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Abnormal Population Growth and Its Effects on Agricultural Resource Management: Focusing the Global Situation with a Micro-level Example

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Abstract *Every year at least 10 million hectares of arable land are eroded throughout the world and consequently for such a loss, a huge amount of replacement is beaded from forests and other sources for agriculture and human settlement. In the meantime, world population exceeded 6 billion in the year 1999, and the projected data indicates that it is going to be almost 9 billion within the next 40 years. For that reason, demographers and environmentalists have highlighted that the main challenge for environmental management throughout the world today is to determine our planet's capacity to sustain such a huge amount of burgeoning human population. This paper assesses specifically the impact of growing population on agricultural resources around the world. To exemplify such a trend of agricultural land use, the paper incorporates a detailed example from an ethnographic case study on indigenous land-use practices and the experiences associated with modern cultivation for adapting to adverse situations caused by severe impact of a growing population in agriculture sector in rural Bangladesh.*

Keywords: *Growing Population, Agricultural Resource Management, Impact in Global Situation.*

1. Introduction

In the last few decades, there has been great concern over the issue of natural resource management in the global context. People are very much aware that the supply of

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various non-renewable natural resources on this planet is shrinking rapidly due to over-exhaustion and enhancement of resource appropriation. There has been rapid transformation of the world's natural landscape to agriculture, which indicates that such use of natural resources will soon exceed its carrying capacity by causing an irreversible damage to its natural ecosystem. While land use practices often vary greatly across the world, the ultimate purpose usually remains the same, which is to extract the natural resources for instant social needs, knowing clearly its severe impact on the environment. In the meantime, the world population has increased from 3 billion in 1959 to 6 billion in 1999, which took only 40 years for it to double. The US Census Bureau of the International Data Base also projected and mentioned that this number will be 9 billion in the year 2044, an increase of 50% within a span of 45 years (US Census Bureau, 2010). Accordingly, the demographers and environmentalists have posed a concern; the main challenge for the global environment is to determine our planet's capacity to sustain such a huge number of growing populations. In this context, the carrying capacity of the planet may further be measured by calculating the per capita requirement of food and nutrition subsistence. To provide adequate food subsistence to the people living with diverse diet will require at least 0.5 hectare of arable land per person (Lal & Steward, 1990), but at this time we have only 0.27 hectare per capita land available to us, which will drastically be reduced to 0.14 hectare per person within the next 40 years due to loss of land caused by population pressure (Pimentel, 1993; Pimentel, Harman, Pacenza, Pecarsky, Pimentel. M., 1994; Pimentel, Harvey, Resosudarno, Sincliar, Keuz, McNair, Crist, Shpritz, Fitton, Saffouri, and Blair, 1995; Pimentel, 1997). In his book titled 'World Soil Erosion and Conservation' published in the year 1993, David Pimentel mentioned that per capita shortage in the availability of land has remained the major reason for severe food shortage and malnutrition in many parts of the world. The environmental depression is further intensified due to soil erosion in agricultural areas where 75 billion of metric tons of soil are demolished from the fields through wind and water, mostly affecting the cultivatable land (Myers, 1993). Furthermore, deforestation and desertification have been occurring in the last two decades causing the human beings to be more vulnerable to shortages of land (Skole & Tucker, 1997). In the process of deforestation and desertification, more forest areas are converted to farming activities (Global estimates of tropical deforestation range from 69,000 km in 1980 to 10000-16500 km in the late 1980s [Devid & Tucker, 1997]).

Based on the informative introduction, the main purpose of this paper is to analyze the effect of population growth on available agricultural resources around the world, which creates pressure on indigenous and sustainable agricultural management.

From the methodological point of view, researchers used both primary and secondary data where the secondary sources of data from global perspective have conceptualized an analytic-descriptive framework for explaining the world's demographic situation, contextualizing its impact on environmental resource management. In consonance with the above dimension, researchers have incorporated an ethnographic documentation at the micro-level, showing the situation at the village level. As a matter of fact, this is an important test on the effectiveness and accuracy of what has been stated at the macro perspective in the global context and an ethnographic brief in this context is proving our statement at the field level.

2. Equation of Population Growth and Its Impact around the World

Until about 18th century, the world population was kept under check through war, famines and diseases. As a result it did not pose any serious threat for the people around the world until that time. The overall statistics on world population exhibits that it remained at 1 billion until 1830, and it took 100 years to double the population to 2 billion in the year 1930. But subsequently, within a range of 30 years later in 1960, the cumulative growth of population stood at 3 billion worldwide. It took only another 15 years in 1975 to increase the total population of the world to 4 billion. To explain more analytically, the causative factor for a lower number of population growth prior to 1930 was not for its lower birth, but because of the high rate of mortality due to some severe and uncontrollable epidemics which caused a huge number of world population to perish at that time. The mortality rate in those days further increased due to conditions like famines, accidents, etc., which reduced human population even though there was high fertility. It is clear from the above statistics that within a stipulated period of only 45 years from 1930 to 1975 the population of the world had simply doubled. In this continuous process, twelve years later in 1987, the population of the world reached 5 billion. In the year 1999, it became 6 billion which further increased to 6.8 billion in the year 2009 (United Nations Population Reference Bureau, 2009). World population is expected to grow to 8.9 billion in 2050, and much of the demographic change up to this period will occur in the less developed nations.

Although the overall population growth rate throughout the world had decreased considerably during the latter part of the last century, the population growth rate in general remained consistently high in many poor and underdeveloped countries. During the period till 1960, the population growth rate throughout the world peaked at 2.4% per year which later fell to 1.9% during 1999, meaning that population increased by 87 million every year. Extrapolating on such trend of

Table 1 : Global Population Situation

Year	Population (in Billion)	Year	Total Fertility Rate
1830	1	1969	6
1901	1.4	1999	3
1930	2	Population Growth Rate	
1960	3	1969	2.4
1975	4	1999	1.9
1987	5		
1999	6	World Population Projected for 2050: 9.1 billion	

Source: *Prema Ramachardaran et al, 2008; UNDP 2009.*

lower fertility rate, UNDP's projected data clearly indicate that the world population will reach 9.1 billion by 2050 (Wright, 2008; UNDP, 2009). Rising population has already been a problem for many poor and developing nations of the world. For instance, the population in India, which is approximately 1.15 billion, inhabits an area of 3,287,240 sq. km. Its current growth rate is 1.3% per year which will double in the next 37 years (Pimentel et al, 1995). Similarly, China has 1.27 billion people with a growth rate of 1.1% which is the optimum desirable rate of the percent size (Qu & Li, 1992). Despite the government's effort to reduce the growth rate by allowing only one child per couple, the population of China has continued to increase every year. One of the poorest countries of the world, Bangladesh has about 153 million people living in a surface area of 1,47,570 sq. km. In 1930, its total population was only 35.5 million which has now increased to more than four times to make it 153.50 million in 2008; Bangladesh now faces a daunting challenge to feed its population where at least half of them are living in food based poverty level (Cuffaro, 1997; Karim, 2011).

3. Population Pressure on Land and Agricultural Resources: Global Context

Population increase in many parts of the world has consequential effect on agricultural resource because an excessive growth of population can drastically minimize agricultural land throughout the world. It is reported that agricultural land, which extracts food and cereals, contains only 12% of the total land area of the planet, which does not seem to be sufficient in terms of covering the subsistence of such a huge incumbent population. Of the remaining land 24% are arid grass land which is used for pasturing and grazing purposes, and another 30% is covered by forest necessary to protect the environment from greenhouse effect and other climatological imbalances. The remaining 34% of the total land of the planet is fully unusable for any crop production as they are stony, too steepy or

are exposed to extremely dry, cold and wet atmospheric conditions (Buringh, 1989). These lands are simply geologically infertile, unusable for pastures as grass land, and climatically unsuitable for crop production (Pimentel, 1989).

Thus, it becomes logical that when population grows at an unlimited rate, it obviously puts pressure on our marginally available 12% of useable agricultural land, the supply of which is also shrinking day by day. An extreme growth of population also squeezes the per capita availability of cultivable land. Based on evidence, it is calculated that at present we require 0.5 hectare per capita crop land as a minimal requirement to sustain a proper diet and nutrition. But due to continuous population growth and also rapid land degradation, the availability of per capita land is reduced to an extreme point day by day (Leach, 1995). In many Third World countries, it is far below the global average, putting people under serious food shortage and effectual causation of poverty and hunger.

We know that land and its terrestrial environment is essentially an important natural resource which provides 99% of humans' food requirement (Pimentel & Pimentel, 1996). Thus, logically it is quite likely that when this land is under serious threat due to population growth, farmers need to use the same land repeatedly through intensive multi-cropping production. When farmers go for intensive cultivation, they have to utilize mechanized farming and make an abrupt shift from their traditional indigenous farming system. The introduction of mechanized farming provides a sharp increase of crop production, which is essential to support a growing population. Traditional subsistence farming in Asia and Africa in the past involved the rotating cultivation or mono-cropping, keeping the land fallow for some time, which as a matter of fact allowed the land to be revitalized and regain its nutrients. But with the increase of population, people put continuous pressure on land, without allowing them any time off. The resulting consequence is the deterioration of the soil, which keeps the land fully dependent on chemical fertilizer and uncontrolled irrigation. Therefore, peasants moving towards mechanized farming no longer depend on seasonal rain and also, at the same time, are totally dislodged from indigenous farming mechanisms. Due to mechanized farming, crop production increases, and yet a complementary notion develops when people usually care less about reducing the population.

4. Demographic Impact on Agricultural Land Use: A Micro-Level Example from an Ethnographic Research

In this part the researchers present an ethnographic documentation on two villages in Bangladesh. Dhonjoypara and Gopalhati are both agricultural communities

located in the same physiographic and environmental setting. They belong to Puthia union (A union usually comprises of 6-15 villages) of Rajshahi District in the north-western part of Bangladesh. Physiographically, Puthia and these villages lie on the outer margin of the riparian tract which is about eight miles from the left bank of the Padma River. The mean temperature for Puthia and the study villages increases from 63^0 in January to $>85^0$ in the summer months. Of the yearly rainfall of about 56 inches, no less than 50 inches fall in the rainy season. Compared to other parts of the country, the rainfall of Puthia villages is far less, which speaks of the necessity for irrigation of its land.

On the basis of surface level, there are three types of land in Puthia: (1) *Daira,* also known as *bhiti* land, meaning land for homestead or the elevated land above flood-level; (2) *Mathan* or the flat fields of intermediate level, which are partially flooded during the rainy season; and (3) *Layal* or the low-lying land which is completely flooded during the rainy season. These diverse soils of the villages provide them with diversified cropping pattern.

5. Settlement Trends: Agricultural Land use and the Population Dynamics in the Villages

Researchers have examined the settlement trend, land use pattern and the population dynamics in Dhononjoypara and Gopalhati to provide data at the micro-level investigation. Information about village settlement is very significant as it gives us an indication about the population pressure, which compels people in the villages to convert their agricultural land to homesteads. Information about village settlement prior to 1850 is not available. According to the first village revenue survey of 1850, Dhononjoypara contained 205 acres of land while Gopalhati had 309 acres of land in its *mouza.* The village revenue survey of 1850 indicated that mouza Dhononjoypara at that time had only five households occupying in total 9 acres for homesteads. The amount of cultivable land in Dhononjoypara was 1990 acres and the remaining 6 acres was waste and uncultivable. On the other hand, Gopalhati had 14 households having 25 acres for homesteads; the amount of cultivable land was 368 acres (Table 2).

The amount of cultivable land was 190 acres and the remaining 6 acres was waste and uncultivable. On the other hand, Gopalhati had 14 households having 25 acres for homesteads and the amount of cultivable land was 368 acres.

The census reports of 1951 and 1961 provide information on population, households and literacy but do not give any information on settlement pattern, thereby making it impossible to analyze in detail the changes over time. However,

Table 2 : Land-use pattern for villages Dhononjoypara and Gopalhati Since 1850 (acres)

	Dhononjoypara				Gopalhati		
Census Year	Land used for Settlement	Land Used for Cultivation	Waste and Uncultivable Land	Total	Land used for Settlement	Land Used for Cultivation	Total
1850	9	190	6	205	25	369	393
1968	58	152	-	210	99	293	392
1974	No information	No Information	No information	210	No Information	No information	399

Sources: *First Village Revenue Survey, 1850; Revisional Settlement Survey, 1968.*

the revisional settlement survey of 1968, which came out in 1978 filled the vacuum in this regard, and the Census Report of 1974 provided gross data on the total amount of land available in each village. According to the Revisional Settlement Survey (1968), *mouza* Dhononjoypara had 210 acres of total land of which 152 acres were cultivated. In Gopalhati, there were 392 acres of total land, of which 99 acres had been used as settlement and the remaining 293 acres were agricultural land. It may be inferred from the Revisional Settlement data that there has been a tremendous increase of land for settlement in both villages since 1850. The reason is obviously the increase in population.

To have a clear picture of population growth in Dhononjoypara and Gopalhati, a demographic view of the villages since 1951 to present time is shown in Table 3. To enquire about the population transition of the villages for the past century it is necessary to know the population dynamics of Puthia Union and Puthia Upazila as a whole. Census recording in the sub-continent of Bangladesh-India and Pakistan began as late as 1872. But there is no information on population at the village level, nor does the Village Census of 1901 dealt specifically with village statistics. It was simply a camouflage in the name of Village Census. In fact, population statistics at the village level only came into existence in 1951.

The reported census of 1872 and 1901 produced data on the *thana* (i.e., present upazila) level which indicate that there were decades of declining population in Puthia Upazila. The Bengal District Gazetters-Rajshahi-1916 (O'Malley, 1916) indicate that the population of Puthia and adjoining Upazilas (i.e., Bagmara, Mohanpur, Paba & Charghat) declined tremendously between 1872 and 1891 due to prevalence of malaria, smallpox, and cholera together with water-hyacinth which blocked the water channels. This caused a 15.01% decrease of population (1976, p.48). Through 1901, Puthia and the adjoining upazilas sustained a loss of population by a decrease of 12.08 % (O'Malley, 1916). Many people died in this swampy water-logged area and others migrated to the comparatively healthier and

Table 3 : Demographic data for villages Dhononjoypara and Gopalhati (1951-2012)

	Dhononjoypara					Gopalhati				
Year	Number of HH	Total Population	Male	Female	Literacy Rate	Number of HH	Total Population	Male	Female	Literacy Rate
1951	No data	350	No data	No data	No data	90	380	No data	No data	No data
1961	72	371	195	176	15.36	93	513	264	249	11.11
1974	62	348	164	84	20.69	151	959	478	481	11.57
1985	105	660	345	316	23.60	196	1207	631	576	14.17
2013	199	915	471	444	47.60	299	1964	997	967	46.50

Sources: *Census Reports 1957, 1961, 1974; Karim, 1990; Field Report, 2013*

more prosperous areas (Naogaon & Panchupur, n.d.) of Rajshahi Region (O'Malley, 1916). Nelson (1923) reported that the population of Puthia decreased by 44% between 1872 to 1912. This declining population trend for Puthia continued till 1951 due to a large emigration of the Hindus to India during and after 1947 (Hossain *et al*., n. d.). From 1951 onwards, the population had again increased in Puthia Union, as it had for Dhononjoypara and Gopalhati. The increase of population for Puthia Union between 1951 and 1960 is 32.2% (Hossain *et al.,* n. d.). This growth rate has been mostly due to increasing birth rates. Side by side with the population growth, we find that there had occurred a tremendous loss of the agricultural land in the villages of Dhononjoypara and Gopalhati.

6. Findings and Discussions

Based on the above discussion, it is observed that since the beginning of human history, global population increased tremendously putting the people on the earth in enormous problems and economic hardship. It has been evidenced that when the world population was 1 billion until 1830, it took only 100 years to double the number to 2 billion in 1930. We found that within a span of 45 years, this number doubled again to 4 billion in 1975. There was an addition of another two billion people by the end of the Twentieth century to raise the world population to 6 billion in 1999. Thus it has been observed that with the passing of time population doubled in lesser and lesser time period. Such increase of population requires more and more land for settlement and habitation having a direct impact on natural resources. It has been calculated that overpopulation is the prime reason for reducing per capita availability of land. To substantiate this statement, the paper has incorporated an ethnographic documentation of two villages from Bangladesh where it has been evidenced that demographic pressure has resulted in the transformation of agricultural land. Based on the data, it has been found that this loss of land in the villages Dhononjoypara was 18% and for Gopalhati, it was 19%. It is thus indicative that population increase puts heavy pressure on cropland when the people in the rural areas have been compelled to divert their farming land toward settlement and habitation.

7. Conclusion and Recommendations

Rapid population growth has been identified as the single most important factor for environmental degradation, which causes extreme poverty and also deterioration of living standard in many nations of the world. It causes tremendous transformation of the world's natural landscape to agriculture. In our

paper, we have documented the gradual incremental rate of population growth in the global context, and also at the same time, we have provided ethnographic documentation of the pattern of such growth at the village level. It has been argued by a few scholars (e.g., Buchholz, 1993; Karim, 2010) that the future of food security and land protection entirely depends on the control of and restriction on births than emphasis on unusual use of chemical fertilizer to boost agricultural production. There is argument that it is more humane and ethical to implement family planning programme to keep the population at the lowest level than allow people to be victims of starvation. To allow the increase in population is nothing but to cause starvation, health problems, increasing unemployment and finally the destruction of the environment. This is particularly true for some Third World countries like India, Pakistan, Bangladesh, Ethiopia, Indonesia and Nigeria where there is rapid increase of population among the lower-income and poorer sections. It is assumed that family planning programme does not work properly in these countries at the rural level. Governments and the NGOs in many of these countries try to popularize family planning programme among the wealthy, rich and educated segments of society who are nevertheless are quite aware of the situation (Karim, 2010). We must remember that when population increases, much cropland is taken for urban and rural habitation. In order to feed many mouths, farmers have to use excessive fertilizers and pesticides which eventually destroy the fertility of the soil and also at the same time, negatively affect human health. It has been proven from the ethnographic examples given in this paper that there has been a tremendous shrinking of agricultural land in the two villages of Bangladesh within the span of one hundred years. This is particularly true for Bangladesh as well as for other developing nations like India, China and Indonesia, which have all the potential of development but often lag behind because of their demographic pressure and low man-land achievement (Kumar, 2000).

Based on the above discussion, we conclude by presenting a very simple formula below for the peasants around the world in regard to their agricultural land-use pattern. The suggestion is that each and every nation around the world should formulate their own policies with a target to bring the population growth at a replacement level, and simultaneously they should invent some techniques to solve the food crisis throughout the world.

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