Ecofeminism and Climate Change (EFCC)

DOI: http://doi.org/10.26480/efcc.01.2023.06.12

ISSN: 2633-4062 (Print)
ISSN: 2633-4070 (Online)
CODEN: XXXXXX

REVIEW ARTICLE

CLIMATE CHANGE AND ITS IMPACT ON GLOBAL CEREAL PRODUCTION: REVIEW

Faiz MMT Marikar

Staff Development Centre, General Sir John Kotelawala, Defence University, Ratmalana, Sri Lanka.
**** Corresponding Author Email: faiz@kdu.ac.lk***

ARTICLE DETAILS

Article History:

Received 04 January 2023
Revised 15 February 2023
Accepted 21 March 2023
Available online 23 March 2023

ABSTRACT

Climate change badly effect the farming community which will lead to breakdown of the backbone of sustainable agriculture. Furthermore, the risk will play a major role when it comes to agricultural production in most countries and leads to lack specific strategies to overcome such situation. Furthermore, in most regions of the world there is a lack of research to understand the factors shaping farmer adaptation to climate change and the institutional links between farmer resilience. This study looked at climate change and its impact on global grain production. The results show that most farmers implementing climate change adaptation strategies are strongly linked with their inherited knowledge. Mostly it was affected to peasant farmers with low income. How will climate change impact the world's food supply and how will its impacts be distributed? Increased or decreased food security risks? Findings suggest that agricultural advisor services are keeping them in the industry, introducing new forestry programs to capture carbon and ultimately reducing urbanization processes suggest that it is necessary to increase grain production.

KEYWORDS

climate change, Cereal production, food security, cereal quality, consumer preferences

1. INTRODUCTION

Industrial agriculture plays a big role in the countries economic sector. This business is practiced worldwide from the inception, with business farmers using available inputs to get high yield (Kabir et al., 2018). Agriculture industry plays an important role and contributes to countries development and also has a role and importance in developing countries, but most cultures depend on a particular region and local climate for the industrial agriculture (Yu and Wu, 2018). In current situation bad weather and bad climate are indicators in global warming. Global climate change poses a huge issue to agricultural activities and is crucial for the sustainable development of countries (Hasegawa et al., 2018). As a result, climate change will have a major impact on agricultural production, affecting soil and water resources through changes in temperature, rainfall, and floods Figure 1 (Anderson et al., 2020). Technological progress in countries like Africa and Asia is expected to reduce the impact of climate change on agricultural production.

It was witnessed that irregular rainfall patterns and rising temperature will leads to significant impact on the production (Clapp et al., 2018). Climate change is not localized issue, it is indeed a global issue (Hristov et al., 2020). Developing countries are mainly agricultural countries in direct contact with nature, which have a major impact on the economy. The climate of the region is conducive to produce wheat, cotton, corn, rice and (Raza et al., 2012). However, wheat is a particularly important crop in this region due to high consumption, demand and, above all, current climatic conditions (Crost et al., 2018). Most research on food availability focuses on increasing agricultural production (Aryal et al., 2020). Climatic (long-term) and meteorological (short-term) factors affect agricultural productivity (Parker et al., 2019). For example, in 1987 Pakistan, India and Bangladesh experienced a sharp decline in agricultural production due to poor monsoons, forcing India and Pakistan to import food (Hussain et al., 2020).

Tropical and subtropical countries are the most vulnerable to climate change due to rising temperatures, minor deterioration of water quality and crop damage. Climate change will increase the vulnerability of agriculture in the form of floods and famines and cause socioeconomic losses to countries (Mundia et al., 2019). Studies have shown that Pakistan needs to increase domestic food production to become self-sufficient and climatic effects alter plant maturity (Fahad and Wang, 2020). Degradation processes may affect soil fertility, frequent pest infestations may be high, fewer crops are grown each year, harvest time is longer, climate change may reduce irrigation use and availability of water (Flörke et al., 2018). It had found that important determinants of agricultural productivity are climatic factors such as extreme events such as rainfall, heat, floods, droughts and hurricanes, which directly affect livestock and crops (Biemans et al., 2019).

Wheat was a domesticated food 8,000 years ago and was a staple food for people in Europe, North Africa, and Western Asia (Scheelbeek et al., 2018). Today, wheat is grown and harvested on more land than any other crop and is an important source of food for humans (Qin et al., 2020). A recent research project estimates that wheat production in South Asia will decline by 50% by 2050, accounting for about 7% of the global total (Jaggard et al., 2010). Wheat yields increase under different moisture conditions ranging from heterogeneous to coastal environments (Hristov et al., 2020). Optimal production requires a sustainable water source throughout the growing season. However, excessive rainfall can reduce yields due to root problems and adult pests (Borrelli et al., 2020).

Varieties with very different lineages grow in different climates and soil conditions and show great differences in their traits (Koubi, 2019), but wheat is grown all year round in different parts of the world, from April to September in the northern hemispheres temperate and October to January Southern Hemispheres (Hoegh-Guldberg et al., 2019) is irreversible and requires global policy change and sustainable agriculture to reduce and reverse long-term environmental damage. The main objective of this

Quick Response Code	Access this article online	
	Website: www.efcc.com.my	**DOI:** 10.26480/efcc.01.2023.06.12

Cite The Article: Faiz MMT Marikar (2023). Climate Change and its Impact on Global Cereal Production: Review. *Ecofeminism and Climate Change, 4(1): 06-12.*

review is to evaluate the impact of climate change on the expected yield of major cereal crops. In addition to promoting the diversification of millet crops, various solutions have been proposed, especially in food-risk areas.

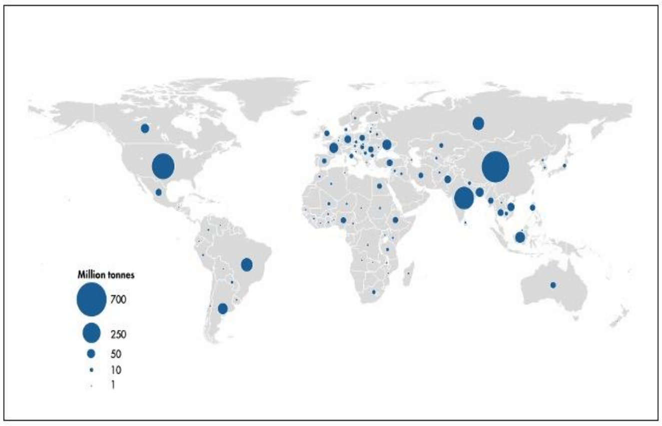

Figure 1: The production of cereals crops all over the world in the year of 2019 (Source FAOSTAT, 2021).

2. CLIMATE CHANGE AND CONSTRAINTS TO CEREALS AND FOOD SECURITY

FAO estimates that 1.2 billion people died of extreme hunger in 2009, the highest level of hunger ever recorded in the world, largely due to declining investment in agriculture (Janssens et al., 2020). It is estimated that by 2050, 8-20% of the world's arable land will be unproductive due to land degradation (von Grebmer et al., 2019). Real issue with water availability and less water and need to increasing food production by 50% to meet the needs of the projected world population by 2050 already a daunting task. Increasing floods/droughts in Asia make the situation even more difficult. 25% of global food production is affected by increased global climate change and issues arose due to irrigation. Frequent flooding causes and it effect badly lives and livelihood (Figure 2).

Not all agriculture products can landmark for food security, because it must be safe and nutritious. Furthermore, food has a social value closely linked to the harvest, transport and receive to end user value chain. Groceries should be readily available, convenient, and available in the quantity and format of your choice. It depends not only on infrastructure, but also on the mechanisms of production, distribution and trade. In Northern Europe, it promotes viral infection to accelerate potato seed establishment, contaminates soil, and reduces the value of apple production, especially during warmer temperatures early in the season (Mbow et al., 2019) . Aphids prey on a variety of insects, including bees and ladybugs, but whether predation is increasing at a similar rate to limit the problem is unclear. Furthermore, Affid is a clone whose insecticide resistance can mainly be monitored in cold northern regions. In temperate climates, highly variable and robust sex populations may be favored, exacerbating producer problems (Mukhopadhyay et al., 2021).

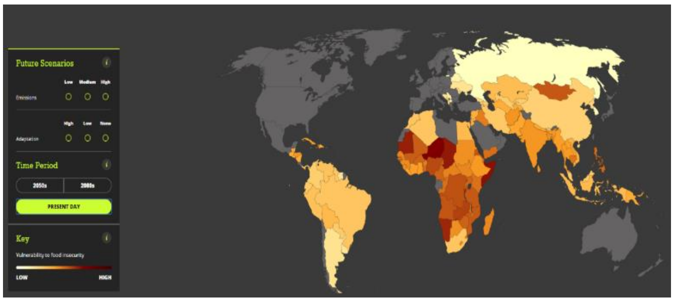

Figure 2: Food insecurity and climate change

Soils are made up of complex body ecosystems with many biological processes, each of which is affected differently by climatic parameters (Leisner, 2020). This directly affects the growth and development of plants. The impact of crops on the environment. These include effects of the culture itself on root and shoot structure (Leisner, 2020). The pathogen Ceratobasidium (Rhizoctonia) cerealis can reduce severity under minimal culture conditions, possibly due to potentiation of natural antagonists (Benites-Lazaro et al., 2018). However, these factors are highly dependent on specific soil conditions, and it has been attributed to climate change.These changes result in changes in plants that directly or indirectly affect the food supply, for example through changes in the number or severity of pathogens and pests (Fones et al., 2020).

Using ample watering, whether direct irrigation or seawater infiltration, can lead to salinity issues in plant growth, but calcium has a direct impact on plant yield because it is associated with pests, pathogens and beneficial microbes. There are also many indirect effects due to their impact on regulatory interactions (Özerol et al., 2020). For example, spores of plant pathogens become more infective under water or salt stress (Borburema et al., 2022). Additionally, stress on drought and cold mitigation may influence the development of disease resistance (Hernández, 2019). Therefore, it is important to consider not only the influence of the culture as a host infection by insects on these interactions, effectiveness of defense mechanisms.

It is evidence that many nutrients influence development of disease but are indirectly affected by adverse weather and deficiencies in some shellfish (e.g. potassium defense pathways, such as the phosphate pathway) are harmful and differentially impact on climate change (Hernández, 2019). In particular, nitrogen nutrient use efficiency, another trait associated with plant growth, is high genetic diversity and significant interaction with the environment (Lloyd and Shepherd, 2020). Modern reproductive that directly affects the fertility of the and it is unclear how further complications of climate change will affect this: yield losses are associated with different types of necrosis. The same is true for biological and biotrophic organisms, the relationship is still "and temperature". Do drought and heat stress have the same effect? It may be specific to a particular culture, environment or agricultural system (Mekis et al., 2018).

The traits required for plant adaptation to the pathogenic threats of climate change are generally grouped into resistance. Environmental ecosystem communities these must be acquired through the normal processes of natural selection, but agricultural systems can favor other traits and lose their functional diversity when plants grow in internal competition (Suryanarayanan and Shaanker, 2021). In such monocultures, widespread pathogen spillover can occur due to the use of key pathogen resistance genes, it different communities this is stable and can lead to sexual behaviors (Menzel et al., 2020). Strategies to increase the resilience of arable crops will therefore generate greater genetic diversity within and between cropland areas in response to the abiotic and biotic stresses they face. It is necessary to mimic a broader genetic basis (Figure 3).

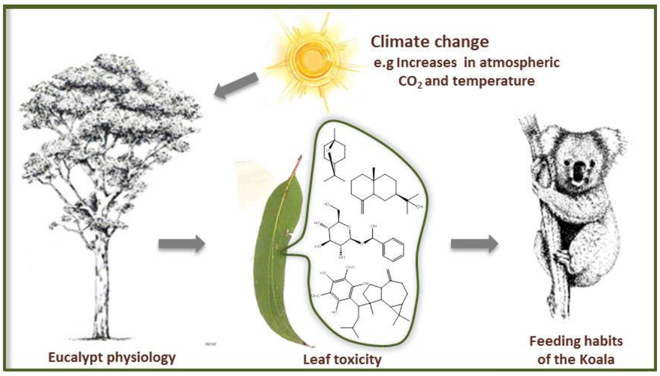

Figure 3: Plant adaptation and Climate Change

The growth cycle of plants has been altered to increase yield compared to wild plants. It's easy to infect the plants by pathogens (Holopainen et al., 2018). It can lead to loss of tolerance to less harvest, a concept often overlooked as a reproductive goal (Dahal et al., 2019). This is due to the high cost of the system. Under natural conditions, when it gets old and starts dispersing its seeds, it no longer needs to be active. But ideally, something should be planted to deal with "environmental resistance". This is because controlling pathogens with less yield loss (Dahal et al., 2019). The choice of plants to grow depends on many factors that limit the choices of others. Climate is the only factor. Other factors such as tradition, end-user demand and payment policies can alter these climate boundaries through crop husbandry and production strategies (e.g. glass, polyethylene, wool, etc. crop protection). Other political factors such as accounting and economics (particularly labor costs, infrastructure and fuel costs).

Frequent extreme weather events and a more unstable climate will lead to, there is a tendency to limit the geoclimatic distribution of plants to low-risk areas away from high-risk ones (Maxwell et al., 2019). The plant distributions not only tended to be further from the margins of the plant distributions, they also varied geographically. However, these should not only reflect rising temperatures but also take into account other factors such as suitable soil and water conditions. However, pathogens infect plants most of them are good opportunists, occupying plant niches that are not adequately protected by resistance mechanisms and crop protection measures. So predicting future threats depends on when and where these niches emerge, and that's what you need to do. To prevent such niche development, pre-tuning may include selecting the correct resistors and installing them correctly to preserve their useful life. Furthermore, once such a niche has emerged, it allows for (i) rapid identification, (ii) localized inoculation of parasites and pathogens into the environment, (iii) niche dissemination, and (iv) occlusion. Confirmation is also set. Limit the spread. In essence, it describes different levels of functional diversity. Functional diversity is complex at all levels and must therefore also be a strategy for adapting to climate change (Bramwell et al., 2021).

3. CLIMATE CHANGE CASE STUDY: FUSARIUM AND WHEAT

Plant diseases are major barriers to food production and quality, and diseases such as Fusarium (FHB) in wheat affect food quality and safety. This is especially important as it not only reduces yields but also directly affects human and animal health. In the context of climate change in Europe, food mycotoxins and pesticide residues are important food safety issues (Desai et al., 2020). This section examines the impact of projected climate change on FHB and its potential impact on components of the grain value chain, including production, processing and marketing. Wheat is an important source of carbohydrates, providing on average one-fifth of the world's total caloric intake, and in regions such as North Africa, Turkey and Central Asia, it accounts for half of our caloric intake total (Li et al., 2018). Grains are processed into many end products to inform consumers, and grain quality is increasingly influencing international grain trade (Giraldo et al., 2019).

For example, Australian durum varieties are used for sandwiches, fresh bread and delicious white pasta, while sweet varieties are used for biscuits, cakes and pastries, and pasta and couscous are used for alcohol. Of the more than 200 million hectares under wheat cultivation, about half are in the least developed countries. Productivity is steadily increasing through genetic improvement for yield potential, disease resistance, improved agricultural usage. Other improvements within grain harvesting include increased demand resulting from population growth, increased living standards leading to a preference for grain-based foods, urbanization leading to less arable land, scarcity of water, unpredictable climates and genetic modification.

It is determined by the balance of food crop discussions. However, higher wheat productivity is needed to address global food security challenges. Restoring yield and quality through improved crop disease control. As a result, Fusarium concern in recent decades, resulting in fewer benefits on food quality and cumulative price losses of up to $7 billion. Flattening the north and center of 1998 cost the United States in 2000 (Giraldo et al., 2019). The production of trichothecene mycotoxins and the estrogen zearalenone in infected host tissues is responsible for poor grain quality, while fungal infections alone can reduce grain quality but are harmful to humans and animals.

4. ON-FARM PRODUCTION

Many Fusarium and tenospodium species cause FHB, but Fusarium graminearum (sexual gibberella) and Fusarium rhizome (sex unknown) (Verheecke-Vaessen et al., 2019). The Fusarium pathogen also causes coronary heart rot (CR), affecting leaves, roots and root tissue, influencing the epidemiology, virulence and prevalence of the disease in most grain producing countries. Connect CR and FHB. However, the mycotoxin burden of FHB seeds was significantly higher than that of CR seeds (Zinedine et al., 2021). The pathogen survives as a spoilage fungus in infected tissue of wheat, maize, and other herbaceous plants and produces ascospores (except F. culmorum) and / or macroconidia. Extensive strain management with little or no conservative tillage resulted in significantly higher pathogen inoculums and higher.

Timing is the most important factor influencing the onset and severity of the disease and determining its relative importance. Loss of CR yield is severe during the dry season after flowering when the pathogen restricts water flow to ray tissue and causes "white spots". When do particles shrink (Zinedine et al., 2021). On the other hand, FHB is prone to partial or complete burns of the head when anesthetized in climates of high temperature and high humidity, reduces yield and quality (particle shrinkage), and reduces density and quality during cooking and it is easily affected. Mycotoxins. (Quesada et al., 2019).

Over the past decade, Fusarium rhubarb and Microdo chiumnivale have been the most popular species in the cold temperate regions of Europe. In the Netherlands, grass is the most important cause of FHB (Sudantha and Suwardji, 2021). Northern Germany and England and Wales have an advantage due to the high temperature conditions in areas with complex diseases. *M. nivale* is not venomous. culmorum generally produces fewer mycotoxins than *F. graminearum*, so mycotoxin levels can be elevated (Vandicke et al., 2019). Recent published articles examined changes in FHB colony, as well as changes that may be associated with mycotoxin contamination (Ji et al., 2019).

Some FHB and CR inoculants directly increase atmospheric CO_2 concentrations. Increases Fusarium biomass production per unit of grain. Both levels of inoculum migration continued significantly throughout the season for tall buildings and CO_2 fabrics. Partially tolerant wheat varieties reduced Fusarium biomass without increasing environmental CO_2 (Hay et al., 2021). The study also showed that the pathogen's degradative capacity remained unchanged at high CO_2 concentrations and was not affected by a reduction in ecological capacity. Furthermore, the increase in stubble increased plant biomass CO_2 by an average of 17%, further increasing the pathogenic inoculum of detrital plants (Peter Mshelia et al., 2020). Other (but not all) empirical studies published in the FHB literature have also demonstrated significant differences (Timmusk et al., 2020).

5. STORAGE AND POST-PROCESSING

In case of climate change, grain quality improvement, degradation under the direct influence of temperature and CO_2, there is the potential to further influence the storage and production of molds and mycotoxins affecting quality during transportation. Reduce grain, protein and micronutrient content. Changes in precipitation patterns and intensities have a major impact on food quality, but because precipitation forecasts are uncertain, meaningful predictions are difficult to make. The most important factors determining post-harvest grain quality are grain moisture, grain storage quality, and temperature. The moisture content of stored and transported grain is 12%, primarily determined by the moisture content at harvest. Harvesting may be delayed to reduce moisture levels if moisture levels exceed acceptable levels, or it may be blended, scraped, aerated or dried after harvesting to reduce moisture levels. 'humidity. Each of these interventions has additional costs, and a late harvest results in daily losses in grain quality and yield (Ding et al., 2022).

Competition between types of pollutants also appears to be important. The presence of Alternaria atenaria, Cladosporium herbarum or Pythium ver rucosum in wheat grains reduced the production of rheum vomitoxin but was stimulated by *M nivale*. Farmers with limited resources and poor agricultural and home storage conditions further increase mycotoxin risk and human health (Ding et al., 2022). However, high levels of vomitoxin and other mycotoxins are a global problem in climate-affected crops and crops harvested under flood conditions (Al-Ghussain, 2019.

6. CHANGE CONSUMER PREFERENCES

Mycotoxins are a greater problem in developing countries than in developed countries due to poor agricultural livelihoods, post-harvest management and storage, and unregulated local markets. Climate change could make the situation worse (Vicente-Serrano et al., 2020). Intake of wheat-based food increases with frequency, thus increasing exposure to mycotoxins such as vomitoxin.

7. DISEASE MANAGEMENT, CLIMATE VARIABILITY, AND FOOD SAFETY

Protecting the crop is an integrated method and the threat is known or real. However, the use of these traditional plant protection products tends to disrupt many of the processes that keep these organisms in a favorable equilibrium under without epidemic conditions. Selection is the result of a complex interaction between these "remedial" and "improving" effects. The whole process is a very complicated which is influenced in different ways by climatic variables. Challenging factor is to create parallel process impacts and significant environmental/climate impacts to predict the likely impact of on climate change and models and production systems (Dubey et al., 2019).

The robustness, vulnerability or sensitivity of various processes and their feasibility for the specification should be evaluated. For example, enhancing endogenous colonization of plants has the potential to increase abiotic and biotic resistance and potentially address the multiple effects of climate change on specific plants. However, the range of responses may be limited and endophytes may not be suitable for many plants. There are also many unresolved practical issues surrounding the establishment and maintenance of colonies. Conversely, effective utilization of key resistance genes under multiple environmental conditions provides high efficiency for the control of highly sensitive and narrowly targeted diseases within a limited time frame. Large-scale single crops or use of disease resistant varieties for large-scale single crops. Use of a single fungicide at the expense of maximum benefit by implementing unsustainable options (Garrett et al., 2021). The challenge of 50 increasing food production 50 by 2050, a case that can only be addressed through the use of fungicides or varieties with one or more resistance genes, suggests an alternative that may not be difficult. We got the best results. return value.

There are many possible touchpoints in parasite-pathogen interactions, but the preferred option is to combine their potential effects and manipulate the feasibility to the benefit of both parties. Many treatments require the development of these skills and an initial investment of resources. However, if the potential return is significant, that should guide your investment. High, medium and low rankings have been proposed, but their validity should be at the heart of research policy discussions. To contribute effectively to the policy debate, potential strategies should include cost estimates for the different coordination phases (Lau et al., 2021).

Pathogen and pest relationship often coexist with the damage are problematic or below the threshold of visual observability (Mora et al., 2022). The mechanisms through which this occurs may represent important processes that themselves lead to resilience and sustainability, properties necessary to address climate change. Cycles of prosperity often result from breeding-based pest control strategies that rely on narrow-spectrum resistance genes or highly effective insecticides. For example, the new *Puccinia graminisuf* can overcome drug resistance that has been cultivated for more than 30 years. *B. rust* resistance of Sr31 grain stem. sp. Ug99 is wheat and these methods have been used for wheat rust (Garrett et al., 2021). Once finalized the development of strength can be evaluated using structures that simulate future climate scenarios, including high temperatures, and their durability can be verified (Casadevall et al., 2019). Preventive breeding could also be initiated in these facilities to identify and replace the most susceptible gene/gene combinations.

Many broad-spectrum necropathogens do not follow gene-specific properties when host resistance is available. They are usually based on several protective mechanisms, each of which can partially reduce the severity of the disease, but not complete protection. After plants begin senescence, the necrotic pathogen proactively reproduces, and by reducing the size of the inoculum, a large inoculum can be produced to infect subsequent plants. In many cases, the benefits of using resistant strains are lost (Pike et al., 2019). To be effective, partial tolerance must be incorporated into agricultural and other practices to develop integrated strategies to protect resilient crops from this expansion cycle to better account for and exploit changes in the geographic distribution of algal blooms. To address nutritional changes in necrosis, we need to significantly improve our understanding of the biology and epidemiology of pathogens in agricultural systems. As croplands evolve to adapt to climatic conditions, reproductive goals themselves change in response to changes in pathogen profiles (Caminade et al., 2019).

Potatoes often cannot be grown economically without the use of pesticides. More frequent applications are needed when changes in plant physiology affect nutrient intake and transport of insecticides, or when other climatic factors change (eg removal of pesticide residues by contact with more rainfall). If this is the case, pesticide use may increase. The rapid growth of plants in high temperatures also increases the need for pesticides. Between 100 and 100 farmers worldwide suffer from acute pesticide poisoning, killing thousands. Developing countries kill 99% and use 25% of world pesticide production (Pozio, 2020).

Hurricanes are common, taking plant pathologists to new regions, and climate change is predicted to increase the frequency of extreme weather events (Frame et al., 2020). In addition to production disruptions limiting market access, this would limit valuable export earnings for some developing countries. For example, Karnalz Bundt recently restricted grain trade in many regions, maintained disease-free status in importing countries, and recently avoided the possible use of biological weapons (Marsooli et al., 2019). CAB International has established a worldwide network of herbal clinics with the resources and experience to provide "Chinese Medicine" with the fastest possible diagnosis and advice for the most difficult diagnostic (http://www.cabi.org). Well-integrated international institutions make this possible. It describes the role of national and international political institutions in defining and implementing solutions to global problems, but with very local influences (Fox et al., 2019).

These actions need to be taken at different levels by many different types of institutions, bringing together knowledge, expertise and strategies. The time frame for these actions can range from a basic understanding of pathogen resistance processes and mechanisms to the appropriate dissemination and distribution of cultivars to farmers in specific locations. This is the goal of initiatives such as the Borlaug Global Rust Initiative. Addresses the global impact of climate change on specific diseases, omissions that could have immediate and significant impacts on food supplies.

8. OBSTACLES AND CHALLENGES

While many may be aware of this diversity in the resilience of farming systems to ameliorate environmental change, the adoption of greater diversification will come too late, and for good reason. First, the policy incentives for low crop production in tightly managed monocultures, recognized as incentives for adopting other farming systems, are likely to change as climate change increases. Secondly scientist together community they have adapted agriculture which is feasible with the environment and climate change crops which is resistant to drought. Finally, the erroneous belief that biomass production is significantly higher in single-culture systems than in multi-species systems has discouraged migration to more diverse systems. These hurdles must be overcome in order to slow down the adoption of different farming systems as adaptation options and to accelerate the implementation of this strategy.

9. AGRICULTURAL PRICE AND INCOME SUPPORT

In USA only they will give concession for farm subsidies select five major crops (corn, wheat, soybeans, cotton, and rice) and provide incentives to grow more of these few crops. Between 1995 and 2002, 89 % of $ 91.2 billion in raw material payments were spent on these crops, increasing the incomes of farmers and ranchers. Only soybean and corn producers received 56 % of this money. Because the payment is dependent on the cultivated land that has been produced, a single cultivation of some crops, a wide landscaped area 1 and promote maximum production of one or several of the plant these incentives, and ecosystem services Encourage the production of less-planted species over space and time to impair ecosystem function (Van Meijl et al., 2018).

10. BIOTECHNOLOGY SOLUTION

The realization that agriculture faces the challenges of climate change has led to significant efforts on changing the technology usage in agriculture which was successfully done in drought tolerant plant cultivation as well. The move to further leverage biotechnology, which focuses solely on crop cultivation, has made progress in some farmers in protecting production, but has not been successfully developed in many situations, especially in the country. However, biotechnology remains central to agricultural adaptation solutions to climate change.

11. BIOMASS PRODUCTION

The belief that a higher productivity than a single cultivation and tightly controlled system is diverse agricultural system will drink in order to shift to a more diverse crop system 1 is one of the challenges. 1 or 2 that is essentially a goal of agricultural paradigm of the current modern to maximize biomass production from one particular crop. Ecosystem functions in these systems continue at greatly reduced capacity such as chemical usage minimal and developed very extensive usage of irrigation system and replace all costly things to cheaper product. Even though how much measurement taken climate change will decide and difficult to predict product production and prices of large-scale monoculture systems (Ray et al., 2019). Even though developed countries also face the advance manufacturing methods there is a limitation due to the high price in cost and transportation which is above average. Oil and chemical inputs used in mechanization technology can be prohibitively expensive. Even in areas where mechanization and chemicals are available. The given solutions are good measures to have a balance between biodiversity and community resilience to climate change by utilizing ecosystem functions and services and maintaining high productivity under potentially adverse environmental conditions (Anderson et al., 2020).

12. STAKEHOLDER PARTICIPATION AND PARTICIPATORY RESEARCH

The new research on climate change is emerging in alarming rate. Therefore, the introduction of sustainable agricultural options in the context of climate change poses a challenge for many communities. Space is important for successful implementation. Doing a SWOT analysis in climate change is important and useful for the people who engage in business. With the outcome stakeholders can take decision to reduce

Carbon foot printing and save the earth. The cost and complexity of customization increases, but so do the benefits of customization. Stakeholder engagement and participatory research are adaptation options that can be embraced by local communities, recognizing that knowledge often belongs to local farmers and needs to include local considerations over the long term. A very useful tool for development.

13. CONCLUSION

Overall crop productivity growth through 2050 will continue to be driven primarily by technological and agricultural improvements, as in the previous century. Even under the most pessimistic scenarios, climate change is unlikely to result in a sharp drop in global yields. Instead, the relevant question on a global scale is to what extent the effect of climate change will materialize in the constant race to keep productivity growing at the same rate as demand. The net impact of climate change and CO_2 on average calorie intake could be in the next few decades pretty close to zero but could reach 20-30% of total return trend. Of course, this global situation hides many small changes that could have significant impacts on food security even if global production were sustained. With the planet's dwindling resources, increasing food production by 50% over the next 40 years of enormous investments of capital, time and effort. Just as past victories in global agriculture brought us the Green Revolution that saved millions from hunger, a key element of the solution must come from improved technology. Global investment which was neglected pipeline in agri-food R&D needs to at least double to accelerate the development and deployment of promising technologies.

REFERENCES

Al-Ghussain, L., 2019. Global warming: Review on driving forces and mitigation. Environmental Progress & Sustainable Energy, 38 (1), Pp. 13-21.

Anderson, R., Bayer, P.E., and Edwards, D., 2020. Climate change and the need for agricultural adaptation. Current opinion in plant biology, 56, Pp. 197-202.

Aryal, J.P., Sapkota, T.B., Khurana, R., Khatri-Chhetri, A., Rahut, D.B., and Jat, M.L., 2020. Climate change and agriculture in South Asia: Adaptation options in smallholder production systems. Environment, Development and Sustainability, 22 (6), Pp. 5045-5075.

Benites-Lazaro, L.L., Giatti, L., and Giarolla, A., 2018. Topic modeling method for analyzing social actor discourses on climate change, energy and food security. Energy research and social science, 45, Pp. 318-330.

Biemans, H., Siderius, C., Lutz, A.F., Nepal, S., Ahmad, B., Hassan, T., von Bloh, W., Wijngaard, R.R., Wester, P., Shrestha, A.B., and Immerzeel, W.W., 2019. Importance of snow and glacier meltwater for agriculture on the Indo-Gangetic Plain. Nature Sustainability, 2 (7), Pp. 594-601.

Borburema, H.D., Graiff, A., Karsten, U., and Marinho-Soriano, E., 2022. Photobiological and biochemical responses of mangrove-associated red macroalgae Bostrychia calliptera and Bostrychia montagnei to short-term salinity stress related to climate change. Hydrobiologia, Pp. 1-16.

Borrelli, P., Robinson, D.A., Panagos, P., Lugato, E., Yang, J.E., Alewell, C., Wuepper, D., Montanarella, L., and Ballabio, C., 2020. Land use and climate change impacts on global soil erosion by water (2015-2070). Proceedings of the National Academy of Sciences, 117 (36), Pp. 21994-22001.

Bramwell, G., Schultz, A.G., Sherman, C.D., Giraudeau, M., Thomas, F., Ujvari, B., and Dujon, A.M., 2021. A review of the potential effects of climate change on disseminated neoplasia with an emphasis on efficient.

Casadevall, A., Kontoyiannis, D.P., and Robert, V., 2019. On the emergence of Candida auris: climate change, azoles, swamps, and birds. MBio., 10 (4), Pp. e01397-19.

Clapp, J., Newell, P., and Brent, Z.W., 2018. The global political economy of climate change, agriculture, and food systems. The Journal of Peasant Studies, 45 (1), Pp. 80-88.

Crost, B., Duquennois, C., Felter, J.H., and Rees, D.I., 2018. Climate change, agricultural production and civil conflict: Evidence from the Philippines. Journal of Environmental Economics and Management, 88, Pp. 379-395.

Dahal, K., Li, X.Q., Tai, H., Creelman, A., and Bizimungu, B., 2019. Improving potato stress tolerance and tuber yield under a climate change scenario–a current overview. Frontiers in plant science, 10, Pp. 563.

Desai, S., Dubey, S.C., and Prasad, R.D., 2020. Impacts of climate change on Fusarium species vis-à-vis adaptation strategies. Indian Phytopathology, 73 (4), Pp. 593-603.

Ding, B., Liu, H., Li, Y., Zhang, X., Feng, P., Li, D., Liu, Marek, G.W., Ale, S., Brauer, D.K., Srinivasan, R., and Chen, Y., 2022. Post-processing R tool for SWAT efficiently studying climate change impacts on hydrology, water quality, and crop growth. Environmental Modelling & Software, 156, Pp. 105-492.

Dubey, A., Malla, M.A., Khan, F., Chowdhary, K., Yadav, S., Kumar, A., Sharma, S., Khare, P.K., and Khan, M.L., 2019. Soil microbiome: a key player for conservation of soil health under changing climate. Biodiversity and Conservation, 28 (8), Pp. 2405-2429.

Fahad, S., and Wang, J., 2020. Climate change, vulnerability, and its impacts in rural Pakistan: a review. Environmental Science and Pollution Research, 27 (2), Pp. 1334-1338.

Flörke, M., Schneider, C., and McDonald, R.I., 2018. Water competition between cities and agriculture driven by climate change and urban growth. Nature Sustainability, 1 (1), Pp. 51-58.

Fones, H.N., Bebber, D.P., Chaloner, T.M., Kay, W.T., Steinberg, G., and Gurr., S.J., 2020. Threats to global food security from emerging fungal and oomycete crop pathogens. Nature Food, 1 (6), Pp. 332-342.

Fox, M., Zuidema, C., Bauman, B., Burke, T., and Sheehan, M., 2019. Integrating public health into climate change policy and planning: state of practice update. International journal of environmental research and public health, 16 (18), Pp. 3232.

Frame, D.J., Wehner, M.F., Noy, I., and Rosier, S.M., 2020. The economic costs of Hurricane Harvey attributable to climate change. Climatic Change, 160 (2), Pp. 271-281.

Garrett, K.A., Nita, M., De Wolf, E.D., Esker, P.D., Gomez-Montano, L., and Sparks, A.H., 2021. Plant pathogens as indicators of climate change. In Climate change, Pp. 499-513. Elsevier.

Giraldo, P., Benavente, E., Manzano-Agugliaro, F., and Gimenez, E., 2019. Worldwide research trends on wheat and barley: A bibliometric comparative analysis. Agronomy, 9 (7), Pp. 352.

Hasegawa, T., Fujimori, S., Havlík, P., Valin, H., Bodirsky, B.L., Doelman, J.C., Fellmann, T., Kyle, P., Koopman, J.F., Lotze-Campen, H., and Mason-D'Croz, D., 2018. Risk of increased food insecurity under stringent global climate change mitigation policy. Nature Climate Change, 8 (8), Pp. 699-703.

Hay, W.T., McCormick, S.P., and Vaughan, M., 2021. Effects of Atmospheric CO2 and Temperature on Wheat and Corn Susceptibility to Fusarium gramine arum and Deoxynivalenol Contamination. Plants, 10 (12), Pp. 2582.

Hernández, J.A., 2019. Salinity tolerance in plants: trends and perspectives. International Journal of Molecular Sciences, 20 (10), Pp. 2408.

Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bolaños, T.G., Bindi, M., Brown, S., Camilloni, I.A., Diedhiou, A., Djalante, R., Ebi, K., and Engelbrecht, F., 2019. The human imperative of stabilizing global climate change at 1.5 C. Science, 365 (6459), Pp. 6974.

Holopainen, J.K., Virjamo, V., Ghimire, R.P., Blande, J.D., Julkunen-Tiitto, R., and Kivimäenpää, M., 2018. Climate change effects on secondary compounds of forest trees in the northern hemisphere. Frontiers in plant science, 9, Pp. 1445.

Hristov, J., Toreti, A., Domínguez, I.P., Dentener, F., Fellmann, T., Elleby, C., Ceglar, A., Fumagalli, D., Niemeyer, S., Cerrani, I., and Panarello, L., 2020. Analysis of climate change impacts on EU agriculture by

2050. Publications Office of the European Union, Luxembourg, Luxembourg.

Hussain, M., Butt, A.R., Uzma, F., Ahmed, R., Irshad, S., Rehman, A., and Yousaf, R., 2020. A comprehensive review of climate change impacts, adaptation, and mitigation on environmental and natural calamities in Pakistan. Environmental monitoring and assessment, 192 (1), Pp. 1-20.

Janssens, C., Havlík, P., Krisztin, T., Baker, J., Frank, S., Hasegawa, T., Leclère, D., Ohrel, S., Ragnauth, S., Schmid, E., and Valin, H., 2020. Global hunger and climate change adaptation through international trade. Nature Climate Change, 10 (9), Pp. 829-835.

Ji, F., He, D., Olaniran, A.O., Mokoena, M.P., Xu, J., and Shi, J., 2019. Occurrence, toxicity, production and detection of Fusarium mycotoxin: A review. Food Production, Processing and Nutrition, 1 (1), Pp. 1-14.

Kabir, E., Kumar, V., Kim, K.H., Yip, A.C., and Sohn, J.R., 2018. Environmental impacts of nanomaterials. Journal of Environmental Management, 225, Pp. 261-271.

Koubi, V., 2019. Climate change and conflict. Annual Review of Political Science, 22, Pp. 343-360.

Lau, J.D., Kleiber, D., Lawless, S., and Cohen, P.J., 2021. Gender equality in climate policy and practice hindered by assumptions. Nature climate change, 11 (3), Pp. 186-192.

Leisner, C.P., 2020. Climate change impacts on food security-focus on perennial cropping systems and nutritional value. Plant Science, 293, Pp. 110412.

Li, A., Liu, D., Yang, W., Kishii, M., and Mao, L., 2018. Synthetic hexaploid wheat: yesterday, today, and tomorrow. Engineering, 4 (4), Pp. 552-558.

Lloyd, E.A., and Shepherd, T.G., 2020. Environmental catastrophes, climate change, and attribution. Annals of the New York Academy of Sciences, 1469 (1), Pp. 105-124.

Marsooli, R., Lin, N., Emanuel, K., and Feng, K., 2019. Climate change exacerbates hurricane flood hazards along US Atlantic and Gulf Coasts in spatially varying patterns. Nature communications, 10 (1), Pp. 1-9.

Maxwell, S.L., Butt, N., Maron, M., McAlpine, C.A., Chapman, S., Ullmann, A., Segan, D.B., and Watson, J.E., 2019. Conservation implications of ecological responses to extreme weather and climate events. Diversity and Distributions, 25 (4), Pp. 613-625.

Mbow, C., Rosenzweig, C., Barioni, L.G., Benton, T.G., Herrero, M., Krishnapillai, M., Liwenga, E., Pradhan, P., Rivera-Ferre, M.G., Sapkota, T., and Tubiello, F.N., 2019. Food security.

Mekis, E., Donaldson, N., Reid, J., Zucconi, A., Hoover, J., Li, Q., Nitu, R., and Melo, S., 2018. An overview of surface-based precipitation observations at environment and climate change Canada. Atmosphere-Ocean, 56 (2), Pp. 71-95.

Menzel, A., Yuan, Y., Matiu, M., Sparks, T., Scheifinger, H., Gehrig, R., and Estrella, N., 2020. Climate change fingerprints in recent European plant phenology. Global Change Biology, 26 (4), Pp. 2599-2612.

Mora, C., McKenzie, T., Gaw, I.M., Dean, J.M., von Hammerstein, H., Knudson, T.A., Setter, R.O., Smith, C.Z., Webster, K.M., Patz, J.A., and Franklin, E.C., 2022. Over half of known human pathogenic diseases can be aggravated by climate change. Nature climate change, 12 (9), Pp. 869-875.

Mukhopadhyay, R., Sarkar, B., Jat, H.S., Sharma, P.C., and Bolan, N.S., 2021. Soil salinity under climate change: Challenges for sustainable agriculture and food security. Journal of Environmental Management, 280, Pp. 111736.

Mundia, C.W., Secchi, S., Akamani, K., and Wang, G., 2019. A regional comparison of factors affecting global sorghum production: The case of North America, Asia and Africa's Sahel. Sustainability, 11 (7), Pp. 2135.

Özerol, G., Dolman, N., Bormann, H., Bressers, H., Lulofs, K., and Böge, M., 2020. Urban water management and climate change adaptation: A self-assessment study by seven midsize cities in the North Sea Region. Sustainable Cities and Society, 55, Pp. 102-066.

Parker, L., Bourgoin, C., Martinez-Valle, A., and Läderach, P., 2019. Vulnerability of the agricultural sector to climate change: The development of a pan-tropical Climate Risk Vulnerability Assessment to inform sub-national decision making. PloS one, 14 (3), Pp. e0213641.

Peter Mshelia, L., Selamat, J., Iskandar Putra Samsudin, N., Rafii, M.Y., Abdul Mutalib, N.A., Nordin, N., and Berthiller, F., 2020. Effect of temperature, water activity and carbon dioxide on fungal growth and mycotoxin production of acclimatized isolates of Fusarium verticillioides and F. graminearum. Toxins, 12 (8), Pp. 478.

Pike, V.L., Lythgoe, K.A., and King, K.C., 2019. On the diverse and opposing effects of nutrition on pathogen virulence. Proceedings of the Royal Society B, 286 (1906), Pp. 20191220.

Pozio, E., 2020. How globalization and climate change could affect foodborne parasites. Experimental Parasitology, 208, Pp. 107807.

Qin, Y., Abatzoglou, J.T., Siebert, S., Huning, L.S., AghaKouchak, A., Mankin, J.S., Hong, C., Tong, D., Davis, S.J., and Mueller, N.D., 2020. Agricultural risks from changing snowmelt. Nature Climate Change, 10 (5), Pp. 459-465.

Quesada, T., Lucas, S., Smith, K., and Smith, J., 2019. Response to temperature and virulence assessment of Fusarium circinatum isolates in the context of climate change. Forests, 10 (1), Pp. 40.

Ray, D.K., West, P.C., Clark, M., Gerber, J.S., Prishchepov, A.V., and Chatterjee, S., 2019. Climate change has likely already affected global food production. PloS one, 14 (5), Pp. e0217148.

Raza, A., Razzaq, A., Mehmood, S.S., Zou, X., Zhang, X., Lv, Y., and Xu, J., 2019. Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. Plants, 8 (2), Pp. 34.

Scheelbeek, P.F., Bird, F.A., Tuomisto, H.L., Green, R., Harris, F.B., Joy, E.J., Chalabi, Z., Allen, E., Haines, A., and Dangour, A.D., 2018. Effect of environmental changes on vegetable and legume yields and nutritional quality. Proceedings of the National Academy of Sciences, 115 (26), Pp. 6804-6809.

Sudantha, I.M., and Suwardji, S., 2021. Trichoderma biofungicides formulations on shallot growth, yield and fusarium wilt disease resistance. In IOP Conference Series: Earth and Environmental Science, 824 (1), Pp. 012032. IOP Publishing.

Suryanarayanan, T.S., and Shaanker, R.U., 2021. Can fungal endophytes fast-track plant adaptations to climate change?. Fungal Ecology, 50, Pp. 101039.

Timmusk, S., Nevo, E., Ayele, F., Noe, S., and Niinemets, U., 2020. Fighting Fusarium pathogens in the era of climate change: a conceptual approach. Pathogens, 9 (6), Pp. 419.

Van Meijl, H., Havlik, P., Lotze-Campen, H., Stehfest, E., Witzke, P., Domínguez, I.P., Bodirsky, B.L., van Dijk, M., Doelman, J., Fellmann, T., and Humpenöder, F., 2018. Comparing impacts of climate change and mitigation on global agriculture by 2050. Environmental research letters, 13 (6), Pp. 064021.

Vandicke, J., De Visschere, K., Croubels, S., De Saeger, S., Audenaert, K., and Haesaert, G. 2019. Mycotoxins in Flanders' fields: Occurrence and correlations with Fusarium species in whole plant harvested maize. Microorganisms, 7 (11), Pp. 571.

Verheecke-Vaessen, C., Diez-Gutierrez, L., Renaud, J., Sumarah, M., Medina, A., and Magan, A., 2019. Interacting climate change environmental factors effects on Fusarium langsethiae growth, expression of TRI genes and T-2/HT-2 mycotoxin production on oat-based media and in stored oats. Fungal biology, 123 (8), Pp. 618-624.

Vicente-Serrano, S.M., Quiring, S.M., Pena-Gallardo, M., Yuan, S., and Dominguez-Castro, F., 2020. A review of environmental droughts: increased risk under global warming?. Earth-Science Reviews, 201, Pp. 102953.

von Grebmer, K.J., Bernstein, R., Mukerji, F., Patterson, M., Wiemers, R.N., Chéilleachair, C., Foley, S., Gitter, K., Ekstrom and Fritschel, H., 2019. Global Hunger Index by Severity, Map in 2019 Global Hunger Index: The Challenge of Hunger and Climate Change.

Yu, J., and Wu, J., 2018. The sustainability of agricultural development in China: The agriculture–environment nexus. Sustainability, 10 (6), Pp. 1776.

Zinedine, A., and El Akhdari, S., 2021. Food safety and climate change: case of mycotoxins. In Research anthology on food waste reduction and alternative diets for food and nutrition security, Pp. 39-62. IGI Global.

+

* * *

Cite The Article: Faiz MMT Marikar (2023). Climate Change and its Impact on Global Cereal Production: Review. *Ecofeminism and Climate Change, 4(1): 06-12.*