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Changing Patterns, Crop Effects and Mitigation

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ABSTRACT: The phrase "cropping pattern" is used to describe the distribution of land between various crops at a particular time. This study applies climate, water, and crop yield models to assess agricultural trends and output. The existing research implies that more comprehensive geographical models might help enhance future projections of climate change. Researchers employed a main questionnaire in addition to a variety of statistical methods and secondary sources of information to measure and analyse the problem. The distinctive cropping pattern that occurs from the globe to the local scale is shaped by physical, cultural, and technological aspects. For the sake of agricultural regionalization and planning, the land must be divided into homogeneous areas on some well-defined basis. Increased agricultural production may result from the successful expansion of irrigated areas. The quality of the surrounding surroundings will also suffer as a result. Many positives, such as soil, erosion, floods, waterlogging, precipitation, irrigation supplies, and others, are emphasised; nevertheless, the ways in which these factors interact with the region's distinctive crop pattern vary substantially. Total harvested area is a major component in identifying the top three crops. Adopting environmentally responsible agricultural practises is critical for a developing country. Horizontal agricultural expansion requires substantial financial investment. If the encouraging method does not provide the intended impact for two or more crop patterns on vast swathes of land, zoning of crop patterns or judicious management may assure food security.

KEYWORDS: Soil, erosion, floods, waterlogging, precipitation, irrigation supply

I. INTRODUCTION

Among the most popular ways to make a living in Bangladesh, agriculture is crucial to the prosperity of both individual farmers and the nation as a whole. It accounts for 14.10 percent of global GDP in 2017–2018. Agriculture is essential because it produces food for people, green feed for animals, and raw materials for many agricultural businesses. Therefore, the most crucial factor in enhancing agricultural output is adopting a methodical, scientific, and appropriate cropping pattern and crop combinations. The term "crop combination" refers to growing many crops in the same agricultural field, whereas "cropping pattern" refers to the percentage of land that is dedicated to different crops at a given moment. Cropping patterns, like combinations, are not static; they evolve with time and place. Factors such as climate, altitude, slope, precipitation (both in terms of total quantity and consistency), soil type, and irrigation water availability all have a role in determining the specific types of crops that may be grown in a given region. Measurements of soil agro-ecology and the local climate may provide light on the pattern of a region's agricultural system [1].

However, for farmers, the potential productivity and financial advantages of a certain crop or cropping system serve as guiding considerations when making this choice. Micro-level infrastructure, socioeconomic variables, and technology advances all interact to limit down the options for choosing crops and cropping systems. Infrastructure includes things like water systems, roads, warehouses, markets, processing plants, and packing houses for harvests.

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A society's socioeconomic conditions include things like its wealth, the size and kind of its landholdings, the availability of its labour force, and the needs of its constituent parts for sustenance, grazing, fuel, fibre, and money, among other things.

A cropping pattern is the relative amount of unoccupied area beneath various crops during a certain time period. Crop data are often used to indicate harvest style. The physical, cultural, and technical elements that govern the cropping pattern vary from macro to micro regions, both in terms of space and time. It is required to split the area/region into consistent regions on some well-defined basis for the purpose of agricultural regionalization and coming up with.

The pattern of crops grown in a given area at a given time may be thought of as a map indicating the regions that are experiencing varying levels of productivity. Trimming pattern is shown by the yield measurements [3]. Both in fact and symbolically, the cropping pattern shifts from a large-scale to a small-scale context. In order to achieve the desired regionalization and arrangement in agriculture, it is necessary to partition the area into homogenous districts based on a set of clearly defined criteria.

The geography, geology, incline, temperature, total and consistent quality of precipitation, soils, and availability of water for water systems may all play a role. Recognizing and assessing environmental factors together help cultivate limited yields in a given area. The potential of an area's quality of each harvest might also be used to resolve instances of a segment's or locale's cropping pattern. In our current environmental situation, efforts to cut down on carbon emissions have been sustained. Various established methods have been developed to this end. But the startling shift in precipitation patterns is cause for concern. Due to the gravity of the situation, this study places special emphasis on rainfall, as it is a direct indicator of the extent of the problem water and weather alike. Rain, snow, hail, and other forms of precipitation are all different ways that water vapour may make its way from the sky to the ground.

These manifest themselves as convective currents that warm the upper atmosphere. Precipitation has been manipulated to meet global warming targets, and this has had an impact on how intensely hot it becomes on Earth.

All of these shifts are now referred to as climate change.

Crop selection is also influenced by locals' impressions and evaluations of the surroundings. Areal strength of particular crops may be used to establish the cropping patterns of a region or areal unit.

II. LITERATURE SURVEY

Thapa[4], Due to factors such as a) annual loss of arable land, b) annual increment, c) annual climate changes, d) annual inadequate management practises, e) annual unfair produce value, and f) annual lean investment in analysis, crop agriculture in East Pakistan is unnatural once a year. About 80,000 hectares (ha) of arable land in East Pakistan is lost to cultivation every year. This terrible loss needs our immediate attention. There should be no time wasted in revising and enforcing the government's land use policy to stop the waste of farmable space. The exponential rise in human population is another issue that threatens agricultural development. In order to ensure reliable food production, it is necessary to handle the double problem of shrinking farmland and expanding urban areas simultaneously. Drought and fluctuating temperatures also often hamper a country's ability to produce its staple food crops. It's crucial to create varieties and technologies that can thrive in spite of these risks. To lessen the blow of climate change, experts advise turning to renewable energy sources, cutting down on fossil fuel consumption, and making the switch. Incorporating chemical fertilisers with organic manure and continuing to support pricey non-urea fertilisers are necessary for maintaining crop yield. As a result of climate change, pests and illnesses have grown much more common in recent years. As a result, it is important to develop several strains that are resistant to the pests. The small and marginal farmers of East Pakistan have limited access to financial institutions. Furthermore, NGOs will not provide them Microcredit. To satisfy their needs, it is advised that a new institution or foundation be established that is consistent with PKSf. These farmers lack organised groups to help them get a fair price for their goods. To verify the fair market value of their goods, the government may promote the formation of farmers' cooperatives. An impending, top-down

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approach from the powerful should be avoided in order to successfully establish such cooperatives. Farmer access to drought-fighting technology may be improved by increasing investment in agricultural research to at least 2% of GDP. Using a semi-structured questionnaire, researchers in two severely drought-prone districts in northwest East Pakistan surveyed 718 farmers from owner, owner-cum-tenant, and tenant farmer households in 14 Upazila (sub-district) villages. Farmers' understanding of drought, its effects, and the steps they are doing to prepare for it were evaluated. In each region, the data showed that farmers felt the weather had changed in recent years. In addition to rainfall and temperature variance, other factors, such as groundwater depletion, a lack of canal and watercourse maintenance, an accumulated population, deforestation, etc., exacerbate dryness in the studied area. Drought has the most devastating effects on agricultural, as well as the social and health lives of farmers. Farmers are using a wide range of measures, including scientific management, crop intensification, water resource utilisation, etc., in order to cope with the effects of drought. In both irrigated and non-irrigated regions, it has been shown that owner farmers are more likely to embrace new technology than owner-cum-tenant farmers and husbandmen. Finally, the research concluded that in the case of a drought, farmers would be unable to maintain their food supply without a strong network of partners, an early warning system, and enhanced conservation techniques.

From 1980/81 to 2002/03, Islam, Rahman [6] examined the pattern of change associated with diversification and found that diversification in areas across various crops predominated.

Rahman [7], investigated Bangladesh's efforts to broaden the country's agricultural base via crop diversification. Using a stochastic input-distance function, the author quantified farm-level economic efficiencies and diversification, concluding that rural infrastructure development was essential for the technological advancement of agricultural diversification. Moreover, it demonstrated the presence of an economic scale, which has crucial implications for crop diversification and combination.

Source: Sarker et al. [8]. wheat, Aman rice, non-wheat, and other farming patterns in northwest Bangladesh. Results showed that during the four-year research period, wheat, potato, and Aman rice output were all greater than similar wheat yield from wheat, T. Aus rice, and T. Aman.

The coastal region has distinct agricultural practises than the study area. Coastal areas often alternate between rice and shrimp cultivation and vice versa. In addition, the coastal agricultural system of Bangladesh has been hit hard by rising salinity, resulting to a decline in crop profits during the last 12-15 years [9].

Miah [10] discovered a pattern of agricultural diversification that shows Boro, Aman, and Aus are the primary crop and that this phenomena is crucial to the nation as a whole.

Over the course of a 19-year period, from 1990 to 2008, Rahman and Kazal [11] looked for the elements that were most responsible for the variation among 17 areas of Bangladesh. They demonstrated a considerable decline in crop variety, particularly among minor cereals, oilseeds, jute, pulses, sugarcane, and fruit and vegetable crops, and a rise in the prevalence of main crops, such as rice and wheat. Major cropping seems to be the norm, as shown above, which is consistent with the findings of the Domarpazilla research.

About 67% of India's poor population lives in rural areas, making agriculture a vital part of the country's economy. Farmers are utilising diverse cropping pattern strategies to improve their financial standing, which has resulted in a greater quantity of non-food crops at the expense of food crops [12].

The effect of crop diversification on the production evaluation of high-value crops (HVCs) on family wellbeing was highlighted by Thapa et al., [13]. Additionally, HVCs have a greater effect on lowering poverty rates and raising per capita income significantly. For the revenue, the research suggests allocating 35% of the least derived share to help alleviate poverty.

Gamar et al. [14] found that compared to areas with heavy rainfall, dry soil was less suitable for agricultural cultivation. It revealed that in the study region of Sheikan and Elrahad in North Kordofan in Sudan, the most important crops are sorghum, pearl millet, sesame, ground nut, hibiscus, cow pea, okra, water melon, and snake cucumber, and that women farmers need particular care to maintain agricultural operations.

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According to Mondal [4], it is estimated that over 80,000 hectares of fertile land are farmed in Bangladesh annually. There are essentially two issues here: the first is that a larger population means less food is being grown, and the second is that neither of these things is good. Furthermore, it is proposed that the technology of agricultural land optimization and production make use of renewable energy, and that chemical fertiliser be substituted with organic manure, for the sustainability of agricultural output.

Bellard, C. Bertelsmeier [15] proposed that the use of nanotechnology as a means to ensure safe food may serve as a starting point. Agricultural output, land quality, soil fertility, water accessibility, and the quality of storage and prepared meals are just a few of the many aspects that contribute to or detract from a nation's food security. As a first step, the framework is bolstered and expanded by tying nanotechnology to agro - food theme areas all throughout agricultural value chain. from there, it is followed to the factors that determine food security..

Climate Change

Human activity has resulted in a global warming crisis that has far-reaching consequences. Rising global temperatures are a likely outcome of human-caused climate change, which is in turn a direct effect of the excessive release of greenhouse gases and their steadily rising concentration in the atmosphere. CO₂ is vital, while other gases also contribute significantly. As the average climate varies, so do the frequency, kind, and quantity of condensed vapours that descend to Earth's surface. The worldwide average surface temperature has risen by 0.740 °C during the 19th century, and it is projected to rise by another 1.40 °C to 5.80 °C by the year 2100 AD. [20] \s.

Temperatures rose and fell in unpredictable ways, as shown by studies conducted in East Anglia (1945-1973). Excessive output of carbon dioxide and other greenhouse gases, as well as urbanisation, are to blame for this dramatic shift. As the temperature rises, the rate of evaporation also rises, resulting in more intense precipitation and shorter rain bouts overall but no difference in total quantity. Due to the increasing quantity of moisture in the air brought on by rising temperatures, the hydrological process has been weakened, delaying the beginning of monsoon rains in certain locations.

There will be negative effects on the water cycle since it has been discovered that the water retention capacity of air rises by 7% for every 10C increase in temperature [30]. Condensed water vapour falls at a rate 10–25% faster than it evaporates. If all other factors remain the same, it is predicted that a 6% increase in moisture will result in a 20% increase in rainfall. [23]. Storm circulation, and not evaporation, is responsible for heavy rainfall.

Here's a rundown of what's involved in the process:

First, it is expected that the intensity of the rain would be high since the increase in moisture from the c-c impact will not be matched by an equally little change in the rain itself.

The danger of dryness, heat, and wildfires is heightened because, at the beginning and conclusion of the season, there is a transition from the solid-to-liquid dropping of vapour.

As the storm's path changes, certain areas get wetter while others become drier, causing a shift in the pattern's complexity.

Fourth, in certain areas, a layer of pollution obscures the sun, reducing evaporation and hence the amount of moisture entering the atmosphere.

Tropics and Sub Tropics

Since 1980, precipitation levels in the subtropics have declined, and since 1995, the equator has also seen a decline in rainfall. [5]India's summer monsoon saw an increase in intense rainfall, while the monsoon itself shifted locations from 70 percent lower than average. It has a negative impact on the start of the monsoon over the south and east, which is estimated to be pushed back by 15 days[19].The number of rainy days has decreased in Southeast Asia and the western and central South Pacific, whereas in Fiji and Polynesia, it has been on the rise.Since 1960, the area south of the Sahara Desert in North Africa has been very dry. [5]Rainfall is thus altering its appearance. Researchers have discovered an increase in extreme rainfall events, even as average precipitation levels remain stable. Although hurricanes and cyclones have contributed to a rise in floods in certain locations.

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Mitigation and Adoption in Agriculture.

As global temperatures rise, heat waves (periods of very high temperatures) will become more common, posing a significant problem for farming. Food production may be negatively impacted by heat waves because of the stress they place on both animals and plants. If the plants' reproductive cycle is interrupted at the crucial blooming stage, for example, there may be no seeds produced at all. Warming that has already happened, as well as increases in the frequency and intensity of heat waves, indicate that they will likely rise in the future. It is difficult to foretell the future frequency and amplitude of heat waves, but most forecasts agree that both will continue to grow in the United Kingdom, Europe, and throughout the world. It is projected that developing nations would feel the consequences of heat waves more severely than more developed nations. Issues with food security may become more serious if climate change impacts like more frequent droughts are taken into account.

Climate change and shifting of temperate crops

It's fascinating to see how climate change affects the seasonal and yearly distribution of temperate crops, particularly those that need cold storage or refrigeration, such as apples, pears, cherries, plums, saffron, cabbage, peas, and cauliflower. Kashmir, Arunachal Pradesh, Uttarakhand, Sikkim, and Himachal Pradesh are among of India's northernmost states, and hence the only ones where temperate crops may be grown. Due to the limited temperature window in which these crops thrive, they may be adversely impacted.

Changing cropping pattern

Some evidence of a shift in the distribution of crops has emerged, and it seems to be most pronounced in the mountainous regions of Himachal Pradesh. As warmer weather is showing up in their typical belts, some apple growing places have moved to higher ranges. Some such instances are winter wheat production in Kashmir and maize growing in Bihar. Similarly, since apples only thrive within a small temperature range, rising winter temperatures in the Kashmir area may have a negative impact on apple harvest in recent years. Growing evidence suggests that a warming planet might facilitate the extension of arable land toward the poles in locations where cold temperatures now provide a barrier to farming.

IV. CONCLUSION

This research demonstrates that most studies focus on analysing the effects of land use on climate change at the national and regional levels. The complexity of these phenomena, however, has prompted several research at various scales. According to the results of these studies, all parties involved need to do their part in conducting and implementing adequate research to solve this problem. What can be done on the ground, and how much attention is paid to adaptation versus mitigation, depends on a number of factors, including the adaptive capacity of individual groups and regions. Landscaping and climate change are two factors that may alter the global and regional climate. The effects of climate change on land use may be modelled simply, and vice versa, to provide rough estimates of the link between the two..

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