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FEATURES OF THE USE OF ELECTRIC FENCES IN LLP «NORTH KAZAKHSTAN AGRICULTURAL EXPERIMENTAL STATION» OF THE REPUBLIC OF KAZAKHSTAN

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ «СОЛТҮСТІК ҚАЗАҚСТАН АУЫЛШАРУАШЫЛЫҚ ТӘЖІРИБЕ СТАНЦИЯСЫ» ЖШС-ДЕ ЭЛЕКТР ҚОРШАУЫН ҚОЛДАНУ ЕРЕКШЕЛІКТЕРІ

ОСОБЕННОСТИ ПРИМЕНЕНИЯ ЭЛЕКТРОИЗГОРОДИ В ТОО «СЕВЕРО-КАЗАХСТАНСКАЯ СЕЛЬСКОХОЗЯЙСТВЕННАЯ ОПЫТНАЯ СТАНЦИЯ» РЕСПУБЛИКИ КАЗАХСТАН

Abstract. *The features of the use of electric fences (electric shepherds) in LLP "North Kazakhstan Agricultural Experimental Station" of the Republic of Kazakhstan are considered. The electric shepherd was used to fence the grazing areas of cattle (cattle). An OLLI 250+ generator was used as a pulse emitter, the electric shepherd fence is made with a braided cord with a woven conductive wire made of stainless steel. Information was used on the influence of local vegetation on the operation of the electric fence, as well as its control in operation mode. Information about the habitat of other animals is provided, which affects the constructive use of electric fences. To check the passage of pulses in remote areas, an Olli Digitester+ electric fence voltage tester with a measurement range of 0.1 – 12 kV was used. The technical parameters of the equipment used are given and recommendations for its use are given.*
Keywords: *electric fence; application features; OLLI 250+; cattle; Republic of Kazakhstan.*

Аңдатпа. *Қазақстан Республикасының "Солтүстік Қазақстан ауылшаруашылық тәжірибе станциясы" ЖШС-де электр қоршауын (электр шопан) қолдану ерекшеліктері қарастырылды. Электр шопаны ірі қара мал (ІҚМ) жайылымының аумақтарын қоршау үшін пайдаланылды. Импульстік Эмитент ретінде Olli 250 + маркалы генератор қолданылды, электр шопанының қоршауы тот баспайтын болаттан тоқылған өткізгіш сымы бар өрілген сыммен жасалған. Жергілікті өсімдіктердің электр қоршауының жұмысына әсері, сондай-ақ оны пайдалану режимінде бақылау туралы ақпарат пайдаланылды. Электр қоршауын конструктивті қолдануға әсер ететін басқа жануарлардың тіршілік ету ортасы туралы ақпарат берілген. Қашықтағы учаскелерде импульстардың өтуін тексеру үшін 0,1 – 12 кВ өлшеу диапазоны бар Olli Digitester+ электр қоршауының кернеу сынағышы пайдаланылды.*
Түйін сөздер: *электр қоршау; қолдану ерекшеліктері; OLLI 250+; ірі қара мал; Қазақстан Республикасы.*

Аннотация. *Рассмотрены особенности применения электроизгороди (электропастух) в ТОО «Северо-Казахстанская сельскохозяйственная опытная станция» Республики Казахстан. Электропастух использовался для ограждения территорий выпаса крупного рогатого скота (КРС). В качестве излучателя импульсов был применен генератор марки OLLI 250+, забор электропастуха выполнен шнуром-плетенкой с вплетенной токопроводящей проволокой из нержавеющей стали. Использована информация о влиянии местной растительности на работу электроизгороди, а также ее контроля в режиме эксплуатации. Приведена информация об*

обитании других животных, что сказывается наконструктивном применении электроизгороди. Для проверки прохождения импульсов на удаленных участках использовался тестер напряжения электроизгороди Olli Digitester+ с диапазоном измерения 0,1 – 12 кВ. Приведены технические параметры используемого оборудования и даны рекомендации для его использования.

Ключевые слова: *электроизгородь; особенности применения; OLLI 250+; крупный рогатый скот; Республика Казахстан.*

Introduction. At the present stage of development and implementation of digital technologies, in response to current national economic and production tasks of agro-industrial complex subjects, it is necessary to identify, set and justify specific tasks, the solution of which will be carried out using systems and networks of information and communication technologies.

When determining such tasks, it is necessary to justify the research strategy and approaches used in the course of research (descriptive, correlational and/or experimental), and the sequence of research.

To achieve the set goals and effective practical use of electric fences, the North Kazakhstan Agricultural Experimental Station LLC (NKAES LLC) conducted research directly on the pastures of NKAES LLC, studied local vegetation and the presence of species of existing wild animals, including rodents etc. in this area.

The optimal installation points for electric fence generators, connection diagrams for pasture sections, optimal electric fence lengths and places for connecting jumpers have been determined to create a short distance and obtain the maximum level of pulses issued by the electric shepherd generator.

The necessary measurements were made, the electric fence used was installed and adjusted.

Literature review. When formulating the problem statement, a review of the necessary sources was carried out. First of all, you need to understand what an electric fence is.

Electric fencing consists of one or more bare wires, such as regular barbed wire, insulated from the ground, which are powered by a device called a controller. An animal or person who touches the wire shorts the circuit to ground, thereby receiving a painful but harmless electric shock. The wire is stretched over insulators supported by light poles at a vertical distance of approximately three-quarters of the animal's height [1].

Fences are used primarily to keep horses where managers want them and secondarily to prevent unwanted animals and people from mixing with the horses. The main considerations when planning fencing are safety, durability, security, cost and appearance. Lightweight, portable fencing can be used to create temporary enclosures for rotational grazing livestock. A strong physical perimeter fence barrier will ensure that any horses that escape onto the farm remain on the property. The pros and cons of different fence materials and styles are explained. Describes the correct construction and maintenance of fences. Discusses the management and proper use of electric fencing. Ideas for suitable gate size, location and design are provided. Horses' water needs are stated before describing methods for obtaining, storing, analyzing and moving water to where horses will drink it. Information is provided on ensuring good water quality, using different water sources, transporting water, calculating water requirements, using different watering devices, keeping the drinker clean, protecting the environment and preventing freeze damage [2].

The situation of using electric shepherd in Brazil has been studied. The Pantanal in Brazil is an important conservation area for the jaguar, Panthera onca. However, the region has the largest beef cattle population in the country. Jaguar attacks on livestock create conflict with ranchers, making conservation of the species a complex issue. We describe the use of electric fences and other management alternatives on a cattle ranch in the Pantanal, Brazil, as a measure to reduce jaguar predation. We also present an evaluation of the use of electric fences as a

deterrent for jaguars and cougar pumas in captivity at two zoological parks. We suggest that under certain conditions this method may be effective in reducing livestock depredation, provided proper equipment and maintenance are used [3].

As cattle learn to respect electric fences, it will be possible to use single electric wires as permanent fences on beef cattle farms. This paper reports two experiments. The first explored a method of training inexperienced cattle in a small yard before being released into pens fenced with single wire. The training yard consisted of a sturdy regular fence with a single electrical wire attached to it. He confined the animals to a small area, thereby encouraging them to explore, get shocked, and learn respect. After 24 hours of such training, the animals were automatically photographed each time they approached one wire in the test pen and compared with an untrained group in a similar test pen. Although not a single group of animals broke through. It is concluded that training is simple and provides a controlled period of training to increase respect for electrified wires and minimize the risk of animals breaking through when first released into pens with electrified boundaries [4]. The use of an electric fence for efficient use of feed is considered. Also considered is the “axle guard,” which was developed by UNL Extension to convert a central axis into a movable cross guard [5].

The control of electric shock in farm animals is considered [6].

The main points on precision livestock farming technology in pasture livestock systems were considered, namely [7]:

– Precision Livestock Farming solutions applied to grazing systems.

– In grazing systems, precision livestock farming can enhance livestock control and thus animal welfare.

– Precision livestock farming can help farmers make decisions, reduce workload and increase profits.

– Precision livestock farming can support research into animal behavior and rangeland conservation.

– Increasing awareness of devices suitable for livestock grazing systems may help promote their adoption.

Issues regarding the use of virtual fencing were taken into account. Fences are used to prevent overgrazing and undergrazing by herbivores. These fences can be permanent, temporary or virtual. Virtual fencing uses collar-mounted GPS devices to contain animals within a specific area. The collars beep when the animal approaches the virtual fence line. If the animal continues to move forward, an electrical impulse is applied. However, if the animal stops or turns around, it does not receive a pulse. We evaluated the application of virtual fencing to dairy cow grazing to understand how people learn virtual fencing simulations. The virtual fence kept cattle in predetermined areas most of the time (99%). However, there was significant variation between individuals in the amount and type of interaction with the virtual fence, as well as the placement of animals within the pen [8].

Now the prospects for the development of information technology in agriculture are unusually high. Some Russian agro-industrial complexes are already successfully using new farming technologies. At the moment, such as programs for calculating and optimizing feeding rations and feed mixtures for various animals, software products for diagnosing diseases of animals and crops, information systems for automating operational accounting, programs for animal breeding, geographic information systems, accounting information systems that take into account industry specifics, integrated enterprise management systems [9].

The results of similar studies in other AES were used. The research was carried out with the aim of developing recommendations for the development of new technologies and equipment in beef cattle breeding, opening up opportunities for the fullest use of the biological characteristics

of meat breed animals and reducing labor-intensive work. The object of the study is two livestock farms in West Kazakhstan (Ural AES LLC) and Kostanay (farm "SP Amanbekova A. E.") region. Based on the results of the research, the necessary instruments and equipment were purchased for these farms - clamps, scanner-readers, "smart" RFID tags, electronic scales, electric fences, electrically heated drinking bowls, a wind-solar power plant, automated machines, installations, apparatus and equipment for preparing and distribution of feed, provision of electricity for technological, veterinary and zootechnical activities. The total cost of the production potential of the model farm of Uralskaya AES LLC amounted to 89662.00 thousand tenge (tenge is the monetary unit of the Republic of Kazakhstan), of which 74450.00 thousand tenge. own funds, 15212.0 thousand tenge – raised under the project, in SP "Amanbekova" the values of these indicators were equal to 108862.0 thousand tenge, 93650.0 thousand tenge, respectively. and 15212.0 thousand tenge. As a result, the capital-labor ratio in the Amanbekov model farm increased by 54.99% and amounted to 36,287.33 thousand. tenge, the capital ratio increased by 16.24%, in Ural Agricultural Production Association LLC the growth was 50.54% and 20.43%, respectively. The planned volume of product sales for the year at SP Amanbekova is 255.3 c. meat, in Uralskaya AES LLC - 271.6 c. meat, the installation of new equipment will reduce its cost by 675.45 thousand tenge. and 710.22 thousand tenge. accordingly, additional capital investments to increase the level of automation of technological processes will pay off in 2.64 and 3.41 years [10].

The article [11] describes an improved method of keeping cows during the grazing period. Methods for increasing the calendar period of keeping cows on pastures using electric fencing are analyzed.

A developed electric fence for cows and calves on a cultivated pasture is described. The farm, along with the electric fence, moves to a new pasture once every 10-12 days. The design of an electric fence, its operation in stationary conditions and when moving around a pasture are considered. The main elements of an electric fence are: a pulse generator, a power supply, grounding and a fence. The fence consists of support posts, live wires and insulators. The current-carrying line is double-row, galvanized steel wire with a diameter of 2 mm is used. To move the farm to new pastures, the supporting and supporting posts are made on "skis". The stands are made of fiberglass rods with a diameter of 10 mm and a length of 120 cm. For electrorobotic farms, flags made of metallized (mirror) lavsan pellicle, attached to a thin synthetic cord every 0.7-1 m, are used as additional visual stimuli for animals. The fence is moved by a field farming robot, which pulls support posts behind it. Electric fence pulse generator blocks EFP-1-1, EFP -1-2 are designed to supply low-power, high-voltage electrical pulses to electrically conductive wire fencing the pasture. The EFP -1-1 pulse generator unit operates from galvanic elements. The EFP -1-2 pulse generator unit has a built-in solar battery that allows it to operate on solar energy in sufficient daylight [12]. The information in the article [13] was also useful. It outlines innovative technologies for milk production when cows are kept on pasture through the use of highly efficient, standardized electric fences.

Current situation and problem statement. The North Kazakhstan Agricultural Experimental Station (NK AES) conducts scientific research in the field of agriculture in relation to the conditions of the North Kazakhstan region in the selection and seed production of agricultural crops and introduces them into production. The station has the status of an elite seed farm.

NK AES was founded in 1956. The main mission of NK AES is the implementation of completed scientific developments in the production and propagation of original and reproductive seeds of agricultural crops [14].

Main scientific achievements of NK AES:

– scientists at the experimental station created varieties of Mogara Large-seeded 1, Chumiza,

spring wheat Ishimskaya 100, Lutescens 53, which were used by breeders of Northern Kazakhstan and are presented in the VIR collection;

– together with the Research and Production Center for Grain Farming named after A.I. Barayev, new varieties of spring wheat Soltustyk and Asyl Sapa were transferred to the State Variety Testing;

– minimal and zero moisture-resource-saving soil tillage technologies are developed and implemented using an integrated plant protection system;

– varietal agricultural technology of new zoned and promising varieties of grain crops is being developed, taking into account zonal characteristics;

– the only laboratory in the region has been created for the production of elite potato seeds on a virus-free basis using the meristem method;

– Recommendations for carrying out spring field and harvesting work have been developed, as well as an agricultural management system for the North Kazakhstan region "Resource-saving technologies for cultivating agricultural crops in the north of Kazakhstan."

The main activities of the North Kazakhstan Agricultural Experimental Station are:

– grain production with the leading food crop spring wheat;

– livestock farming with dairy cattle, developed pig farming, fine-wool sheep farming and poultry farming;

– improvement and implementation of moisture- and resource-saving technologies for cultivating grain crops with maximum use of intensification factors and natural and climatic resources of the region.

North Kazakhstan Agricultural Experimental Station is a producer of elite seeds of grains, oilseeds and leguminous crops, as well as potatoes. In addition to industrial crop areas, there are scientific plots in the fields of the station.

In 2022, the North Kazakhstan Agricultural Experimental Station begins implementation of a project to create a livestock farm based on the existing 180 heads of cattle and 50 horses for meat and dairy production [14].

Based on the history of the development of the North Kazakhstan Agricultural Experimental Station, we can highlight the main stages of its systemic affiliation:

– since 2002 – an enterprise in the system of the Ministry of Agriculture of the Republic of Kazakhstan;

– since 2010 – NK AES was part of KazAgroInnovation;

– 2012 – a breeding department for grain crops was opened, working according to the full scheme of the breeding process;

– 2020 – NK AES became part of the NC JSC "S. Seifullin Kazakh Agrotechnical University", currently NC JSC S. Seifullin Kazakh Agrotechnical Research University" (KATRU).

In 2021, KATRU scientists won a project within the framework of program-targeted financing of scientific research and activities № 9 PTF MA/21 "Development and creation of science-based Smart farms (herd horse breeding, beef cattle breeding) using various at least 3 digital solutions for each area of digitalization implementation for the current production tasks of agricultural subjects and the formation of the necessary reference database for training employees of farms and peasant farms and transferring digital knowledge to students."

In this regard, one of the main platforms for the creation of science-based Smart farms (horse herd breeding, beef cattle breeding) was NK AES. One of the issues of this project was the installation of an electric shepherd on the pastures of NK AES, its research, functionality and effectiveness of use.

Purpose and objectives of the study. The purpose of this work is to study operating modes and the effectiveness of practical application on pastures in Northern Kazakhstan.

This goal will be achieved by conducting the following experiments and analyses:

1. Analysis of the presence and monitoring of the condition of pasture lands of the farm and existing methods for identifying and mapping pastures;
2. Conducting a geobotanical survey of pasture areas to determine the seasonal productivity and nutritional value of pasture mass;
3. Monitoring of pasture lands on farms using remote sensing data (RSD);
4. Conducting a comparative analysis of ground surveys with data obtained using GIS technologies (geographic information system, GIS);
5. Determination of pasture capacity by paddock and development of a pasture rotation scheme with optimal grazing load for beef cattle;
6. Creation of a geo-portal with digital maps with visualization of bioclimatic and soil characteristics, botanical composition of vegetation, load of farm animals on pastures with detailed legends and methodological recommendations for managing pasture resources using RSD.

Practice studies. Before starting the practical research, the following steps were completed:

1. Collection of materials about the farm (land and cartographic maps, identification numbers of plots of farm land in the AIS SLC system (Automated information system of the state land cadastre), land area, breed of grazing livestock, livestock population).
2. Analysis of received materials on the farm and methods.
3. Drawing up an approximate route for surveying the pasture area.
4. Recording pasture boundaries and contours using the Garmin Montana 610 GPS navigator using GPS/GLONASS satellite data.
5. Overlaying the obtained coordinates of points on the map in the GIS center of S. Seifullin KATU.
6. Preparation of a full-fledged expedition for a geobotanical survey of the farm's pasture lands.
7. Calculations of feed shortage in the studied pasture area and the need for additional pasture area, development of an optimal pasture rotation scheme.
8. Import and adaptation of the obtained experimental data into ArcMap and ArcGIS 10.4.1.
9. Creating an electronic card.
10. Entering attribute information for each contour (pen).
11. Creation of an automated system for the transition of livestock from one paddock to another.

The next stage of research for the task was the choice of brand and model of electric fence. As a result of the analysis of the current situation of pastures and monitoring of the electric shepherd model options available on the market, the project working group selected the OLLI 250+ option (Figure 1).

Figure 1. Electric fence pulse generator OLLI 250+

Figure 1 shows the OLLI 250+ electric fence pulse generator. OLLI 250+ is a powerful electric shepherd powered by a 12 V battery for any animal. This is the most powerful OLLI model, powered by a battery with a pulse energy of 2 J. It has an LED display and is mounted on a wall or on a support. This model is equipped with a function for monitoring the condition of the fence, monitoring the battery voltage and protecting it from deep discharge, as well as four buttons for selecting the operating mode [15].

At the moment, the electric shepherd OLLI 250B+ is used on the pasture in the NK AES (Figure 2).

Figure 2. Installed electric fence pulse generator OLLI 250+ on the pasture of NK AES

Figure 2 shows the installed electric fence pulse generator in the NK AES pasture. The generator was mounted on a birch pole buried in the ground, which made it possible to minimize the costs of its mounting and operation.

Figure 3 shows a block diagram of the installation of electric shepherd generators in the pasture area.

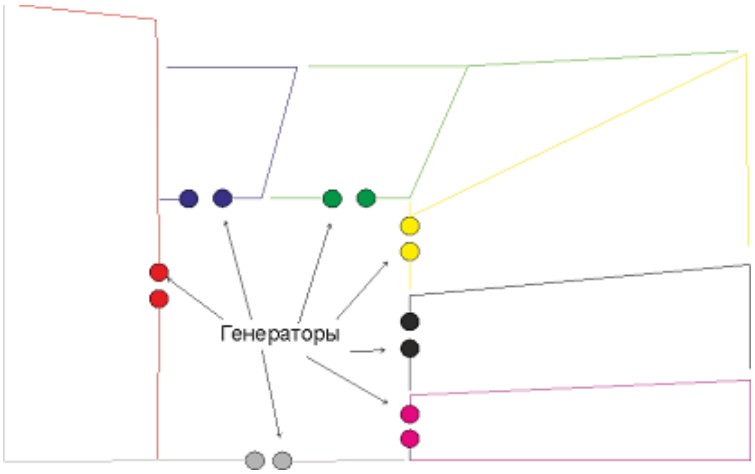

Figure 3. Structural diagram of the installation of electric shepherd generators in NK AES

Using Figure 3, you can navigate to the places where the generators were installed. A braided cord is used as a fence (Figure 4).

Figure 4. Braided cord (wire) for electric fence

In accordance with the image presented in Picture 4, it can be determined that the length of one bay is 1000 m.

Based on the set goals, a plot of natural pasture was identified, shown in Figure 5, with its subsequent transformation into a cultivated pasture by sowing perennial grasses.

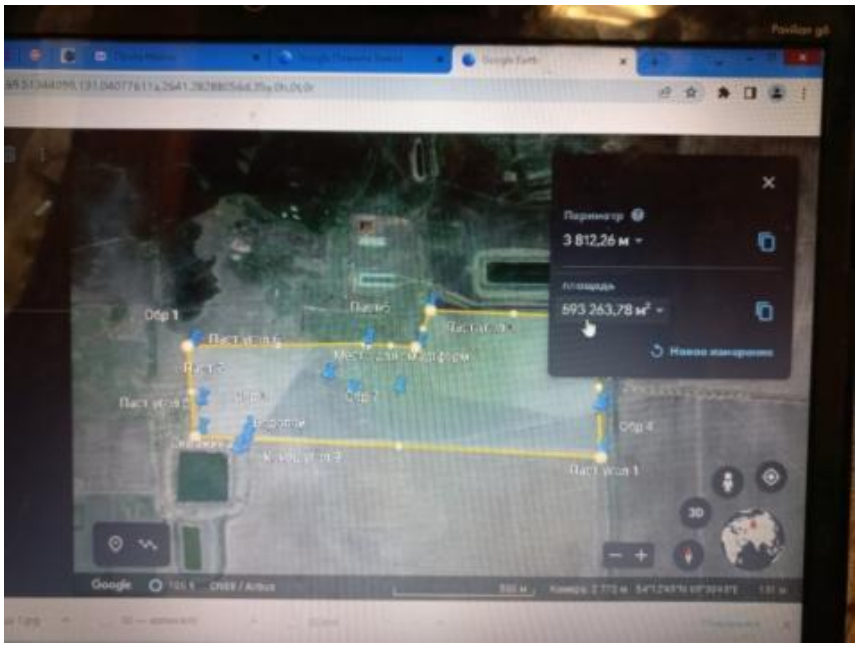

Figure 5. Natural pasture area

Using the Google Earth geographic information system, a general image of the pasture was obtained (Figure 5). The total area of natural pasture is approximately 70 hectares, next to which there are two natural reservoirs fed by wells.

To optimize the resources of natural and cultural lands for grazing animals, the existing pasture is divided into 7 sectors (pen) with individual access for daily watering of cattle.

Based on data obtained using remote sensing of the earth, a primary digital pasture rotation scheme was created, as shown in Figure 6.

Figure 6. Pen layout plan

From Picture 6 it can be determined that each sector is fenced with an electric fence to prevent the free movement of livestock and foreign animals and has its own entrance/exit to the watering hole. These sectors represent a separate paddock, each of which has an area of approximately 9 hectares with different vegetation composition and grass height. General values of areas and perimeters of pasture sectors are given in Table 1.

Table 1. Perimeter and area of pens

Corral	Perimeter, m	Area, sq.m.	Area, hectares
1	1 420	99 410	9,9
2	2 030	92 606	9,3
3	2 577	95 733	9,6
4	2 884	95 150	9,5
5	2 845	97 008	9,7
6	2 728	96 844	9,7
7	2 712	94 613	9,5

Results and discussion. Based on the research carried out on the operation of the electric shepherd, it is possible to optimize the connection diagram, which will affect the need to constantly recharge the batteries (including their number) and will affect the ease of use in general.

The Olli 250B+ electric shepherd generator has a standard connector for connecting a solar panel. It is possible to connect several generators from a common solar panel installed in the SHS, subject to the necessary technical conditions.

The Olli 250B+ generator provides an electric pulse along a perimeter of 90 km in the total length of the wires. If 2 rows are used, then 45 km, if 3 – 30 km. In this case, it is necessary to take into account the peculiarities of the appearance of unwanted elements (foxes, rodents, etc.).

Conclusions and recommendations. At the moment, there are recommendations for using an electric shepherd that affect the most necessary parameter – battery discharge. It is necessary to constantly monitor the electric fence to prevent a large leakage of current generated by the electric shepherd generator (wire tension, insulator breakage, fittings fastening). Climatic conditions create the need for constant monitoring of the electric fence, namely:

1. Wire breakage monitoring (Figure 7);

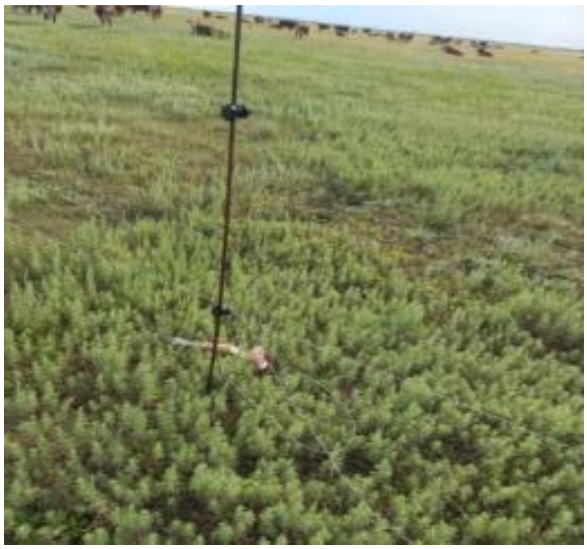

Figure 7. Broken wires

2. Closing wires and tilting fittings (Figure 8);

Figure 8. Closing wires

3. Short circuit of electric fence wires to installed metal fittings (Figure 9);

Figure 9. Shorting wires to metal fittings

4. Monitoring the condition of insulators located on metal reinforcement (Figure 10);

Figure 10. Monitoring the condition of insulators

5. Ensure that vegetation under the lower wire of the electric fence, which leads to large current leakage, is mowed. Or create conditions for its absence (Figure 11);

Figure 11. Current leakage to ground through overgrown vegetation

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