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Abstract. The world population is growing rapidly and it is becoming a challenge to food security and nutrition. There is a strong tendency for urban population increase, which is more a consumer than food producer in large volumes. Crop productivity is still low in Kyrgyzstan. In 2019, grain crop yields were 32.1 c/ha, wheat - 25.1 c/ha, barley - 22.7 c/ha, corn - 66.1 c/ha, sugar beet - 514.8 c/ha, vegetable crops - 198.7 c/ha, fruit and berry crops - 52.9 c/ha. In the total volume of agricultural production in 2019, crop production was - 50.1%, livestock - 47.3%, forestry - 0.2%, fisheries - 0.2% and services - 2.2%. Peasant farms and private subsidiary farms accounted for 95.8% of total output. Over 60% of arable land in the country are affected by water and wind erosion, about 50% of pastures are degraded. Out of nine basic food security products, there are insufficient meat and meat products (62.8%), fruits and berries (21.6%), eggs (47.1%), sugar (89.2%). There is also insufficiency in vegetable oils. For other basic products (potatoes, vegetables and melons, milk and dairy products) there is sufficient supply. Demand for bread and bakery products is met by imports from Kazakhstan.

Key words: Food security, nutrition, yield, land, population.

Introduction

Food security is one of the main functions of states and governments. Level of food security achievement varies from country to country and depends on economic, political and financial stability of each country. The state of food security is directly correlated with the natural resources endowment of the country and their management

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approaches. The development of agricultural technologies in growing and processing of raw products, based on evidence-based approach, is of great importance. At the same time, food security or insecurity also depends on public management and the number of population in a country. However, the spread of different epiphytotics and epidemics also greatly reduces the capacity to meet the objectives of Sustainable Development Goals (SDGs). In this regard, we have attempted to review food security and nutrition in Kyrgyzstan against the challenges of endogenous and exogenous origin.

Methods

The article includes data from open scientific sources of countries with which Kyrgyzstan has borders (Uzbekistan, Tajikistan, Kazakhstan, China). The article also includes Russian data, with which our country has close economic relations. It also uses unpublished data: reports, summaries.

Focus group method, interviews and study of reports of various departments of the Ministry of Agriculture, Food Industry and Land Reclamation (MoAFILR) and the State Inspectorate on Veterinary and Phytosanitary Safety under the Government of the Kyrgyz Republic were used in data collection.

The number of groups was 5 - 8 participants and did not exceed 10; men and women participated in the discussions in equal numbers; duration of the discussion varied from 1 to 3 hours. Economist, agronomist and veterinarian moderated discussions depending on the focus group of departments. The authors of the article participated as moderator in one case and assistant in another case, depending on the type of focus group.

Based on a pre-developed questionnaire we conducted unstructured interviews with staff of the MoAFILR, the State Inspectorate on Veterinary and Phytosanitary Safety under the Government of the Kyrgyz Republic. The reports of the MoAFILR and the State Inspectorate on Veterinary and Phytosanitary Safety for the last 5 years were reviewed during our desk study.

Results and discussion

Today the world population is 7.8 billion people. Of these, 4,378,993,944 live in cities, which is 56.2% of the total number of people. And in the year 200 of the new era, the world population was only 190 million people.

In 1951, the world population was 2,584,0340,261, of which 775,067,697 lived in urban areas, representing 30% of the total population. In 1961, the world population was 3,034,843,507, of which 1,055,435,648 lived in cities, representing 34% of the total population. By 2030, the world population is expected to be 8,548,487,400 people, of which 5,167,257,546 will live in urban areas, which is 60 percent of the total population. In 2050, the world population will increase to 9,735,033,990 and the urban population will be 69%, reaching 6,679,756,162 people [1].

The above data shows that the world population is growing rapidly and is becoming a challenge to food security and nutrition. There is a strong tendency for urban population increase, which is more a consumer than a producer of food in large volumes.

Currently, 50% of all inhabited lands are used in agriculture [2]. Of these, the most valuable are arable lands. In the world in 1991 they were 11.1%, in 2010 10.7%, and in 2016 11.06% of agricultural land [3]. In this regard, development of agriculture at the expense of inhabited land may be different in various countries. Kyrgyzstan, Russia, Ukraine, Turkey and Uzbekistan can do more than they currently have. Turkmenistan, Kazakhstan, Norway, Sweden, etc. do not have such opportunities [2].

The Kyrgyz Republic has 1.2 million hectares of arable land [4]. At the same time, the USA has 174.45 million ha, India has 159.65 million ha, the Russian Federation has 121.78 million ha, China has 103.4 million ha, Turkey has 23.83 million ha [5].

Compared to other countries, our country is not rich in land for sowing agricultural crops. In this regard, land users must rationallyuse arable lands and adopt advanced agricultural technologies based on evidence-based approach.

In 2019, the total area under agricultural crops in the country was 1,216.7 thousand ha and increased by 1.8 thousand ha, or 0.1 %, compared to the previous year. In cropping system, 554.2 thousand ha (45.6 % of the total sown area) were under cereal crops (without grain legumes, rice and buckwheat), 62.2 th.ha (5.1 %), oilseeds - 26.0 th. ha, respectively, (2.1 %), cotton - 24.4 th.ha (1.9 %), tobacco - 0.4 th.ha (0.03 %), sugar beet (factory) - 14.4 th.ha (1.2%), potatoes - 79.2 th.ha (6.5 %), vegetable crops - 53.4 th.ha (4.4%), other crops (rice, melon, etc.) - 23.1 th.ha (1.9%) and fodder crops - 379.4 th. ha (31.2%).

Crop productivity is still low, for example, in 2019, the yield of cereal crops was 32.1 c/ha, wheat - 25.1 c/ha, barley - 22.7 c/ha, corn - 66.1 c/ha, sugar beet - 514.8 c/ha, vegetable crops - 198.7 c/ha, fruit and berry crops - 52.9 c/ha. At the same time in Kazakhstan, the average yield of cereal crops was 12.6 c/ha with a total area of 15.2 million ha.

In the total volume of agricultural production in 2019, crop production amounted 50.1%, livestock - 47.3%, forestry - 0.2%, fisheries - 0.2% and services - 2.2%. Peasant farms and private subsidiary farms accounted 95.8% of total output. The increase in gross agricultural output compared to the previous year was mainly due to increase in both livestock (by 2.5%) and crop production [4].

Meanwhile, over 60% of arable lands in the Kyrgyz Republic are vulnerable to water and wind erosion and about 50% of its pastures are degraded [6]. However, intensification to close yield gaps and diversification to improve ecosystem function and growing need in agricultural products face the limitations of widespread natural resource degradation [7].

All of the above affects the food security in the country. Out of nine basic food security products in Kyrgyzstan there are insufficient meat and meat products (62.8%), fruits and berries (21.6%), eggs (47.1%), sugar (89.2%). There is also insufficiency in vegetable oils. As for other basic products (potatoes, vegetables and melons, milk and dairy products) there is sufficient supply. The demand in bread and bakery products is provided by import from Kazakhstan.

Livestock farming is important component of food security and nutrition. Although global livestock productivity has increased in the last 50 years, these changes are modest compared to crop yields. World meat production per estimated cow has increased by about one -quarter compared to 1961, which is significantly lower than improvement in cereal yields for the same period. It increased by about five times in many countries. Livestock farming accounts for 80 % of global agricultural land and produces less than 20% of the world's calorie requirements. This means we must consider what, how much people should consume and how much they actually eat when determining the amount of land needed to produce our products. The richer people become, the more diverse their nutrition and their consumption per person increases. Unfortunately, economic growth leads to the undeniable impact of land resources [2].

The Kyrgyz Republic has 9.7 million ha of pastures and hayfields. Pastures are mainly used as seasonal fodder resources from April to October each year. In some snowless areas, they are used throughout the year. In addition, 106,385 ha of corn and 206,376 ha of barley are used to create a fodder base. At least 80% of the gross yield of these crops is used for fodder production. In addition, about 300 thousand ha of alfalfa and sainfoin are used for hay production. Farmers do not use this huge resource effectively.

This can be seen from the data of the Statistical Committee on Livestock Productivity. Currently, there are no published data in the Kyrgyz Republic on how land resources used for livestock farming are involved in producing necessary calories. This means that for a given period there is no evidence of natural resources impact on food security.

The quality and volume of products manufactured in the country largely depend on used natural resources and applied agricultural technologies, which directly affect food security and nutrition of the country's residents. The nutrition structure based only on cereals has changed, in general, due to the improvement of living standards and diet [8, 9].

The products must not only be stable physically and economically available for population, but also be safe and nutritionally adequate and in accordance with people's cultural and religious characteristics.

Globally, the needs of agriculture to support better nutrition and health were identified and reflected in discussions led by the United Nations in the "Sustainable Development Agenda 2030" [10]. In today's world, the attempt is being made to develop conceptual systems or guidelines that outline the impact of agriculture on nutrition. This involves creating a multidisciplinary, strong link between agriculture, health and nutrition [11]. It follows that we are obliged to organize nutrition-sensitive agriculture. It is a food-based production approach where agriculture provides nutritionally rich, healthy diverse and fortified products to prevent malnutrition and exhaustion. This approach emphasizes the multiplying benefits that are not only good nutrition for people, but also socially important, supporting rural well-being.

In order for our country to be integrated and supported by such systems, let us refer to FAO global dates [12]. Thus, it is known from this source that in Kyrgyzstan in 2016-2018, 0.4 million people (7.1% of the population) suffered from malnutrition (undernourishment). In Uzbekistan 2 million people (6.3%) and in Serbia 0.5 million people (5.5%) respectively. During the same period in Central Asia, 14.5% of men and 15.3% of women suffered from moderate and severe food insecurity among adults. The same source suggests that the proportion of malnourished children under 5 years of age in Kyrgyzstan was 2.8%, Kazakhstan 3%, and Armenia 4.2%. Women at childbearing age suffer from anemia in Kyrgyzstan - 36%, Kazakhstan - 31% and Armenia - 29%. These unpleasant figures, we assume, are the result of staple foods underproduction or due to eating habits of nations.

The development of each link in food chain of plant production and livestock farming influences on food security and nutrition. Today the majority of livestock population belongs to private farms. Livestock products move in this chain: feed in the field (pasture) ↔ animal on the farm ↔ slaughter by farmer ↔ market (bazaar), store ↔ consumer. There is another chain: fodder in the field (pasture) ↔ animal on the farm ↔ intermediary buyer, supplier ↔ intermediary seller ↔ slaughterhouse ↔ consumer. According to the existing veterinary legislation and other regulations, all actions of product owners and intermediaries are under the supervision of a veterinary specialist, starting with livestock keeping, transportation from farm for sale, to the consumer of animal products. Due to the lack of competent veterinarians, in villages there is a high incidence of dangerous infections in animals such as brucellosis, echinococcosis, salmonellosis, anthrax, etc. Statistics on animal morbidity for these diseases in the KR is maintained and available only for official use, and very rarely published in the media. The drama of these diseases is not only that they lead to decrease in productivity and loss of animals, but also that if necessary rules of human hygiene and regulations for vaccination of animals by veterinarians are not observed, they are transmitted to humans [13].

In food security strategy, the important role is assigned to timely implementation of veterinary measures to prevent the emergence and spread of infectious animal diseases, production and sale of safe veterinary and sanitary products of animal origin.

There are 1229 foci of anthrax in the Kyrgyz Republic. It was found 583 foci of anthrax on the ground, of them only 434 are fenced, 517 are concreted, and 691 foci are not found on the ground. In 2010, veterinarians vaccinated 4952 animals against anthrax [14].

The disease situation in neighboring CIS countries shows that there are constant threats. According to the International Epizootic Bureau (IEB) in 2014 in **Kazakhstan** there were 3 cases of foot-and-mouth disease type A, 1 case of anthrax in horses. In **Russia** there were recorded 2 cases of highly pathogenic avian influenza H5N1 (H5N1), 4 cases of classic swine fever, foot-and-mouth disease type A-11 (cattle, sheep, pigs), 8 cases of type O, 73 cases of African swine fever (ASF). In **Tajikistan** there were 2 cases of small ruminant plague (PPR).

In neighboring **China** there were 4 cases of foot-and-mouth disease type A and 2 cases of type O, as well as cases of highly pathogenic avian influenza (HPI): H5N1 - 20, H5N2 - 10, H5N3 - 1, H5N5 - 1, H5N6 - 26, H5N8 - 2; Mildly Pathogenic Avian Influenza (HPAI): H7N9 - 43; Reproductive Respiratory Swine Syndrome (RRSS): 18, PPR: 242 cases [15].

In 2018 the Russian Federation notified the OIE about 82 outbreaks of highly pathogenic influenza in poultry population, they were recorded in seven constituent entities of the country, previously satisfactory in terms of this disease, including one caused by the virus type H5N2, and 81 - the virus type H5N8. This figure was 2.3 times higher than in 2017 [16].

Since the beginning of 2020, there has been a reverse trend in the world with increase of highly pathogenic avian influenza (HPAI), in January 2020, the OIE received reports on HPAI outbreaks from 12 countries (Germany, China, Romania, Slovakia, Ukraine, Czech Republic, Hungary, Poland, Taiwan, Saudi Arabia, Israel and Vietnam) [17].

According to official data in 2016-2017, 66 countries had unfavorable situation with foot-and-mouth disease, including 36 - African, 27 - Asian, 1 - South American and 2 - European [18].

In 2016, three outbreaks of PPR were identified in Georgia (January-March) and, thanks to intensive antiepizootic measures, the disease did not spread [19].

Currently, PPR is widespread in Tajikistan and it is 55% of sheep and goat infectious pathologies [19]. During the research using immune enzyme analysis of blood serum samples from Gorno-Badakhshan Autonomous Region, rayons of republican significance of Khatlon and Sughd regions in 2013-2016, positive samples were 30-75%, and in 2016 out of 31 samples examined by polymerase chain reaction, two were positive. The volume of vaccination of small cattle in the above-mentioned regions annually amounts from 265 thousand to 1.1 million heads.

The modern plague nosoarea of small ruminants covers countries in Africa and Eurasia, including the European part of Turkey. It has been spread in 55 countries: 35 countries in Africa and 20 countries in Eurasia. According to the OIE, over 38 thousand outbreaks were registered during the 30-year period (1984-2013). In Africa, 12.8 thousand outbreaks were detected, the largest number was in Nigeria - 2 901, Guinea - 1 836, Benin - 1 671, Ghana - 1 619. In the Eurasian region 25.2 thousand outbreaks were registered, Iran - 8 944, India - 5 713, Oman - 3 958, Nepal - 3 362.

According to the State Inspectorate on Veterinary and Phytosanitary Safety under the Government of the Kyrgyz Republic for the first 9 months of 2019,81 veterinary control postsregisteredinfectious animal diseases, including : rabies - 21, horse trypanosomiasis - 16, pasteurellosis - 2, brucellosis in **small ruminants**- 1, salmonellosis - 1, pasteurellosisin **small ruminants**- 19, enterotoxemia in **small ruminants** - 1, bradsotin sheep - 5, necrobacteriosis - 1, Newcastle disease - 2, Marek's disease - 1, salmonellosis in **pigs**- 1, colibacillosisin **small ruminants**- 1.

In the first 6 months of 2020, 60 veterinary control posts registered infectious animal diseases. Among them are rabies - 22, trypanosomiasis of horses - 11, **pasteurellosis** - 1, salmonellosis - 4, bradsot in sheep - 2, enterotoxaemiain small ruminants- 1, varroatosis - 1, European rot - 2, smallpox of birds - 1.

The current situation with zoonotic infections in the country remains tense. The Veterinary Service is making efforts to reduce the incidence of these infections, including the improvement of existing laboratories and construction of new ones, which are provided with new laboratory equipment, materials and diagnostics, specialists are trained in modern diagnostic methods, including express methods.

In connection with the above, it is very important for the country to implement HACCP (Hazard Analysis and Critical Control Point). It is necessary to adapt the country's monitoring and control system to the principles of HACCP (Hazard Analysis and Critical Control Point). HACCP is Hazard Analysis and Critical Control Point, a standard that has become synonymous with food safety. This system identifies, assesses and controls risks that pose a serious threat to food safety. The system provides assurance that the food safety monitoring and control system is implemented effectively. It considers the risks or any factors that could affect food safety and subsequently controls in order to prevent harm to the consumer.

In China, they have achieved significant economic results and solved problems of food security by building science and technology industrial parks (STIP). This has been widely reported. For example, in 14 years from 1992 to 2006, the growth of annual production in each STIP was more than 40%, the productivity of each labor force increased more than seven times and the number of firms involved in STI also increased seven times [20]. Considering the food security in our country and lag in agricultural technologies, there should be a demonstration site where innovative technologies on crop and animal production are applied and everything is demonstrated to farmers. In this regard, a technological park of advanced technologies will be built in educational-experimental farm of the Kyrgyz National Agrarian University (KNAU). In addition to introduction of advanced technologies, a training center for application of such standards as Codex Alimentarius, HACCP and ISO will operate in the technology park.

Conclusion

Thus, based on the limited natural resources (arable land, forest) and their degradation, low crop yields, risks of animal morbidity with infectious diseases due to carryingof infections into the country, lack of veterinary specialists, a large proportion of the population with insufficient nutrition, food security of the country should be based on construction of technology parks and promotion of human nutrition-sensitive agriculture. In the future, it is necessary to conduct studies on food security and nutrition at household level.

Scientific and Innovative Agricultural Technopark in KNAU will adapt innovative technologies in intensive farming, greenhouses, livestock production, support of veterinary science and practice, as well as product logistics on intensification of agro-industrial complex and show how to solve biological, food and environmental security of the Kyrgyz Republic.

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