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SUSTAINABLE INNOVATIONS IN AGRICULTURE: COMPLEX CHALLENGES IN THE INNOVATION SYSTEM

Abstract. Innovations in agriculture should help to cope with future challenges such as climate change or scarcity of resources. In addition, they are at the center of societal debates, such as those currently on genetic engineering or certain forms of animal husbandry. Among other things, the article provides information on the extent to which the causes of these conflicts are rooted in the framework conditions and in the course of innovation processes in agriculture. For this purpose, the innovation system of Kazakhstan agriculture will be examined from an innovation system-theoretical perspective and verified with empirical findings on innovation barriers. The innovations examined in three case studies each contribute to overcoming current challenges and are influenced by several factors in their development process: different technologies, diverse actors, connections to other sectors, overlapping framework conditions and current challenges as well as social discourses. The applied innovation system approach and the empirical investigation on several levels allow to gain insight into the interactions and thus to recognize starting points for changes. The high demands on innovations in agriculture and the social acceptance debates can be explained and solved from the perspective of the authors on the basis of the following aspects: (1) A prerequisite for innovation is the existence of a basis of trust. This arises in agriculture - and not only there - primarily in smaller, longer-term networks. (2) The success of innovation depends heavily on integrating societal demands into innovation processes, for example through the early involvement of trade and consumers. Beyond this balance of continuity and openness of agricultural innovation networks, the results raise questions about the (self-) understanding and design of the innovation system, the incentives and the design of interdisciplinary cooperation as well as the roles of the stakeholders.

Keywords: Agricultural innovation policy, innovation mechanism, precision farming, animal monitoring, energy in horticulture.

1. Introduction

In recent years, innovations in agriculture have been of great societal interest, such as the genetic engineering debate, the debate on animal husbandry, the use of bioenergy or discussions about "inferior" food quality through "industrial" production and manufacturing practices in agriculture and food industries [1,2]. In addition to such technology-related ethical debates, the ability of all actors in the agri-food sector to adapt to global challenges such as scarcity of resources, climate change, demographic change, biodiversity loss and others is becoming increasingly important and urgent. One possible approach to tackling these global challenges is seen in the knowledge-based bio-economy, which plays a key role in national and European research funding [3]. At the same time, research and politics around the world are increasingly focusing on the innovative capacity of agricultural systems [4].

While there is a wealth of statistical information about the economic structural features of the Kazakhstan agricultural sector, the innovation process is not sufficiently statistically mapped. The

Mannheim Innovation Panel, which is the central innovation survey and at the same time the Kazakhstan contribution to the European Innovation Survey, contains no statements on agriculture. In contrast, the statistics of expenditure on research and development (R & D) and of the R & D personnel of the Kazakhstan economy, which is created by the Government, shows the economic activity "agriculture and forestry, fishery". However, only if different performance indicators can be evaluated over a longer period of time can it be described retrospectively how the innovation system contributes to economic success [5]. However, Hall et al. for agricultural innovations noted that evaluating with only economic indicators is not expedient because decision-makers cannot derive conclusions for the institutional design of innovation conditions and innovation processes. Against the background of the difficult data situation and the current necessity to orient innovation conditions and processes in agriculture to the mastering of future challenges, this article describes the innovation process in Kazakhstan agriculture and analyzes mechanisms and influencing factors in innovation processes.

Malerba's Sectoral Innovation Systems approach provides the theoretical and methodological basis for the analysis [6]. It provides a comprehensive and systemic view of the actors, their relationships with each other and the framework conditions within which they are involved in innovation processes, and also allows qualitative analyzes if the corresponding quantitative (statistical) indicators are missing. The results of an innovation system analysis can thus provide information on the current competitiveness and innovation capacity of the sector and on the design of innovation conditions and processes.

At the same time, this comprehensive and context-specific perspective on innovation also allows a territorial and sectoral approach adapted to the study subject at various levels (national, regional) [7].

A peculiarity of agri-innovation systems is that they can be seen in the context of the respective agricultural policy paradigms. An example of this is the establishment of publicly funded advisory and testing services in the 1960s or the common agricultural policy (CAP). It can also be explained that the publicly funded part of the sector is sometimes considered to be the only relevant "system" and so far derived mainly for these intervention measures (World Bank 2006) [8]. These specific conditions of innovation in agriculture do not take into account Malerba's innovation system approach, in particular the specificities of the publicly-funded part of official advice and experimentation as an interface between science and practice. Furthermore, this approach does not provide any information on how innovation systems can be designed in the long term so that economic as well as ecological and social goals are taken into account [9,10]. Nevertheless, the international literature recognizes an added value of the innovation system approach for the discussion of the future design of the agricultural knowledge and innovation system and continues to be discussed [11].

Rakhimzhanova A. developed approaches to researching the innovation system of the Kazakhstan food industry and expanded it in 2010 by Eisner and Daniel for the food industry, including with regard to consumers. However, the entire Kazakhstan agricultural sector, including the upstream sector, is a "terra incognita" in recent innovation research. The aim of the article is therefore to analyze the innovation system of Kazakhstan agriculture and to explain the emergence of innovations in agriculture [12].

The paper begins with a theoretical part, in which the gap between innovation research in agriculture and other sectors is first closed by an adapted conceptual framework with four system levels (Section 2). The third section describes the methodological conception of three case studies - Precision Farming, Animal Monitoring and Energy in Horticulture. The fourth section presents the empirical findings. The fifth chapter discusses the results in the context of innovation systems research in general. By understanding the structures and modes of operation that constitute innovation, the last section provides guidance for adapting the agricultural innovation system to the future challenges of sustainable food supply.

2. Theoretical background for the study of agricultural innovation systems

With the innovation system approach, differences in innovation activity can be identified by means of a uniform analysis framework of the framework conditions. Malerba's Sectoral Innovation Systems Approach synthesizes scientific evidence from innovation research into a (normative) hypothesis on how innovation systems can ideally be designed. At the same time, it is a theoretical-empirically grounded heuristic analysis framework, but not a self-contained theory and does not provide any concrete

methodological guidelines for the analysis. Therefore, the system boundaries and the level at which innovation processes take place must first be defined [13].

First of all, it can not be assumed that agriculture is a coherent, closed innovation system. As a result of specialization and division of labor, there are different economic sectors (including plant and animal production, horticulture, viticulture) and technology approaches (such as agricultural technology, breeding, animal husbandry systems). These each form homogeneous subsystems, which in turn are each closely networked. Not only the individual company perspective, but the understanding of the sector as a complex system of different value chains is therefore helpful for the explanation of developments [14]. The central assumption is therefore that only the perspective on the value chains allows to adequately investigate innovation processes and to draw conclusions on how innovation processes can be improved in the sense of sustainable mastering of future global challenges and supported by appropriate funding instruments. The study thus conceptualizes value chains or networks as the arena and relevant system level on which the innovation processes take place, which are used to investigate innovation mechanisms.

The innovation system approach provides for analysis the six elements described below that need to be explored in innovation systems in order to make statements about its structures and interaction relationships.

1. Agents / Actors and Organizations. Here, existing organizational forms including their characteristics and key actors are analyzed and their characteristics are described. Actors are understood as individuals, groups and organizations at different levels of aggregation.

2. Interactions and Intermediaries. The focus of this sub-section is on market and non-market relations and actors' communication and their interaction within the sector and across sectors. These include exchange processes, competition, but also implicit or explicit collusion, hybrid forms of governance or formal research and development cooperation. Innovation intermediaries are organizations or groups within organizations that work to innovate.

3. Knowledge base and human capital. The element contains statements about sector-specific and cross-cutting knowledge. Factors such as the mobility of labor or the dissemination of knowledge come into play here.

4. Technologies and Demand Analysis of existing technological trends (products, services) and demand can shed light on which key development and future potentials can be expected for the sector and which problems require innovative solutions.

5. Institutions and Politics. This system element describes the implicit and explicit rules for the interactions of actors and organizations. These include, for example, laws, standards, but also behaviors or routines. Among other things, the actors of the innovation system agriculture are significantly influenced by the legal framework applicable to them, for example the sector-specific departmental policy.

6. Competition. The competitive situation in the field of innovation and the positioning of Kazakhstan y in international comparison are outlined. In general, the competitiveness of supply chains can be considered.

7. Innovation processes. This point is not listed in Malerba. Based on the question of how innovations are created in agriculture, this element has been added to the frame of reference by the authors. It allows an insight into innovation mechanisms, which makes it easier to recognize influence possibilities.

Most international studies on agricultural innovation systems do not relate to the innovation system approach. The literature has a large number of case studies that compare overarching conclusions and design statements [15].

It remains to note that (1) there is no universal method of analyzing innovation systems and (2) a methodology adapted to the specifics of the agriculture sector needs to be developed.

That's why the authors take the agriculture sector as a sub-sectoral industry. The subsystems differ in each case through specialization from each other and in them innovation processes take place in specialized networks / subsectors or fields of innovation. The sector as a whole (level 1, agriculture as a whole) is subdivided into the subsectors crop production, animal production and horticulture (level 2). Within these there are concrete innovation processes in socio-technological subsystems,

Value networks or innovation fields at level 3, using individual innovations (level 4). This multi-level approach secures connectivity with current innovation research, which assumes socio-technical niches and regimes as sites of innovation as sub-levels of sectoral innovation systems [16]. Figure 1 illustrates the

multilevel research approach presented here as part of the Sector Study to Investigate the Innovation System of Kazakhstan Agriculture.

3. Methodology

Creating quantitative indicators for describing innovation systems and evaluating innovation policies poses a problem for data availability, loss of meaning through aggregation, and economies of scale. This is why qualitative indicators are becoming increasingly important. Rogers also notes that innovation research is limited in its own meaningfulness by limiting itself to indicators and ignoring important aspects [17]. In particular, the process nature of individual decisions and the spread in the system are often too short in diffusion and adoption research. It is also problematic for the agricultural sector those individual areas of the value chain are assigned to other sectors (for example, chemicals, construction, trade, services) and that these industry statistics do not explicitly identify the relevant agricultural innovation figures. In order to generate insights into the development process of agricultural innovations, an explorative and process-oriented approach is necessary in addition to the analysis of secondary statistical indicators [18].

The first empirical step to investigate the agricultural innovation system was initially an expert workshop with 16 experts involved in various innovation processes from politics, associations, science and upstream areas such as banking and consulting. The workshop discussed the following issues: (a) how are innovations in agriculture, (b) what are promoting and inhibiting factors in the innovation process and (c) which fields of innovation are suitable for further investigation at level 3. The case studies to be examined should be as appropriate meet the following criteria:

• role model in tackling current challenges such as environment and resources, developing markets, social trends and ethics, food security,

• contributing to competitiveness, for example through increased efficiency, cost savings, new markets or niches,

• relevance to the labor market and value added, such as working conditions, jobs in agriculture and supply industries,

• the case studies should have been advanced by actors from Kazakhstan y in order to establish a connection to the innovation system of Kazakhstan agriculture,

• relevant significance for the innovation system of Kazakhstan agriculture, in particular with regard to economic, ecological and social sustainability dimensions.

On the basis of the presented criteria, of which as many as possible should be fulfilled, the authors were recommended by the experts to investigate the following case studies: Precision Farming, Animal Monitoring and Energy in Horticulture. The reasoning of the experts for this was that in these fields of innovation important aspects of agricultural innovation processes in Kazakhstan y can be traced and that they have a model character for the sector. For the processing of the selected case studies 15 expert interviews were conducted along the value chains [19]. The experts were identified according to their participation in innovation processes in the chosen innovation fields at different stages of the value chain.

4. Results

4.1. Secondary analysis of the total sector

The results of the analysis of various innovation-related indicators at the level of the overall sector point to an increasing importance of research and development in the Kazakhstan agricultural sector, albeit at a comparatively low level. For example, agricultural expenditure has risen slightly in recent years. In 2016, the volume of investment in fixed assets of agricultural enterprises increased by 51% and amounted to KZT 253 billion. The share of internal R & D expenditure in agriculture in the economy as a whole is from 2.4 percent in 2015 to 3.3 percent in 2016 as opposed to total declining R & D expenditure. In comparison to the economy as a whole, more R & D contracts are awarded to other companies or research institutions in agriculture. This indicates the actors' ability to work together in networks. The focus of R & D expenditure and the proportion of new product sales has been higher in the last five years than in any other sector, indicating increased innovation momentum, at least in the exploitable patent classes [20]. Despite the slight increase, however, it also becomes clear that the input variables for

agricultural innovation activities within the Kazakhstan economy, which are to be mapped with indicators, are of relatively low importance.

4.2 Expert workshop

The main findings of the expert workshop on the origin, promoting and inhibiting factors of innovations in agriculture with 16 experts from different areas of the agricultural innovation system can be summarized as follows:

• Innovations in agriculture are difficult to implement by individual actors.

• Dialogue, interdisciplinary networks and innovation partnerships along the value chain promote innovation.

• The promotion of innovation is sometimes not transparent enough, coupled with too many conditions, restricts entrepreneurial freedom and is perceived as inadequately coordinated with other policy instruments.

• A reliable funding structure and laws, especially in the early stages through pilot and demonstration projects, as well as the availability of venture capital are required.

• Federal structures in agricultural consultation, research and education make the emergence and spread of innovation more difficult.

• There is a lack of incentives for innovative and timely science thinking in the field of science that hinders innovation.

• A lack of social acceptance partially inhibits innovation.

• Entrepreneurship, solid education, competition, scarce resources and entrepreneurial freedom drive agricultural innovation.

According to the experts, the political framework would increasingly have to be aligned with other laws relating to innovation in order to take account of the systemic nature of innovations in agriculture and to avoid false incentives (for example in the bioenergy innovation field with energy legislation such as the EEG). A further assessment of the experts was that questions of social acceptance of agricultural innovations require a factual social discourse. Also, training and the fragmentation of agricultural research were named as determining innovation conditions in Kazakhstan.

4.3 Case Study Precision Farming (Subsector Crop Production)

Precision Farming (PF) can be defined as an information-led management concept that allows site-adapted and site-specific management in crop production using various technologies and applications. This involves both completely new solutions and technologies that come partly from other areas and have been recombined and developed for use in agriculture, for example Global Positioning System (GPS), a global navigation satellite system for position determination and time measurement or agriculture-specific mobile phone applications [21]. According to the interviewed experts, Precision Farming is "still at a very good idea stage" (interviewed expert 2011), which exists in the form of many individual innovations, but not yet as a complete system. The market penetration of the various PF technologies is estimated by some interviewed experts and in the literature with a general user rate of seven to ten percent in Kazakhstan. In particular, nitrogen fertilizer or crop protection technologies are the focus of demand, with the most widely used applications being land surveying, soil sampling, yield mapping and tracking systems. The main actors in innovation in this field of innovation have been the supply industry (mainly as an applied research and development provider), science (long-term, basic research), and agricultural businesses (users and demanders of innovations, prototype testers, field trials).

The arena within which Precision Farming is being developed consists of a manageable number of actors, among whom there are already numerous contacts and network structures. The experts emphasize the basis of trust that is often created through joint projects or long-term (personal) customer relationships. In the innovation process, trade and consumers had no direct influence on developments. However, consumer and trade demands for transparency, traceability and sustainability are trends that may lead to greater use of Precision Farming. From the invention to the market launch, it took up to ten years for some of the individual innovations studied.

In the area of knowledge base and human capital, it has been established that Precision Farming currently lacks specialist advisers. It was also estimated that there will be a shortage of skilled workers in

the future as well as in the overall sector. Due to the use of modern agricultural technology as well as information and communication technology, jobs in agriculture would become more and more demanding. General conditions such as documentation requirements or traceability favor the use of certain innovative technologies, such as navigation satellite systems (GPS) and geographic information systems (GIS) [22]. However, standards and standards are also capable of inhibiting innovation if manufacturers cannot agree on common standards. Furthermore, there are still deficits in the transfer of research and development results from science into agricultural practice. The innovation example illustrates a specific feature of the sector: Very often industries outside the agricultural sector are involved here (for example, sensors, mechanical engineering) [23]. Strong international competition from both agricultural machinery manufacturers and farmers has resulted in high levels of innovation among pre-suppliers and greater adoption of precision farming technologies by agricultural machinery service providers coupled with new services offered to farmers. Many small and medium-sized agricultural machinery companies in this area also operate globally at the same time.

At present, a low degree of compatibility of individual technology components and data formats is particularly inhibiting. Despite proven knowledge of economic and environmental benefits, the effects on individual operations are often difficult to estimate. The company takeover process is therefore often very tedious due to training and continuing education needs in agricultural trade and distribution and the lack of special advice.

In addition, the spread of precision farming is characterized by a variety of (cross-sectoral) feedback loops. Examples of this are the serial interfaces for machine control in automotive technology developed by farmers in the USA, the GPS systems made available by the US military since the 1990s for civilian use al Experts reported the promotional innovation effect of (free) access to satellite data, aerial photographs and digital terrain maps.

4.4 Animal monitoring case study (Subsector Animal Production)

The innovation field Animal Monitoring refers to the continuous electronic recording, collection and evaluation of animal data, which are used to assess behavior, health status, net performance and growth. The basis of this system is electronic animal identification. Animal monitoring should make a decisive contribution to securing and expanding the international competitiveness of animal husbandry in Kazakhstan. In addition, animal monitoring should provide a technological answer to current social discourses as well as statutory provisions on animal and consumer protection, as animal welfare and product characteristics can be monitored in the production process and influenced by individual animals.

In the interviews it became clear that also in animal monitoring the main actors in the innovation process are science, subcontractors and agricultural enterprises. Farmers are perceived by the experts to be less innovative, and are rarely involved in innovation development, taking on the role of test farms and feedback providers. Low profit margins for meat producers reduce their willingness to invest [24]. The test and demonstration functions also often take over the teaching and experimental goods of the respective state institutions. Consumers, politicians and consumers on the one hand, and the food trade and industry on the other hand, are the current indirect drivers of developments with demands for animal and consumer protection or quality and traceability systems. In addition, the ongoing trend towards automation and rationalization (including labor savings) further supports innovation in this area. However, many technical systems are not yet compatible with each other, which hinder market penetration. The innovation field of animal monitoring is characterized by small, specialized actor networks, according to the secondary analysis and the interviews. According to interviewees, there is a shortage of well-trained professionals in consulting, practice, research and sales. In addition, the experts observe a reduction of application-oriented teaching and research resources at the universities, coupled with a "haphazard" development of the structure of the research landscape. The quality of cooperation is a decisive factor for success in innovation projects for the experts.

Deficits in the design of the framework conditions and funding programs are a low focus on the needs of SMEs, no promotion of innovative ideas beyond the mainstream, problems in long-term validation, stringent requirements for test facilities for development, and high costs of licensing new systems. When it comes to animal monitoring, Kazakhstan science and research, according to the interviewed experts, have a high standard but also a low market and exploitation orientation. The subcontractors in the area of

milking and feeding systems and stable equipment are partly world market leaders and are characterized by a high export orientation. Here, from the point of view of the experts for innovation success, close cooperation between research and development and practice partners is required, since the innovation process is characterized by a multitude of intersectoral feedback, for example to human medicine or mobile and mobile phone technology.

4.5 Case Study Energy in Horticulture (Subsector Horticulture)

In addition to workers, energy represents one of the two most important cost factors in horticulture. For this reason, innovations for the efficient use of energy in greenhouse cultivation are particularly important, as Kazakhstan horticultural companies are facing increasing competition from climatically favored growing regions. The topic of energy in horticulture also gains importance from the social discourse about sustainability and environmental aspects of production. The innovation field currently consists of various horticultural-specific individual innovations such as climate computers and roofing materials and is even further away from an integrated technological-organizational paradigm than the Precision case study:

1) Farming. A key player in the innovation process is science, which contributes a great deal to knowledge production in this area. According to the surveyed experts, however, this knowledge is often not developed in a practice-oriented manner and is not translated into market-compatible products. A second group of actors are the market-oriented suppliers who have to design their products for a very small, highly segmented market. The production companies are rated by the experts as little innovation-friendly. Above all, they act as the "recipients" of innovations, but rarely act as proactive

2) Feedback providers. In addition, many experts discussed that the numerous networks in this very heterogeneous subsector are in part not known to all actors and there is a lack of cross-value chain management. In addition, consumers and commerce are not included in these networks.

Respondents are also troubled by the different performance evaluations in industry and science, which rarely provide incentives for closer cooperation.

According to the experts, horticultural consultancy, which has traditionally grown but has undergone major changes in recent decades and has very different regional structures, is still of particular importance in innovation. According to the experts, horticultural consulting acts as a mediator between the individual actors and "languages". However, the heterogeneous field "energy in horticulture" is not fully comprehensible for the individual consultant. A peculiarity for the adoption of innovations in horticulture is that company-specific solutions are necessary, which would require a detailed analysis of the operating conditions. According to the experts, this rarely happens. Special consultants are often lacking in developing individual innovations available on the market such as climate computers, roofing materials, energy shields or combination solutions of alternative fuels with the operations manager to form consistent overall concepts for the individual company [25]. Here the respondents observe a shortage of skilled workers. Although the legal framework currently promotes energy-related improvements in the under glass businesses through different facts (for example, the Renewable Energy Act (EEG)), the subsidy is not sufficiently used. According to respondents, funding programs are often only relevant for science because the barriers to entry for small and medium-sized horticultural businesses are assessed as very high. It is also criticized that (semi-) sector-specific conditions are not sufficiently taken into account in the programs (for example, harvest times or failures).

Social and procedural innovations must also be considered in this innovation example: These include, among others, the ecological footprint of horticultural products, traceability systems or new (energy) forms of cooperation. Innovations in the processes are conceivable, among other things, in logistics. However, according to the statements of the actors, these aspects did not (yet) play a role in the subsector, for example in France or Great Britain. In terms of technical innovation, however, Kazakhstan companies are considered to be leaders in international competition, also favored by strict national environmental regulations and standards. Social innovations (such as environmental foot printing methods) still need to be tackled in comparison to other countries, for example, in creating a single data base for the environmental footprint. In this case study, the friction losses in the communication between individual players, lack of demand by the companies as well as organizational obstacles are named as innovation-inhibiting. As promoting spatial proximity and trust were called.

5. Conclusion

The study shows that an investigative approach adapted to the various levels of innovation systems can describe the current framework for innovation in an industry with a combination of quantitative and qualitative information. The adapted analytical concept of the innovation system approach links the framework conditions for innovations and their effects in the concrete arena of the respective value chain with a process perspective (analysis element innovation processes).

In this way it is possible to describe the interplay of innovation conditions and innovation processes and to explain innovation success. This makes starting points for improvements visible to all actors, the framework conditions and the design of innovation processes.

With the classic concept of sectoral innovation systems, the multiple links to other sectors and niches would not be visible. The investigated case studies, which are considered to be typical for innovations in agriculture, show a technological complexity, for the co-ordination of innovation processes from the view of the authors a common system and role understanding of the actors is necessary. Only from this shared system understanding, in the sense of a common mental model, effective coordination mechanisms can be derived. This is not easy in the context of regionally different changes in the publicly funded part of the agricultural system, changes in general conditions and social debates, and controversial incentives for interdisciplinary cooperation. In addition, trade and consumers are not directly involved in innovation processes, but their expectations are translated into policy processes or trade requirements. From this experience, some of the actors can see a wait-and-see attitude until social trends are confirmed by the adaptation of the framework or delivery conditions.

The apparent contradiction between the high demands and expectations of innovations in agriculture on the one hand and the social acceptance debates on the other can be solved from the authors' point of view by two findings and conclusions derived from our empirical findings: (1) The prerequisite for innovation is the existence of a basis of trust. This arises in agriculture - and not only there - primarily in rather small longer-term networks. (2) In the innovation processes taking place in these networks, social and agricultural requirements must be integrated at an early stage, for example through the early involvement of trade and consumers. Thus, not only complex constellations have to be taken into account in agricultural innovation processes, but the innovation management faces the challenge to enable a trusting cooperation of the participants, but at the same time to remain open to changed claims or developments, in order to avoid acceptance debates in the diffusion process [26].

The authors see further need for research on ways of making better use of the innovation potential of agricultural enterprises to improve acceptance and adoption as well as opportunities for the further development of individual solutions towards integrated innovation fields. In addition, from the perspective of the authors, it should be examined how decision-makers can better be provided with information on innovation activities in the sector in the sense of monitoring.

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АУЫЛ ШАРУАШЫЛЫҒЫНДАҒЫ ИННОВАЦИЯЛЫҚ ПРОЦЕССТЕРДІ ТҰРАҚТЫ ДАМЫТУ: ИННОВАЦИЯЛЫҚ ЖҮЙЕДЕГІ КЕШЕНДІ МӘСЕЛЕЛЕР

Аннотация: Соңғы онжылдықта агроөнеркәсіп саласындағы инновациялық зерттеулер кеңейді. Бұл ауыл шаруашылығындағы инновациялар климаттың өзгеруі немесе ресурстардың жетіспеушілігі сияқты азық-түлік қауіпсіздігіне қатысты болашақтағы жаһандық проблемаларын жою мақсатына байланысты. Агроөнеркәсіптің даму бағыттары қазіргі гендік инженерия мен мал шаруашылығының кейбір түрлеріне байланысты салаларға әсер етеді. Бұл мақалада Қазақстанның агроөнеркәсіптік кешеніндегі инновациялық процестердің дамуы туралы ақпарат бар. Осы мақсатта Қазақстанның агроөнеркәсіптік кешенінің инновациялық жүйесі теориялық жағынан зерттелді және зерттеулер инновациялық даму кедергілерінің эмпирикалық деректермен расталады. Инновациялар үш зерттеу тақырыптарда қарастырылған, инновациялар өзекті мәселелерді шешуге және олардың даму процесінде бірнеше факторларға байланысты: түрлі технологиялар, әртүрлі әртістер, басқа секторлармен байланыстар, үйлесімділік жағдайлары мен ағымдағы проблемалар мен әлеуметтік дискурстар. Инновациялық жүйенің қолданбалы көзқарасы және бірнеше деңгейдегі эмпирикалық зерттеу осы өзара әрекеттесу туралы түсінік береді және осылайша ұсыныстарды әзірлеу үшін бастапқы нүктелерді белгілейді. Авторлардың пікірінше, ауыл шаруашылығында инновацияларға деген жоғары талаптар және әлеуметтік қабылдау туралы пікірталас келесі аспектілер

негізінде түсіндіріледі және шешіледі: (1) Инновацияға алғышарт - сенімнің негізі. (2) Инновациялардың табысы негізінен инновациялық процестерге әлеуметтік талаптарды біріктіруге байланысты болады, мысалы, тұтынушылық сұранысты ұлғайту. Агроөнеркәсіптік инновациялық процестердің ашықтығына қосымша инновациялық жүйені дамыту, ынталандыруды күшейту және пәнаралық ынтымақтастықты дамыту, сондай-ақ мүдделі тараптардың маңыздылығы көтеріледі.

Түйін сөздер: Ауыл шаруашылығындағы инновациялық саясат, ауыл шаруашылығындағы инновациялық үдерістер, ауыл шаруашылығындағы мониторинг.

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УСТОЙЧИВОЕ РАЗВИТИЕ ИННОВАЦИОННЫХ ПРОЦЕССОВ В СЕЛЬСКОМ ХОЗЯЙСТВЕ: КОМПЛЕКСНЫЕ ПРОБЛЕМЫ В ИННОВАЦИОННОЙ СИСТЕМЕ

Аннотация. В последние десятилетия исследования в области инноваций в агропромышленности расширились. Это связано с тем, что инновации в сельском хозяйстве развиваются с целью искоренения будущих глобалтных проблем, связанных с продовольственной безопасностью, такими как изменение климата или нехватка ресурсов. Направление развития агро инноваций в настоящее время затрагивает такие области как генная инженерия и некоторые виды животноводства. В данной статье представлена информация о том, в какой степени находится развитие иннвоационных процессов в агропромышленности в Казахстане. С этой целью изучена инновационная система сельского хозяйства Казахстана с теоретической точки зрения и исследования подтверждены эмпирическими данными об инновационных барьерах развития. Инновации, рассмотренные в трех тематических исследованиях, способствуют преодолению текущих проблем и зависят от нескольких факторов в процессе их развития: различных технологий, различных участников, связей с другими секторами, пересекающихся рамочных условий и текущих проблем, а также социальных дискурсов. Прикладной подход инновационной системы и эмпирическое исследование на нескольких уровнях позволяют получить представление об этих взаимодействиях и тем самым распознать отправные точки для разработки рекомендаций. По мнению авторов, высокие требования к инновациям в сельском хозяйстве и дискуссии о социальном принятии могут быть объяснены и решены на основе следующих аспектов: (1) Необходимым условием для инноваций является наличие основы доверия. (2) Успех инноваций во многом зависит от интеграции социальных требований в инновационные процессы, например, за счет роста спроса потребителей. Помимо необходимости открытости сельскохозяйственных инновационных процессов, ставится вопрос о необходимости разработки инновационной системы, наращиванию стимула и развитию междисциплинарного сотрудничества, а также важности заинтересованных сторон.

Ключевые слова: Инновационная политика в области сельского хозяйства, инновационный процессы в сельском хозяйстве, мониторинг в сельском хозяйстве.

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