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The Impact of Sustainable Agriculture on Animal Production, Food Security and Climate Change

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Abstract: The sustainability of agriculture is a crucial perspective for many societal parts today. Sustainable agriculture takes into account ways to lessen the effect of climate change in both branches of the agricultural sector, both environmentally and economically, starting with the farming tools or practices that all farmers use in the farm production process in order for it to be sustainable. However, in many instances, the study of sustainable agriculture focuses solely on the effects of its application on society, including all of its constituents, as well as on how it affects the environment and the economy. This neglects the main effects and importance of sustainable agriculture parallel to the effecting of climate change on animal production and food security, which are also addressed. The purpose of the study is to mention Animal Production, Food Security and Climate Change through the existence of sustainable agriculture, this study is a review article, which is based on previous research and reports. Findings suggested that applying sustainable agriculture largely influences animal production and reducing of climate change effects.

Keywords: Sustainable Agriculture, Animal Production, Food Security, Climate Change.

1. INTRODUCTION

The study briefly described scientifically how Sustainable Agriculture effects animal Production, food Security and climate change. Livestock production is increasingly challenged by the potential impacts of climate change on the supply and processing of livestock products, as well as on the quality and safety of livestock products due to pathogen or pesticide contamination and reduced nutritional quality and sensory appeal,but it should be noted that in hotter climes, increasing the nutritional value of animal diets becomes crucial. Concerns about the environment and animal welfare have an influence on these cultural achievements as well, and civil society, governmental organizations, and other institutions are increasingly supporting them. Changes in cultural standards, especially in high-income countries, are likely to have an influence on nutrition value [1,2], while the implications for the consumption of cattle products are still largely unexplored, [3] claim that temperature variations can also affect consumers' food choices. There is currently no evidence and sufficient research on whether alteration in the price of livestock products and the relative degree of price changing across goods and commodities will also affect of behavior pattern of consumption, farm stakeholders must stay in continuosly contact with agricultural researchers (research agencies) in order to understand the overall vision of agriculture in the countries. Additionally, farm stakeholders should be able to evaluate their capabilities.Threfore, this study aims to understand how sustainable agriculture provide food Security and support animal Production in existance of the climte change.

2. METHODOLOGY

The study was created based on a thorough review of the Sustainable Agriculture literature, Food Security, Climate change such as [4,7,8,9,10]. Animal production, feeding and the Climate change such as [21], however Animal production, Labor, Prices subjects based on articles such as [38,39].

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3. LITERATURE REVIEW

3.1.Sustainable Agriculture, Food Security, Climate change.

Two most important areas for climate switch intervention are cultivation and food security. Even the low end of forecasts for global mean temperatures in 2100—2C—show that agricultural productivity is extremely fragile, with significant ramifications for rural poverty and food security in both rural and urban areas. Due to the size of the land area devoted to crops and rangeland, as well as the extra mitigation possibilities offered by aquaculture, the agricultural sector also offers unexplored chances for mitigation. Numerous patterns and consequences remain highly unknown at many geographical and temporal dimensions in the existing scientific understanding of the effects of climate switch on agricultural and food chain systems, as well as the implications and results of adaptation ,mitigation and applying ; It is necessary to make significant advancements in forecasting how climatic change will impact future food security, production and safety. Regardless of these ambiguous, it is evident that the significance and tempo of anticipated changes would necessitate modification. Two main categories that overlap are used to classify adaptation actions: (1) Effective management of agricultural risks brought on by rising variability climate and extreme weather, including improving climate information services, (2)accelerated adaptation to progressive climate change over decadal time and coordination between technology, agronomy, and policies [4], in the figure below there are policy and institutional environmental sustainability ratings in time series between 2005 to 2021, the scale of sustainability value from 1.00 which is lower to 6.00 which is higher depending on World Bank data.

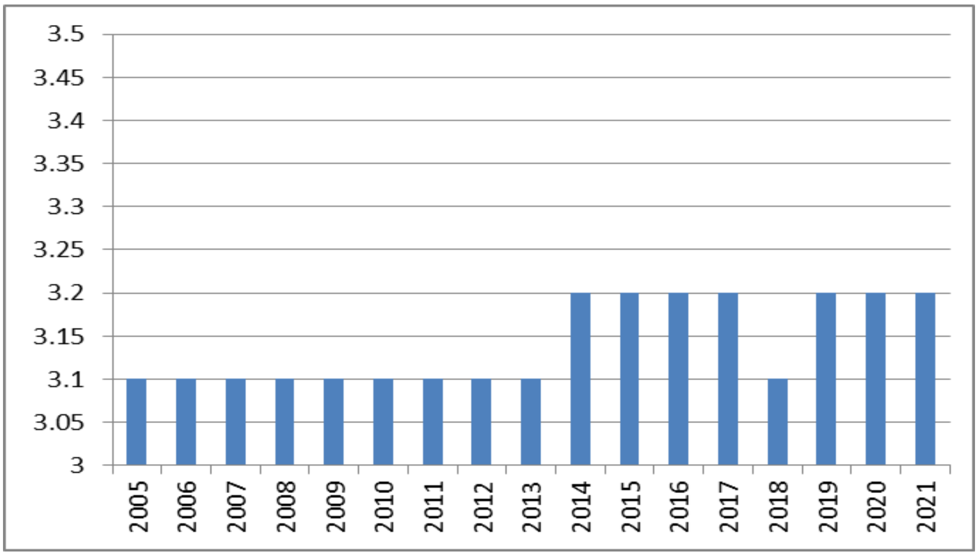

Figure 1. policy and institutional environmental sustainability in the world from 2005-2021

Decadal-scale climate change, technology, agronomy, and international policy are alternatives for farmers to improve food systems. Optimization of agriculture's mitigation possibilities, investments in technological innovation, and agricultural concentration related to higher input efficiency, such as the development of motive and monitor mechanisms that include smallholder producers and farmers. Climate change concerns to agriculture and food security request holistic and strategic strategy to merge knowledge, and realization with action. Critical components of this include increasing communication between decision-makers and academics in all fields, agribusiness, climate, and food security groups working together more, and taking into account interdependencies across whole food systems and geographies. Regardless of the uncertainty, food systems confronting climate change require an immediate response [4, 5] .

The amount of food produced worldwide has expanded in lockstep with demand, and occasionally even more so. But according to the FAO, the consumption of grain will increase by 70% by 2050 and double in certain low-income nations [6], Undoubtedly, increasing food supply is necessary to meet growing demand. However, Even in regions where food is abundant worldwide, poor people' inability to get food through markets and non-market channels may pose a threat to food security [7], For people who rely on subsistence, access to local food

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is a major determinant of food security. Access is essential, especially in terms of dietary diversity and nutrition for the majority who trade money, other goods, or labor for food, even if most food is produced through agriculture.The effects of climate change on food security should thus be studied, paying particular attention to both direct effects on local food production and a wider range of interactions with the overall food system [8,9,10] .

The world's efforts to meet the Millennium Development Goal of halving hunger by 2015 look to be in vain despite notable advancements in global food production in recent decades. According to the FAO's most recent estimate from 2009, there are now over a billion people who are chronically hungry, up from less than 800 million in 1996 [11].

The bulk of hungry people on earth reside in South Asia and Sub-Saharan Africa. These regions have large rural populations, widespread poverty, and large expanses of poor agricultural productivity because of steadily declining resource bases, constrained markets, and severe climatic risks. Due to considerable seasonal changes in rainfall and pervasive poverty, farmers and landless laborers who depend on rainfed agriculture are particularly susceptible. These countries, which are already grappling with local and global environmental changes as well as significant interannual variability in climate [12,13,14], must prioritize addressing climate change[15,16]. Changes in the mean and variability of climate, for example, would impact the hydrological cycle and agricultural output[17] as well as land degradation[18]. Conflicting demands for land, water, labor, and capital have lately increased food insecurity in many of these locations, which has increased pressure on farmers to increase output per unit of land. For instance, South Asian agriculture has lost some of its most productive locations and access to high-quality irrigation water due to rapid urbanization and industrialisation [17]. Even a 2°C increase in global mean temperatures by 2100, as anticipated by the IPCC's low-emissions (B1) scenario, will have a negative impact on current farming practices [17]. Food distribution, markets, and availability can all be impacted by climate change, notably agricultural, animal, and fisheries productivity patterns[19] . The capacity for rural and urban communities to adjust to economic and social shocks and changes is enormous, but it needs ongoing, persistent support[20]. Climate change is arguably the most severe concern for mankind as we try to feed ourselves because it will make the issues that millions of people now have with food security worse.

3.2. Animal production, feeding and the Climate change

Modern animal nutrition seeks to offer secure, superior animal-based foods with high production efficiency and little environmental impact. However, these characteristics also contribute to the complexity and rapid growth of nutrition research. The ever-growing human population's need must be met while preserving the sustainability of output from a shrinking agricultural region. According to global trends, the following problems will affect animal nutrition in the twenty-first century: Animal agriculture needs to be more aware of and active in order to meet society's expectations for adequate quantities of high-quality, safe food[21,22]. Animals raised for food have different energy and nutritional metabolisms depending on the environment. Climate change is causing an increase in the average global temperature, and in some parts of the world, extreme weather events may even occur. This necessitates a study of feeding tactics for climate change, including as nutritional adjustments and feeding under stressful cold and hot weather conditions.

According to recent studies and model predictions, the Earth's average temperature is rising, which will have a substantial influence on agricultural productivity[23]. However, many sections of the world are expected to see more frequent storms and temperature fluctuations between hot and cold due to climate change. Along with the feed crop sector, it appears logical to predict that the cattle industry will develop new tactics and solutions for maintaining and even boosting output potential in the face of changing climatic circumstances. Given the increasing need for food from a growing human population, it is imperative to create an action plan[21]. Because the ambient temperature has a significant influence on the energy metabolism of farm animals that produce food, it is essential to get familiar with the principles of livestock production, particularly with the processes associated to the consumption of dietary energy.

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For this reason, the concept of the thermo neutral zone, its importance, and how animals control their body temperatures are briefly explained below. Heat production, or the total of an animal's inefficient energy use and the energy "lost" during the processing of food, is connected to physiological processes. The nonproductive energy is utilized for maintenance, which entails that it supplies the required energy for a number of crucial physiological functions, including ion pumping, controlling body temperature, the nervous system, and organ function [21]. Heat increment is the total amount of heat generated during metabolism, excretion, and digesting. The animal regularly produces a given amount of heat within a specific range of ambient temperature in addition to regular feed and nutrient intake. The thermo neutral zone refers to this range of temperatures. The animal produces the least heat in a thermo neutral environment, enabling the optimum use of dietary energy for production (growth, milk production, and egg) [21] .

Unfavorable temperatures—whether they are too cold or too hot—cause an animal to create more heat, which lowers the efficiency of energy consumption since there is less energy available for production at the same amount of energy intake. The animal expends more energy as a result.

Unfavorable temperatures—whether they are too cold or too hot—cause an animal to create more heat, which lowers the efficiency of energy consumption since there is less energy available for production at the same amount of energy intake. The animal expends more energy as a result, These illustrations show how, as the lower critical temperature rises and the higher critical temperature falls, the animals' comfort zones contract in situations of high humidity. Farm animals can use dietary betaine supplementation, low-protein diets with synthetic amino acids in accordance with the optimal protein concept, and fat supplementation to minimize their total heat generation. High-fat diets lessen the animals' overall output of heat since fat generates the least heat when compared to other nutrients, whether it is stored as body fat or consumed as energy [21].

Thus, adding fat reduces feed rejection, which is crucial for production capacity. Including fat in the diet also improves the energy density of the diet since fat sources (both of plant and animal origin) have a significantly higher energy content than other nutrients and complicated feeds. An amino acid pattern with precisely calculated ratios of the essential amino acids, given as a percentage of lysine, is referred to as a "ideal protein." Even though feed intake somewhat decreases beyond the highest critical temperature, the energy demands of the animals can be accurately met by incorporating fat in their diet. The optimum protein's amino acid composition changes somewhat during the course of an animal's life based on the animal's degree of production. The conversion of amino acids and nitrogen excretion are at their lowest levels when meals are scheduled using the optimal protein concept. Extra amino acids that, due to a limiting constraint, cannot be used to build proteins (such as a limiting amino acid, energy supply or genetic potential).

When compared to other nutrients, amino acid oxidation generates the greatest heat, which adds to the overall heat production. As a result, the heat increase is greater when there are too many amino acids in the diet. If the diet's protein content meets the animal's protein needs and the number of amino acids that can be digested in the ileum is in accordance with the optimal protein concept, the heat rise from protein metabolism will be at a minimum [21].

Betaine (trimethylglycine), a choline catabolic intermediate metabolite, can alter osmolarity, act as a methyl donor, and perhaps have lipotropic effects. [24] discovered that dietary betaine supplementation (1.23 g/kg) decreased the overall heat output of pigs in thermoneutral circumstances. The glutathione-peroxidase system's antioxidant defense may utilise betaine, a methyl donor, to successfully halt the loss of cell water retention. When pigs and poultry are experiencing heat stress, betaine should be supplemented to their meals according to study [25].

A dilemma emerges over how feed should be prepared for species that require high amounts of dietary fiber, such as gestating sows and ruminants, given that dietary fiber increases the heat generation of the animals. Pregnant sows are kept from gaining weight, which may otherwise result in health issues and insufficient milk supply during lactation. Instead, they consume a diluted (low calorie) diet with a high fiber content. The addition of indigestible fiber sources in the diets of gestating sows may be advantageous at high temperatures because, according to research by [26], the overall energy cost of consuming and excreting indigestible material

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in developing pigs is relatively low, It may thus be useful at high temperatures to include kinds of fiber that are harder to digest in meals for gestating sows. Strong dietary fiber delivery in the daily ratio is crucial for healthy rumen fermentation in ruminants.Given the link between food metabolizability and energy consumption effectiveness, it is advised to give ruminants high-quality forages and other forms of highly digestible fiber while they are under heat stress. As a result, the cows will produce a little less heat than cows fed with subpar forages. It's likely that in the meantime, the harsh weather conditions would make it difficult to grow high-quality forages without utilizing specialized agricultural methods, which would raise the price of such forages.

The importance of legumeous plants and drought-tolerant grasses (such brome grass, tall fescue, crested wheatgrass, etc.) increases. Although new varieties of grass would likely be employed, the socioeconomic effects of climate change are more apparent in the flora of pastures for grazing animals [21]. This calls for collaborative research efforts between plant breeders and animal nutritionists.

The amount of feed rejected when animals are under heat stress and its impact on animal performance were covered in the sections above. The animals' needs for high production potential and high-quality food production will be satisfied by the nutrient supply if the decline in feed intake can be stopped or avoided.

3.3. Compensating for reduced nutrient supply

In hot regions, it is desirable to provide animals more concentrated diets that contain significant amounts of easily digested nutrients since heat stress inhibits feed intake and nutrient digestion. This needs to be accomplished by making use of the various feed production options (hydrothermal treatments, micronization), as well as by increasing vitamin and mineral consumption and maybe improving their bioavailability.In order to increase the bioavailability of nutrients, it may be possible to increase absorption of nutrients as well as the ileal digestibility of nutrients in the small intestine (e.g., using organic trace elements). In table 1 some enzyme dietary supplements can enhance the ileal digestibility of nutrients like amino acids, carbohydrates, calcium, and phosphorus. However, it is advisable to use dietary enzymes that are specific to the substrate in accordance with the amount of feed (such as phytase, xylanase, and -glucanase) [21].

Table 1. Amino acid composition of ideal protein as a percentage of lysine for growing and finishing pigs, source[21].

	Body Weight Range		
Amino Acids % of LYS	5-20 kg	20-50 kg	50-100 kg
Lys	100	100	100
THR	65	67	70
TRP	18	19	20
MET + CYS	60	65	70
ILE	60	60	60
LEU	100	100	100
VAL	68	68	68
HYS	32	32	32
PHE + TYR	95	95	95

Environmental protection factors make it desirable to employ techniques that increase nutrient bioavailability and digestion. The environmental impact of animal husbandry can be reduced through increasing nutrition conversion and digestion, as well as correctly addressing the needs of the animals, however, that improving the nutritional value of animal diets becomes crucial in warmer regions[21].

3.4. Animal production,Labor, Prices

More and more people are becoming concerned about the social legitimacy of the livestock industry due to the potential effects of climate change on the supply and processing of animal products, as well as on the quality and safety of animal products due to contamination with pathogens or pesticides, decreased nutritional quality, and sensory appeal. Concerns about the environment and animal welfare also have an influence on these cultural achievements, and as a result, civil society, governmental entities, and other institutions are supporting them more and more,changes in cultural standards, especially in high-income countries, are likely to have an impact on diets [1].

While the ramifications for the consumption of cow products are yet largely unknown, research suggests that temperature changes might also affect consumers' food choices [3]. The relative magnitude of price changes across commodities and variations in the price of animal products will both have an impact on consumption patterns [27] [28].

These changes will depend on the dependability and accessibility of the products as well as the expenses of the supply chain. Depending on how rapidly the gross domestic product expands, which is influenced by climate change, different consumer spending habits will emerge [29]. Engel's Law and [30] claim that as income increases, the proportion of money spent on food tends to decrease. Since value-added processing, packaging, and branding increasingly determine the price of food, it is possible that as supply networks get more complex, the sensitivity to prices for fundamental commodities may also decrease. For instance, in the European Union, the agricultural component of the value added to food decreased from 31% in 1995 to 24% in 2005 [31]. The productivity and labor availability are important factors in determining how effectively the cattle supply chain operates, this is particularly true in less developed areas without a mechanized economy. However, as discussed in earlier research, a wide variety of direct and indirect consequences of climate change can impair human performance and health [32,33] climate change, floods and storms, UV radiation, diseases, air quality, nutrition, work-related health, mental health, violence, and conflicts are some of the effects that are mentioned. For instance, in 2010 more than 7% of the worldwide burden of disease was attributable to the inhalation of climate-altering pollutants other than CO_2[33]. Below, we go into further depth about two major factors affecting labor productivity that affect agricultural workers particularly: illnesses and extreme heat.

In 2019, the International Labor Organization[34] at 24-26 °C, labor productivity starts to decline; at 33-34 °C, a worker exerting moderate effort loses 50% of their work capacity. Furthermore, being exposed to extreme temperatures can have potentially fatal repercussions such as heatstroke. In hot places like Asia and the Caribbean, productivity may decline by 11-27% by 2080, and by 2050, high-intensity job productivity may decline by as much as 31%-38% (RCP 4.5-RCP 8.5) in Southeast Asia and the Middle East compared to a baseline 2050 without climate change[35,36]. For human activity, 30 to 40 percent of the year's daylight hours in some areas will be too warm [37].

Agriculture-specific literature emphasizes the difficulties of performing physical labor in hot conditions, with dehydration frequently being the primary factor in decreased labor output [38,39] . As noted in [40], heat stress is a particular problem in production systems that depend on high inputs of human labor and are situated in existing hot locations, such as smallholders in sub-Saharan Africa, in certain nations, like the U.S., a significant portion of the agricultural labor force consists of foreign laborers, who are particularly vulnerable.

Foreign farmworkers frequently don't understand the native tongue, have poor earnings and education levels, and have restricted access to healthcare because they may have entered the country illegally. They frequently feel powerless in the job and are hesitant to voice concerns about dangerous working conditions. As of [41] climate change affects more than just heat stress; workers who work in the livestock supply chain also run the danger of contracting cholera, bluetongue, borreliosis, salmonellosis, dengue fever, and tick-borne encephalitis [42,43,44]. For instance, in Sub-Saharan Africa, leptospirosis outbreaks are made worse by prolonged periods of heavy rain and high temperatures, which simultaneously encourage the growth, transmission, and dispersal of the malaria-causing Plasmodium species [45,46].

In areas with insufficient access to water and sanitation, flooding increases the likelihood that residents may get cholera and salmonellosis. On the other side, Australia's dry climate and extended droughts have aided in the spread of Q-fever since the disease-causing bacteria Coxiella burnetii may thrive and travel long distances on dust particles mixed with animal or birth fluid feces [47]. According to reports, rising cow populations are

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associated with warming temperatures in northern latitudes, which encourages the spread of anthrax [48]. Climate change raises the danger of zoonosis, and people who often contact with animals and nature are more susceptible to zoonotic infections [49].

The aforementioned climate-related problems with resource availability and consumption levels may raise the costs of water, feeding, housing, storing, transporting, retailing, and insurance, which negatively affects parties participating in the supply chain for livestock. The price of cereals will rise by 29% by 2050 along common socioeconomic pathways under climate change, according to a collection of crop and economic models that take into account various representations of the world's food supply and associated assumptions (such as those pertaining to technological advancement, land-use regulations, or consumption habits) [50] . As a result, food prices would rise for consumers over the world, with regional variations in the effects.

The impacts of climate change on animal products are mostly visible through changes in the price and supply of feed, as seen by the predicted price increases for animal goods, which are expected to be around half that for grains. These results also show the feed substitution potential of the livestock business. Most climate research has placed more emphasis on price levels than price volatility. However, it is expected that food costs would be more fluctuating as a result of climate change given the rising regional and temporal fluctuation in production and supply chain efficiency [51] .

Regional trade, i.e., trade between Europe and the Mediterranean Basin, North America, etc., dominates the international agricultural trade system, and while a few major international exporters control trans-regional trade (e.g., soybeans from Brazil, maize from the US, rice from Southeast Asia, lamb from New Zealand-lamb, etc.) [52] , major shocks to these large producers might sharply increase the volatility of global markets and drastically decrease the reliability of those markets. Additionally, it could affect national supply-protection regulations that make food shortages worse [53], Undisturbed topsoil perimeters and catchment regions should be planted with high-value crops that are drought-tolerant and do not require significant irrigation water. To reduce initial expenditures, low-cost replacement materials may be employed to construct runoff interceptors. Runoff interceptor maintenance should be done on a regular basis. Use high-value, off-season, and low-water-requirement crops for agricultural cultivation in terraced regions. Undisturbed topsoil perimeters and catchment regions should be planted with high-value crops that are drought-tolerant and do not require significant irrigation water. To reduce initial expenditures, low-cost replacement materials may be employed to construct runoff interceptors. Runoff interceptor maintenance should be done on a regular basis. Grow high-value, off-season, and low-water-requirement crops [54], To advise local producers of agricultural goods on the required drivers to construct a sustained industry-viable product to reach a bigger market and become a rural development driver, a suggested complete framework for sustainable rural development strategy was developed [55] .

4. RESULTS AND DISCUSSION

Understanding the importance of sustainable agriculture, how climate change affects animal output, and how this affects food security were the study's main objectives. Researchers think that these elements jointly impact animal production and food security due to the amount of the land area devoted to crops and rangeland, extra mitigation chances afforded by aquaculture, and the agricultural sector's enhanced capacity for mitigation. This operationalization of sustainable agriculture includes sustainable agriculture equipment. The study's conclusions support and agree with those of [4] that substantial improvement is needed in forecasting how future food security will be impacted by climatic variability and change. The reasons for this are because many geographical and temporal dimensions of the impacts of climate change on agricultural and food systems, as well as the implications for adaptation and mitigation of numerous trends and consequences, are highly unclear. Given the extent and speed of the anticipated changes, it is clear that adaptation would be required despite these uncertainties. The two main categories of adaptation strategies are (1) effective management of agricultural risks brought on by increased climate variability and extreme weather events, such as better climate information services and safety nets, and (2) accelerated modification to progressive climate change over decadal time scales, such as integrated packages of technology, agronomy, and policy solutions. There is no question that food systems affected by climate change require an immediate response, but the researchers believe that

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increasing interactions between policymakers in Ministry of Agriculture, Ministry of Environment, Farmers Syndicate, Agricultural Engineers Syndicate, Agricultural Research and Extension Institutions, Scientific Research Institutions and researchers in all fields, fostering collaboration between the agribusiness, food security, and climate communities, and taking into account interdependencies across entire food systems and regions are crucial components of this on the basis of [4,22].

The study shortly described scientifically the environmental variables make strategies that promote nutrition bioavailability and digestion attractive, the environmental effect of animal husbandry may be decreased through improving nutrition conversion and digestion, as well as properly meeting animal demands. It should be mentioned, however, that in warmer climates, increasing the nutritional value of animal diets becomes critical.

The livestock production is under increased scrutiny due to the possible impacts of climate change on the supply and processing of animal products, as well as on their safety due to pesticide or disease contamination, decreased nutritional value, and sensory appeal. Concerns about the environment and animal welfare have an impact on these cultural developments as well, and civil society, governments, and other institutions are increasingly supporting them. Particularly in high-income nations, changing societal norms are likely to have an influence on diets [1]. According to [3], temperature variations can also influence consumers' food choices , while the implications for the consumption of cattle products are yet largely unexplored, and if the Consumption patterns will also be affected by changes in the price of animal products and the relative degree of price changes across commodities ?, however there is no proofment currently ,an not adequate researches related to that. The study's potential value to the agriculture sector cannot be overstated; the findings have important implications for agricultural management and stakeholders. In order to understand the entire picture of agriculture in the countries, farm managers must first have frequent communication with agricultural researchers (research organizations). Farm stakeholders must be able to evaluate their own capacities in light of the data they obtain from research organizations. Although there is no desired outcome with regard to climate change, it is crucial for stakeholders to figure out how they can incorporate that dimension to the overall benefit of the agriculture in the countries. There should be a national consensus on how sustainable agriculture tools can be implemented to maximize the overall benefit, increase the cooperative efforts of farmers, food suppliers, and food exporters in order to effectively achieve sustainable agriculture. The ministry of agriculture and rural development provides farmers with greater support in order to encourage them to embrace sustainable farming practices, This assistance could come in the form of loans, grants, or other types of payment. Farmers must be consulted with the need for a sustainable agricultural trend that takes into account food production, climate change, and profit. Farmers' thoughts on the need of staying current with agricultural developments in connection to sustainable agriculture should be taken into consideration, Farmers should engage with universities regarding research and development in sustainable agriculture.

5. CONCLUSION

This study investigates the role of sustainable agriculture in enhancing animal production and food security with presence of climate change. Sustainable agriculture systems provide food security and food independence for the planet. The study's potential value to the agricultural industry cannot be overstated; the conclusions have important ramifications for stakeholders and agricultural management. To achieve food security at a time of climate change, the agricultural sector needs to undergo a profound transformation. This study also show that all of these efforts will have a more significant impact when governments and regional bodies enact policies that promote sustainable farming. To begin with, in order to have a thorough grasp of agriculture in their different countries, farm managers must maintain constant connection with agricultural specialists. Although there is no desirable consequence from climate change, it is crucial for stakeholders to figure out how to include that aspect into the overall advantage of agriculture in the country. Increase the cooperation between farmers, food suppliers, and food exporters in order to successfully implement sustainable agriculture. Farmers should also communicate with universities about research and development in sustainable agriculture. Finally, farmers' perspectives on the importance of staying up to date with agricultural trends in relation to sustainable agriculture should be heard. Loans, grants, and other types of help are possible sources of this support.

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