

Project name: BR10865103 "Development and creation of scientifically proved smart farms (herd horse breeding, beef cattle breeding) using at least 3 different digital solutions for each digital area of implementation for the actual production tasks of agribusiness entities and the formation of the necessary reference database for training employees of farms and transferring digital knowledge to students"

Relevance:

National food security occupies an important place in the life support of the country's population since the availability of affordable food is a basic condition for human life. Food products are necessary every day for every inhabitant of the planet, and the level and environmental safety of food determines the health of the nation and the life expectancy of people.

Livestock breeding sectors horse breeding and beef cattle breeding are among the priority sectors for the Republic of Kazakhstan. At the same time, these industries in our country are traditional with extensive technology of keeping, feeding, reproduction, etc., both in the grazing period and in the stall period of keeping animals.

The program has international significance due to the planned wide involvement of scientists from different countries, the exchange of international experience in all production processes of beef cattle breeding and herd horse breeding, as well as the rational management of pasture resources. An analysis of the state of knowledge of the problem shows that scientists and specialists of Kazakhstan in various soil and climatic regions have developed many methods aimed at increasing the productivity of animals, but when conducting mobile animal husbandry, studying and comparative analysis with various management systems for beef cattle breeding and horse breeding, including foreign ones.

In most of Kazakhstan, especially in remote pastures (mountain and steppe zones), there is no Internet connection, which does not allow online livestock identification. The use of other data transmission networks will make it possible to obtain data as soon as possible, which will make it possible to make operational decisions on all production processes in the herd and beef cattle breeding.

Presented on the Kazakhstan market, modern technologies for monitoring the maintenance and feeding of beef cattle do not always correspond to the description of the expected results (remoteness of the economy, harsh natural and climatic conditions, etc.). In this regard, the Program will study modern foreign technologies and create new domestic ones in the conditions of specific farms, with recommendations on their use and the economic efficiency of their implementation.

Goal: Creation of integrated systems in herd horse breeding and beef cattle breeding based on digital solutions

Expected results:

Upon completion of the program:

An integrated system for collecting, processing, and analyzing data on the localization of horses using Smart technology will be created in the conditions of existing farms in Kazakhstan (7 farms in different regions);

The effectiveness of the functioning of tools that do not require an Internet connection will be determined to detect the localization of horses in mountainous and steppe areas;

The cost-effectiveness of year-round use of means for detecting the localization of horses under various weather conditions will be determined;

Creation of at least 3 Smart Farms in different regions of the republic using at least 3 digital solutions of various vendors for each area of digitalization implementation for the actual production tasks of agribusiness entities and the formation of the necessary reference database

for this for training employees of farms and peasant farms and transfer of digital knowledge to students (for further replication in other digital farms).

A wearable IoT device for the real-time location of horses will be developed using the technology of energy-efficient long-range networks LoRaWAN;

A database will be created on objects of epidemiological significance for horse breeding farms. Electronic maps of the studied territories will be developed to visualize epidemiologically significant objects on them.

4 Smart farms will be created in different regions of the republic using 3 digital solutions from various vendors for each area of digitalization implementation for the actual production tasks of agribusiness entities and the formation of the necessary reference database for this to train employees of farms and peasant farms and transfer digital knowledge to students (for further replication in other digital farms) so that these digital farms provide a full cycle of using digital solutions from the beginning of farming to the final results in the field of animal husbandry.

An experimental platform will be developed for stress-free weighing of cattle, determined using microwave radio identification with the functions of monitoring livestock watering and antiparasitic treatment;

A scientifically based comparative analysis of 3 digital solutions of domestic and international developments for monitoring and tracking farm animals (horses, cattle) will be carried out, with the application and implementation on an experimental digital model farm with the possibility of training students and farmers;

A scientifically based comparative analysis of 3 digital solutions of domestic and international developments, platforms for on-farm livestock activities with elements of telematics will be carried out, with the use and implementation on an experimental digital model farm with the possibility of training students and farmers;

A system will be developed for planning and monitoring the feeding of beef cattle during the stall period;

A scientifically based comparative analysis of 3 digital solutions of domestic and international developments of integration platforms will be carried out to combine all types of digital agricultural activities in a unified solution, with the application and implementation on an experimental digital model farm with the possibility of training students and farmers;

An additional module will be developed for an experimental stress-free weighing platform for monitoring feed intake (feed conversion) with software (web application) for analyzing data from the control unit and making decisions;

A system will be developed for the rational use of pastures using remote sensing of the earth, a geo-portal with digital maps with visualization of bioclimatic and soil characteristics, the botanical composition of vegetation, a load of farm animals on pastures with detailed legends;

A scientifically based comparative analysis of 3 digital solutions of domestic and international developments will be carried out using several types of communication channels and their compatibility with digital farm telematics elements (GPS / GLONASS satellite communications, LPWAN, including LoRaWAN, NB-IoT, LTE, 3G, GPRS, GSM) and autonomous equipment in the absence of communication lines and access to the Internet, as well as the absence of electricity, with the use and implementation on an experimental digital model farm with the possibility of training students and farmers;

A scientifically sound economic feasibility of using all digital solutions in a digital animal model farm will be carried out, indicating the direct and indirect benefits of acquiring, using digital solutions and the payback period;

A database will be created and methodological tools will be developed to calculate the economic effect of the introduction of digital solutions on labor productivity;

2 articles will be published in the scientific edition of the Scopus database with a non-zero factor with a quartile of at least Q3 and 5 articles in journals recommended by COXON and

RSCI, 2 recommendations, 1 monograph, 9 presentations at international conferences, 4 copyright certificates and 1 Patent of the Republic of Kazakhstan.

Young specialists will be involved, incl. at least 3 undergraduates and 4 students.

6 seminars will be held with the involvement of at least 100 listeners, incl. farms and stakeholders.

Achieved results for 2021. Research in 11 basic farms are laid, collection and analysis of zootechnical, economic, veterinary, and technical data are carried out Studied: advanced digital solutions for determining the localization of horses; integrated systems for collecting, processing, and analyzing data on the localization of horses using three solutions: Lives' Talk Nomadic Solutions, X-Pet #5, GPS shepherd. A comparative analysis of GPS trackers has been carried out, requirements for them from operating conditions have been determined. A block diagram has been developed, a functional description of the GPS tracker modules has been given.

Conducted: comparison of analogs of digital solutions in beef cattle breeding Gallagher Weighing and EID Systems, GrowSafe, Smaxtec; comparative analysis of technological processes of systems for planning and monitoring feeding. An experimental site was selected on an area of 70 hectares (divided into 7 contours), a scheme of automatic gates was determined. An algorithm for the operation of the electronics unit has been developed, taking into account spraying, the choice of communication protocol and reliability, and the algorithm for the operation of a "smart" feeder; the architecture provides for: a cloud application, a cross-platform mobile application, hardware modules for automating the accounting of primary data, marking and veterinary treatment of animals, combines the tasks of feeding, weighing and evaluating bulls in a single software solution that will be available to users via the Internet and on mobile devices; a methodology for calculating labor productivity has been developed, taking into account the use of digital technologies.

The requirements for the design of the GPS tracker from the operating conditions are determined. A block diagram of a GPS tracker has been developed. A functional description of the modules of the developed device is given. A comparison was made of the design features of weight platforms for weighing animals and "smart" feeders (GrowSafe, Intergado). The description of the developed weighing platforms and the "smart" feeder is given. A description of the universal block diagram of the electronic unit is given, a microcontroller (STM32F407) and communication modules are defined. The design of automatic gates for the creation of systems of "Smart" pastures has been developed.

Achieved results for 2022. 5 types of trackers were installed in 7 basic farms of herd horse breeding and their comparative analysis was carried out. The trackers made it possible to assess the ethology of horses. A database of objects of epidemiological significance for horse breeding farms was created. Developed: prototype software for visualizing the history of movements and current location of horses; prototype of wearable IoT device of own design; prototype software for analyzing data coming from the control unit and making decisions, with the ability to save and view data for three (3) kinds of smart devices: weighing platform, feeder, sprayer; "smart feeder". Bulls were evaluated by their own productivity when using 2 systems, the installation of the Intergado system and the system of KATU own design was carried out, the effectiveness of the use of "smart" pasture technology, an assessment of the economic effect of the introduction of "smart" technologies. Based on the results, 10 articles have been published, 3 seminars on dissemination of knowledge have been held. 1 master's work prepared.

Achieved results for 2023. In 7 basic farms, trackers were installed and a comparative analysis was carried out for horses. The analysis of the trackers showed that, depending on the natural and climatic conditions, the lack of electricity, communications, and other infrastructure, the use of satellite communications allows for real-time monitoring of horses in large areas. However, their use is associated with economic costs, including the cost of devices and subscription fees. Systems based on cellular communications (GSM, GPRS, 3G, LTE, NBIoT) have a limited coverage area, which may affect the reliability of monitoring in remote or mountainous areas.

In this regard, a proprietary tracker has been developed, which requires further research, based on GPS and Larawan. An important result of the study was the justification of the combined approach, which reduces operating costs and provides reliable monitoring of the location of horses.

For the first time, the ethology of herd horses was evaluated using trackers. The results have been published in CQASHE journals, international conferences, and Scopus.

In the field of beef cattle breeding, research was conducted on the basis of 4 farms in Akmola, Pavlodar and North Kazakhstan regions. A scientifically based comparative analysis of the technical aspects of our development of the bovine stress-free weighing platform (CATI) with the Intergado (Brazil) and Vytelly (Canada) systems has been carried out, which allow us to determine the residual feed consumption, which makes it possible to reduce feed consumption by up to 12%, methane emissions by 30%, and increase the value of offspring.

The advantage of the developed stress-free weighing platform is automatic treatment with veterinary drugs, flexibility in adapting to various conditions of maintenance and placement; an additional module designed to control feed consumption, and a hardware weighing module of the feed mixer, remotely without stress for animals to carry out weighing and processing, which gives 100% veterinary well-being from blood-sucking insects.

The developed technology for "smart" pastures for remote herd control is environmentally friendly, since the load on pastures is reduced and pasture degradation is prevented. When evaluating the effectiveness of the technology of "smart" pastures; the economic effect has reached up to 23.8% profitability and up to 18 months of payback.

The acts of implementation of integrated systems in horse breeding and beef cattle breeding based on digital solutions have been obtained.

Study group members:

№ п/п	Full name	Position in a Project	Scopus Author ID, Researcher ID, ORCID, если имеются
1	Bostanova Saule Kuanyshpekovna	Program Manager	https://www.scopus.com/authid/detail.uri?authorId=57191709794 https://orcid.org/0000-0001-6661-8362
2	Uskenov Rashit Bakhitzhanovich	Deputy Program Manager	https://www.scopus.com/authid/detail.uri?authorId=57194221497 https://orcid.org/0000-0003-2163-2392
Livestock Breeding Subgroup			
3	Issabekova Saltanat Aitymovna	Lead Subgroup	https://www.scopus.com/authid/detail.uri?authorId=57191709794 https://orcid.org/0000-0002-0401-6443
4	Alimzhanova Ludmila Vasilievna	Lead Researcher	https://www.scopus.com/authid/detail.uri?authorId=57191710025
5	Shauenov Saukymbek Kauysovich	Lead Researcher	https://www.scopus.com/authid/detail.uri?authorId=56770098500 https://orcid.org/0000-0003-2259-7111 https://www.webofscience.com/wos/author/record/17930264
6	Isskhan Kairat Zhalelovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57211314687 https://orcid.org/0000-0001-8430-034X
7	Akimbekov Amin Richardovich	Senior Researcher	https://orcid.org/0000-0002-1697-8113 https://www.webofscience.com/wos/author/record/26316071

8	Baymukanov Dastanbek Asylbekovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=55916445700 https://orcid.org/0000-0002-4684-7114 https://www.webofscience.com/wos/author/record/7154989
9	Shaikenova Kymbat Khamitovna	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57190005556 https://publons.com/researcher/4105739/kymbat-kymbat/ https://orcid.org/my-orkid?orkid=0000-0002-5684-7564
10	Kazhgaliev Nurlybai Zhigerbaevich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57189595544 https://orcid.org/0000-0001-5122-9030
11	Aubakirov Khamit Abilgazievich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57191637088 https://orcid.org/0000-0003-2670-4834
12	Asanbaev Tolegen Shonaevich	Senior Researcher	https://orcid.org/0000-0003-1096-7410 https://www.webofscience.com/wos/author/record/31481138
13	Kurzshikaev Zhumagazy Kuzenbaevich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57194220890 https://orcid.org/0000-0002-6716-4662
14	Ibraev Dulat Kusainovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=56770169800 https://orcid.org/0000-0001-7316-8478 https://www.webofscience.com/wos/author/record/17583804
15	Matakbayev Dauren Amanzholovich	Junior Researcher	https://orcid.org/0000-0002-4197-320X
16	Tilepova Assel Kozhabekovna	Junior Researcher	https://orcid.org/0000-0002-2040-9255
17	Sharapatov Tlekbol Sungatovich	Junior Researcher	https://orcid.org/0000-0002-5177-4001
Veterinary Subgroup			
18	Mukhanbetkaliev Ersyn Ergazievich	Lead Subgroup	Researcher ID: S-8811-2016 https://www.scopus.com/authid/detail.uri?authorId=57194544992 https://orcid.org/0000-0003-3320-7182
19	Akibekov Orken Sultankhamitovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=56606295400 https://orcid.org/0000-0002-8647-0083
20	Mukhanbetkalieva Aizada Aikenovna	Senior Researcher	Researcher ID: O-8690-2017 https://orcid.org/0000-0001-8232-345
21	Abdrakhmanov Sarsenbai Kadyrovchich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57189578133 Researcher ID: O-5800-2017 https://orcid.org/0000-0003-3707-3767
22	Leader Lyudmila Alexandrovna	Senior Researcher	Researcher ID: O-8442-2017 ORCID https://www.scopus.com/authid/detail.uri?authorId=56058488900 https://orcid.org/0000-0001-5842-0751

Supergroup			
23	Serekpaev Nurlan Amangeldinovich		https://www.scopus.com/authid/detail.uri?authorId=55801930900 https://orcid.org/0000-0003-0774-4750
24	Nogaev Adilbek Aidarkhanovich	Senior Researcher	Researcher ID B-4307-2017 https://www.scopus.com/authid/detail.uri?authorId=55801245500 https://orcid.org/0000-0002-8826-817X
25	Ermekov Farabi Kerimbaevich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57212018560 https://orcid.org/0000-0002-0290-3866
26	Usalinov Erkin Baltabaevich	Senior Researcher	https://orcid.org/0000-0003-1907-9532
27	Akhylbekova Balzhan Akhmetbekkyzy	Researcher	https://orcid.org/0000-0002-4671-8232
28	Ashirbekova Inkar Adilbekkyzy	specialist	https://orcid.org/0000-0001-5219-348X
29	Baitelenova Aliya Askerovna	specialist	Researcher ID G-4116-2016 https://www.scopus.com/authid/detail.uri?authorId=57205155293 https://orcid.org/0000-0003-0774-4750
30	Bolatbek Zhadyra	Senior Assistant	https://orcid.org/0000-0002-3801-450X
Radio Electric Tech Subgroup			
31	Mirmanov Arman Barlykovich	Lead Subgroup	https://www.scopus.com/authid/detail.uri?authorId=14632521600 https://orcid.org/000-0002-7112-1374
32	Nabiev Nabi Kozyevich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57195502251 https://orcid.org/0000-0002-7558-1810
33	Sarsikeev Ermek Zhaslanovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=56252099900 https://orcid.org/0000-0002-7209-5024
34	Asainov Gibrat Zholamanovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57202009038 https://orcid.org/0000-0001-7586-9016
35	Dunaev Pavel Alexandrovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57208718183 https://orcid.org/0000-0003-0379-315X
36	Alimbaev Aidar Serikovich	Leading Specialist	https://www.scopus.com/authid/detail.uri?authorId=57222012080
37	Baiguanysh Sanat Beybetuly	Leading Specialist	https://www.scopus.com/authid/detail.uri?authorId=56826029700
38	Sharipov Askar Sarsembaevich	Senior Design Engineer	https://www.scopus.com/authid/detail.uri?authorId=57222011748 https://orcid.org/0000-0002-0127-8800
39	Kokcholokov Azamat Samidinovich	Senior Design Engineer	https://www.scopus.com/authid/detail.uri?authorId=57222025066 https://orcid.org/0000-0003-3851-4499
40	Akhmadiya Aset Akhmadiyevich	Researcher	https://www.scopus.com/authid/detail.uri?authorId=57207877387

			https://orcid.org/0000-0001-9136-7999
41	Zhamalatdinov Damir Zairovich	Researcher	https://www.scopus.com/authid/detail.uri?authorId=57202390424
42	Makhanov Kanat Matovich	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57217354220 https://orcid.org/0000-0002-1263-0734
IT Subgroup			
43	Tretyakov Igor Igorevich	Lead Subgroup	https://orcid.org/0000-0003-2491-3683
Economics Subgroup			
44	Mogilny Sergey Valerievich	Lead Subgroup	https://www.scopus.com/authid/detail.uri?authorId=57195503712
45	Tokenova Sandugash Meiramzhanovna	Senior Researcher	https://www.scopus.com/authid/detail.uri?authorId=57212195455 https://orcid.org/0000-0003-0203-6843
46	Nabieva Dinara Nuridinovna	Leading Specialist	https://orcid.org/0000-0025-5509-2972
47	Orazbayeva Ayagoz Sovetovna	Researcher	https://www.scopus.com/authid/detail.uri?authorId=57211825127 https://orcid.org/0000-0001-7685-1782
48	Sauganbaev Arman	Patent Specialist	https://orcid.org/0000-0002-1254-9848

List of publications and patents published within the framework of this project (with links to them):

№	Title	Printed, or on the rights of a manuscript	Publisher, magazine (title, issue, year)	Number of pages, pp.l.	The names of the authors
In journals recommended by the RSCI					
1	The main technical parameters of the installation for the cattle spraying system	Print.	Internauka: electron. scientific Journal 2022. No. 37(260). https://doi.org/10.32743/26870142.2022.37.260.345600	4	Nabiev N.K., Mirmanov A.B., Akhmadiya A.A.
2	Monitoring of maternal instinct, duration of grazing and rest of mares of Kazakh horses using GPS tracking collars	Print.	Bulletin of Tuvan State University of Natural and Agricultural Sciences, No. 1 (1), 2023 https://doi.org/10.24411/2221-0458-2023-01-41-50	10	Aubakirov H.A., Asanbayev T.Sh., Iskhan K.Zh., Uskenov R.B., Sharapatov T.S.
In journals recommended by the CQASHE					
1	Distribution of helminths of the	Print.	Bulletin of Science of KazATU named after	10	Leader L.A., Mukhanbetkaliev

	gastrointestinal tract of horses of herd content in the regions of Kazakhstan		S.Seifullin. – 2022. – №3(114). – Pp.91-100.		E.E., Akmambayeva B.E., Seitkamzina D.M., Usenbaev A.E.
2	The effectiveness of the use of trackers to ensure veterinary well-being and monitoring of livestock in stud horse breeding	Print.	Bulletin of Science of the Kazakh Agrotechnical University named after S. Seifullin (interdisciplinary). - 2022. - №3 (114). – Part 2. - pp. 202-213. https://doi.org/10.51452/kazatu.2022.3(114).1193	12	Mukhanbetkaliev E.E., Uskenov R.B., Tokenova S.M., Mogilny S.V., Orazbayeva A.S.
3	Determination of residual feed consumption using vytelle (growsafe) technology	Print.	Bulletin of Science of the Kazakh Agrotechnical University named after S.Seifullin (interdisciplinary). - 2022. - №2 (113). – Part 1.- pp.104-115 https://doi.org/10.51452/kazatu.2022.2(113).977	12	Matakbaev D.A., Tilepova A.K., Shauenov S.K., Bostanova S.K., Uskenov R.B.
4	Evaluation of meat qualities of Kazakh white-breasted Bulls during life	Print.	Bulletin of Science of the Kazakh Agrotechnical University named after S.Seifullin (interdisciplinary). - 2022. - №3 (114). – Part 1. - B. 4-11. https://doi.org/10.51452/kazatu.2022.3(114).1095	8	Uskenov R.B., Akkair B.J., Isabekova S.A., Bostanova S.A., Nasir J.K.
5	Distribution of helminths of the gastrointestinal tract of horses of herd content in the regions of Kazakhstan	Print.	Bulletin of Science of KazATU named after S.Seifullin. – 2022. – №3(114). – Pp.91-100. https://doi.org/10.51452/kazatu.2022.2(113).1013	10	Leader L.A., Mukhanbetkaliev E.E., Akmambayeva B.E., Seitkamzina D.M., Usenbaev A.E.
6	Technology of keeping herd horses using	Print.	Bulletin of science of the Kazakh Agrotechnical	12	Asanbayev T.Sh., Shauenov S.K., Ibraeva D.K.,

	GPS trackers		University named after S.Seifullin, – 2022. – №4(115). – Pp. 232-243. https://doi.org/10.51452/kazatu.2022.4.1253		Sharapatov T.S., Mirmanov A.B., Akilzhanov R.R.
7	Organization of corral grazing for the rational use of pastures	Print.	Multidisciplinary scientific journal of Kostanay Regional University named after A. Baitursynov 3i: intellect, idea, innovation - intelligence, idea, innovation”, No. 4 December 2022 – pp. 170-179. https://doi.org/10.52269/22266070_2022_4_170	10	Serekpaev N.A., Nogaev A.A., Ansabaeva A.A., Akyzbekova B.A.
8	Monitoring of the daily frequency and duration of rest of herd horses, using GPS tracking collars	Print.	"Science and Education" Scientific and practical journal of the West Kazakhstan Agrarian and Technical University named after Zhangir Khan, No.1-2 (70) 2023. pp. 87-98. https://doi.org/10.52578/2305-9397-2023-1-2-87-98	12	Baimukanov D.A., Aubakirov H.A., Asanbayev T.Sh., Iskhan K.Zh., Akimbekov A.R., Uskenov R.B., Sharapatov T.S.
9	Prospects and conditions for the introduction of Smart livestock technology in Kazakhstan: Farmers' view	Print.	Bulletin of Science of the Kazakh Agrotechnical University named after Saken Seifullin (interdisciplinary).- Astana. - 2023. – №2(117). – Pp. 291-302. https://doi.org/10.51452/kazatu.2023.2(117).1432	12	Orazbayeva A.S., Tokenova S.M., Mogilny S.V.
10	The growth and development of Kazakh white-headed bulls depending on their temperament	Print.	Bulletin of science of the Kazakh agrotechnical University named after Saken Seifullina (interdisciplinary).-	9	Uskenov R.B., Konja Yu., Bostanova S.K., Strelets A.V., Aqqair B.,

			Astana. - 2023. – №2(117). – Pp. 51-59. https://doi.org/10.51452/kazatu.2023.2(117).1405		
11	The use of digital technologies in beef cattle breeding In Galitsky LLP	Print.	"Science and Education" Scientific and practical journal of the West Kazakhstan Agrarian and Technical University named after Zhangir Khan, No.2-3 (71). pp. 20-30. 2023 https://doi.org/10.52578/2305-9397-2023-2-3-20-30	10	Kazhaliev N.J., Shaikenova K.H., Isabekova S.A.
12	Investigation of daily changes in live weight of bulls based on data from an experimental weighing platform	Print.	Bulletin of science of the Kazakh agrotechnical University named after Saken Seifullina (interdisciplinary).- Astana. -2023. - № 3(118). - Pp.37-46. https://doi.org/10.51452/kazatu.2023.3(118).1443	12	Tretyakov I.I., Mirmanov A.B., Uskenov R.B.
13	Modern approaches to the treatment of cattle from ectoparasites	Print.	Scientific and practical journal "Science and education" of the Republic of Kazakhstan agrarian and Technical University named after Zhangir Khana-2023. №1-3 (72), pp. 77-87 https://doi.org/10.52578/2305-9397-2023-3-1-77-87	10	Leader L. A., Akmambayeva B. E., Mukhanbetkaliyev E. E., Akibekov U. S., Mukhanbetkalieva A. A., Begmat G. A.
Publications Scopus					
1	Patterns of Growth and Development of Young Herd Horses of Eurasia	Print.	American Journal of Animal and Veterinary Sciences, 17(1), 61-65. Submitted On: 3 November 2021. Published On: 15	5	Aubakirov K.A., Kargayeva M.T., Mongush S.D., Iskhan K.Z., Baimukanov D.A.

			March 2022. The 26th percentile, Q3 https://doi.org/ 10.3844/ ajavsp.2022.61.65		
2	Creation of Smart Farms in the Herd Horse Breeding of Kazakhstan (Results of using Trackers).	Print.	OnLine Journal of Biological Sciences 2023; Q3, 41-й процентиль https://doi.org/ 10.3844/ ojbsci.2023.44.49	6	Akimbekov A.R., Uskenov R.B., Iskhan K.Zh., Assanbayev T.Sh., Sharapatov T.S, Baimukanov D.A.
3	Automatic cattle weighing on pastures with behavioral analysis during drinking	Print.	Journal of Animal Behaviour and Biometeorology, Vol.11 Issue 3 (2023), Q2, 68th percentile https://doi.org/ 10.31893/jabb.23020	7	Uskenov R.B., Mirmanov A.B., Tretyakov I.I., Bostanova S.K.
In the materials of international conferences					
1	The economic and social role of digital technologies in the growth of meat production in the Republic of Kazakhstan	Print.	Proceedings of the XXXVII International Scientific and Practical Conference "Modern ways of solving the latest problems in science". Varna, Bulgaria. - 2022. - pp. 92-96.	5	Tokenova S.M., Orazbayeva A.S., Ermakov F.K.
2	Technical and organizational problems of using digital solutions in cattle breeding	Print.	Materials of the international scientific and practical conference "Seifullin readings 18(2): "Science of the XXI century – the era of transformation". Astana, - 2022.	2	Tretyakov I.
3	Implementation of the Internado system for bull evaluation	Print.	Materials of the international scientific and practical conference "Seifullin readings - 18(2): "Science of the XXI century - the era of transformation"2022.- Vol.I, Part II.-pp.121-123.	3	Aqqair B.,
4	Microscopic	Print.	VI. International	3	Uskenov R.,

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Information for potential users: business entities of the horse and beef cattle breeding students at universities