Adaptation of animal husbandry in Poland to climate change

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Temperature rise and changes in the volume, frequency, and cycles of precipitation are expected to affect various aspects of animal husbandry, including its size, efficiency, methods, and regional distribution. Irrespective of positive or negative assessment of these phenomena, the sector's adaptation needs will entail administrative works, organization, research, and investments, which all will in turn lead to increased expenditures, not envisaged in the current agricultural policy or operational programs.

Crop cultivation is prone to floods and droughts as natural risks related to climate change, whereas livestock production is immediately affected by these phenomena as well as being widely threatened by less intense climate fluctuations. Harm inflicted on livestock production by natural disasters is more direct and severe. Even mere damage to facilities can be detrimental to livestock. In the most extreme cases, flooding or long-term thermal stress can each lead to their death. In closed-loop livestock farming, i.e. including a breeding stage, natural re-establishment of production is hence impossible. In open-loop farming new stock can always be purchased, which, however, generates losses. The disposal of dead animals also needs to be coped with. From the point of view of nutrition, the use of farm-grown feed increases the vulnerability to climate risks. Reducing the reliance on the farm's own feedstuff supply, susceptible to weather conditions, can raise the production costs of monogastric animals by 30% and is utterly impossible for ruminants. In the latter case, there simply does not exist a bulk feed market in Poland. Farms only produce bulk feeds for their own needs. Although Poland's considerable reserve of grasslands is capable of sustaining bulk feed production, such a solution requires the implementation of completely new administrative and market mechanisms.

From the social perspective, all consumers and specialised livestock farmers seem to be at risk. The former ones will face temporary and eventually permanent price rises of animal products, whereas the latter ones the necessity to change their specialisations. In contrast to a manifold production, a branch of which can easily be customized, a specialized production challenged with a growing economic downturn or environmental stresses cannot be smoothly and cheaply substituted with another. Poor employment diversification in rural areas increases the risks.

Regional or even local environmental transformations resulting from climate change will affect the food processing industry and trade, and consequently the whole economy. The problem concerns small businesses, which buy their supplies on the local market. Rising transportation costs will hinder these companies' ability to compete against larger ones which can operate on a national scale.

Potential substantive losses in livestock production are presented in Table 1.

Table 1.

Item	Description	Field	Literature or expert's opinion (proven in the given report)
1.	Decrease in the population of ruminants in extensive farming	Livestock production	Due to potential droughts and torrential rains in spring, the number of small farms raising cattle has been observed to decrease, especially in mountainous regions and in Masovia.
	Decrease in animal productivity due to thermal stress – breeding, weight gains, milk yield, milk protein and fat content.		Practical husbandry experience indicates that the risk increases in summertime, especially in regard to poultry and dairy cattle.
	Deterioration of livestock's well-being and health due to thermal stress.		Extreme cases of poultry dying by thousands, increase in deaths of pigs by 10%.
	Breeds more immune to environmental stress will have increased their share in farming – facility refurbishment and stock reconstruction costs.		Increasing share of Polish cattle and swine breeds in industrial farming.
	Increased viability and infectivity of pathogens.		Standard disinfection preparations used in livestock facilities need to be replaced with dedicated ones.
	Increased feeding costs of ruminants due to elimination of grazing, declining importance of grasslands.		Phenomenon commonly occurring in highly productive cattle herds, related also to the increased feeding needs of livestock whose productivity is higher.
	Lower quality and yield of bulk feeds in areas affected by heavy precipitation.		Phenomenon observed in Pogórze (Carpathian Foothills) under heavy precipitation.
	Lower yield of forage with high watering needs, reconstruction of feedstuff base and a decrease in the competitiveness of animal husbandry in areas dealing with water shortages.		The problem concerns both dairy and beef cattle farming in Masovia. Attempts to replace corn silage with sorghum.
	Increased costs of the ventilation of livestock facilities, increased electricity consumption, necessary technological modernizations.		Supplementing natural ventilation of half-open cattle facilities with mechanical ventilation in summertime. Increasing ventilation

			costs (electricity consumption) in indoor husbandry. Equipping poultry facilities with air conditioning and pig facilities with foggers.
	Increased costs of storing animal products (farms and storage)		Increased energy consumption for the refrigeration of eggs, milk, and meat; also in farms themselves.
	Increased importance of indoor husbandry, increased costs of stalls and facility space unit		Decline in grazing in the grazing season; pastures being increasingly mowed, not grazed. Cattle staying indoors in summertime, insulating ceilings and even shelters shelters against heat, installing extra air conditioning equipment and more efficient ventilation.
	Increased loss of nutrients from solid manure.		High temperatures and increased precipitation will increase losses in manure storage and application.
	Increased water demand in animal husbandry.		All species under high temperature stress consume larger amounts of water owing to their physiology. Technically, animals contribute to water losses by splashing it in order to enhance their own thermoregulation through dermal layers.

Climate change can also entail positive effects in areas where water- and temperature-related factors have constrained the productivity of feedstuff base and livestock alike. Potential gains are presented in Table 2.

Table 2.

Item	**Description**	**Field**	**Literature or expert's opinion (proven in the given report)**
1.	Extended growing season	Livestock production	It will affect the grazing of animals and the productivity of plant species and cultivars which constitute part of the feedstuff base. The phenomenon has already been observed in husbandry practice: in some regions grazing season begins in early May and lasts through mid-October. The observed prolongation does not occur every year but can amount to 3-4 weeks. Longer vegetation will also increase some species' crop yield per area unit and will boost

			metaboliazable energy per dry matter unit.
	Lower heating costs		Owing to milder temperatures in wintertime, heating costs of poultry and pig facilities can be decreased by about 15-20%.
	Lower emissions of nitrogen compounds.		Owing to milder temperatures in wintertime, manure undergoes self-heating more easily, which stops ammonia emissions.

Adaptive actions necessary to limit the effects of climate change (at present and in the future)

As there does not exist a consolidated program aimed at all livestock production in terms of its adaptation to climate change, it is crucial that an appropriate body be established under the auspices of the Ministry of Agriculture and Rural Development. The actions of that body should focus on two aspects of animal husbandry, namely the health and well-being of livestock.

Well-being of livestock

Current assessment of the effects of climate change on livestock production leads to the conclusion that adaptive actions must be taken in order to modify the livestock keeping and feeding methods, and to update and spread our knowledge of the matter. The following actions should be taken to improve the well-being of livestock:

– **Construction of infrastructure for the monitoring of the impact of climate change on different aspects of livestock production, including its scale, concentration, distribution, costs, and the quality of animal products.**

The existing government services and agencies must use their own framework to establish units responsible for collecting and processing data on the impact of climate change as well as on potential temporary risks resulting from it. A large portion of the data is already available through Agricultural Market Agency, Agricultural and Food Quality Inspection and National Veterinary Institute. However, these services still lack administrative coordination or effective monitoring and data processing methodology. We already know the correlation between weather cycles and the quality and market supply of cereals, which further affect the livestock population and food prices. Investigating long-term trends of production indicators will allow timely introduction of mechanisms dedicated to counteracting negative structural and economic changes.

– **Supporting the provision of animal facilities and structures with technological solutions enhancing protection against thermal stress.**

The Rural Development Programme must support investments aimed at shielding indoor livestock production from climate change. Support needs to be addressed not only to semi-subsistence farms, but also to those with a high concentration of production. It is actually the ones with high stocking rates that are affected the most by thermal stress. Besides standard mechanical ventilation, the following solutions need to be considered: high-performance heat

exchangers, foggers, and full air-conditioning in extreme cases. Actions should also be aimed at improving the storage of feedstuffs and at upgrading facilities such as silos and drying rooms as well as cold stores and chillers for milk, eggs and other products. In addition, these solutions should be characterized by effective heat recovery. The level of funding for these devices should depend on the renewable energy sources used (RES) to power them.

– Supporting technologies and solutions that rationalize the use of process water and secure the supply of drinking water for animals.

Water is a key environmental factor in livestock production. In some areas, the size and efficiency of production are already limited by insufficient water supply. In areas provided with a water-pipe grid, increased water consumption for production purposes may in the future lead to competition against communal purposes, including the supply of drinking water for people. Increased air temperature results in increased water consumption in livestock husbandry. In the light of the above, for the adaptation to climate change the RDP should support actions aimed at storing water on farms, at securing independent water sources, at recovering process water and at rationalizing water use. The level of support should depend on the simultaneous introductions of waste management solutions which protect soil and water against the excess of nitrates and other nutrients.

- **Technological consulting addressing different aspects of adaptation of livestock production to the conditions of increased climatic risk.**

Insufficient knowledge of the global climatic effects on local farming is related to the relatively low level of education of farmers and to the media-raised clamour which hinders effective action. Even highly qualified experts have only recently acknowledged the detrimental impact of thermal stress. At present, many leading farms are fully committed to tackling these issues. Similar attitudes can be observed among advisory professionals. That is why the Foundation of Assistance Programmes for Agriculture and agricultural Development Funds must provide training to both advisory professionals and farmers. Training should be comprehensive and address all the issues in question, including cause-and-effect relationships. Scientific institutions should also assume the responsibility for applying proper know-how to actual production processes. Adapting nutrition profiles, microclimate conditions and other aspects of livestock husbandry should become a standard part of training organized by Agricultural Advisory Centre and voivodship advisory centres.

– Supporting research and development as well as husbandry works related to obtaining alternative nutrition patterns, adjusting the existing ones and composing feed rations for animals.

As was mentioned in the risk assessment, adaptation to climate change will entail a number of modifications in animal nutrition. Scientific institutions, R&D units in particular, should work on alternative livestock nutrition patterns, which could help keep animal products competitive and farms profitable. If necessary, new plant species and cultivars should be employed. However, native plants which for various reason have fallen out of use should be the first choice. The priority is to ensure that the economy can utterly rely on its own feedstuff supply. In order to achieve that, it is crucial that the Ministry commission and fund proper research.

The commissioning should require that research results be confirmed in practice and applied to actual production.

– Supporting research and husbandry programs aimed at selecting animals with higher immunity to thermal stress under hot temperatures.

At present livestock husbandry research is aimed at enhancing animal productivity only. Environmental aspects or the well-being of livestock are investigated superficially. In the context of adaptation, national programs should be modified not only to address the problem of genetic susceptibility to stress, but also the question of varying feedstuff quality and environmental conditions, including temperature. The more primitive native breeds as well as those foreign ones which for generations have been bred with regard for the environmental factors, provide a natural reservoir of such qualities. In order to achieve the desired genetic quality of livestock, proper research and funding will be essential at the early stage.

– **Developing mechanisms to ensure the supply of feedstuffs after the occurrence of extreme events.**

Current observations of the effects of natural disasters on livestock production lead to the immediate conclusion that a feedstuff reserve, including especially bulk but also concentrated feeds, needs to be created. Such a reserve, built up by voivodship administrations, would allow a swift reaction in response not only to a natural disaster but also to sudden fluctuations of market prices. Certain elements of the system have already been created, but they are not directly dedicated to adaptation mechanisms. A system based on administratively coordinated voivodship reserves will greatly reduce the reliance on external factors while offering high efficiency and reactivity to given needs.

– Supporting the development of RES microinstallation in reponse to the increased needs for energy in husbandry

Adapting husbandry facilities to climate change will increase their demand for electricity. In the context of the impact of the energy sector on climate change, RES are to be preferred on farms. Such an approach is in line with the assumptions of distribution generation and will greatly benefit the whole economy. For the needs of livestock husbandry, small and micro RES installations should be promoted. RDP must set out proper guidelines while the availability of funding must be facilitated and expanded in relation to the current situation. Also the RES act, which is being prepared, should include proper regulations. At present, the number of small and micro RES installations on farms is slender. In Germany only there have been installed over 6,000 agricultural biogas facilities, let alone other types of energy solutions.

New diseases affecting livestock

In terms of the health of livestock, future adaptive actions must encompass broad monitoring as well as research and development of means for diagnosing and combating new diseases.

– **Monitoring health risks posed to livestock by new diseases resulting from climate change.**

There has been evidence that some infectious diseases characteristic of warmer climates, including especially those transmitted via insect vectors, are currently being encountered in areas previously free from them. So far they have only occurred seasonally in the hottest periods, but as the climate warms up, they are likely to become an constant risk to livestock. Whether dependent on or independent of human activity, changes in ecosystems affect contact patterns between pathogenic microogranisms and their vectors as well as between germ reservoirs found in wild vertebrates and those encountered in livestock. As a result, a disease can emerge in various locations and develop various epidemiological patterns, depending on given conditions, including climate change. These patterns are often termed 'episystems.'

Clime-related livestock conditions which have never been recorded in Poland include: **Vesicular stomatitis, Peste des petits ruminants, Lumpy skin disease, Rift valley fever, Bluetongue disease, African horse sickness, and African swine fever.** Bluetongue disease (BT) provides an excellent example of how global warming affects the emergence of new episystems. Caused by Bluetongue Virus (BTV), a member of the genus Orbivirus and the Reoviridae family, BT spreads among domesticated and wild ruminants such as sheep, goats, cattle, buffalo, deer and most African antelopes. The disease can only be transmitted by vectors, in this case insects belonging to the genus Culicoides (midges). Affected ruminants do not transmit BT. The disease was first discovered in South African sheep 125 years ago. In 2000 it was identified in the European Mediterranean Basin and in 2006 in Holland. In the first half of 2008 fewer outbreaks were noted as compared to 2007, which was mainly the result of widespread vaccination against BT in late 2007. This shows that proper adaptive actions, prevention being the most effective approach, can modify new episystems caused by climate change.

Rift Valley Fever (RVF), another infectious disease, have not been observed in EU yet, though climate change provides favourable conditions for its spread. The condition is caused by a virus belonging to the genus Phlebovirus of the Bunyaviridae family. The virus is transmitted by at least 6 genera of mosquitoes, Aedes mostly, and their 30 species. It is pathogenic to humans and ruminants. RVF outbreaks are correlated with precipitation and another climatic factor – high ambient temperatures in tropical or subtropical climates.

International organizations specializing in combating infectious diseases in animals, e.g. World Organisation for Animal Health (OIE), recommend that veterinary services of countries located in the temperate zones, including those in Europe, develop early warning systems in case of an outbreak of the disease. To a large extent such systems rely on serological and virological surveys of ruminants as well as on entomological examination intended to detect RVF vectors. Animals imported from countries where RVF occurs commonly also undergo proper check-ups.

Animal diseases which are not transmitted by vectors belong to a different category of infections. According to a definition found in a EU directive Avian Influenza (AI) is an infection of poultry or other birds, caused by any influenza A, subtype H5 or H7, virus. Predicted global warming will enhance the number of birds and their mutual contacts as well as expanding their living areas. This will result in cross-infections. The number of carrier and shedder species of different sets of AI virus subtypes will thus increase. In the light of the above, the risk of poultry being affected may increase during regular migrations of wild birds

in Europe. New AI episystems may emerge following changes in the migration patterns of wild birds.

Not only do wild animals transmit new diseases, but also they spread those which have already been combated for some time, such as rabies, tuberculosis or Classical Swine Fever (CSF). Availability of water supplies will predictably be reduced, which in turn will increase the population density of wild animals. Under such conditions the mentioned pathogens will pose a permanent and widespread risk to livestock.

Besides that, temperature changes and rainfall periodicity may lead to an increased incidence of disease entities that previously occurred only locally. These are diseases which are not subject to EU veterinary legislation but still affect the health and well-being of livestock, e.g. parasitic diseases, nutritional disorders, sunstroke, dehydration. Their increased incidence will greatly impact on the economy of livestock production.

The following services are obliged by law to cooperatively monitor the incidence of infectious diseases which can affect livestock: National Veterinary Institute, Veterinary Inspection and Chief Sanitary Inspectorate.

Administrative procedures laid down in animal health codices and guidelines for state veterinary services must always be followed as they are aimed at preventing and combating infectious diseases affecting animals and zoonoses. That is why the quality of a given country's veterinary services, scientific institutions and livestock production organization plays a crucial role here.

Therefore, within their own framework, the existing services, National Veterinary Inspection in particular, must establish a unit dedicated to the monitoring of the already known and predicted pathogenic entities whose incidence will be caused by climate change. Such a unit must have all the available research and diagnostic facilities at its disposal. Its work must take into account the research carried out at National Veterinary Institute, National Research Institute and other scientific institutions. The described actions require financial backing to set up programs and purchase research equipment.

– Supporting research and development aimed at adapting the existing programs and devising new ones for animal hygiene as well as for disease prevention and treatment

In the case of identifying new disease entities or detecting changes in the patterns and spread of those already known, effective prevention and treatment methods must be developed. In order to achieve this, it is necessary to commission and fund proper research which can be conducted by scientific units of the existing services and specialized research institutions throughout Poland. Just as before, the obtained results must be confirmed in practice while the gathered knowledge widely shared with veterinarians and farmers.