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THE LAWS OF NATURE AND HUMAN ACTIONS ON HUMAN ECOLOGY IN BANGLADESH

M. AMINUL ISLAM AKANDA

Associate Professor, Department of Economics, Comilla University, Kotbari, Comilla, Bangladesh

ABSTRACT

Global warming-led climate change, interventions on river system, rapid urbanization and unplanned industrialization have interrupted natural laws, which appeared as threats to human livelihoods in Bangladesh. This study synthesized of how much has the human actions influenced and would influence the human ecology. This research acknowledged that food security, healthcare and settlement for growing population fall in some severe problems. Water crisis would disquiet food production, for which river system must be preserved and protected. With lower level of interventions on natural laws compared to the developed countries, the human ecology of Bangladesh became vulnerable. Compensatory receipt of resilient fund from developed world might address the issues in the short-run. However, a country would not be able to reshape its natural laws without effective mitigation measures and modified human actions at global level. Consequently, the long-run solution should incorporate legal consensus to cut undue human actions on nature all over the world.

KEY WORDS: Laws of nature, Climate change, Hydrology, Human ecology, Food security

INTRODUCTION

The Newtonian paradigm created a tremendous human capacity, which promoted for a breakthrough of the laws of nature. According to other deterministic and time reversible paradigms, the world became vast automated by human actions through manipulation and exploitation of natural environment (Mesarovic & Postel, 1974). The fuel-driven industrial revolution since the mid-eighteenth century increased industrial production in some developed countries (Bairoch, 1982). An interdisciplinary team of scientists of the Club of Rome forecasted for upcoming limited production function from energy crisis (Meadows, et al, 1972). Meanwhile, the global climate has been changed in the process of industrialization, urbanization and other forms of commercialization (IPCC, 2007). However, possible break of civilization were not considered during the occurrences.

Human actions would follow its rising trend in Bangladesh because of rising the percentage of workforce besides booming the population (MOP, 2011). In addition to domestic pressure on environment, India created obstructions on the natural upstream flow, which brought out the scarcity of surface water in dry season and the saline water intrusion in coastal areas (MOEF, 2008). Such human

actions came in constituencies and networking among environmentalists, social scientists and natural scientists. Moreover, the issues of protecting environment were addressed in major international conferences from Kyoto to Cancun. However, the discussion could not bring any global legal consensus to stop violation of natural laws and global warming.

Among the researches in this regard, Rahman & Alam (2003) identified the impact of climate change on crop production through experiments on sensitivity to temperature, moisture, salinity and fertilization. Subsequently, Huq & Ayers (2008) explored the vulnerability of people in respect to coastal hydrology and migration. Earlier, WARPO (2001) in its National Water Management Plan showed the way of handling the problems with saline water intrusion due to sea level rise and hydrological imbalances due to obstruction on and diversion of river system. Mirza et al. (2001) analyzed the changes in water supply situation of the Ganges River after India's diversion of river flow. Accordingly, Ahmed & Roy (2007) addressed some of issues with water supply and showed how the water crisis to be appeared in coming decades. In a recent research, Akanda (2010) identified a water efficient and diversified crop production system to address such a water crisis. Moreover, the World Bank (2010) in the World Development Report 2010 critically mentioned a few cases related to climate change and diversion of river system.

This research aims to explore how have the human actions on laws of nature shaped the production system and human livelihoods in Bangladesh. The impact of such actions has been evaluated on food security, human healthcare and human settlements for the past, present and future. The study is based on extensive review of related literatures on climate change, hydro-morphology, farming system, water crisis and human livelihoods. The secondary data has adequately been presented to clarify the interactive factors related to the human ecology in a least developed country like Bangladesh.

POPULATION GROWTH AND HUMAN ACTIONS ON PRODUCTION SYSTEM

Bangladesh is one of the most densely populated countries in the world with its four times density of India, thirteen times of Myanmar and one hundred times of Russia (Neaz, 2009). The population was tripled during the second half of last century and reached to about 150 million in 2011 (BBS, 2012). The country is at present at the late third stage of demographic transition model (Blacker, 1947) with a crude birth rate of about 19 per thousand people in 2010 (MOP, 2012). Its population would not decline as per the Malthusian theory, which states that whenever human beings obtain more than mere subsistence, their number goes up until everybody backs to mere subsistence (Malthus, 1798). However, the income level of the people tends not to decline back to mere subsistence just because of higher agricultural productivity in Bangladesh.

Human actions on laws of nature were first intensified for food production, which had serious environmental consequences. On the other hand, the country was reported to loss about 1% of cultivable land annually for housing, communications, industries and other infrastructures (MOP, 2011). However, industrialization was likely despondent because of its colonial episode. Per capita industrialization of greater India went down from 7 to 2 during 1750-1913 based on an index of 100 in 1900 for the Great

Britain (Bairoch, 1982). After the departure of British in 1947, the food scarce country concentrated more on food production. In the mid 1980s, it overcame the Malthusian trap with a higher growth rate of food production than that of population (Akanda, 2008). Because of irreversible supply function for technological progress, the modern farming would continue to expand under suitable soil and climatic condition capable of producing crops in three seasons in a year.

High yielding varieties (HYV) farming was a demand-led adoption by all types of farmers. Accordingly, the groundwater irrigation expanded for rice farming in dry season at a high rate over expectations (WARPO, 2001) from 6% to 74% of total irrigation during 1972 to 2009 (MOA, 2007; BBS 2011). Gradual expansion of HYV rice farming contributed much to rice production, which in turn stimulated the use of fertilizer to 282 kilogram and pesticides to 3.7 kilogram per hectare in 2009 from an insignificant amount in the early 1970s (MOA, 2007; BBS, 2011). Meanwhile, the peasant mode of farming was found shifting to commercial farming of both rice and non-rice crops (Akanda, 2008). Such a commercialization has broken the natural laws through mechanized irrigation, excessive fertilization, etc.

On the other hand, the demand for industrial products started to increase in the late 1980s. Being the predominant industries, the jute, fertilizer, sugar, leather and cotton yarn could not expand much. However, the labor-intensive ready-made garment industry accommodated sufficient amount of pauper labor (Ahmed, 2000). Moreover, some pharmaceuticals, beverage, cosmetics, cement and agro-processing industries emerged and expanded since the late 1990s, reflected from the Quantum Index for industrial production (BBS, 2011). In addition, the demand for non-food and processed-food items increased for expansion of non-farm activities and urbanization.

Rapid urbanization raised urban population from 5.2% to 25.1% of total during 1961 to 2008 and is projected to be 57% in 2050 (Nabi, 2012). Meanwhile, fossil fuels based urbanization resulted in water and air pollution, too. However, yearly per capita CO2 emission was found negligible at 0.3 ton in Bangladesh compared to 17.6 ton in the USA in 2010 (Wikipedia, 2012). Being least responsible for climate change, Bangladesh has been identified as the most vulnerable country to cyclones in the world (MOEF, 2008). Moreover, interventions on river system resulted in hydrological imbalances. In view of this, the livelihood of ever-growing population of the country has fallen on trap of cyclones, floods, draughts, riverbank erosions, coastal erosions and other forms of natural disasters.

PROBLEMS WITH CLIMATE CHANGE AND INTERVENTIONS ON RIVER SYSTEM

In this age of global warming and climate change, the country warmed up by 0.5°C over the last century (EJWG, 2007: referring to the Bangladesh Unnayan Parishad). The maximum temperature during the 1990s was 41°C, which rose to 46°C in 2010 beside a drop of minimum one to 6°C (BBS, 2011). Surface temperature was estimated to rise by 1.3°C by the year 2030 with a seasonal variation of 1.4°C in dry season covering the months of November to April and 0.7°C in wet season covering May to October (Rahman & Alam, 2003). On the other hand, out of 2.54 meters total rainfall, only 19% occurred

in dry season over the last few years (BBS, 2011), which was estimated to fall to 12% by 2050 (MOEF, 2008). Meanwhile, the incidence of natural disasters increased from 6 in 1976 to 10 in 1982 to 12 in 1994 to 14 in 2000 (CEDR, 2009). The flood is a major disaster for which any inundation of more than 20% of total area is recognized as major. During the period 1963 to 2007, the frequency of floods and the percentage of inundated areas were found increasing (BWDB, 2008).

River system of the country accounted for an upstream flow of approximately 1000 billion m^3 per year, which was equivalent to 74% of total water resources (Ahmed & Roy, 2007). The Ganges, Meghna and Brahmaputra (GMB) system is one of the largest river systems in the world, which used to carry 1.7 billion tons of silts from innumerable tributaries. The southern part of Bangladesh continued to grow from sedimentation since million years. About 60 to 70 kilometers land accreted inside the Bay of Bengal since 1760s compared to the Rennell's map for the Bengal and Bihar Atlas. However, the natural system of land accretion impeded due to human actions on river system (Kudrass et. al, 1999). Though the upstream seems sufficient for 147,570 km^2 land areas, its share was found only 1% of total flow in a critical month of February (Ahmed & Roy, 2007).

Scarcity of surface water was visible when India illegally diverted upstream flow since 1975 by the Farakka barrage on the Ganges River at 18 kilometers far-off Bangladesh border (Mirza, et al., 2001). The minimum flow of the Ganges River at Hardinge bridge point was 857 cubic meters per second (m^3/s) in 1987, 786 m^3/s in 1999 and 472 m^3/s in 2007 (FPCO, 1993; BBS, 2009). The Ganges River had a minimum flow of only 1.27% of its maximum flow at Hardinge bridge point, which was 4% for Meghna River at Sylhet point in 2007 (BBS, 2009). Such a lower water flow in dry season is also a factor for rapid expansion of groundwater irrigation.

Submerging of low-lying coastal land together with saline water intrusion became devastating in coastal areas. Meanwhile, the sea level in the Bay of Bengal rose by 0.5 meter over the last century and will lead to another rise by maximum 0.5 meter by the year 2030 (EJWG, 2007). About 17% of total land areas would be submerged for one-meter rise of sea by the end of this century (World Bank, 2010). At this stage, the sea level was not the only factor for saline water intrusion but the lower water discharge from upstream was also found as a critical factor (Haque, 2006). Accordingly, the coastal areas were frequently and widely inundated due to higher water pressure from upper sea and lower upstream water pressure, which is responsible for larger coastal erosion.

In addition to this, inadequate upstream flow stimulates deposition of enough silt and lowers the water conveyance capacity for upper the riverbed. Out of total 2,400 kilometers of riverbank, every year about 1,200 kilometers was actively eroded and more than 500 kilometers faced severe problems related to erosion. It was reported that the GMB basin lost 106,300 hectares during 1982 to 1992 (EJWG, 2007). Consequent to the constructions of dams, barrages, embankments, etc., the hydro-morphology of river system has been changed, which also affect human ecology of Bangladesh.

IMPACTS OF HUMAN ACTIONS ON HUMAN ECOLOGY

The progess towards the Millenium Development Goals indicate that food intake, consumption pattern and health condition of the people improved over time (MOP, 2012). The main factor behind higher food availability was the expansion of irrigation-led HYV farming that raised rice production to more than three times during last four decades. Moreover, the rice researchers of the country released salinity tolerant varieties yielding up to 6.43 MT per hectare (BRRI, 2011). However, the saline water intrusion and arsenic contamination in groundwater would be more dangerous for agricultural production in some south-central parts (WARPO, 2001). What is more is that country's rice-intensive farming was found concentrating to rice monoculture (Akanda, 2008), the production of which was identified as water-intensive (Pimental, et. al, 1997). In this regard, the crop production would be hampered from water shortage in future.

Total water requirement for crop production was 77 billion m^3 in 2006 which was distributed as 4.3 29.2, and 43.8 billion m^3 for summer, monsoon and winter seasons, of which rice farming required 90%, 97% and 87% of water in the respective seasons. Around 12 billion m^3 out of 23 billion m^3 stock of groundwater was withdrawn in dry season and the rest amount came naturally from surface water, soil moistures and atmospheres (Akanda, 2010). To meet up the current rate of consumption for the population to be upto 190 million in 2030 (MOP, 2011), the crop agriculture would require 6.1, 33.2 and 52.8 billion m^3 of water in summer, monsoon and winter seasons, respectively. Notwithstanding the under-stream to contribute to groundwater, it might not contribute to stock because of lifting water from almost everywhere. Uunder gradual scarcity of surface water, the higher pressure on groundwater would create severe problem with agricultural production system.

Upcoming water crisis could be addressed through crop diversification because at least 1.9 m^3 of water was required for one kilogram of rice production, which was much higher than 0.5 m^3 for potato and vegetables (Pimental, et. al, 1997). In this context, existing food basket could be made a balanced one by cutting rice and adding potato, vegetables and other foods. After adjustment, the crop agriculture would consume 5.2, 29.8 and 49.8 billion m^3 of water in summer, monsoon and winter seasons, of which 3.8, 28.7 and 38.2 billion m^3 for rice production, respectively. Such change would require a cut of rice farming by 16% in all crop seasons (Akanda, 2010). Moreover, it would be required to care for production of fish, meat, milk and egg that would be distorted from temperature extremes, uneven humidity and extensive natural disasters.

Human health, on the other hand, faces threat to chemicals, germs and diseases. Food adulteration appeared as a new threat to good health. The quality of hybridized and genetically modified foods was reported much inferior to organic foods and likely the culture fisheries to capture ones, and non-natural livestock to natural ones. Moreover, rice produced in arsenic prevalent areas were contaminated @ 1.7 milligram per kilogram in 2008, which was above the maximum safe limit of 1.0 (Chowdhury, 2010). Though a positive demographic transition took place for mitigation of preventable

diseases, maternal, antenatal and postnatal healthcares (MOP, 2012), it might not sufficient to ensure good health under dynamism of diseases.

Out of total death incidences in 2010, more than 50% took place due to attack of five diseases, among which coronary heart diseases 17.1% followed by influenza & pneumonia 10.9%, stroke 8.6%, tuberculosis 8.5% and lung diseases 5.2% (WLE, 2012). Moreover, the intensity of stroke and cardiovascular diseases from heat wave was reported very high reflected from an average death of 121 people during the first half of 2000s (Huq & Ayers, 2008). The heat related problems became severe in densely urban areas for the multi-storied buildings to block wind and to absorb heat. Without the cooling process, their indoor temperatures sometimes rose by about 4°C over the outdoor in a hot afternoon (Mallick & Mourshed**,** 2012). This is the way in which the temperature extreme and urbanization affect the microclimate and eventually human health.

Human actions forced people towards hazards and fears of apocalyptic destructions. According to the statistics of the PreventionWeb, out of 234 extreme cases of disasters during 1980-2010, a total 0.2 million people were killed and 323 million were affected with an economic loss of $17 billion. The most severe case of killing per event was 1,548 against the 0.5 million people affected during cyclone, which were accounted for 183 and 3.5 million for flood, respectively. It was estimated in 2010 that around 12.9% of people was in hazard zone for floods, which was 3.1% for cyclone, 1.1% for tsunami and 0.9% for earthquake (PreventionWeb, 2012).

Another study said that about 0.73 million people were displaced by riverbank erosion during 1981-1993 at an annual rate of 63,722. Moreover, the rate of land erosion increased to 8,700 hectares per year (EJWG, 2007). Beside the river erosion, coastal erosion was also found responsible for homelessness and migration. People loosing their traditional livelihoods became rootless climate migrant during the cyclone Sidr in 2007 and Aila in 2009, which was reflected from the zero growth of population in coastal district Barishal and 0.6% in Khulna district compared to the national rate of 1.34% (BBS, 2012). There were about four million rootless environmental refugees in 2010, which would reach at 20 million within next 100 years (World Bank, 2010).

In-migration rate to urban areas was 4.5%, which was about 6.0% for Dhaka city. The poor and homeless migrants, in most of the cases, got shelters in slums. Not only has Dhaka been experiencing rapid urban growth, its density in the slums in 2010 was roughly 200 times greater than national population density (Nabi, 2012). Moreover, many fishermen already migrated and would migrate to cities because of drying the rivers up (Huq & Ayers, 2008). Meanwhile, the number of slum people reached to more than one third of people living in major cities (BBS, 2011). In future, the cities will be more dangerous places for settlement due to the limited access to safe food, safe water, sanitation, power, transportation, etc.

CONCLUSIONS

Human interventions on the laws of nature brought out some sort of risks to human civilization. The domestic, industrial and commercial spaces were expanded at the expense of green lands and water bodies. Meanwhile, the Newtonian interventions made the globe warmer and other human intervention affected the natural river system. Consequently, human manipulations beyond certain limit caused a long-term environmental degradation. This Gangetic delta, being not much responsible for violating the laws of nature, got international reputation as one of the most vulnerable countries in the world. With the highest concentration of population, the country has fallen in threat from global climate change, India's withdrawal of upstream and other forms of human actions.

How have the food security, human settlement and healthcare of the country become questionable is explored in this study. Upcoming water crisis and incessant natural disasters would reduce food production. Albeit the improvement of varieties being satisfactory, the agriculture would not be able to produce water-intensive rice to meet the demand for rice-intensive food habit. This water related problem could be addressed by at least 16% cut of rice farming in each crop seasons. In this regard, the national policy must adapt balanced food basket by adding low-water demanding non-rice crops. In the process of shifting, it would be required to create demand for no-rice foods, to diversify dishes from existing curry-based dishes and to motivate children towards non-rice food. Unless promoting the non-rice crop farming with incentives and climate reseilient varieties, any endeavour of reducing rice and expanding non-rice crops will not be effective.

Good news is that the food intake in both rural and urban areas increased over time. However, new problem created with food adulteration for all food items ranging from rice to fish and vegetables to fruits. The unsafe-food also originated from arsenic contamination, modification of varieties and over-use of chemicals in production process. It is crucial to stop production and marketing of adulterated food by the government interventions. On the other hand, the people beside diarrhea, dysentery and skin diseases attacked increasingly by new diseases due to the fluctuations in rainfall, humidity and temperature. Moreover, urbanizations added to temperature extreme from high-rise buildings beside natural calamities, which would raise the intensities of cardiovascular and respiratory diseases.

Incessant natural disasters influenced much of human settlement. In-migration to urban areas reached to four times of population growth, which was mostly concentrated on capital city. People, being climate refugees for river and coastal erosion, migrated to cities. They got shelter mostly in slums, where around one third of city people used to live. Such a pressure in capital city and a few large cities stressed their livelihoods for power outage, traffic congestion, water scarcity, inadequate sewerage, etc. However, the problem with unplanned and rapid urbanization was not addressed in the past and has little probability to adequately address the slum-based expansion in future.

The 'Bangladesh Climate Change Strategy and Action Plan 2008' is expected to deal with problems like water crisis, river erosion, saline water intrusion and ecological problem. In light of compensation from developed countries, Bangladesh received commitment for more than a hundred million dollar as climate resilient fund. Effective utilization of the receivables would be a short run means to solve a few problems with food security, human settlement, healthcare, etc. However, the country with its own actions would not be able to save itself because of externalities from others' actions. Meanwhile, a few treaties were signed with India to keep minimum upstream flow during dry season, which was not fruitful due to extensive human interventions on river system. The RIO+20 in 2012 showed the green path to address disasters and environment-related problems. Meanwhile, Bangladesh has planned to formulate 'The Bangladesh Delta Plan 2100'. However, it might not be able to reshape its earth in the long run without any global legal consensus to modify human actions. In this context, will not the nature continue to figure out its own course of actions and its own judgment?

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