

## **H-4 Development of Evaluation Method of Environmental Security and its Application in Asian Region (Abstract of the Final Report)**

**Contact Person** Hideo Harasawa  
Section Head, Social and Environmental Systems Division  
National Institute for Environmental Studies  
16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan  
Tel:+81-298-50-2507 Fax: +81-298-50-2960  
E-mail: harasawa@nies.go.jp

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### **1. Introduction**

In Asian region where all the countries except Japan are developing countries, they are now facing serious environmental problems induced by rapid growth of population and economy. Economic growth rate represented by GDP is very high, but the most of the people in both big cities and rural areas are still suffering from poverty and insufficient infrastructure such as sanitation and social equity such as job opportunity. Future climate change will make this current situation worse.

### **2. Research Objective**

This research project was designed to analyze the major causes affecting the above environmental problems and devise the prediction methods in population, food security, water resources and so on,. Then applying these method to the region, and environmental security will be suggested based on these research results.

This research project are divided into 5 sub research projects as following:

- 1) Human and Environmental Security in the Context of Sustainable Urbanization in Asia
- 2) Environmental Changes and Food Security in Asia
- 3) Evaluation of Future Water Supply/Demand and Possible Measures in Asia
- 4) Evaluation of future urban air environment and possible measures in Asia
- 5) Development of method to evaluate environmental security in Asia

These 5 researches are closely linked through human activities and information, and research results will be integrated into response strategies to maintain the environmental security in Asian region.

### **3. Major Results and Discussion**

### **3.1 Study on Human and Environmental Security in the Context of Sustainable Urbanization in Asia**

This study aims to examine the concepts of human and environmental security and to explore the evaluation methods for the two interrelated security in order to contribute to the formulation, implementation and evaluation of policy measures to assure human and environmental security in the context of sustainable urbanization in Asia. We attempt to achieve this goal through the analyses of indicators of sustainable urbanization at the micro-level within the framework of human and environmental security.

In the three years we have mainly conducted the comparative analysis of existing micro-data as well as the collection and analysis of micro-data from sample surveys conducted by this project in cooperation with local collaborators in two cities each in the Philippines, Thailand and Vietnam. We have analyzed the determinants of migration, adaptation to the urban environment and environment-related behaviors.

#### **(1) Research Method**

We have analyzed micro-data from the Demographic and Health Surveys (DHS) in Asian Countries. First, we have conducted comparative analyses of married women's pregnancy loss and morbidity and mortality of their young children based on the DHS data from Indonesia, Pakistan, the Philippines and Sri Lanka, Thailand, and Turkey. Second, we have conducted comparative analyses of maternal and child health based on the DHS data from Indonesia, Kazakstan, the Philippines, Pakistan, Turkey, and Uzbekistan.

Partly drawing on our feasibility study<sup>1)</sup>, we conducted sample surveys on migration and environment in Metro Manila and Davao in cooperation with Prof. Nimfa B. OGENA, University of the Philippines Population Institute, in Bangkok and Hat Yai in cooperation with Prof. Bhassorn LIMANONDA, College of Population Studies, Chulalongkorn University, and in Hanoi and Ho Chi Minh City in cooperation with Prof. Anh DANG, Institute of Sociology, Vietnam. Then, we analyzed the data from these surveys based on logit models.

#### **(2) Results and Discussion**

The comparative analyses of the DHS data suggest that the urban environment has both positive and negative effects on maternal and child health. The childhood residence also has effects on health. Some variables have opposite effects on the health of male and female children, suggesting the importance of women's status.

According to the analyses of our survey data, female migration seems to be determined as a family strategy to a larger degree in Thailand, but to a much smaller degree in the Philippines. Women with higher socioeconomic status are more satisfied with physical environment in the Philippines and Vietnam, possibly because they live in nicer residential areas. Non-migrants are more likely than migrants to use private means of transportation in the Philippines, but not in Thailand. But high-income

women are more likely in both countries, suggesting positive income elasticity of energy use.

The results of our study suggest that rural-to-urban migration in Asia has significant effects on women's status and their adaptation to the urban environment and that we have to pay due attention to women's status and migration at the micro-level in order to achieve the human and environmental security within the framework of sustainable urbanization. They also suggest that Japan's official development assistance should support public policies in Asian countries to empower the disadvantaged, the minority, and women.

Major results of this study have been published in our reports<sup>2),3),4)</sup> and some results have been presented at our annual international workshops.

### **3.2 A Study on Environmental Changes and Food Security in Asia**

Recently, agricultural production in Monsoon Asia has been diversified due to the population pressure and the economic development. As the modernization process accelerates, the traditional agriculture that had depended heavily on the natural rainfall and floodwater is changing into an industrial agriculture controllable to some extent. The excessive uses of underground water for irrigation, chemical fertilizers and land resources have begun to reveal environmental limitations of the modern agriculture. In addition, the global climate change may affect the rainfall patterns of the Monsoon, which has been the base of the rice cultivation society of the region. All these changes surrounding the agricultural resources warn us about the deterioration of food security in the region.

This study aims at a quantitative evaluation of the interactive mechanism between agricultural activities and environmental changes in Monsoon Asia. It tries to understand the past and current processes of the interactions between environmental changes, such as seasonal rainfall changes, degradation of land resources and so on, and human activities that appear on the food supply-demand situation and on the changes of rural society, at local levels. By conducting quantitative analyses and model simulation analyses, it pursues conditions for maintaining food security and sustainable production in the region on a larger scale.

#### **(1) Research Method**

Firstly, typical study areas are selected. Interviews and statistical analyses are carried out to single out the major environmental problems that affect food production and rural society. Secondly, based on the research findings using the existing crops models and regression analyses of the climate and yield data, quantitative evaluations are carried out. Thirdly, interactions between the environmental change and the structure of supply and demand are modeled using a system dynamics method. Finally, based on these analyses, conditions for the sustainability of agricultural production and rural society are suggested.

## **(2) Results and Discussion**

The study revealed the seriousness of the impacts of environmental changes and resource degradations on food supply-demand situation both quantitatively and qualitatively. It clarified, on the other hand, that valueability and farmers' responses to the changes varied according to the geographic and social conditions of the study areas. The followings are the main points of the study results.

- 1) In Shandong province of China, water scarcity will become a major bottleneck of the agricultural production. A model analysis showed the future water supply would influence heavily on the food supply-demand situation of the province.
- 2). Increase of ozone density in China, which is estimated with a model analysis to have reduced more than 10% of rice production potential in 1990, will further deteriorate the Chinese rice production potentials.
- 3) In Northeast region of Thailand, where agricultural resources are excessively utilized, salinization of paddy fields forces farmers to abandon their land and to shift their labor into non-farming activities in remote cities.
- 4) Case studies of the past El-Niño events and historical surveys showed diversified responses of the farmers to the environmental changes among regions. Crop diversification / shifting was suggested to be a rational response in many water-scarce regions.

For future studies, the accuracy of the survey data should be improved. As for the quantitative analyses, it is necessary to be further modified for geographically wider applications on one hand, and for incorporating the detailed regional conditions on the other hand.

### **3.3 Evaluation of Future Water Supply/Demand and Possible Measures in Asia**

Because of many reasons such as increasing population, industrial development, and expanding irrigation, which are expected to continue in future, shortage of water resources has become more severe in many parts of the world. In order to assess the balance between water demand and supply in future under climate change, surface runoff and water demand in each river basin are estimated from 2050 through 2059. It is found that the estimated spatial patterns of runoff change in 2050s differ considerably by GCM used, especially in Central Africa and the north part of South America. In developed countries, industrial water demand will increase, while agricultural water demand will slightly decrease. In developing countries, water demand will increase in all sectors, especially the share of industrial water demand will increase significantly.

From the results of the assessment, it is possible to qualitatively grasp how the susceptibility to water shortages will change compared with the present condition in each area. For example, more water stress in 2050s is predicted for Amur and Changjiang rivers in China due to the significant population increase and rapid industrialization.

In addition to the water resource assessment at global scale, more detailed

projections of water demand by 2032 were done focusing Asian countries. In the model, water demand is related with population, economic growth, historical trend of water-supplied population and irrigated area, and rate of technology improvement. Four alternative patterns of future development were simulated. The result shows the change of regional water consumption by 2032 relative to 1995. Share of each country's contribution is also illustrated. Because of the rapid growth of economy and water-supplied population, the growth of water consumption will be larger in the developing countries than in developed countries in all scenarios. In most developed countries such as Japan, water consumption can even decrease slightly in some scenarios.

### **3.4 Evaluation of Future Air Pollution and its countermeasures in Asia**

In Asian developing countries, huge urban cities called Mega cities are located in coastal region of the countries. In those countries, rapid growth of population and economy is still alive, and growth rate of consumption of energy is still higher than other countries. Huge population and consumption of burst amount of energy in the urban cities have caused air pollution, sanitary problems, and so on. This study focuses the air environment of the mega cities in Asian region, and analyze the current condition and possible future impacts of such air pollution in these cities. For this purpose, a model will be developed and applied to the region. In the first year of this research a model of air pollutant prediction was developed and was tried to apply to the region.

### **3.5 Comprehensive Assessment of Environmental Security in Asian Region**

In 1997, the biggest El-Niño event occurred and made broad area in the South - East Asian countries drought condition. At that time, deforestation by both big and small scale plantation developments were going on. As a result, bit forest fires occurred in Indonesia. This was accelerated by historically severe drought condition, and haze generated from forest fires moved other countries and triggered a transboundary haze problem. This haze disaster affected on natural ecosystems such as extinction of endangered species, and socio-economic systems such as transportation, tourism, and human health. In this research, a symposium on forest fire in Indonesia was held in February, 2000. Based on collected information on this disaster, researchers in Indonesia and Japan had discussion its cause and possible countermeasures.

## **4. References**

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