ENVIRONMENTAL, HEALTH AND ECONOMIC CONDITIONS PERCEIVED BY 50 RURAL COMMUNITIES IN BANGLADESH

Ryutaro Ohtsuka[1], Tsukasa Inaoka[2], Kazuhiko Moji[3], Enamul Karim[4], and Mari Yoshinaga[1]

[1] *Department of Human Ecology, School of International Health, University of Tokyo, Hongo, Tokyo 113-0033, Japan / Email: rohtsuka@humeco.m.u-tokyo.ac.jp*
[2] *Department of Environmental Sociology, Faculty of Agriculture, Saga University, Honjo, Saga 840-8502, Japan*
[3] *Institute of Tropical Medicine, Nagasaki University, Nagasaki 852-8523, Japan*
[4] *Health and Life Sciences Partnership, Mirpur No. 10/C, Dhaka, Bangladesh*

For randomly selected 50 villages in Bangladesh, an interview survey with a structured questionnaire was conducted to reveal their perception on the environmental, health and economic conditions at present and for the past 10-year change. The eight following items were analyzed in this paper: air pollution and water pollution, which represent environmental conditions with close relation to health conditions, soil degradation and deforestation, which represent environmental conditions with close relation to economic conditions, epidemic diseases and malnutrition, which represent health conditions, and poverty and jobless, which represent economic conditions. Among the 50 villages, deforestation was most frequently perceived serious at present and worsened in the past 10 years. Of the remaining seven items, those related to economic conditions were more seriously perceived than those related to health and environmental conditions. As revealed by the cluster analysis for the inter-item relations, epidemic diseases, which formed the same cluster with the environmental items, were recognized less serious whereas malnutrition, which formed the same cluster with the economic items, was recognized more serious. These findings are useful not only for rural development programs but also for mitigation programs toward health and environmental hazards in Bangladesh.

Keywords: Community-oriented development ecology; primary health care; primary environmental care; poverty; deforestation

INTRODUCTION

Poverty or underdeveloped welfare in rural populations of developing countries has become one of the most serious problems for human survival at a global level in the 21st century. The United Nations Development Programme (UNDP) emphasized urgent needs for release from poverty in such populations, focusing on not only economic aspects but also demographic, environmental, health and educational aspects because poverty is generated by various factors so that it cannot be properly evaluated with only economic indicators such as household income (UNDP, 1998). It is also the case that environmental degradations at a regional or local level have become critical issues worldwide. Munasinghe and his colleagues, who have studied biogeophysical sustainability in developing countries, emphasize importance of understanding the relations of environmental conditions with socioeconomic conditions (Munasinghe, 1993; Munasinghe and McNeely, 1995). Nonetheless, little has been known about the interrelatedness of such different aspects in the local ecosystems, especially those under retarded developmental situations. Similarly, the local populations' perception about their environmental, health and economic situations has seldom been simultaneously elucidated.

The authors have begun a "community-oriented development ecology (CODE)" project to contribute to rural development, based on the ideas of primary health care (PHC) and primary environ-

mental care (PEC), both of which encourage the local people's participation in, and organization of, the development programs. For this purpose, a structured questionnaire for use in interview with the members of a community was developed and then applied to 6-12 communities in Bangladesh, India and Nepal, respectively, for the preliminary survey (Moji et al., 1998; Ohtsuka et al., 2000). The questionnaire with minor revisions, which was used in this study, is designed to grasp the community's perception on geographical, demographic, social, economic, environmental and health matters at present and their changes in the past 10-20 years, by asking at least five community members with representation from both genders, all of whom freely discuss about each item with adequate time.

After the above-mentioned preliminary survey in Bangladesh in 1996 (Moji et al., 1998), the main survey, on which this paper is based, was conducted in 1998 to 1999 for randomly selected 50 villages from the whole country. The present paper reports the 50 villages' perception about environmental, health and economic conditions at present and their changes for the past 10 years, focusing on air pollution, water pollution, soil degradation, deforestation, malnutrition, epidemic (infectious) diseases, poverty and jobless. Comparing the degrees of severity perceived for the eight items, this paper aims to clarify how Bangladeshi villagers recognize their living conditions.

SUBJECTS AND METHODS

Natural and socioeconomic situations in Bangladesh

Bangladesh is one of the least developed countries in Asia. As shown in Table 1, any demographic, health and economic indicators were worse in Bangladesh and Nepal, compared to India, Indonesia and Thailand. In particular, lower per capita GNP, higher adult illiteracy rate, higher infant mortality rate and shorter life expectancy in the former two countries indicate their retarded economic, educational and health conditions. One problem specific to Bangladesh is a high population density, i.e., 889 persons per km^2 in 1998, which has caused, for instance, excessive land use for agriculture and reduction of forest area; consequently, vulnerable lands, such as frequently flooded lands, have been exploited for agricultural fields (Datta, 2001) and the main sources of fuel for cooking and other domestic purposes among the rural households have been agricultural residues and dung of cattle (World Bank and Bangladesh Centre for Advanced Studies, 1998). The high population density, in tandem with nearly 2.0% annual population increase rate, has accelerated, and will accelerate, not only environmental deterioration but also degradation of the people's quality of life; this population increase level has been almost constant since the 1960s and will continue until 2040 (World Bank and Bangladesh Centre for Advanced Studies, 1998).

Furthermore, many recent studies have disclosed that drinking water from a large number of tubewells in this country are contaminated with naturally occurring groundwater-derived arsenic beyond its safe level, i.e., 0.01 mg/L, which is recommended by WHO and that 35-50 million people,

Table 1. Selected sociodemographic characteristics in Bangladesh and other four Asian countries

	Bangladesh	Nepal	India	Indonesia	Thailand
Annual population increase rate (%)	1.9	2.4	1.9	1.5	1.1
Population density (per square km)	889	148	295	107	119
Infant mortality rate (per 1000 live births)	75	83	71	47	33
Female life expectancy at birth (years)	59	57	62	66	72
Male life expectancy at birth (years)	57	57	62	62	67
Female adult illiteracy rate (%)	74	86	62	22	8
Male adult illiteracy rate (%)	51	59	35	10	4
Child (<5 years) malnutrition rate (%)	68	49	66	40	13
Per capita GNP (US$)	360	220	370	1110	2740

one-third or more of the total inhabitants, are recognized as a risk population of arsenic poisoning (Ahmad et al., 1997, 2001; Khan et al., 1997; Chowdhury et al., 2000, 2001; Karim, 2000; Watanabe et al., 2001). Arsenic poisoning, called arsenicosis, causes skin manifestations such as melanosis and keratosis as the initial signs, which eventually develop to skin cancer and internal organ cancers, as well as cardiovascular and neurological disorders (Chen et al., 1992; Bates et al., 1992; WHO, 1999).

In Bangladesh, the whole land is geomorphologically grouped into plain, riverine, island (i.e., land area within or along a river and occasionally inundated) and hilly environments. Except for hilly areas in the southeastern and northeastern parts, most lands are flat and fertile but are frequently subject to floods (Ahmed, 1999; Datta, 2001). More than 80% of the people in this country inhabit rural areas and most of them are small-scale farmers or landless laborers (Hye, 1996; Banik, 1998); according to the governmental survey in 1995-96, the proportion of working population engaged in agricultural sector accounted for 63.2% (Bangladesh Bureau of Statistics, 1999). Despite small agricultural land area per person, underdevelopment of other economic sectors has made it difficult for the villagers to find salaried jobs.

Selection of the study communities

Administratively, Bangladesh is divided into six divisions, comprising of 64 districts called zilas. The 64 zilas are divided into 496 thanas (sub-districts), 4,451 unions, and then 59,990 mouzas (primary administrative units); the mouza is recognized as a village and the average number of mouza population was 1,900 in the 1991 National Census. In this study, 50 villages (mouzas) were randomly selected from the country, applying the randomly generated numbers to the serial numbers of mouzas in the governmental list. Thus, the numbers of mouzas selected from the four geomorphological regions were proportionate: 23 from the plain, 14 from the riverine, 4 from the island and 9 from the hilly region.

Data collection

The original CODE questionnaire in English was translated into Bengali. Using the translated version, an interview survey was conducted in each village by well-trained local assistants under supervision of the authors. In each village, five or more villagers, including the leading members of both genders, were invited to participate in the survey. The interviews lasted for about half a day long. To each question, the villagers discussed about their perception to reach a conclusion. Of a large number of questionnaire items, the above-mentioned eight items at the current situation and for the changes in the past 10 years were analyzed in this paper. For these items, the same numbers of alternatives were prepared: i.e., "very serious," "a little serious" and "not serious" for the current situation, and "worsened very much," "worsened," "not or little changed," "improved" and "improved very much" for the past 10-year change.

Data analysis

The eight items were hypothesized to place in a triangular model with the environmental, health and economic aspect at the respective corner, as illustrated in Figure 1; (1) air pollution and water pollution represent environmental conditions and are related to health conditions more than economic conditions, (2) soil degradation and deforestation also represent environmental conditions but are related to economic conditions more than health conditions, (3) malnutrition and epidemic diseases represent health conditions, and (4) poverty and jobless represent economic conditions. These four groups are called, respectively, environmental/health items, environmental/economic items, health items and economic items.

For the questions about the change in the past 10 years, the five alternatives were recategorized into "worsened" (including "worsened very much"), "not/little changed" and "improved" (including "improved very much") while the three original alternatives, i.e., "very serious," "a little serious" and "not serious," for the current condition were used for analysis. Thus, all of the 16 items, eight each for the current situation and the past 10-year change, were assessed by the three levels. Correla-
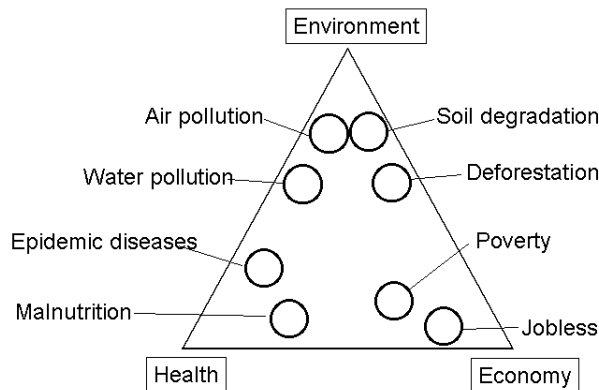
Fig. 1. A triangular model, with the environmental, health and economic
foci at the respective corners, in which the eight items are placed.

tion analysis and cluster analysis were performed, using SPSS 7.5J for Windows (SPSS Inc., Chi-cago).

It was difficult to evaluate the validity of random sampling of the 50 villages (mouzas) from more than 50,000 villages. However, there were no significant differences in the distributions of their answers among the village groups belonging to the four geomorphological regions, i.e., plain, river-ine, island and hilly (the Pearson's Chi-square test). Thus, the analysis was conducted without dis-crimination of the target villages by the four regions.

<div align="center">RESULTS</div>

Current situation

As shown in Figure 2, there are four major observations for the answers of the 50 villages to the eight items at the current situation. First, deforestation was the only item in which the "very serious" was higher than the other two alternatives and the proportion of the "very serious" was the highest in deforestation among the eight items. Second, the secondly highest proportion of the "very serious" was found in jobless, though its proportion was lower than that of the "a little serious." Third, pov-erty, malnutrition and soil degradation were characterized by the highest proportion of the "a little serious," with 12-18% of the "very serious" and 8-14% of the "not serious." Fourth, air pollution, water pollution and epidemic diseases were not perceived serious by the majority of the villages, with only 0-4% of the "very serious."

Change in the past 10 years

The items, in which the proportion of the "worsened" was higher than that of the other two alternatives, were deforestation, poverty and malnutrition, though the "improved" exceeded the "not/little changed" (Figure 2). Epidemic diseases showed the opposite extreme, represented by 80% of the "improved" and about 10% each of the "worsened" and "not/little changed." The four remaining items were perceived differently by the villages; judging from the proportion of the "worsened," jobless was the highest, followed by soil degradation, water pollution and then air pollution.

Relations between the current situation and the past 10-year change

Examination of the relationships of the 50 villages' perception for the eight items between the current situation and the past 10-year change focused on the proportion of the "very serious" for the former and that of the "worsened" for the latter. As shown in a scattergram of the eight items (Figure
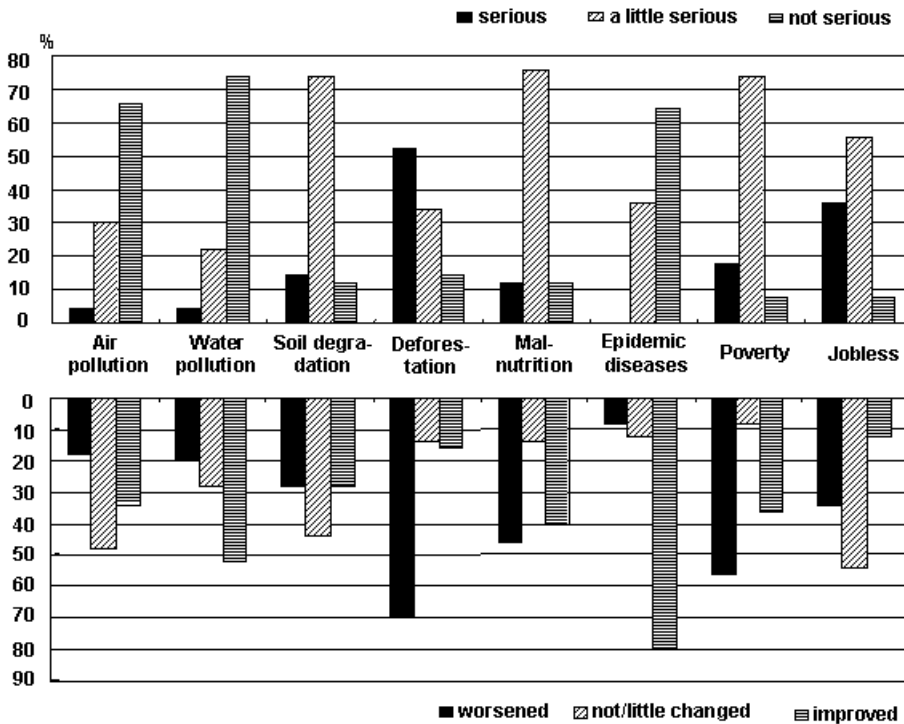
Fig. 2. Percent distributions of the three levels of the 50 villages' perception for the eight items for the current situation (upper part) and the past 10-years change (lower part).

3), the two proportions were significantly correlated (*P*<0.05).

Inter-item relations

To examine similarities and dissimilarities of the eight items, a cluster analysis was performed, based on the three perception levels of the 50 villages, separately for the current situation and the 10-year change. The results for the former are illustrated in Figure 4, in which the dendrogram demonstrates that the eight items were classified into two clusters: one consisting of air pollution, water pollution and epidemic diseases and the other of soil degradation, poverty, malnutrition, jobless and deforestation. In other words, the former cluster consisted of two environmental/health items and one health item whereas the latter of two economic items, two environmental/economic items and one health item. As shown in Figure 5, the dendrogram for the 10-year change demonstrates that air pollution, water pollution, soil degradation and epidemic diseases made one cluster and malnutrition, poverty and jobless made another cluster, though deforestation markedly differed from the other seven items so that it was recognized as unclustered.

DISCUSSION

Discussion begins with the proportions of the "very serious" answer for the eight items at the current situation. This proportion was particularly high in deforestation. The reasons why the villagers judged serious for deforestation may have come from not only small or reduced forest area per se but also difficulty of obtaining firewood from the forest. The forest cover of Bangladesh was estimated at 16-18% in the 1950-60s and reduced to less than 6-8% in the early 1980s (FAO/UNDP,
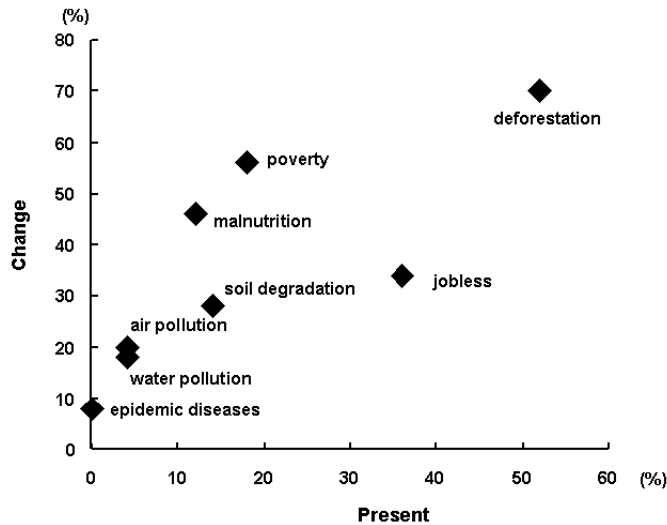
Fig. 3. A scattergram of the eight items, based on the proportion of the "very serious" answer for the current situation and that of the "worsened" answer for the past 10-years change.
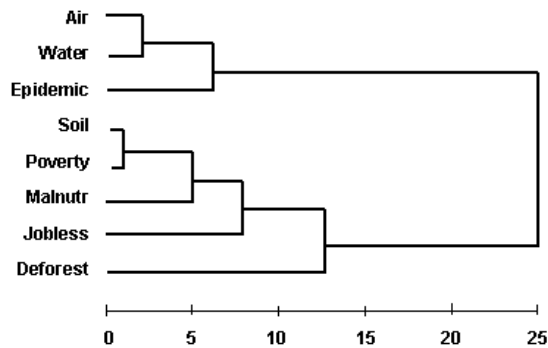

Fig. 4. A dendrogram showing the inter-item distances for the current situation, based on the cluster analysis for the 50 villages' perception. Air: air pollution, Water: water pollution, Epidemic: epidemic diseases, Malnutr: malnutrition, Deforest: deforestation.

1984); thereafter, the reduction rate of approximately 2% per year has continued and will continue until 2020 (World Resources Institute, 1996). Jobless and poverty, which were recognized serious, next to deforestation, were economic items. In contrast, two health items, i.e., epidemic diseases and malnutrition, and two environmental/health items, i.e., water pollution and air pollution, were less or not perceived serious.

The low proportion of the "very serious" answer for health and environmental/health items is inconsistent with vulnerable health status of Bangladeshi people. For instance, of approximately 17 million children under five years of age, 380,000 died every year, mostly from readily preventable or treatable conditions; in particular, 120,000 deaths were associated with symptoms of pneumonia and 70,000 with symptoms of diarrhea (Baqui et al., 1998). Country-wide arsenic hazard, which derives from water pollution, has been a major target of many overseas and international aid programs (World
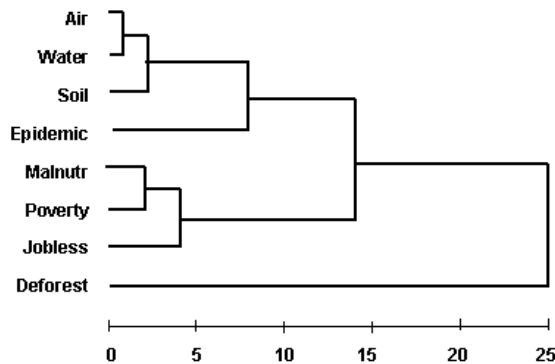
Fig. 5. A dendrogram showing the inter-item distances for the past 10-years change, based on the cluster analysis for the 50 villages' perception. The abbreviations are the same as in Fig. 4.

Bank and Bangladesh Centre for Advanced Studies, 1998; WHO, 1999). However, the villagers' less attention revealed in this study may have reflected the perception of the bulk of Bangladeshi villagers. For instance, Ushijima et al. (2001) reported that among the villagers in severely arsenic affected area only those who belonged to the higher-income group or those who had suffered from severe arsenicosis recognized arsenic toxicity and some of them took preventive or curing actions; furthermore, the villagers' poor knowledge about arsenic toxicity due to underdeveloped health education and information flow systems was pointed out as the underlying causes.

The significant correlation between the proportion of the "very serious" answer at the current situation and that of the "worsened" answer for the past 10-year change indicates that the more worsened in the recent past the more serious by the villagers' perception. The item with the highest proportion of the "worsened" answer was again deforestation, followed by poverty, malnutrition and jobless. For the three items except deforestation, jobless was characterized by the relatively higher "very serious" proportion while the remaining two items by the relatively lower "very serious" proportion. Thus, jobless was considered to have prevailed from the past with less change in the recent decade whereas poverty and malnutrition have become problematic in the recent past, suggesting that the latter two items are considered to be more serious in the near future. On the other hand, the lowest proportion of the "worsened" and the highest proportion of the "improved" of epidemic diseases may have been largely attributed to the recent increase in the national coverage rate of immunizations; this rate in 1992 and 1998 was, respectively, less than 2% and 70% in children aged 12-23 months who completed the series of recommended immunizations, and less than 2% and 80% in women with a child aged less than one year, who obtained at least two tetanus toxoid immunizations (Perry, 2000).

The above discussion is related to the inter-item relations. The results of cluster analysis for the current situation and the past 10-year change demonstrated that the linkages of the items were basically similar between the two dedrograms. For the former, one cluster comprised of air pollution, water pollution and epidemic diseases and the other of soil degradation, poverty, malnutrition, jobless and deforestation. The two items differed in the latter dendrogram; soil degradation moved to a cluster which involved air pollution, water pollution and epidemic diseases and deforestation was not involved in the two clusters since its distance from any items was markedly far. One of the important findings in this study was difference in the positions of the two health items; "epidemic diseases" was similar to the environmental items while malnutrition to the economic items. It is difficult to explain the close position of epidemic diseases to the environmental items but its high proportions of the "improved" and "not serious" answers may have come from the reduction of their risks mostly owing

to the increase in immunization coverage rate, as mentioned above. In contrast, malnutrition was basically conditioned by the household economy despite the fact that malnutrition was recognized as a strong underlying cause of deaths; according to Schroeder and Brown (1994) and Pelletier et al. (1995), 66% of childhood deaths in Bangladesh were attributable to malnutrition. This contrasting pattern implies that immunizations and other health services, which reduce the risks of epidemic diseases, are more realizable than economic improvement, which largely contributes to reduction of malnutrition.

The final discussion focuses on the ways of mitigating Bangladeshi villagers' serious environmental, health and economic situations. As mentioned above, deforestation may not be easily mitigated since the bulk of land in this country has already been used for agricultural, commercial, industrial, residential and other purposes under the densely populated condition (World Resources Institute, 1996). More important findings of this study were the villagers' more serious recognition on the economic items than the health and environmental items and the relatively higher proportion of the "worsened" answer in malnutrition, which was positioned close to the economic items. Thus, it is judged that economic development should be prioritized for improving the people's living standard or quality of life, though this is difficult with the villagers' efforts themselves and needs the governmental efforts and/or international aids. Nonetheless, this result does not necessarily devaluate the efforts for mitigating health hazards and environmental hazards, both of which have prevailed in Bangladesh. It is reasonable to conclude that such efforts should be continued and promoted, though the villagers' serious perception on the economy-related matters should also be adequately understood by the administrators, aid groups and scientists who are engaged in such mitigation actions in this country.

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