be affected by major climate impacts such as intensive melting of the glaciers, increased incidents of droughts and floods, and a high degree of water deficit. Therefore, without long-term, well thought out strategies on overcoming the climate impacts on water resources, Uzbekistan's agriculture sector may face serious water-related issues. Therefore, water services, such as the dissemination of water saving technologies, should be widely practiced.

Potential development paths for extension services

The current position of extension services is rather scattered and not linked around the whole system concept. Still, most of the services are public and funded/steered by the state. However, from 2000 the number of companies in the private segment offering different types of agricultural service started to grow (IAMO 2021).

Uzbekistan has launched an ambitious and large-scale ICT development strategy (lex.uz) that promotes a range of ICT transformations in the country. Particularly, improved digital services for the agriculture sector across rural and small towns are one of the cornerstones of these connectivity-driven changes. The wide application of and embracing these digital transformations is critical for overcoming increasing demand for food and yielding the necessary growth of the sector. Therefore, systematic and long-term strategy on **ICT based agriculture extension** services should help enhance capacities of both ICT companies and agriculture sector stakeholders, and open up new business potential for startups, companies that are interested in investing in and developing new agricultural ICT platforms.

Accumulating value from the growing portfolio of information technologies can indeed enable widespread changes in the agriculture sector. Different delivery channels, sensors, cameras, and other emerging technologies, and their application by farmers makes possible to develop **digital and visual extension services** such as short video information, audio materials, live-monitoring information and other types of visual extension support. Hence, the integration of technology can therefore help farmers in multiple ways.

For instance, it assists them with analytics to enable them to make crop and livestock management decisions, optimize their operations, reduce costs, and increase yields. Technology-enabled monitoring systems also allow farmers to detect signs of disease in crops and take immediate countermeasures. Moreover, ICT tools can enhance the efficiency of resource consumption in the agriculture sector. Improved extension services can provide these capital-intensive potential benefits of technology, yet they require the technical, human, and financial resources in the first place. Once long-term robust public policies are in place, providing these services can start to become a possibility.

However, some alternative activities can be realized in the shorter term, which can contribute to bigger sectoral changes. Setting up industrial and **agricultural parks** of large agricultural companies in rural areas, both for commercial advertising and extension services, is a viable alternative to extension services. Promoting their own products and providing post-sale services has the potential to bring more technology, knowledge, and extension services to agricultural producers. This also attracts private capital into agriculture.

The number of private and public universities in Uzbekistan is growing, including those with agricultural faculties. Therefore, supporting and encouraging new universities to set up their **field laboratories** in rural areas to conduct research and provide extension services could help to establish a network of independent scientific extension systems in rural Uzbekistan.

The implementation of these sectoral changes should be evaluated in national framework documents—first and foremost in the nation's agriculture strategy. However, more practical solutions—such as setting up service centers in rural areas for commercial companies, easy access to the high-speed internet, credit incentives, and tax reliefs—are also favorable conditions for the establishment of extension services.

Agriculture Strategy of Uzbekistan 2020-2030: extension services development

Uzbekistan's strategy to develop its agricultural sector 2020-2030 includes an assessment of the current state of extension services. The strategy highlights the agricultural producers' insufficient and inefficient coverage of extension services. Moreover, the strategy shows only the public nature of the current services; the absence of effective information sharing, training, and education of agricultural expertise points to cumbersome and limited extension services. The strategy also highlights the lack of private sector engagement in extension services.

The document aims to set up effective, modern, and holistic extension services for agriculture and food systems by improving the provision of information, capacity building, and education. In order to achieve these goals, agriculture science and research will need to be reformed. Agricultural education and training will be improved with support from IFIs. The review of state support of agricultural business will be audited to give a better insight into the strengths and weaknesses of the current system.

Also, the strategy underlines the establishment of the coordination center for information and consultations on ecologically safe and effective agriculture methods, and climate adaptive technologies. The consultancy center will be organized in the public–private partnership mode and the staff will be trained accordingly.

Although the strategy clearly indicates the shortcomings of the current system of extension services in Uzbekistan, it fails to provide an implementable roadmap for improving it. The objectives are clearly set out in theory but the practical steps to improve the services are not clear enough. The proposed increased role of private service providers requires serious amendments to agricultural policies in general. This goal can be achieved through genuine market reforms of the agriculture sector.

Conclusions and recommendations, policy lessons

The current situation regarding agricultural extension services in Uzbekistan is scattered, weak, and uncoordinated. Although the government is leading these efforts, private initiatives and companies are also emerging to cover numerous aspects of extension services. The scattered nature of the services, limited financing, an absence of up-to-date methodology, and a lack of trained staff mean that agriculture research systems in Uzbekistan are uncompetitive and unfit to take a key role in extension services for the agriculture sector. Providing incentives for the development of private sector efforts in extension services would seem to be the most logical intervention. However, the conceptual and strategic aspects of the development of extension services in Uzbekistan are still under discussion at policy level.

Unfortunately, the universities with the most to offer in terms of empirical and applied research are still a long way from reaching the extension service provision roles. Without systematic, well-furnished, and financed public or private extension services, agriculture in Uzbekistan will not be able to perform at its highest productivity. The continuous impact of climate change, as well as increased incidents of crop diseases and unplanned cropping may lead to regular failures of agriculture production. Stronger regulations, market incentives, and transparent, market-based interactions in agriculture will support the development of extension systems; however, the government's role in the production and promotion of the innovative knowledge is key to this process. The role of the private system could enhance the provision of high quality, demand-based services and keeping in touch with the everyday needs of producers.

The private sector must become a stronger and more viable player in the provision of different extension services. It already has a strong presence in the supply of seed and agrochemicals. However, the private sector could deal with much more than just supply issues. There is scope for the sector to play a stronger role in legal, agro-engineering, and crop protection issues. Current legal provisions are sufficient to organize private sector extension services. However, more incentives for private providers of extension services could help to increase their role and interest. In particular, supporting the numerous family producers—*dekhkan*—is a crucial part of improving the extension service provision for the agriculture sector.

Current developments in the ICT sector open up the potential for improving extension services on a large scale. IoT, new messengers, video applications, and other relevant technological services could easily pertain to the agricultural extension services in Uzbekistan. A variety of applications based on ICT platforms could both improve the productivity of existing services and help to build up a wider range of agricultural extension services.

The following is a set of practical recommendations for setting up more effective and viable extension services in Uzbekistan:

1. Increase the access of farmers to technology through education, and support the use of IT systems in rural areas, which will in turn help to develop IT-based extension services.

Increasing the access of farmers to technology through education is crucial for the development of agriculture in rural areas. Technology is a major driving force for transforming and improving farming practices, leading to increased productivity, profitability, and sustainability. Educating

farmers about technology and providing them with the necessary skills to use it effectively will enable them to explore and access new markets, improve their crop yields, and reduce production costs. In addition, supporting the use of IT systems in rural areas can help to develop IT-based extension services. By using IT systems, extension workers can reach a larger number of farmers at a lower cost, and provide real-time information and services. This will make it easier for farmers to access advice and support, and to take advantage of new technologies and ultimately achieve the maximum use of extension services.

2. Promote, support, and provide tax releases for universities to set up their network of field laboratories for conducting both field research and scientific extension services.

Field research and scientific extension services can help universities to better understand the local environment in which they operate and help them contribute knowledge and solutions to the community. Additionally, these laboratories also provide a platform for the development of new technologies and collaboration between universities, businesses, and local organizations. Ultimately, this can unlock the potential of universities to drive agricultural innovation and promote sustainable development that will advance agricultural extension services.

3. Promote and give financial support to agriculture supply companies to enable them to set up promotion and post-sale services in rural areas.

Promoting and supporting agriculture supply companies to set up promotion and post-sale services in rural areas can help farmers access the latest agricultural innovations and technologies to improve their yields and ultimately their livelihoods. Moreover, it can create employment opportunities in rural communities, which helps reduce rural–urban migration while retaining talent for the sector. Financial support for these supply companies also has a positive impact on the local economy, as it can stimulate economic growth in the agricultural sector.

4. Encourage private sector involvement through financial incentives for private agribusiness companies to set up/extend extension operations in rural areas.

Encouraging private sector involvement through financial incentives for agribusiness companies to set up or extend extension operations in rural areas is another effective way to strengthen agricultural productivity and promote rural development. It helps bridge the gap between agricultural knowledge and innovation and the rural farming communities who need it most. Incentivizing private companies to invest in and expand their extension services provides farmers with timely access to vital agricultural information and technologies, such as modern agricultural techniques, improved seeds, and high-quality fertilizers. This, in turn, boosts agricultural productivity, increases yields, and improves food security in rural areas. Furthermore, supporting private sector investments in rural areas helps create jobs and stimulate local economies.

It is important to indicate that extension services must be gender sensitive. Women play a crucial role in agricultural production, particularly in developing countries. Therefore, agricultural extension services may pay particular attention to gender dynamics in agricultural systems and ensure that extension services are designed to be gender-sensitive and inclusive. Other aspect is sustainability into extension service delivery: agricultural extension services should incorporate sustainability into their own operations, such as by using renewable energy sources, reducing waste, and promoting sustainable transportation options for staff.

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