

Climate Change and Livestock Production in Iraq: Pathways Toward Sustainable Development

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Abstract— Climate change poses a systemic threat to livestock production in Iraq, a sector essential for national food security, rural livelihoods, and economic stability. Rising temperatures, frequent heat waves, droughts, declining water resources in the Tigris–Euphrates basin, and increasing feed import dependency collectively threaten productivity. Empirical evidence indicates that each 1°C increase above thermal comfort thresholds reduces dairy milk yield. Especially in semi-arid and arid areas as Iraq, climate change poses a major danger to agricultural infrastructures worldwide. Developing diseases, woodland loss, erratic weather patterns, and temperature increases all negatively affect livestock longevity, productivity, and agriculture profits. This study examines the relationship between climate variability and the production of animals in Iraq, examines significant obstacles, and recommends integrated strategies that promote the Sustainable Development Goals 1 (Zero Poverty), 13 (Climate Action), and 15 (Life on Land). Research shows that increasing resilience in cow rearing requires sustainable feed and water management, improved veterinarian care, ecologically friendly practices, and supportive laws and rules.

Keywords — Livestock, agricultural earnings, climatic.

INTRODUCTION

The raising of livestock is a vital part of the Republic's agricultural sector, supporting the rural economy, cultural heritage, financial stability, and healthy eating. The livestock sector includes a range of animals, such as cattle, buffalo, sheep, goats, and poultry that generate milk, meat, wool, and eggs. Fortunately, Iraq's financial and environmentally friendly problems are getting worse as a result of climate change, which has rendered the nation's livestock industry more vulnerable. The country's lengthier heatwaves, rising average temperatures and limited water supply have affected the productivity of livestock as well as fodder output [1]. Climate change and erosion of soils further diminish grassland potential, and parasitic and diseases transmitted via vectors that threaten the

welfare of animals are also on the rise [1]. Additionally, their dependence on imported animal feed grains and the lack of proper veterinarians put small-scale farmers, who comprise the vast majority of breeders of animals in Iraq's rural, at greater risk [2]. The relationship between variability in the weather with the production of livestock has an immediate effect on the country's capability to achieve the Goals for Sustainable Development. Climate change poses serious challenges to agricultural and livestock production in Iraq, particularly due to rising temperatures, water scarcity, and land degradation. These impacts threaten food security, animal productivity, and rural livelihoods, aligning closely with the Sustainable Development Goals (SDGs), especially SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 15 (Life on Land). Given the importance of livestock systems to Iraq's economy and food supply, addressing climate-related challenges is essential for achieving sustainable development. Therefore, this study aims to analyze the impacts of climate change on agricultural and livestock production in Iraq, identify key challenges, and propose practical strategies to enhance long-term resilience and sustainability.

This study aims to Assess the environmental and economic impacts of climate change on Iraq's livestock sector.

Quantify productivity losses under temperature rise and drought scenarios). Evaluate feed dependency and climate-sensitive disease risks (WOAH, 2022; IFPRI, 2024). Propose evidence-based adaptation strategies aligned with Sustainable Development Goals (SDGs 2, 13, 15). Forecast positive outcomes if adaptation strategies are implemented, including reduced mortality and increased milk production

Climate Impacts on Livestock Production in Iraq Heat Stress and Animal Health

Overstressed animals suffer from reduced immunity, production of milk, dietary requirements, and reproductive potential as a result of increased temperatures. Warm temperatures increase the risk of serious illnesses, metabolic issues, and delayed developmental stages in animals [3]. Dairy

cattle, livestock, and other economic animals are particularly vulnerable throughout prolonged hot spells.

Water Scarcity and Feed Shortages

Iraq's supply of water had been severely strained by upstream dam construction, fewer inches of rain, and inefficient water management. Lack availability to adequate water affects the irrigation of crops and grassland development, decreasing the availability of food for animals and increasing reliance on imported feed cereal. [3]

Degradation of Rangelands

Intensive grazing and prolonged drought have caused prairies to be destroyed or severely damaged. This reduces the ability of the farmland to graze, forcing landowners to purchase larger amounts of feed and increasing farming costs.

Spread of Animal Diseases

Environmental change alters the geographical distribution of insects that transmit illnesses, such as ticks, fly species and mosquitoes. As a result, there are additionally risks to the health of people and animals through parasites related viruses, In Iraq, several outbreaks of Crimean-Congo hemorrhagic fever have been reported, particularly in central and southern provinces such as Dhi Qar, Wasit, and Muthanna, where close contact with livestock during milking and handling increases the risk of infection.[2]

Social and Monetary Consequences

Reduces in animal production affect income in rural areas, increasing vulnerability and economic hardship. Community resiliency could be undermined, accessibility to food nationwide could be threatened, and migration from rural to urban areas could be increased [2].

Key Constraints and Strategies for Resilience

Numerous administrative, healthcare, monetary, and environmental issues face the Iraqi livestock business. To create effective strategies for overcoming these obstacles, a cohesive approach is required.

The Planning Competition Suggested Resolution: Heat waves, shortages of water, and grasslands degradation are examples of natural and environmental causes. It is necessary to introduce indigenous types that are resistant to extreme temperatures and disease, such Iraqi buffalo with Awassi sheep. Utilize water-saving techniques, such as drip irrigation, and rainwater collection. Adopt suitable feeding techniques that produce drought-tolerant feed[3].

Financially: Expensive nutrition, inadequate facilities, and no assistance for entrepreneurs Encourage the production livestock locally sourced nourishment, such as hydroponically produced crops, silage, and green fodder. Establish partnerships of collaboration to promote growth in animals. Give tiny-scale farmers financial assistance as well as additional incentives.

Veterinarians and medicine: emerging diseases, insufficient veterinary treatment Improve medical equipment, such as networks of veterinarians. Establish early identification systems and monitoring infrastructures for diseases. Plan vaccination campaigns and other preventative health measures.

Organizational & Administration: Lack of a national plan, poor comprehension, and insufficient collaboration Establish consistent national animal adaptation initiatives which endorse the SDGs. enhance connections connecting research facilities

and colleges to promote sharing of knowledge Implement community-based and educational courses about sustainable livestock farming [3]

Direct Effects

Temperature is the main environmental factor affecting the productivity of animals. This is influenced by warmth, humidity, and wind movement [4]. The combination of factors that defines the most productive conditions in this area is referred to as the thermally pleasant range. Throughout this area, organisms are most productive and expend a small percentage of their individual energies [5]. As temperature rise throughout the entire area, manufacturing methods becoming less effective and more work is required to maintain the appropriate temperature [6]. Animals suffer from stress caused by heat everytime the outside temperature fluctuates more than what they can tolerate. The structural response of an animal to specific types of stress is referred to as sensitization [7, 8].

Temperature stress appears to be more harmful and has a greater effect than freezing concern [9, 10]. Furthermore, it is very possible that temperature increases brought on by change in the environment are making people more sensitive to heat and less stressed by cold. Thermal exhaustion has become the center stage when talking about stress from heat. The effects of heat stress has been demonstrated to affect mammals in experiments. [11]. Heat exhaustion occurs when animals are unable to release sufficient heat to keep their internal temperatures stable [12]. This occurrence has been shown to cause a higher heart rate, pulse, and breathing in addition to raised temperature within. This could then result in reduced feed intake, milk production, and reproductive efficacy, as well as changes in morbidity and immune system functioning. These consequences are then discussed in more detail, with an emphasis on animal performance rather than the underlying biochemical causes.

Feed Intake

Reduced consumption of food is a typical reaction to rising temperatures in the outdoors. Ruminant animals show reduced cognition, alimentary tract activity, and appetite after increased heat-induced tension [19,20]. The milking cows lower their nutritional admissions as their body temperature rises over 25–26 °C; these declines are more noticeable above 30 °C [13]. Goats appear to be less susceptible to extreme temperature stress than other mammals. However, its intentional food intake falls once the ambient temperature exceeds its comfortable thermal zone by more than 10 °C [14]. Sheep under stress from heat exhibit elevated temperature levels and a 10.9 percent decrease in the consumption of feed whenever temperatures rise around twenty and thirty five °C [15]. Despite the hogs' being exposed to temperatures that are extremely low or high, these consequences persist. Thus a result, it is thought that treatment promptly in the early hours could stop the intake of feed from declining [16].

Furthermore, decreased consumption of feed due to extreme temperatures lowers milk, meat, and egg production for all cattle types, which further reduces industrial losses.

Indirect Effects

Animal nutrition is mostly composed of vegetation and grain and oil crop commodities. The generation of such items is

affected not only by the availability of water, particularly irrigated and soil moisture, but also by temperature. Destruction of the ecosystem therefore has a secondary impact, primarily on water and feeding sources. The substantial quantity of literature that has been written regarding how crop yield is impacted by warming temperatures is too comprehensive for us to go into here, but for a summary, read Reilly et al. [17], Shukla et al. [18], and IPCC [19]. During livestock production, grains and forages provide the breeding materials that these creatures consume. From this way, environmental change affects the supply of feed for livestock, but the degree to which it affects animal productivity has not yet been objectively investigated, despite the fact that the issue is often mentioned. greater broad aspects of this topic will get covered in the remainder of this part of the article.

Let's begin by defining certain terminology. The United States Fodder and Graze Terminology Committee describes fodder as "edible parts of vegetation that may supply feed for animals that graze or that can be harvested for feeding" [20].

Plants such as legumes and grasses are both of the primary types of forage plants. In along with each of these groups, there are species of hardwood in cultivated environment. Because these kinds of plants are generally not thought of as a significant source of feed for animals at home and because the impacts of increasing temperatures and the nutritional status of hardwood varieties have not been sufficiently well examined, we are not including them in our present analysis. Two relevant papers to review are Papanastasis et al. [21] and Hejzman et al. [22].

Legumes are divided into two categories based on the structure of their leaves: summertime (C4) and cold seasonal (C3) [23]. Though the degree varies by animal species, geographic location, and livestock administration, temperature and atmospheric carbon dioxide levels alter both the amount and the grade of fodder [24]. The main impact of variations in rainfall and harsh climate variables on production variation. Supplies of water are another crucial component that is going to be discussed in more detail soon.

Although corn and millet are expected to react to the elevated CO₂ right away, these crops might unintentionally benefit from dryness. better carbon dioxide concentrations result in better yields from C3 crop varieties, which include wheat, cotton, and soybeans. Rainfall, temperature, and extreme weather conditions like drought also affect how much feed for animals is used. More precipitation is beneficial for soybeans, wheat, maize, and millet [26, 27]. Rising temperatures are more beneficial to species of C4 in terms of moisture, albeit these advantages differ according to the region, species of plants, and production process. Drought drastically reduces crop output, especially in warmer climates [28, 29]. In Iraq, drought stress has been shown to significantly disrupt wheat water use and reduce crop performance, particularly by impairing evapotranspiration during critical growth stages, leading to severe yield limitations under prolonged dry conditions. [30]. The accessibility of grassland fodder is also impacted by changes in the climate. The distribution of biomes, patterns, and traits of grassland are significantly impacted by variations in the average temperatures. Increased periods of drought combined with altered rainfall patterns might shorten the agricultural

period. Although some research argues that warmer temperatures are better for grasses than forbs and legumes, additional investigations have demonstrated that changes in temperature, CO₂, and nitrogen in the air lower the basic productivity of cattle [31].

Forage Quality

Creatures rely on forage for nourishment, and healthy diet is crucial for general mass gain, efficiency, and reproductive. Although various species of animals have varying nutritional needs and the nutrient profile of fodder differs greatly between and within commodities which supply forage, feeding livestock with the right nutrition requires finding an appropriate equilibrium. The overwhelming majority of studies on the superiority of forage have focused on the consequences of nutritional value, digestibility, voluntary utilization, and adverse characteristics [32].

Additional power is obtained for every gram every swallowed dry material (DM) from harder to digest substances. Pastoral studies generally provides nutrient content that include neutralization detergents fiber (NDF), acidity dishwashing fiber (ADF), protein from primitive origins (CP), and minerals such as calcium (Ca), phosphorus (P), magnesium (Mg), and potassium (K) [33]. Nitrate and soluble water sugar concentrations can alter as a result of increasing temperatures and dry conditions, which can affect quality [32]. The nutritional value of the feeding may also be improved by an increase in non- structural carbohydrates caused by a greater carbon dioxide level [33,34].

According to Lee et al. [35], rising temperatures lower the nutritional qualities of livestock feed, which could result in increased flatulence generation.

Water

Drinking water is under limited availability worldwide, and the degree of this scarcity is based on the amount of supply compared to demand. Agriculture accounts for 69% of global freshwater consumption, which makes it the largest importer of the resource [36]. As people grow in number, financial resources, and demand for produce from agriculture increase, the scarcity of drinking water is going to become an increasingly substantial barrier to farming for productivity. In the agricultural industry, water is utilized for consumption by animals, growing crops, and product manufacturing. Approximately 40% of worldwide water consumption, particularly 22% of all evapotranspiration (ET) from agricultural land globally, is attributed to it [37]. Increased temperatures are predicted to affect the consumption of water during animal husbandry and availability of water [38]. As temperatures rise, it is anticipated that the amount of water used by creatures and for irrigation purposes would increase per animal and per land area [39, 40]. The climate becoming more salinized due to rising sea levels is another issue [41, 42]. Enhanced agricultural practices are required to address the issue of water scarcity since cattle, crops, and other industrial uses are predicted to compete more fiercely for water in the coming decades [43].

Seasonal Variation and Extreme Climate Events

The forage supply is threatened by a greater probability of severe flooding, and adaptation Climate change might have

further effects upon animal productivity by changing the pattern of seasons and unpredictability of the output of plants and availability to supplies [44, 45]. When heat waves happen more often and linger longer, livestock will be more stressed by the heat. Knee et al. found significant seasonal changes in the amount of bovine carbohydrate in muscles [46]. Additionally, they found that early-season beef contains a greater grade and midsummer meat is of lower caliber when grasslands are rich and healthy. Additionally, changing annual changes in feed supplies may create new challenges for cattle management and grazing [47]. In order to cope with such dire situations, action is required [48].

CONCLUSION

Iraq's cow agricultural sector is facing an increasing number of challenges as a result of warming temperatures, including heat stress, water scarcity, pasture damage, and diseases that threaten output and livelihoods. Through combining environmentally friendly breeding, proper water and nutrition management, improved veterinarians, and supportive policies, Iraqi livestock farmers might become flexible and permanent providers of protein. Implementing these rules in accordance with the goals of Sustainable Development ensures the industry's sustained prosperity in addition to advancing agricultural regions and the environment.

Recommendations

1. Promote the use of ecologically friendly cattle breeds that are resilient to the challenges posed by disease and heat.
2. Use suitable agricultural and water management practices to mitigate the effects of shortages.
3. Enhance veterinary care by putting preventative and disease monitoring measures into place as soon as possible.
4. Offer small-scale farming enterprises financial incentives, training, and direction.
5. Include agricultural adaptation strategies in national environmental plans in order to meet the Sustainable Development Goals (SDGs).
6. Invest scientifically and technologically in climate-conscious animal infrastructure, like precise nutrition and computerized tracking.

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