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POPULATION, DEVELOPMENT AND ENVIRONMENT: THE EMERGING ISSUES

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It is now widely recognised that there is a need to take the scope of the population policy in Bangladesh beyond the confines of achieving population stabilisation through reduction of fertility. Although in recent years the approach to reduction of fertility has changed from narrow family planning to a broad based reproductive health approach, it is being increasingly felt that Bangladesh's population policy should encompass other equally important issues which have wide implications for the development process and the quality of life of people of Bangladesh. To address some of the related pertinent issues the Centre for Policy Dialogue has initiated a programme which aims at undertaking a series of studies covering the broad area of **Population and Sustainable Development.** The major objective of these studies is to enhance national capacity to formulate and implement population and development policies and programmes in Bangladesh, and through close interaction with the various stakeholder groups, to promote advocacy on critical related issues. The programme which is scheduled to be implemented by the CPD between 1999 and 2002 shall address, *inter alia*, such issues as population dynamics and population momentum and their implications for education and health services, the nexus between population correlates, poverty and environment, impacts of urbanisation and slummisation and migration, as well as human rights. The study has benefited from generous support provided by the United Nations Population Fund (UNFPA). The programme also envisages organisation of workshops and dialogues at divisional and national levels and also holding of international thematic conferences.

As part of the above mentioned CPD-UNFPA collaborative programme the CPD has planned to bring out a series of publications in order to facilitate wider dissemination of the findings of the various studies to be prepared under the aforementioned CPD-UNFPA programme. The present paper on the theme of ***Population, Development and Environment: The Emerging Issues*** has been prepared by Professor M. Ataharul Islam of the Department of Statistics, University of Dhaka. The paper was presented at the launching National Workshop on *Populaiton, Development and Urbanisation: The Emerging Issues* which was organised by the Centre on July 4, 1999.

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Population, Development and Environment: The Emerging Issues

Introduction

The population of Bangladesh has been passing through a difficult phase of transition. The population has already grown to a size that poses a formidable difficulty for the policymakers to plan for a sustainable development. The policies for education, health, industrialization, energy, social welfare and all other sectors have to take into account not only the prevailing population size but also the absolute size of the population during the next forty to fifty years. The population of Bangladesh may exceed the size of 200 millions during the next forty to fifty years due to population momentum even if replacement level is achieved in near future. This implies that without integrating the population concerns into the economic growth of the country, the problems will be multiplied in the future. Another concern that has gained importance during the past two decades is associated with the environmental issues. It has been observed that environmental concerns need to be linked with the population and economic growth factors, otherwise the survival of the population will be at stake. However, in the past, the linkage between population growth, economic growth and environmental degradation factors have not been examined critically in the setting of Bangladesh. This is of utmost priority for the policymakers now to delineate policies for sustainable development in the light of growth of population and environmental degradation.

The main objective of this paper is to highlight the issues concerning the interrelationship between Population and economic growth (P-D) as well as the relationship between population growth and environmental degradation (P-E) factors. These relationships can be examined within the broad framework of interrelationships among population growth, economic growth and environmental degradation which is known as PDE approach. The theoretical developments, mostly based on empirical findings from cross-national data, have been reviewed critically in view of the prevailing constraints in Bangladesh. Then some of the issues related to these linkages have been discussed in different sections. It is noteworthy that although a large number of research works have been conducted in the past separately in the broad fields of population and economic growth, however, very little is found concerning the linkage between population growth and economic growth. Similarly, any substantial contribution regarding the linkage between population growth and environmental issues is, almost non-existent in Bangladesh. However, there is a growing urgency to formulate and implement policies interlinking population growth, economic development and environment as was expressed in the ICPD, 1994. This is more important for a country like Bangladesh where achievements in economic growth and human resource development have been very slow but the rate of population growth was very fast in terms of absolute increase of the absolute size of the

population. In addition, the natural resources of Bangladesh have been exploited almost to the level of their maximum potential particularly in the agriculture sector. Hence, the supply of food, as also many other socioeconomic necessities, will pose formidable challenge to the policymakers in the near future.

Population, Development and Environment - Linkage

The concept of the linkage among population and environment factors emerged due to growing concerns about environmental problems at the global and local levels. Population - Environment interrelationships were examined critically by the participants of two conferences on the theme of population and environment held in Belgium in 1991 and in Austria in 1993. It was observed that the P-E interrelationship is diversified arising from the differing distributions, densities, dynamics and compositions of population (Clarke, 1995). The issues that were identified for further research are listed below: (i) P-E data issues, (ii) population concentration, (iii) identification and analysis of P-E crisis areas, (iv) P-E relationships in settlement systems, (v) migration in P-E relationships,, (vi) health and environmental degradation, (vii) fertility and the environment, (viii) women and children in the environment, (ix) P-E modelling, (x) P-E policies, (xi) P-E education, (xii) environmental quality and quality of life, (xiii) perception of P-E relationships, (xiv) P-E relationships in historical perspectives, (xv) impact assessment of positive and negative, planned and unplanned effects of P-E relationships, (xvi) analysis of energy/water consumption in P-E relationships, (xvii) P-E projections, (xviii) P-E sanitation and community health, (xix) P-E relationships under different occupational and family systems, (xx) field analyses of Malthusian and Boserupian hypotheses, etc.

The dynamics of population deals with the determinants and consequences of changes in the structure, growth and distribution of population over time. The structure of population is the distribution of a given population by age and sex. The growth of population indicates change in the population size relative to a base population size. The growth of a population is measured by three components: births, deaths, and migration. The distribution of population refers to the spatial distribution of a given population, such as population distribution by rural and urban locations in a country. This is also measured by population density for different regions (Sirageldin, 1995).

According to Lutz (1905), only certain characteristics of population have an effect on the environment and the economy. The basic characteristics are total size, growth rate, density, age, distribution, sex ratio, and regional distribution of population. These are subject to any change through fertility, mortality and migration and the process of such change is termed as population dynamics. In other words, any change in the measures of structure and distribution occur as a consequence of prior changes in the components of population growth. However,

even after reaching replacement level, it may take quite a long time to attain a growth rate of zero due to young age structure of a population. Due to young age structure, the population continues to increase even after reaching replacement level, because a relatively larger proportion of girls continue to enter into the childbearing age groups until the age structure stabilizes. This is known as population momentum. To explain the population momentum, age and sex are the two basic characteristics that need to be considered. These are integral parts of the larger social, economic and environmental system. In addition, Lutz, however, employed only two other basic components, education and labor force participation. Although these variables are not demographic in strict sense, but these population characteristics have shown increasingly important role in explaining fertility, mortality and migration. Hence Lutz suggested to use these variables in order to explain the interrelationships in PDE. These variables are thought to be representative of the most important aspects of population dynamics in a PDE model.

The basic components of environment germane to the interrelationships of PDE can be considered in terms of the four known elements: air, water, fire and land. These were first suggested by Anaximander in 600 BC. In the PDE model , we can redefine these components as air, water, energy and land. Another environmental system that needs to be taken into account is the sum of living species on earth. This is required to distinguish between human species and other species in order to give special attention to the change in biodiversity.

Air includes factors such as winds, humidity, temperature, and change in composition. Emphasis would be placed on air pollution (carbon dioxide emission) at the local level but the global emphasis needs special attention on greenhouse gases. Two of the most important issues at global concern are: (i) depletion of the ozone layer, and (ii) climate changes. All these factors are associated with health conditions of population as well.

The factors associated with water are rainfall, streamflow, groundwater, lakes and sea and man-made systems. Both the quantity and quality of water are directly associated with human life support system. Due to toxic and non toxic wastes stemming from industrial civilization, quality of water has been increasingly under pressure and resulting in severe threat to health of people in both developing and developed countries. Nuclear contaminations and acid rains are more characteristically found in developed countries, whereas deforestation and erosion are more common in developing countries (Martine, 1995). The arsenic pollution in the groundwater has emerged as one of the most severe health hazards in Bangladesh. Some other problems such as depletion of natural resources and floods cause problems at varying degrees to the humankind.

Demand for energy has been increasing sharply since the Industrial Revolution. The great expansion in the energy sector witnessed changes in the fuel base from fuelwood to wind and water power, coal, hydro-electric power, oil, nuclear and solar power, etc. The least developed countries do not have the technology and means to take advantage of the more contemporary sources of energy and remain captive to both traditional form of energy such as fuelwood, wind water, animal wastes, which coexist with uses of coal, oil, gas and where available hydro-electric power.

Some of the important factors associated with land are soil composition, topography, land use, etc. Although environmentalists placed much emphasis upon natural hazards, human actions have contributed significantly to the perpetuation of such problems through over cultivation, overgrazing, deforestation, excess population pressure. These have been compounded by the excessive commercial extraction of natural resources to serve global markets which has contributed to resource depletion and environmental degradation.

Man made disasters thus tend to be much more devastating than natural disasters because of the sustained as distinct from episodic nature of such aggressions on nature.

Population and Development Issues

The linkage between population and development has central to the development discourse over the past fifty years or so. Two views have prevailed in this debate. The first one has been termed known as the 'alarmist' or neo-Malthusian view mostly supported by biologists or ecologists. The alternative view is known as 'revisionism' which is mostly attributed to the works of Boserup (1981) and Simon (1981). The alarmist view claims that the finite natural resource base both at the national and global level strictly limits the growth of human population and consumption and if these limits are exceeded then the obvious outcome remains poverty and social breakdown (Homer-Dixon, 1995). The alarmist view is strongly articulated by Paul Ehrlich and according to him the levels of human population have already exceeded the limit that can be sustained by the earth's resource base (Ehrlich and Ehrlich, 1990). On the other hand, the revisionist view, pioneered by Simon, argues that human beings are the ultimate resource and scarcities pose no bounds to human prosperity which remains governed by human ingenuity (Simon, 1981). According to this theory the real problem of scarcity can be attributed to the maldistribution of resources and wealth. They consider poverty and inequality as the cause, not the consequence, of high population growth rates and practices that deplete resources. A third view about the interrelationship between growth of population and economy has emerged from amongst the revisionists on the basis of the works of Boserup (1981). Boserup's work presents a direct challenge both to those analysts who have attempted to understand the relationship between resource endowments and population growth in neo-Malthusian terms and to those

who view population as the ultimate resource and its rapid growth as a source of improvements in the human condition. Boserup does, however, view the pressure of population growth against natural resource endowments as an important source of technological transfer in agriculture in preindustrial societies.

In Boserup's view, an important deficiency of the classical models of Malthus and Ricardo was their failure to take into account the adoption of more labor intensive fanning systems, including increased frequency of cropping in response to rapid population growth during the initial stages of economic growth. According to Schultz (1990):

> "Boserup's thinking involves most centrally the interrelationships among labor productivity, population pressure, and demographic and economic behavior, as constrained by nature through climate and natural resource endowments and as limited by society by malleable human institutions such as the family, through infrastructural investments such as land improvements, and through education and technical knowledge, with their implications for productive practices."

Within this backdrop, the interrelationship between population and economic growth has been examined by many researchers in order to establish either the neo-Malthusian or the revisionist theories. The outcomes of such research remain confusing and inconclusive .

Most of the studies examined the correlation between population growth rates and per capita income for different periods taking into account cross country data. The *Independent Inquiry Report into Population and Development* commissioned by the Australian Government in 1994 summarized the findings of this debate. It was observed that the pessimist view of negative association between population and economic growth is based on mostly short term adverse effects derived from fixed resources. However, the long term view taking into consideration both direct and indirect mechanisms governing the relationship appears to have no significant association between per capita output growth rates and population growth rates over time and across countries. This was strongly supported by Simon Kuznets who was subsequently awarded a Noble Prize in Economics (Kelly and Scmidt, 1994). We may cite the wake of Repetto (1985) assessing the validity of these studies: " It does not matter how many times the exercise is repeated, or whether it has been by Noble Prize winners. Nobody has ever won a prize for such analysis, nor ever will. It is fallacious. Every graduate of a basic course in economics or any other social science knows as much. Yet, these simple correlations continue to be cited as evidence that population growth has no effect on living standards, and continue to influence the unsophisticated. It is time to put an end to it." Repetto considered these exercises as meaningless because everyone knows that correlation does not indicate which variable influences the other or whether there is any third variable which is associated with both (known

as confounders). Coale (1986) suggested use of fertility rates (or even better if both fertility - mortality rates are used as variables), instead of population growth, to examine the relationship with economic growth. Barlow (1994) employed lagged fertility as an additional variable with the current rate of population growth in order to explain current per capita income growth. The result confirmed negative association between population and economic growth and Barlow concluded that there can be negative partial correlation between population growth and economic growth even for data sets producing zero correlation in the two-variable model. However, this model could also be subject to criticism because of the underlying relationship between fertility (or even lagged fertility) with population growth on the ground that fertility is a component of population growth. Nonetheless, there is a general agreement or caution among the revisionists that the developing countries would be benefited from a slower rate of populiti6n growth (Martine, 1995).

The economic consequences of population growth as summarized in the *Inquiry Report* (Australian Government, 1994) are listed below. As we mentioned earlier, the findings summarized below are too simplistic to be generalized or interpreted for the developing countries, in particular. However, due to lack of more reliable and methodologically sound information in this area, we summarize the findings so as to provide some insights, on the basis of cross-country data about the prevailing wisdom on the relationship between population growth and economic growth. The scenario, in reality, could be spelt out below, could be however be quite contrary to the circumstances of the least developed or developing countries. These relationships can also be changed with the modification in methodology. Most of these areas have not been examined in the setting of Bangladesh with specific reference to the relationship between population growth and economic growth.

(a) Resource Use: There is no strong evidence of a relationship between population growth and global resource use for the current generation but there might be carry over effects on the future generations, attributed to improper use of our exhaustible resources. This issue needs to be examined in the context of Bangladesh.

(b) Savings and Investment: The traditional view of reduction of savings and investment as a result of rapid population growth has not been supported in the report. However, what happens to the countries where the population size has already exceeded an affordable limit is not adequately addressed.

(c) Education: The enrolments in schools has expanded rapidly under population pressure. It is observed that the expansion has not been financed by diverting public investment funds to education but by increased efficiency of allocated resource use as well as by decreased per pupil cost. This not clear though to what extent this could be true in countries such'as Bangladesh where the increase in the number of children under 15 in a short span of time

was very large. Another important consideration in this regard is the quality of education. If the per pupil expenditure decreases over time, then the quality of education is also expected to deteriorate. These are very critical issues to be addressed with a view to assessing the impact of population growth on education in Bangladesh.

(d) Urbanization: It is observed that the rapid growth of the urban population can be modified through government actions. In addition, it has been asserted that the growth of the urban population cannot be controlled by reducing the overall growth rate of the population. However, this process appears to be more complex and many other variables are associated directly or indirectly with the growth of urban population. Hence an understanding to this relationship cannot be based on the simplistic views that have emerged from the empirical studies conducted so far.

(e) Pollution: A major share of the pollution related problems could be contained by policy interventions at the national and global level. However, a slower growth rate of population provfd6s governments with more time to introduce and implement such policy interventions.

(f) Renewable Resource Degradation: The impact of population growth on renewable resources such as fishing areas, rain forests, etc. is observed to be very damaging to the sustainability of the resource base.

(g) Health and Education of Children: The expenditure per head on health, nutrition and education of children decreases in a setting of rapid population growth. It is difficult to assess the qualitative impact attributable to such decrease in per child expenditure. This can be a very crucial factor in the relationship between population growth and economic growth in Bangladesh. The quality of education as well as its governance is, however, increasingly being recognised as a no less important factor than the relative and absolute levels of expenditure needs greater emphasis.

(h) Offsetting effect: In the long run the positive impact of population growth is not sufficient to offset the negative association between population and resources. This is more so for countries such as Bangladesh where the population has already increased to a great extent and thus makes it difficult for the government to set specific targets and to achieve those targets simply because of the size of population.

Now let us summarize the discussion here. Due to methodological fallacies employed repeatedly in explaining the relationship between the population growth and economic growth across countries, we are unsatisfactorily equipped to trace a realistic scenario about the nature of the relationship, if exists at all. Hence, it is important to know for Bangladesh, in the context of the current population size and rate of growth of the economy, whether any relationship between population growth and economic growth exists or not. If any relationship exists, then we need to identify the factors that exert direct and indirect influence on the relationship. In

addition, we also want to know how the findings concerning the impact on economic growth can be translated into policies and strategies for implementing such policies.

Population and Environment

The Population-Environment (P-E) relationship has been discussed mainly by the alarmist biologists. The initial formulation was introduced by Ehrlich and Holdren (1971) by the following equation:

$$I = P. F$$

where I= environmental impact, P= population and F= per capita impact. Here, the term per capita impact is rather vague This equation was modified at a later stage (Martine, 1995) as follows:

$$I = P. A. T$$

where A= affluence and T=technology. Noted biologist Barry Commoner was against this kind of formulation because according to him pollution does not have any relationship with either population or consumption. However, he emphasized the impact of technology in defining the. outcome of the relationship. The IPAT formulation takes into account the more general environmental impact. This formulation simultaneously takes into account overpopulation, affluence and technology. Although this formulation of the P-E relationship has survived since it's inception as a good starting point, some of it's limitations have been recognised and remain increasingly subject to criticism. The main elements of this critique may be summarized as follows:

(a) statistical association is treated as causation,
(b) subject to incorrect aggregations,
(c) data on poor and rich are aggregated and hence generalized improperly,
(d) elements in the equation depend largely on a much more complex mechanism arising from the socioeconomic, political and institutional factors which are not reflected in the formulation.

These equations show that keeping any two elements constant, the environmental impact will increase if the third factor is increased. This implies, in terms of the *alarmist* viewpoints, that population control is a necessity to keep the environmental impact at a minimum level. The major criticism by the revisionists of the P-E approach is that although there might be some sort of linkage between population growth and economic growth, particularly in developing countries, there is no such relationship between population growth and environmental problems

(Martine, 1995). In the 1986 report of the *National Academy of Sciences* on the P-E relationship, the support was in favor of non-alarmist school of thought. However, this report indicates population growth as the cause of resource exhaustion, of savings and investment constraints and shifts away from productive physical capital formation, but on other hand, argues that markets will eventually solve everything, including rapid rates of population growth and environmental degradation.

Martine criticized the P-E formulation for the reason that all environmental problems are aggregated without making attempts to discriminate between serious and generalized problems with minor and localized problems. There is little effort made so far .to rank the various environmental problems and their sources. Among the most important problems that are endangering humankind's survival on the earth are: (i) depletion of the ozone layer, (ii) global climate changes, (iii) accumulation of chemical and radioactive wastes, (iv) human over-appropriation of biomass, (v) loss of biodiversity, etc. These are termed as critical/global problems by Martine. The secondary problems are caused by: (i) use of inappropriate technologies, (ii) maladministration of natural resources, (iii) population growth, (iv) poverty, and (v) combination of these factors. Let us give an example of both the critical/global and secondary environmental problems from a report (UNFPA, 1991):

> " With barely 25 percent of the world's population, developed countries consume 75 percent of all energy used, 79 percent of all commercial fuels, 85 percent of all wood products and 72 percent of all steel production. In addition, developed countries generates three quarters of all carbon dioxide emissions which account for half of all greenhouse gases in the atmosphere."

In a more recent report (World Bank, 1998) it has been highlighted that United States, European Union and Japan contain only 13 percent of the world population, but account for 42 percent of global carbon dioxide emissions.

In Bangladesh, environmental degradation problems have received some attention only in recent years. The major issues facing Bangladesh include.. (a) impact of the greenhouse effect on the population, (b) impact of climate change on the population of Bangladesh, (c) loss of biodiversity and its impact on the population, (d) deforestation causes and consequences and remedial measures, (e) air pollution of different types, determinants and its consequences, (1) water pollution including arsenic pollution impact, causes and remedies, (g) energy crisis and it's impact on population and development linkage, etc. In addition, Bangladesh has been facing growing problems arising from urbanisation due to rural over-population which has contributed to the emergence of urban slums and on floating population which have led to a particular

variety of environmental problems associated with deteriorating living standards in overcrowded places, extensive use of polythene and other materials that create environmental problems, problems of safe drinking water and hygienic sanitation, poor drainage and garbage disposal systems and the resultant environmental hazards (contamination of water, air pollution), use of excessive toxics in agriculture without knowing much about the associated problems, etc. All these problems have had a profound impact on health conditions of the people living in both the rural and urban areas.

Population of Bangladesh

Since the independence of Bangladesh, population programs have been given top priority by successive governments of Bangladesh (GOB) with a view to reducing the growth of population. Due to the efforts made by the government, mostly through family planning programs, the level of fertility could be reduced from 6.3 in 1975 to 3.3 in 1996 (NIPORT, 1997). Until 1998, government programs were separately implemented under the respective Ministries of for Family Planning and of Health. The priority of public policies was to increase the level of contraceptive prevalence, through door-step motivation and services provided to the potential clients. These services were provided through a complex network of field workers deployed at the grassroots level. There are reasons to believe that Bangladesh has achieved remarkable success in its family planning programmes without realising any significant change in the socioeconomic conditions in the country. However, Islam (1996, 1998) has shown that if the existing service delivery system continues then the cost of family planning will increase by about two to three times by 2010. In this context, the *Fifth Five Year Plan* (FFYP), the *Health and Population Sector Program* (HPSP), and the *National Integrated Population and Health Program* (NIPHP) initiated some new strategies to integrate health and family planning services at the unit level. This requires a massive restructuring of the traditional organizational set up and the government is currently redesigning its administrative hierarchy to establish a new integrated system for health and family planning. There are serious problems about the process of restructuring that have yet to be resolved (Islam, 1998). The impact of these policy changes, without being tested on a pilot basis, might influence the existing Level of achievement.

The program of action adopted at the ICPD 94 clearly states the following set of objectives (UN, 1995):

> " The objectives are to fully integrate population concerns into : (a) Development strategies, planning, decision-making and resource allocation at all levels and in all regions, with the goal of meeting the needs, and improving the quality of life, of present and future generations; (b) All aspects of development planning in order to promote social justice and to eradicate poverty through sustained economic growth in the context of sustainable development".

However, Bangladesh's government policies and strategies are yet to be formulated with a view to integrate population concerns into the economic growth perspective. As we have mentioned earlier that there **is** an ongoing and unresolved debate on the relationship between population growth and economic growth. As a result no specific guidelines or policy agendas to realise a process of sustainable development can be put in place which can ensure through optimal utilization of the population of Bangladesh. Thus the process of integration of operational population and development remains a far cry.

Four important characteristics of the population that are hypothesized as being associated with economic growth include age and sex composition, education and labor force participation. Again the dynamics of age composition depend on fertility, mortality and migration. Hence, the relationship of all these factors with the variables of economic growth needs to be examined on a priority basis in the specific setting of Bangladesh. It may be hypothesized on the basis of the previous discussion on population growth and economic growth that neither the alarmist nor the revisionist view completely address the situation in Bangladesh. The situation in Bangladesh is somewhat different for the reason that without experiencing any substantial change in the socioeconomic setting of the country, the total fertility rate has declined during the recent past. However, two major issues are yet to be resolved in order to make the process sustainable: (a) the heavy dependence on aid donors makes the entire population program vulnerable to external resource flows as well as policy guidance and hence puts its sustainability at risk, (b) integration of population 'growth factors with socioeconomic factors has not yet been examined in terms of the specific policy inputs in the given socioeconomic and demographic circumstances of Bangladesh.

Some of the characteristics of the population of Bangladesh are discussed here. It is evident from table–1 that the population increased from 89.9 millions in 1981 to 111.5 millions in 1991 at a rate of 2.13 percent per year.

Table 1. Selected Characteristics of the Population of Bangladesh

Characteristics	Year			
	1981	1991	1996	2005
Total Population (millions)	89.9	111.5		142.5
Growth Rate (%)	2.32	2.13		1.75
Population Density (per Sq. Km.)	609	756		966
Urban Population (%)	15.2	20.2		
TFR	4.9		3.3	
CPR	19.1		49.2	
Life Expectancy at Birth (Years)				
Male		56.5	59.1	
Female		55.7	58.6	
IMR/ 1000 Live Births		128	82	
Maternal Mortality Ratio (per 1000 Live Births)			4.3	
Average Household Size	5.87	5.60		
Safe Drinking Water (%)		80		
Sanitary Toilet		21		
Literacy				
Male	33.8	38.9		
Female	17.5	25.5		
Per Capita GNP (US $)		220	270	

Sources: World Bank, 1998; Islam and Chakraborty, 1999; NIPORT 1997 ; Various BBS publications.

A projection of population (Islam and Chakraborty, 1999) shows that the population of Bangladesh will be about 142.5 millions in 2005, based on an estimated growth rate for the period 1991-2005 of 1.75 percent. The proportion of the population below 15 years of age today constitute almost half of the total population in 1991. Population density has increased from 609 per sq. km. in 1981 to 756 per sq. km. in 1991. It is expected that the density of population will increase to 966 persons per sq km in 2005. Bongaarts (1996) showed that Bangladesh is the-fourth most densely populated country, among 90 developing countries, in the world in terms of persons per hectare of potential arable land (12 persons per ha of potential arable land in 1989).

The per capita GNP is estimated to be US$ 270 in 1997. Two-thirds of the males and three-fourths of the population aged 7 years or over are found to be illiterate in Bangladesh.

However, education is one of the most important indicators of human resource development and this provides the strongest link in explaining both economic growth and reduction of fertility. Hence, any future plans to integrate population growth and economic growth should take into account the role of education, particularly for women. The growth of the urban population is also remarkable. The share of urban population increased from 15 percent in 1981 to 20 percent in 1991. The total fertility rate declined from 4.9 in 1963 to 3.3 in 1996 and the corresponding contraceptive prevalence rate had increased from 19.1 percent in 1983 to 49.2 percent in 1996. The BBS estimates show that the life expectancy at birth has increased for both males and females during the 1991-96 period, from 56.5 and 55.7 years in 1991 to 59.1 and 58.6 years in 1996 respectively. The estimated infant mortality and maternal mortality rates for 1996 were 82 per thousand live births and 4.3 per thousand live births respectively. According to Census 1991, 80 percent of the households had access to safe drinking water, but only 21 percent of the households had access to sanitary latrines. These are indicative of the prevailing poor human resource development situation in Bangladesh.

Human Capital Accumulation Factors

In this section, the human capital accumulation factors in the context of the linkage between population, development and environment are discussed. There are relationships between population growth and health, schooling and nutritional status. According to Lucas (1993):

> " The main engine of growth is the accumulation of human capital - of knowledge - and the main source of differences in living standards among nations is differences in human capital. Physical capital plays an essential but decidedly subsidiary role."

The relationship between schooling and economic growth is very important. Although, *the Independent Inquiry* report summarized that there is no apparent relationship between population growth and education with some reservations regarding decrease in the share of expenditure in the family budget on education of children, we can show that population growth is strongly associated with the process of development and thus with the population growth as well. We can take example from the East Asian experience. Haq (1997) observed that the per capita income in South and East Asia were the same in the 1960s and currently East Asian countries enjoy per capita income much higher than that of the South Asian countries. According to Haq, the most compelling reason for such differences originates in the disparities in investment in education. In 1960, the primary school enrolment reached a level of 120 percent in East Asia compared to 77 percent in South Asia. The factors that explain the success in achieving universal literacy in East Asian countries can be attributed to: (i) rapid growth of the manufacturing sector increased demand for a more skilled labor force, (ii) pressure of

competition in global markets, (iii) decrease in the rate of school age population due to an early demographic transition, and (iv) large budgetary share for education by the government. Haq considered the relatively large share of expenditure on education as the most important factor that explains the achievement in the education sector in East Asia.. In 1960, Pakistan spent only 1 percent of its GNP on education, compared to about 2 percent in Korea and about 3 percent in Malaysia and Singapore. The cumulative impact of such investment contributed to the big difference in the per capita GNP of East and South Asia, however, this happened through improving the human capital in East Asian countries. The relationship between education and development was thus seen to have been established from the disparate experiences of East Asia and South Asia.

On the basis of the comparison between the experience of East Asia and South Asia the question regarding population growth and education remains unclear. In the East Asian countries, a relatively early demographic transition helped the development of the education sector. In the South Asian countries, the process of demographic transition started later than expected. Hence, the decline in the level of fertility preceded the achievement in the education sector. It may be noted that the literacy rates in the East Asian countries were relatively higher even before the transition. The experience from Mauritius can provide us with some explanations in this regard. As in East Asia, the fertility decline took place before economic growth in Mauritius. The high level of educational attainment, particularly for women, preceded the initiation of demographic transition in Mauritius (Lutz, 1995). In case of Mauritius, the fertility decline in Mauritius is attributed largely to female education. This is the most important factor associated with the reduction in fertility levels. Srilanka and Kerala have demonstrated similar trend and have shown that with South Asia it is possible to realise human development levels approximating East/South East Asian standard.

The health conditions of a population provide important indications about human development and welfare. The infant mortality rate reflects the overall health conditions in terms of the human development scenario prevailing in a society. Another such indicator is maternal mortality. The association between infant/child mortality and birth intervals shows that the death of a child shortens the subsequent birth interval to a large extent (Park et al, 1998) and thus increases the level of fertility. This implies that high infant mortality encourages a higher rate of growth of population. Similarly, the high maternal mortality rate indicates the lack of essential health care services in a society. In other words, insufficient allocative priorities to health care in form essential services such as antenatal and postnatal care to the pregnant women can impact on both population growth and economic growth.

Table-1 presented earlier shows the infant and child mortality rates in Bangladesh. The rates are still very high as compared to most of the Asian countries. The infant mortality rate appears to be very high among those who do not have formal schooling, who give birth at an age of below 20 years, and those who are high parity women (Islam, 1998).

The maternal mortality ratio for Bangladesh is estimated to be 430 per 100,000 live births (Akhter, Chowdhury and Sen, 1996). The authors considered the estimate to be somewhat lower than thetrue value. According to a review (Australian Government, 1994) the maternal mortality rate in Bangladesh is about 3 times higher for first births. The pregnancy related mortality is very high for teenagers. In Bangladesh the number of unsafe abortions is also very high. A recent estimate shows that about 730,000 abortions take place in Bangladesh annually (Singh et al., 1997). According to a review on Bangladesh, about 18 percent of the maternal mortality may be attributed to post-abortion complications (Australian Govermnent, 1994) which was even higher (26 percent) - in 1978-79. Thus unsafe abortion remain a major cause of these postnatal complications. Trussell and Pebley (1984) estimated on the basis of data from Matlab *Thana* that avoiding childbirth under 20 and over 39 and avoiding births of parity 6 or higher, slightly more than one-fifth of prevailing levels of maternal mortality in Bangladesh could be avoided. A similar finding by Winikoff and Sullivan (cited in the Inquiry Report, 1994) demonstrates that upto 58 percent of maternal mortality could be avoided by additionally avoiding parity 5 or higher order births. As the desired number of children in Bangladesh is 2, the effective service delivery system of the family planning program can help the couples to delay the first birth for the teenagers and avoid unwanted pregnancies as a result or which maternal mortality can be drastically reduced. It might be recommended that a very straightforward and targeted approach to improve reproductive health conditions, through a maternal health component of the integrated health and family planning service providing system, needs to be implemented on a priority basis. It is noteworthy that every woman has to be exposed to a high risk of pregnancy related mortality several times during her reproductive span. Hence, the lifetime risk is increased by the average number of times a woman becomes pregnant during her lifetime.

It is found in many studies (see the Inquiry report for details) that young children with more young siblings suffer from chronic malnutrition. In other words, children in large families suffer from malnutrition related problems. Jha et al. (1993) showed that economic returns from improved nutritional and health status may be equivalent to that from schooling. Jha et al. cited an example from a study conducted in India (Deolikar, 1988) that a 1 percent increase in weight-for-height of family farm workers raise labor productivity by 2 percent. Among the children, the effect of chronic malnutrition is manifold and the impact 'lasts for a long time. Primarily, it is evident that due to malnutrition children have a lower rate of enrolment and lower grades in the school (Jha et al., 1993). Thus chronic malnutrition among children can have a long term and

decisive impact on the earning capacity of a person due to potential for lowering their productivity.

Population Growth and Poverty

There is a relationship between population growth and extent of income inequality. McNicoll (1984) showed a pronounced negative relationship between population growth and the income shares of the poorest 30 or 40 percent of the households. Similarly, a positive association between population growth and the richest quintile of the population has been evident (Ahluwalia, 1976). In other words, a decline in the population growth results in a reduction in income inequality implying an increase in the share of income for the poorest group of the population. Jha et al. cited a study conducted in some north Indian districts that-indicated that the poorest groups comprising mainly of landless laborers, experienced the largest decline in real incomes for the districts with the highest increase in population density.

A conceptual framework for explaining the relationship between population growth, income distribution and poverty takes into account the following *a priori* theoretical considerations:

(i) Families with large family size are likely to be poorer because of their higher dependency burden.
(ii) Poor people start with the preconditions of being poor, or in other words, poverty is transmitted from one generation to another, because the poor families invest less on the improvement of the human capital accumulation factors of their children,
(iii) Rapid population growth increases the proportion of the young population (major share of the burden population without or with little income) and hence the income distribution becomes. worse.
(iv) Agricultural lands become scarce and hence excess supply of agricultural laborers keeps wages at a minimum level in absolute terms.

The profile of the rural poor in Bangladesh shows the following (Mujeri and Ahmed, 1997): (a) the rural poor households are essentially comprised of mainly landless and functionally landless households, (b) rural labor households constitute the hardcore poor group. Hossain and Sen (1992) observed that the poverty incidence is 78 percent for the landless and 71 percent percent for those with land of less than 0.5 acres. Similarly, 91 percent of the hardcore poor have less than 1.5 acres and 53 percent do not have any cultivable land. Education is found to have a positive association with rural income. Income increases

substantially with the level of education. The role of education appears to be more prominent among those who are engaged in non-farm activities than that of the farm activities. Poor households in the villages with electricity earn significantly more than those who live in villages without access to electricity. In addition, access to improved transport facilities is associated with higher levels of income.

Mujeri and Ahmed further identified some characteristics of extremely poor urban compared to moderately poor urban households. The important characteristics are: (a) lower male labor force participation ratios, (b) higher proportion of children under 10 years, (c) lower rate of educational involvement, (d) smaller housing space, and (e) higher incidence of mortality. The slum population constitute the bulk of the extremely poor population in urban areas. Some of the characteristics of the slum population as identified by Thwin et al. (1996) are: (a) higher proportion of women in the reproductive age group, (b) higher level of fertility and higher level of unwanted pregnancies, (c) lower rate of literacy, (d) very high crowding in households, (e) higher proportion of female-headed households, (f) higher rate of teenage marriage and teenage pregnancy, (g) access to safe water and hygienic sanitation is very poor, (h) high unmet need for family planning methods, (i) very low access to healthcare facilities, and G) very high rate of infant mortality. All these characteristics indicate that the urban poor population is subject to very low human capital accumulation.

The growth of the rural non-farm (RNF) sector can be thought of as a remedy to reduce the income inequality in rural areas which can play a major role in the reduction of rural poverty. The extent of rural poverty might be above 50 percent and with an average annual GDP growth of around 4 percent it would be quite difficult to reduce the extent of rural poverty (World Bank, 1997). Based on the *Household Expenditure Survey* conducted by BBS, the World Bank report observed the following impact of RNF on income, poverty and inequality in the rural areas: (a) the non-farm per capita growth was positive in the past unlike per capita agricultural income, and (b) the incidence of poverty is lower among rural non-farm households than that of farm labor households. It is noteworthy that although only one-fourth of the population was engaged in the RNF in rural areas in 1991, the trend shows a faster growth in the rural RNF employment than that that of the total labor force or the rural labor force. It is expected that if the current trend continues then the share of rural RNF will increase to 60 percent of the total rural employment in 2005. Access to non-agricultural income can provide the means to reduce the level of poverty, particularly for the landless and poor households, in the rural areas of Bangladesh (World Bank, 1997). Similarly, Hossain and Sen (1992) argued for absorption of landless-poor households in the non-agricultural sector to alleviate poverty, in addition to modernization in the agriculture sector through irrigation and other new technologies as well as through development of the rural infrastructure. However, although the modernization of

agriculture would increase the yield of the agricultural sector, it is unlikely that modernization would result in reduction of rural poverty because more landless and agriculture labor would lose their employment.

Population Growth and Agriculture

The growth of population has an immense impact on agriculture for obvious reasons. The neo-Malthusians or alarmists expressed their serious doubts about the future of our agricultural production. According to them the demand for food has been growing rapidly due to the high rate of population growth. This gap between supply and demand may grew in the near future because the expansion in food production will not be able to keep up with the growth of population (Dyson, 1994).

The concerns of the pessimists are based on several important factors associated with population growth and agricultural production, such as environmental stress, increasing difficulties in expanding agricultural land, water supply, crop yields, and controlling of pests (Bongaarts, 1996). In addition, they have further doubts about sustaining the present level of production in many countries. However, optimists emphasize the need to increased efficiency and technological transformations, including greater investments in human resources, in all sectors of agricultural production in order to improve production through higher land and labour productivity.

The population density in Bangladesh is one of the highest in the world today. This implies a very low availability per capita of arable land. Almost all the arable lands in Bangladesh are under cultivation. Hence use of arable land has already reached its peak. The annual use of fertilizers appear to be higher (86 kg/ha) in Bangladesh than in any other South Asian countries. It is also a daunting task to increase production through improved irrigation facilities. Environmental problems associated with deep tubewells and shallow tubewells pose a formidable threat to the health conditions of the people. The indiscriminate use of pesticides is also posing an increasing threat to both environment and health conditions of the population. Above all, the poor human resource capability of those who are involved with production of agriculture remains important variable. However, we do not foresee that there will be dramatic improvement in the human resource condition in the near future because of the absolute size of the population.

Bongaarts (1996) proposed a model for estimating total food consumption in a country. The model can be employed for projecting the future demand for food. This model takes into account the major components that play a major role in the relationship between growth of population (demand for food) and supply of food. The model is shown below:

$$Pc = Fu.\ Fc.\ Ff..\ Fy.\ Ft.\ Fd.\ Fa.\ L$$

where Pc= total consumption of food, Fu= proportion of potential arable land used for growing crops, Fc=cropping frequency, Ff=proportion of harvested area used for production of food crops, Fy= average crop yield (tons of grain equivalent), Ft= trade multiplier, Fd= proportion of domestic use for direct human consumption, Fa= animal product multiplier, and L=amount of potential arable land..

According to Bongaarts, the empirical evidences from 90 developing countries demonstrated that the increase in food supply would be mostly affected by percent of land cultivated and trade multiplier. Out of the 90 developing countries, 30 countries including India, China, Bangladesh and Indonesia, account for 72 percent of the population. For these countries, the proportion of land cultivated is already 80 percent , and hence these countries have already reached their peak for using cultivable lands. The alternative left for these countries is to increase the crop yield, cropping intensity, or trade multiplier. In Bangladesh, the cropping intensity is already very high, 1.68 to 1.75 during 1989-1994 (Abdullah and Shahabuddin, 1997) whereas even for the most densely populated of the developing countries, the average crop intensity in 1989 was estimated to be 1.01. So the increase in crop intensity is not a feasible choice as well for increasing the production of food in the future. Hence, essentially we are left with two other options: to increase the average crop yield and the trade multiplier. In other words, Bangladesh will require the massive transformation in their agriculture sector in order to increase the production of crops or the country will have to depend increasingly on imported food from other countries which will have to be paid out of an expansion in export earnings. In this context the operative issue relates to Bangladesh's capacity to enhance its export earnings through both non-agricultural as well as labour exports, to be able to import food for its growing population. The East Asian model solved the problem of its food gap through such a process.

If the capacity for food production in Bangladesh has reached its biological limit that the agriculture sector in Bangladesh may not be capable of meeting the growing demand of the future needs of rural population if the size increases even at a modest rate. Thus for Bangladesh the only option left is to keep the size of the population as low as possible. This view does not provide any hope for our population at this moment, or even for the future, in terms of the

supply of food. If environmental disasters are taken in account, the growth of population will pose even greater challenge to the problem of food supply.

Concluding Remarks

There are two strong views concerning the interrelationship between population and economic growth, the neo-Multhasian or alarmist and revisionist. However, it **is** not possible to conclude decisively about the plan of action for Bangladesh on the basis of the empirical findings from cross national data. The problem is attributable to the crossnational variations that prevail in different regions among least developed, developing and developed countries at different stages of their economic and population growth..

Hence, in this paper it has been indicated that neither the neo-Multhasian nor the revisionist view can be adequately explain the reality of Bangladesh. We therefore need to examine this relationship taking into account time series data as well as cross-sectional data on all important variables that are associated with both or one of the components .

The population -environment relationship has been examined in two international conferences in 1991 and 1993. It has been observed that the P-E relationship cannot be interpreted meaningfully without taking account of the national development process. However, little work has been conducted so far in this field in Bangladesh in relating population, environment and development.

This paper demonstrates that the relationship between population growth and economic growth can be explained to a great extent by the human capital accumulation factors of education, health and nutrition. In other words, the improvement in human capital accumulation factors can 'reduce the rate of population growth and can provide the necessary impetus to improve the economic growth of Bangladesh.

Experience from the agriculture sector of Bangladesh reveals that Bangladesh has already reached a point of maximum utilisation in terms of potential arable land and intensity of cropping. Hence the only option left for Bangladesh is to improve agricultural production through massive transformation farm productivity through irrigation, use of fertilizer, modernisation of tools employed in agricultural production improved seed varieties and related advances of the technology frontier. However, on the basis of empirical findings from other countries, it be argued can that without improving human capital accumulation, such a technological transformation may not be feasible.

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