H-2.1 Changing Population Dynamics in Asian Countries and its Effects on Global Environment

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Abstract This research project aimed at 1) grasping changing population dynamics in China and Thailand in connection with urbanization process. 2) investigating the effects of changing environment on demographic and health behavior making use of DHS data sets. 3)examining the effects of urbanization on global warming by the Edmonds-Reilly model incorporating various scenarios. In China, excess population created by a natural increase rate over 1% in rural areas, and their subsequent urban-bound migration caused some problems both in urban and rural areas. In the rural Thailand, demographic transition completed by fertility decline in the early 1970s, in response to the end of encroachment of forest land in the 1960s. Increasing opportunities of work in rural areas have changed the meaning of labor migration to Bangkok from negative to positive. The analysis of DHS clarified the tendency of urban-bound migrants to settle under mal environments and their experiences of infant death were related. The incorporation of the sub model considering urbanization indicated the decrease of CO_2 emission by 22 % in the year of 2050 in the whole world compared with the calculation from the original model.

Key Words Asian Countries, Urbanization, Fertility, Global Warming Models, Demographic and Health Survey (DHS)

1. Introduction and Research Objectives

Population growth, especially in Asian countries, is one of the most important causes for the problems of global environment and development. Both at United Nations Conference on Environment and Development in 1992 and International Conference on Population and Development in 1994, "Population, Environment and Development" became a main topic of discussion and called wide attention. The latest population prospects of United Nations reported that world population would grow from 5.3 billion in 1990 to 9.8 billion by the mid twenty-first century. Yet more striking is that 99% of this 4.5 billion increase would occur in developing countries and 55% in Asia. In face of such regional differences of population increase, problems of global environment and development should be recognized not only as an issue of the global society as a whole, but as an extremely crucial theme which Asian countries must corporate with.

Nevertheless, the relationships of population growth with global environment and development are multifold, and the field of research is wide. In this difficult situation, we

have selected urbanization as one phase of population and development, and undertaken research on its connection to the environmental problems, especially to global warming. Urbanization is a factor to promote demographic transition and as a result, it functions to suppress population increase. At the same time, however, it possibly increases an energy-consuming type of population and accelerates the worsening of global warming problems. By analyzing urbanization and its impacts, we believe that some clue can be obtained to reveal and comprehend complex interrelationships among population, environment and development.

This resaerch aims at 1) grasping the relationship between population Change and urbanization in China and Thailand. 2) investigating the effects of changing environment on demographic and health behaviors utilizing DHS data sets. 3) examining the effects of urbanization on global warming by the Edmonds-Reilly model incorporating various urbanization scenarios.

2. Results and Discussions

2.1. Changing Population Dynamics in China

In China, with the social and economic development the urbanization is going so rapidly, which has played a positive role on the whole, but some problems caused by large scale economy, such as excessive consumption of resources, overloaded operation of urban public facilities, environmental sanitation and public security, can not be neglected.

There has been great deal of rural-urban migration since the middle of 1980s in China. That is caused mainly by the factors below.

The first factor is related to the results of heavy industry-oriented strategy adopted by the government in the early 1950s. The imbalanced industrial structure caused from the strategy has provided little chance for economic growth to absorb the surplus labour force in agriculture in one hand. And the institutional obstacles, which is called the household registration system, have restrained rural residents from permanent out-migration across sectors as well as regions on the other hand. As a result, the economic growth and structural change in terms of output have not been associated with the transformation of employment structure and allocation of rural and urban population.

A second is the increasingly deepen gaps in income among regions partly because China's reform strategy that has been favoured of relatively developed coastal provinces, and partly because there has not been an integrated national commodity market which would have provided an opportunity for the regions to trade the goods with each own comparative advantage.

This way of urbanization was changed after the carrying out of farm production responsibility system in rural areas in 1982 and the beginning of economic reform in 1984 in urban areas. Township enterprises as a new force suddenly came to the force in economy, which open a new way for urbanization in China by the transfer of the rural economy from agriculture to non-agricultural industry. This rural-urban migration has been shown as floating population.

Despite of several reforms in social and economic aspects, the gaps in income among regions still increase. The rural surplus labour force will be increased to 200 million in 2000, who will be the main force in the rural-urban migration and the progress of urbanization.

In terms of relationship between population and global environmental issues, China is in serious condition.

Deserted farmland has been increasing because more farmers quit farming and move to large cities as migrant workers. Further, in the development rush, the areas under cultivation have been decreasing due to the transformation of the most productive farmland into sites for factories, housing, and roads. Population growth reduced the average area under cultivation per head from 18 hectares in 1949 to 8 hectares in 1994.

According to official figures by the Chinese government, about 15 million hectares of farmland were diverted for other uses in the past 30 years. The acreage under grain cultivation across the country decreased by 1% per year from 90.8 hectares in 1990 to 87.4 hectares in 1994. Above all, 1.6 million hectares disappeared in each of 1984 and 1985.

To make matters worse, ecological deterioration is progressing unchecked. Topsoil drainage, desertification, salinization, decreasing fertility, disappearing grassland, and soil pollution are all causing serious deterioration of arable land. Water resources are diminishing and harvest per unit area is leveling off in many parts of the country. There is little chance that China could boost the productivity of land fast enough to counteract the rate at which farmland is disappearing. There is little arable land left although China has a large territory.

Pressure of large scale of population and rapid increase directly or indirectly causes environmental deterioration. Much less under China's situation where land for human habitation is limited compared with the large territory. Distribution of population is disproportionate: 94.2% live in the area of east land, which accounts for 42.9% of the total territory.

Paul Ehrlich of Stanford University in the United States discusses population and the environment in terms of the famous equation $I = P \cdot A \cdot T$. Today's problem, he says, is that as P (population) grows rapidly, I (the total environmental impact of human activities on a global scale) exceeds E (earth's capacity) [$E<I$], resulting in ecological deterioration or global environmental problems. To rectify the imbalance between E and I, it is necessary to increase E or decrease I, but it is impossible to increase E. Furthermore, driven by I, humans are also consuming renewable capital (capacity) which originally exists in E, reducing E itself. Therefore, it is necessary to control I.

I is a combination of population (P = Population), affluence or consumption per head (A = Affluence), and technology that produces affluence in various fields (T = Technology). The figures in this equation are different in cases of developed countries (the North = n) and developing countries (the South = s). The equation can be factorized as follows:

$$I = P \cdot A \cdot T = Pn \cdot An \cdot Tn + Ps \cdot As \cdot Ts$$

2.2. Changing Population Dynamics in Thailand

The study concerning Thailand is composed of two parts, namely results from field surveys and results from comprehensive analysis on population and environment change in Thailand.

We conducted three field surveys concerning rural-urban migration. The first survey was conducted in Bang Khen District, northern suburb of the Bangkok Metropolis, aiming to clarify urbanization process of Bangkok suburbs and migration career of the new middle

class population in suburbs. We classified the survey respondents (husbands of the 771 households) into three categories by their migratory and social characteristics, urban middle class, non-native working class and native Bangkokians. The "native Bankokians" are ex-farmers and the first residents of Bang Khen District. In the process of urbanization from 1960s the other two groups, "urban middle class" and "non-native working class" have settled down. The main reason for migration to Bangkok for the "urban middle class" seems to be educational opportunity while occupational opportunity is important for the "non-native working class". The second filed survey was conducted in rural Northeast Thailand, aiming to understand the relationship among fertility decline, environmental change and out-migration. The following results were yielded from the analysis, 1) family planning programs were accepted smoothly in the rural areas in the early 1970s. 2) Encroachment of forest land nearly ended in 1960s in Northeastern region and the farmers began to feel the necessity of birth control. 3) that was one of the important reasons why they adopted family planning programs so quickly. The third field survey was conducted in a village in Chiang Mai Province concerning labor migration from the village. From the survey more and more villagers are attracted to work in Bangkok, but their average period of stay in Bangkok was calculated only 13 months and most of those working in Bangkok do not want to stay in Bangkok forever.

Concerning population and environmental change, we analyzed a trend of energy consumption and CO_2 emission in Thailand during 1980s, when the country experienced rapid economic growth. The analysis revealed the importance of economic activity as a determinant factor that basically regulates the environmental loads. From the trend of CO_2 emission and carbon exchange capacity in Thailand in the 1980s, we can estimate that the annual CO_2 emission from fossil fuels in Thailand will exceed the carbon exchange capacity of forests by 2003-2004.

2.3. Environmental Determinants of Demographic and Health Behaviors in Asian Countries: A Comparative Analysis of the DHS Data

This study has aimed to clarify the effects of environmental factors, particularly the environmental health and the urban environment on fertility, morbidity and mortality in six Asian countries (Indonesia, Pakistan, Philippines, Sri Lanka, Thailand and Turkey) for which the DHS data are available. Since it is difficult to specify variables representing environmental factors at the micro level based on sample surveys, we have mainly focused on the effects of environmental health variables. In addition, we have introduced urban-rural residence as an environmental variable and have conducted separate analyses for each area because it is considered to represent, in a way, an aggregation of environmental factors. For urban residents, we have introduced migrant status as an additional environmental variable because it can represent different neighborhoods within the same urban area.

This study has vaguely followed the analytical framework for child mortality proposed by Mosley and Chen (1984). The broad hypothesis tested in this study was that an unfavorable environment tends to decrease a couple's coital frequency and to increase the incidents of spontaneous abortions and young children's diarrhea and deaths. In addition, being inspired by Brockerhoff's (1995) framework, we have tested the hypotheses that the migration experience, associated with a lower level of environmental health, has a

negative effect on coital frequency and positive effects on spontaneous abortions and young children's diarrhea and deaths and that the effects of environmental variables differ according to the migrant status among urban residents.

Many of the results are as hypothesized, but there are also some unexpected ones. Spontaneous abortions and young children's diarrhea and deaths tend to be associated with a low level of environmental health, but coital frequency does not seem to have such a relationship with it. There are variations among countries, but Turkey seems to distinguish itself from others in its results possibly because of its geographical distance and possibly because of its very large regional disparities. On the other hand, the results for Pakistan seem to be most consistent with the hypotheses. While the urban environment seems to have both favorable and unfavorable effects, this study has revealed that urban residents, particularly migrants seem to be directly and indirectly disadvantaged. A further study incorporating the effects of rural-urban migration may be necessary in this regard.

2.4. Incorporating Urbanization into the Model of Future Carbon Dioxide Emissions

The most important cause of global warming for the future is carbon dioxide emissions which is primarily due to energy consumption. Not only population growth but also urbanization is the important demographic concept to analyze energy consumption and/or carbon dioxide emissions.

The regression line expressed by the following equation is obtained from data for countries in 1980 and 1993[1-3].

$$\ln e = 4.18U + 1.67 \quad (1)$$

In the equation (1), e denotes energy consumption per capita measured in gigajoule per year and U denotes the proportional size of the urban population.

The relationship between U and e may imply that a degree of economic development determines U and e simultaneously. However, it is also likely that U determines e according to the energy consumption per capita of both urban and rural areas, namely, that urbanization is the cause of the increase in e. If the latter mechanism exists, there must be difference in energy consumption per capita between urban and rural areas.

Data for administrative divisions of China in 1990[4,5] show that the average e of Beijing, Tianjin and Shanghai was 3.1 times as large as that of the rest of China. For the period 1986-1990, however, population growth in these three cities was a minor cause of the increase in energy consumption of the whole of China because the annual increase in population of the three cities, 1.32 percent, was smaller than that of the rest of China, 1.79 percent.

In this study, the typical model for projections of carbon dioxide emissions, the Edmonds-Reilly model[6], is improved in the aspect of the change in structure of production which is clearly related to urbanization. The model divides the world into nine regions and the procedures to determine the energy service demand of four of them are altered. The four are Centrally Planned Asia, Africa, Latin America and South and East Asia, namely, the developing regions except Middle East.

The data for each of four regions over the period 1950-1990[1,7] shows the relationship expressed by the following equation.

$$I_P = U^{a} \quad (2)$$

In the equation (2), I_P denotes the proportional size of the labour force in

non-agriculture. The parameter α is less than 1 and characteristic of each region. It is possible to make projections of I_P by utilizing the equation and the projections of U to the year 2025[1].

The energy service demand for each region is determined by population and GNP. In this study, GNPs of the four developing regions are divided into that in non-agriculture and that in agriculture.

The new projections of carbon dioxide emissions are shown in Figure 1. Since almost all of the projected GNPs of the each of four developing regions decrease, the projected emissions in 2050 also decrease by 11 percent and 22 percent for the four developing regions and for the whole world, respectively. The emergence of the significant decrease in the emission for the whole world is primarily due to decrease in the consumption of coal.

The projections by the Edmonds-Reilly model are on the assumption that the remarkable economic development in the developing regions will continue even in the next century. As a conclusion, however, it can be said that the plausible urbanization for the future is not remarkable enough to sustain the required change in structure of labour force.

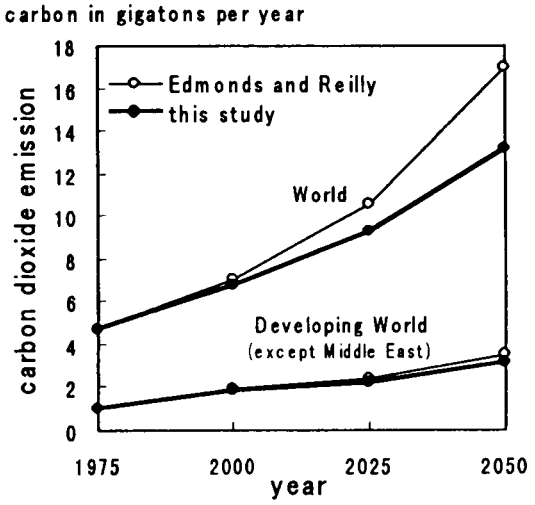

Figure 1 Projections of Carbon Dioxide Emissions

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