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## Ecological Imbalance: Impact on Agriculture of Bangladesh

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### ABSTRACT

The causes and effects of ecological imbalance are vast. As such, the paper will be limited in discussing the effect of water depletion on ecological imbalance and its effect on Bangladesh agriculture. An attempt has been made in this paper with the objective to assess the effects and impacts of drought at Barind area in northwest region of Bangladesh. Accordingly, effective management strategy of water under complex situation also has been tried to illuminate.

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### INTRODUCTION

1. Our Environment is our surroundings. This includes living and non-living things around us. The non-living components of environment are land, water, air etc. The living components are germs, plants, animals, people etc. All plants and animals are adjusted to the environment in which they are born and live. A change in any component of the environment may cause discomfort and affect normal life. Ecology has been central to the development of conservation and environmental control during the past 200 years. Belatedly it is now appreciated that the environmental problem is also an economic issue indeed. For these reasons, there is no scope to visualise economic and environmental activities in isolation. Flood, drought, cyclone etc are the environmental disaster which is the normal phenomenon in our country. An integrated approach is, therefore needed for the sake of efficient management of environmental resources.

2. Drought can be referred as dryness caused by precipitation shortfall during the crop growing period resulting substantial reduction in yield. It occurs with some recurring intervals in Bangladesh. It is prominently prevail in North-west region of Bangladesh, Particularly in Barind area. Uneven distribution and deficit rainfall throughout the year causes drought. Each drought produces a specific set of impacts, depending on its severity and duration. One of the challenges of planning for drought mitigation is to understand its impact on environment, economic and social. The environmental impacts are the result of damage to agricultural crops, plants, animals species, fisheries, loss of biodiversity, soil erosion etc. The soil water management, massive plantation, conjunctive use of ground and surface water, introducing crop diversification, and avoiding mono-cropping, the negative impact caused by drought may be mitigated.

3. Because of its geographical location Bangladesh suffers from a range of environmental problems, arising from drought, flood and other natural hazards. Frequencies of hazards are on the increase day by day. The quality of soil has deteriorated due to reckless use of agrochemicals, unplanned land use, undesirable encroachment on forest areas for agriculture and settlements and indiscriminate disposal of hazardous industrial wastes. Unplanned land use and intrusion of saline water are causing degradation of soil in the coastal area. The arsenic concentration in the ground water in many areas is a major problem in Bangladesh now. Bangladesh is an agro-based country. 80% of the population lives in the village. Their produced crops plays vital role in the national economy. The cultivators depend on the water sources for their irrigation. But presently water depletion is taking place due to many reasons and causing ecological imbalance particularly in the North Bengal.

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### ECOLOGY

#### *Ecology*

4. Different plants and animals are found in different environments, suitable to them. Any change in that environment may affect their living. Study of plants and animals in relation to one another and to their surroundings is ecology.

#### Ecological Balance

5. In an ideal condition, we can live together with plants and animals, without disturbing each other. This is known as 'ecological' balance.

### Need for Ecological Balance

6. Plants are the basic for all. Some small animals feeding on plants are eaten by larger animals. Plants or animals which serve as food for others become a part of the food chain. Destruction of these plants or animals may affect the lives of others in the food chain. We can locate several food chains around us. Existence of different plants and animals in sufficient number to support the food chain is an indication of a good ecological balance. With increasing population, more and more people have to live on the same piece of land, and this will lead to an ecological imbalance. With more people, we need additional houses, more food, fuel and other commodities. But, we cannot create additional land. We need to produce more crops on the available land itself. Hence, the agricultural scientists have introduced the following modern practices to increase our food production:

- a. Development of high yielding varieties of crops. However, new varieties require more manure, assured irrigation, protection from diseases and insect attacks.
- b. Application of agro-chemicals such as chemical fertilizers, insecticides, fungicides, bactericides and weed killers.
- c. Application of chemical fertilizers, because a large quantity of cattle manure required for growing high yielding varieties, is not available.
- d. Spraying of insecticides on crops control insect attack. Fungicides and bactericides control diseases.

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## **ENVIRONMENTAL DEGRADATION AND AGRICULTURAL GROWTH**

7. Continued agricultural growth is essential if the country is to continue feeding itself in the coming years. Unfortunately, environmental degradation threatens to undercut the prospects for achieving this growth. This is the lesson that studies of the combined impact of agricultural, population and environmental trends. Failure to heed this lesson will consign Bangladesh to unnecessarily low agricultural yields, degraded areas of agricultural lands and high expenditures on agricultural. Other than the agricultural sectors, it will result in lower fish production, loss of wetlands and forests, inadequate biomass generation for household fuels, and loss of biodiversity. Finally, in terms of social welfare and equity, this means lower overall land and labour productivity, higher rates of rural poverty, more rapid migration to cities and higher costs for achieving national nutritional self-sufficiency. Measures to protect soil and forest resources are an investment in the future prosperity of the agriculture, forestry and fisheries sectors. Environmental degradation is linked with lowered rates of economic growth is true not only in Bangladesh, but also in many countries of the world. Government has a strong role to play to limit the environmental degradation in agriculture through research, information dissemination and closer partnership with landowners and farmers. Public awareness of the issues is an absolute requirement in this regard.

### Environmental degradation in agriculture

8. Environmental degradation related to agriculture falls into three general categories; land use conflicts, soil degradation, and toxicity impacts linked to the use and handling of agricultural chemicals. It is useful to separate these three types of degradation, not only because they have different root causes, but because they require different policy and investment responses.

9. Land Use Conflicts. The first type of rural environmental impacts stems from land use conflicts, or land areas in which agriculture competes with other uses of land, such as shrimp cultivation or brickfield areas. Many of these conflicts are inevitable, as land is the most fundamental constraint in our country. It is important to find a process that can resolve local issues of conflicting land use in rational ways that favour long-term sustainability also. The Bangladesh National Conservation Strategy has identified six important areas of conflicting land use in rural areas:

- a. Agriculture vs. shrimp and capture fisheries.
- b. Forest land vs. shrimp and capture fisheries.
- c. Agriculture vs. livestock.
- d. Agriculture vs. settlements.
- e. Agriculture vs. brickfields, and
- e. Agriculture vs. newly accreted char lands.

10. Soil Degradation and Water Scarcity. The second area of impacts is from the agricultural soil degradation, not from non-agricultural land uses such as shrimp farming. Common categories of land degradation are erosion, water logging, salinity, and depletion of nutrients. All these are found in Bangladesh. The soil degradation in Bangladesh is approximately about 10% of the net cultivated land that suffers from medium and high salinity in the dry season. Another 10% in the hilly areas is considered highly eroded and a very high percentage, over 50%, of the total has impeded drainage and suffers from water logging and poor aeration. In some areas, crop yields have been stagnant or even declining although some of the decline productivity of land is camouflaged by higher fertilizer applications. As average losses due to soil degradation on crop yields in India, recently calculated by the World Bank were to 4 - 6.3%. Over the last 20 years, growth in total agricultural output in Bangladesh has been only 2.1%, and average rice yields have increased 2.5%, although these growth rates may have fallen slightly in the past two to four years. When these low yield growth numbers are compared with the negative percentage impact of soil degradation, it appears that Bangladesh runs the risk of much of its hard-fought gain in annual yields being offset by the impact of soil degradation. The margins that represent the difference between food self-sufficiency and food deficits are very small, and a swing of only 1% towards slower grower growth can make an enormous difference especially when the effect of a single year's degradation becomes compounded over many successive years.

11. **Toxicity Impacts.** The third area of environmental degradation linked to agriculture is the impact of toxicity from improper pesticide and fertilizer use. The greatest threat of toxic exposure is from the use of pesticide on vegetables, which puts both vegetable producers and consumers at risk. The use of pesticides on other crops is widely dispersed and administered at low dosages. The other type of toxicity-related damage is from pesticide and fertilizer overflow, and especially from pesticide residues in ground water.

## A CASE STUDY: Effect of Drought in Barind for Crop Production

12. **General.** The term “Drought” refers as an extended period of dryness caused by a precipitation shortfall during the crop growth period, resulting in a substantial reduction in yield. Drought is grouped into three categories:

- a. Meteorological: Rainfall is substantially below the climatologically expected level.
- b. Hydrological: Surface and groundwater depleted.
- c. Agricultural: Inadequate soil moisture to support the growth of plant and crops.

13. Bangladesh has experienced numerous occurrences of droughts over the years. Drought history of Bangladesh shows that drought occurs in the country within 3 to 5 years period. The drought prone area in Bangladesh falls mostly in the South-West and North-West region including Barind area (Figure 1). Deficit rainfall is one of the main reasons for occurring drought in Barind area of Bangladesh. Drought is pivoting factor for crop production in Rajshahi Division. Drought prone area mainly covers the District of Rajshahi. Chapai Nawabganj, Naogaon, Natore, Bogra, Joypurhat, Dinajpur, Thakurgaon, Panchagarh, Rangpur, Nilphamari, Sirajgonj, Gaibandha, Kurigram and Lalmonirhat. It affects about 0.75 million hector of potential agriculture land. Due to drought 50%-90% crops may be damaged around the year in the Barind area.

14. **Impacts of Drought in Barind Area.** The impact of drought may be environmental, economical and social. The environmental impact is the result of damages to agriculture crops, plants and animal species, air and water quality, forest and fisheries, degradation of landscape quality, loss of biodiversity and soil erosion. Some of the effects are only short-term and normal conditions are quickly re-established. Other environmental effects linger for some time or may even become permanent. The economical impact occurs in agriculture and related sectors, including forestry and fisheries, which depend on the surface and groundwater supplies. In addition to obvious losses in yield in both crop and livestock production, drought is associated with the increase in insect infestation, plant disease and wind induced erosion.

15. **Key Issues for Managing Drought.** The impacts of drought in Barind area can be reduced through mitigation and preparedness (risk management). Some of the issues for reducing the impacts of drought in Barind area have been discussed below:

- a. **Long Term Rainfall Pattern in Barind.** Analysis of long term rainfall in Barind area (Figure 1) shows that mean annual rainfall is about 1400 mm, about 78% of rainfall occurs during June to September, and in this period rainfall usually occurs more than 200 mm per month. Again about 700 mm rainfall occur during vegetative to reproductive stage (Mid July to September) of the T. Aman crop and about 30% of total rainfalls occurs during land preparation period (June to Mid July). Only 6% of total rainfall occurs in ripening stage (October) of T.Aman crop.

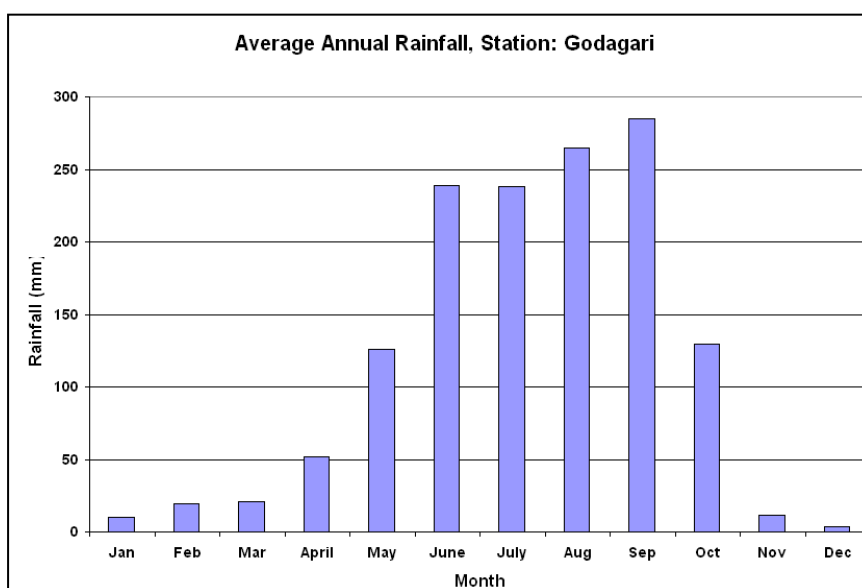


Figure 1: Average Annual Rainfall in Barind area, Station: Godagari

Very little rainfall occurs during November to April, where there is only 45 mm dependable rain in last 30 years record, when net demand for wheat is about 250 mm and for Boro is about 1075 mm. In early days agricultural practices in this area was dependent on climatic conditions and the nature's variation. Farmers till the seventies followed traditional agricultural practices. Aman was the main rain-fed crop, cultivation of dry land Aus rice is around 7% to 10% was the only practice in early Kharif-I season. Rabi crop was generally produced on small areas around low-lying water bodies. As agricultural practices in this area were dependent on climatic conditions, it was very common phenomena that available water could not meet crop water requirement and water stress used to develop in the plant that adversely affected crop growth and ultimately the crop yield. In general, overall agricultural productivity in the area was very low (about 2.40 ton per hectore) mainly due to non availability of irrigation facilities.

b. Adaptation Strategy of the Farmers. Diversification of farming is an ancient but an effective approach to reduce the risk associated with farming in scarce rain and unpredictable environments. "Mixed cropping" or "intercropping" is an example of a traditional and a successful approach to crop diversification on a single parcel of land, where two or more crops are grown together in various possible configurations. In Barind area, intensive use of land is essential for survival against drought. Vegetables, jute, wheat, sugar cane, potato, Mango, etc. are major non-paddy crops. It has been observed that Boro has the maximum water requirement, whereas potato has the lowest irrigation water requirement. On the basis of economic analysis, best monetary return crops to be selected for the area.

c. Rainwater Harvest and Water Management. The landforms of the Barind area are mostly level in the eastern area and undulating in the western area. Moreover, in the eastern area land mass is slightly tilted to the southeast direction. Topography of Barind area has been shown in Figure 3. The Atrai, Little Jmuna and Shib-Barnai are the major rivers to carry most of the drainage water in the eastern part. In the western part most of the drainage water flows through the river Padma and Mohanonda. The depressions in the Mahananda and Atrai floodplains remain watery almost throughout the year due to steady water flow from upland river systems of the rivers Karotoa, Teesta and the Jamuna. There are lots of kharies and ponds also exist in Barind area.

d. Supplemental Irrigation. Due to scarcity of rainfall from November to May, and scatter and insufficient rains in months of September and October, irrigation is essential for intensive use of cultivable land. Major part in Barind area is undulating and is not suitable for flood irrigation. It is found in Barind area that during monsoon, T.Aman always suffers drought of long or short spell at reproductive stage of the crop. In this context, supplemental irrigation plays a vital role in alleviating drought impact during monsoon especially in T.Aman rice.

e. Moisture Management for Rabi Crops. The Soil Resources Development Institute (SRDI) prepared soil association maps of the country including Barind area. A general soil type of Barind area may broadly be classified into two groups: flood plain soils and terrace soils. Terrace soils are Modhupur clay, which occupies more than 50% of the Barind area, and flood plains constitute the rest. Flood plains soils are Teesta Alluvium, Atrai Alluvium and Ganges Alluvium.

f. Mechanization and Crop Establishment. From field observation, it is found that directed-seeded rice cultivation practices required less amount of water for crop establishment compare to transplanted rice cultivation. Also recent studies indicate that direct seeded rice cultivation by drum seeder method shows better yield performance as well as drought tolerance in T.Aman season. This technique can be adopted in Barind area to alleviate drought.

16. To mitigate drought in Barind area, following issues need to be addressed also:

a. Spatial diversification of fields. In Barind area, the farmer's land is divided into several fields or plots which may differ in their topography, soil and hydraulic properties. Some fields may be prone to flooding while others do not hold surface water. Certain fields may be on a warmer slope while others on a cooler one.

b. Varietal Diversification. Planting varieties of crop offer probability of loss reduction caused by environmental stress, as compared with growing one type only. For environmental stress conditions varietal diversification is based mainly on differential phenology, primarily flowering date. A typical example is a transient cold or heat wave that is likely to occur around flowering time of the specific crop.

d. Plough Pan Management. Plough pan retards deep infiltration and help to build up moisture in the root zone and thereby increase productivity. Deep ploughing is to be discouraged to save the plough pan.

e. Judicious Use of Irrigation Water. To ensure the judicious use of irrigation water, the following points need to be taken as consideration;

(1) Ensure conjunctive use of water for irrigation purpose. In this regard, rainwater harvesting is essential.

(2) A minimum levee height of farmer's plot and farm reservoir in each plot can be used for maximum utilization of rainwater in Barind area. It will provide an opportunity to conserve water in the soil profile. The levees of the plot may be used for growing vegetables.

(3) Invent and introduce genetically modified paddy having long stem in water shortage area as it will use more water from ground, thus will reduce loss of standing water.

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## ROOT CAUSES OF THE ECOLOGICAL PROBLEMS IN BANGLADESH

17. Trans-Boundary Rivers. Bangladesh has 57 trans-boundary rivers, of which 54 are shared with India and 3 with Myanmar. A significant amount of water flow is withdrawn and diverted in upstream by neighbouring country for irrigation and other purposes and thereby reducing normal flow of water. The Farakka Barrage on the river Ganges is a notable example. Desertification prevails in some northwestern areas of Bangladesh due to

withdrawal and diversion of upstream water in the dry season by India. Besides, the proposed Inter-basin River Link Project of India, if implemented, the annual water flow of Bangladesh will be drastically decreased which will have profound negative impact on agriculture, economy, society and environment of Bangladesh.

18. Pollution. Air pollution is one of the manmade environmental disasters that are taking place all over the world. There are two major sources of air pollution in Bangladesh, vehicular emissions and industrial emissions, which are mainly concentrated in the cities. There are also numerous brick kilns working in dry season all over Bangladesh, which is another source of air pollution. Almost all of these kilns use coal and wood as their source of energy, resulting in the emissions of sulphur dioxide and volatile organic compounds.

19. Natural Resources. The flood plains of Bangladesh provide one of the most productive and diverse freshwater faunas in the world. Seven hundred rivers and numerous open water bodies seasonally amount to more than 50% of Bangladesh's land surface, providing an area of some 3 million hectares of permanent waters. Over 3000 species of plants and 400 species of fish and other aquatic fauna depend on wetlands for whole or part of their life cycle.

20. Climate Change. Climate change is strongly affecting many aspects of physical and biological systems, particularly rainfall distributions and increases of temperature. Recent warming has been of numerous consequences in agriculture and forestry. Warmer and drier conditions are partly responsible for reduced agricultural productivity. In addition variation in the amount and timing of precipitation is other major challenge due to global warming. In Bangladesh, recent studies indicate that there is an increasing trend of temperature of about 1<sup>o</sup> C in May and 0.5<sup>o</sup> C in November during the 14 year period from 1985 to 1998. The temperature projection for the 21<sup>st</sup> century based on climatic models indicate that in South Asia annual mean warming would be about 2.5<sup>o</sup> C.

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## MEASURES TO COUNTER ECOLOGICAL DEGRADATION

21. Diplomatic measures. The following diplomatic measures can be taken to solve the issue.

a. Bilateral Dialogue. About twenty per cent of the world's populations live in South Asia. Of this, nearly 40 per cent live in the region of the Ganges-Brahmaputra-Meghna (GBM) river system. The territory covered is second only to the Amazon in drainage area and volume of discharge. The three river systems stretch across 16 states of India, Bangladesh, Nepal, Bhutan and the Tibet region of China. On the other hand, owing to seasonal variability of water volume in the GBM river systems, the dry season flows of the GBN Rivers, particularly of the Ganges, are inadequate to meet the combined needs of the region. In fact, the reduced flow of the Ganges in the dry season has exacerbated the process of northward movement of the salinity front, thereby threatening the environmental health of the region.

b. Attention of The International Community. The general flooding pattern is similar in all the three countries, characterised by some 80% of annual rainfall occurring in four to five months of monsoon, often concentrated in heavy spells of several days. Bangladesh being the lowest riparian bears the brunt of flooding in the GBM region.

22. Domestic measures. The following domestic measures can be taken to solve the issue.

a. Creating Reservoir. Water reservoirs may be made to preserve water. During the dry season water can be used from those reservoirs. At the same time fresh fishes also can be found from those reservoirs.

b. River tunnel out. Another factor affecting us is river bank erosion. The general flooding pattern is similar in all the three countries, characterised by some 80 per cent of annual rainfall occurring in four to five months of monsoon, often concentrated in heavy spells of several days. Bangladesh being the lowest riparian bears the brunt of flooding in the GBM region. Large seasonal variations in river flows and the gradual loss of channel depth are causing our banks to erode and river courses to change.

c. Planting trees. Adequate trees can be planted to create greener environment. That will reduce draught environment, try to stop land erosion, likely to give more shadow. These all will have direct impact over agriculture, economy and social elements.

d. Reduction of pollutions. Due to water and air pollution our environment is penalised. Ultimately we all are paying in many ways. Immediate steps may be taken to stop that pollution. That will reduce the money expended behind fertilizer, insecticides, chemicals, health etc.

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## CONCLUSION

23. Water stress is certainly one of the major risks that affect crop production in Bangladesh in almost every year. For sustain crop production, what is needed to address this problem in an integrated manner. A multi-disciplinary approach is appropriate for increasing crop productivity which includes- irrigation, fertilizer, improved crop husbandry, pest management etc. These all are caused by ecological imbalance. A paradigm shift is needed from current water development approach to water resources management approach to ensure and to protect the world's precious water resource. Water could be successfully used as the engine to promote this economic development. With reallocation and redistribution of already available resources, much can be accomplished. We are severely handicapped by recurrent floods which cause damage to life, property and infrastructure. At the same time it is causing a serious threat to the balance of the ecology.

24. The water quality in the GBM region is also progressively deteriorating due to increased withdrawals for various uses, leaving insufficient flows for dilution of pollutants during lean periods. The increased use of agro-chemicals and the discharge of untreated domestic sewage and industrial effluents into rivers have aggravated the problem. Owing to the interaction between different types of surface water, pollution of the entire water resource system has now reached alarming proportions. In addition to the above causes, in Bangladesh, the magnitude of water quality deterioration has been further compounded by salinity intrusion in the south-western region.

25. On the other hand earlier Barind area was drought prone area and symptoms of desertification were found due to shortage of surface water and rainfall. However, impact of groundwater use should be monitored and it should be used judiciously without creating environmental hazards. Since drought in Barind area damages crops, livestock, fisheries, forestry and create hazards for human habitation, it should be addressed on priority basis on the national context. Because Barind area has vast potential agricultural land along with so many small water bodies like ponds and khals. It may be the prime approach to intensify agriculture and conversion to generate stable income for the habitant of the Barind area as well as to contribute to national crop production for self sufficiency of food. It is very important to maintain the balance of the ecology.

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#### RECOMMENDATIONS

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26. The followings are recommended to alleviate the situation and manage the ecological balance in Bangladesh:
- a. Necessary measures to be taken to stop withdrawing water by India from upper reveries locations.
  - b. Adequate measures may be taken to restore the surface water. Like creating reservoirs, increasing river and canals depth etc.
  - c. Implement the rules and regulation to reduce the air and water pollutions.