Population Is a Critical Factor for Global Carbon Dioxide Increase

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Based on Intergovernmental Panel on Climate Change (IPCC) assessment report at 2007, it is likely that there has been a substantial anthropogenic contribution to global warming. Carbon dioxide (CO_2) is a major anthropogenic greenhouse gas and its increase is thought to give rise to the recent global warming. Although studies suggested the impact of population growth on carbon dioxide increase, much attention has not been paid. In this study population was plotted as compared to the atmospheric CO_2 concentration. A quite linear relationship was observed between population and CO_2 concentration at both before and after 1970, after which the global temperature rapidly increased. In addition, direct and indirect human-derived CO_2 emission appeared to contribute much to the total amount of CO_2 emission in developing countries and as the economy grow fossil-fuel-derived CO_2 emission increased more as compared to human-derived emission. These findings indicate that population growth especially in developing countries is a critical factor for manipulation of global CO_2 increase.

Key words —— population, carbon dioxide, global warming

INTRODUCTION

Global warming is a serious issue for human beings. The 4th Intergovernmental Panel on Climate Change (IPCC) assessment report at 2007 indicated that carbon dioxide (CO_2) has increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values, and the amount of CO_2 in the atmosphere in 2005 (379 ppm) exceeds by far the natural range of the last 650000 years (180–300 ppm).[1] CO_2 is a major anthropogenic green house gas, which is believed to contribute to the global warming.

Human activities require energy for essentials of life such as clothing, food, housing and so on, which require CO_2 emission. The human activities increase as the growth of population. Studies suggested that population growth is one of the major factors for CO_2 emission in both developed and developing countries.[2–5] It has been also suggested that rising income levels have been associated with the increased CO_2 emission.[5] However, still much attention has not been paid for the population. In this study the impact of population on CO_2 increase in atmosphere was determined. The study indicates that population growth is closely associated with the increase of CO_2 in atmosphere, and suggests that population growth in developing countries is a critical factor for manipulation of global CO_2 increase.

MATERIALS AND METHODS

Population is based on United Nations (UN) world population prospect: The 2006 revision. Global temperature (5-year mean) is based on National Aeronautics and Space Administration/ Earth System Research Laboratory (NASA/ESRL). The atmosphere CO_2 concentration is based on NASA/ESRL and Carbon Dioxide Information Analysis Center (CDIAC). The amount of CO_2 emission of is based on CDIAC.

RESULTS AND DISCUSSION

Population was plotted as compared to the atmospheric CO_2 concentration and global atmospheric temperature (Fig. 1). The temperature indicates 5-year mean surface temperature anomaly relative to 1950–1980 mean. Almost all the plots were closely associated with CO_2 concentration. Interestingly these associations were observed at both before and after 1970. Before 1970, CO_2 concentration does not fit with the global temperature, but after 1970 the temperature rapidly increased with concurrent increase of CO_2. A quite linear relationship was observed between population and CO_2 concentration (Fig. 2). It is of note, however, that after 1960, whose population was 3 billion, the slope

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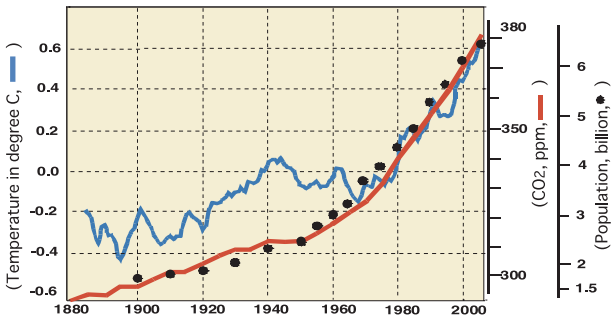

Fig. 1. Comparison between Population, Global Temperature and Atmospheric CO_2 Concentration

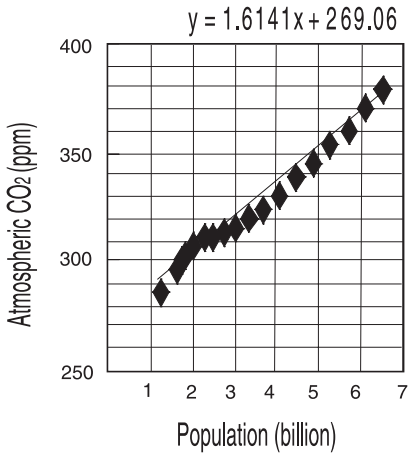

Fig. 2. Relationship between Population and Atmospheric CO_2 Concentration

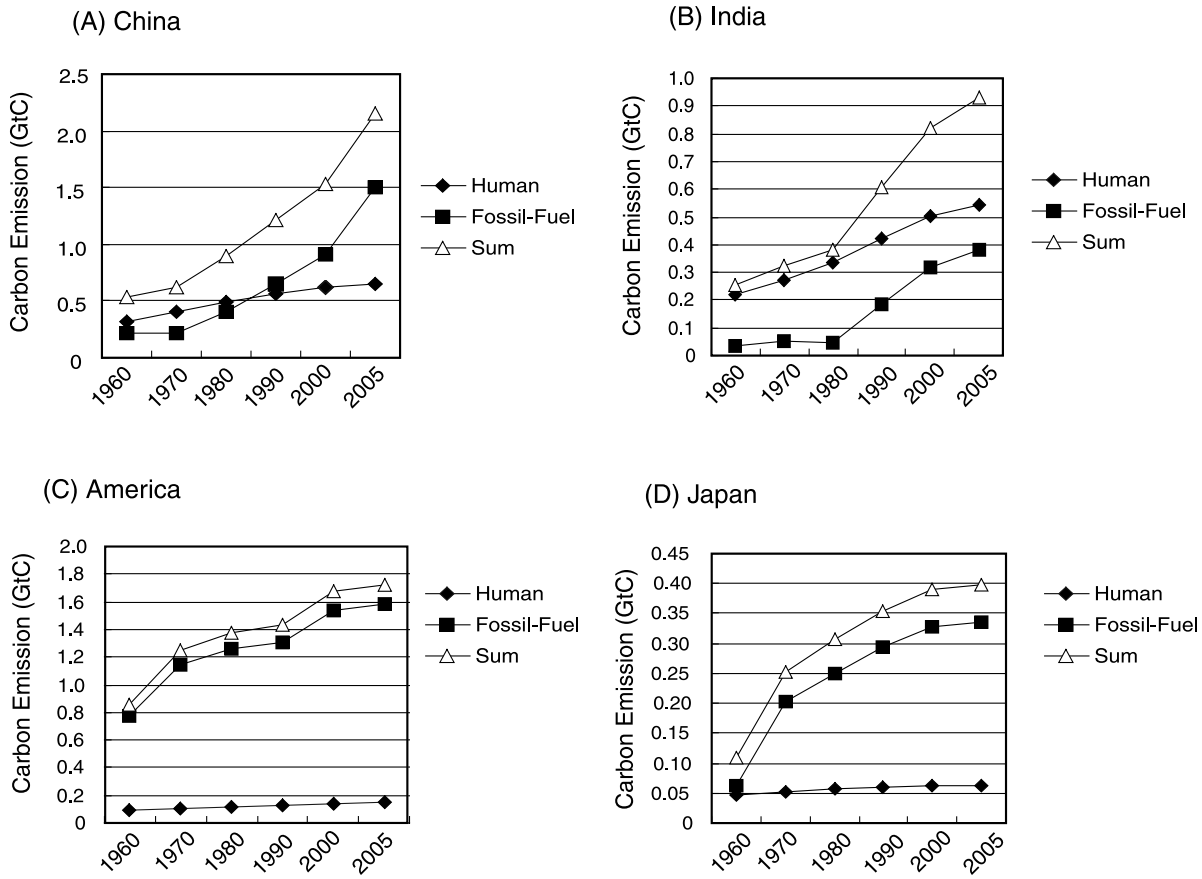

Fig. 3. Comparison of the Amount of CO_2 Emission from Human (Direct and Indirect) and Fossil-Fuel among Developing and Developed Countries

Human-derived CO_2 was estimated by the report of Prairie and Duarte.[6)]

was steep as compared to 1960s from 1940, whose population was 2 billion. This difference could be due to social events like wars, energy crisis, saving energy, economical growth and so forth. These findings strongly support the notion that natural factors, such as volcanic activity, do not much contribute to the CO_2 increase. IPCC indicated that most of the anthropogenic CO_2 is derived from fossil fuel use and changes in land use.[1)] However, it is reported that direct and indirect metabolic CO_2 release by

humanity much contributes to the CO_2 emission. Direct metabolic CO_2 is comprised of respiration of humans, and indirect CO_2 is composed of the decomposition of their resulting wastes, and respiration and resulting decomposition from a large livestock population to feed themselves as well as a large number of domestic animals. The direct and indirect metabolic CO_2 release from humans (3.1 Giga ton Carbon (GtC)) assessed at 2003 reaches up to 43% of the total CO_2 emission (7.2 GtC) from fossil fuel consumption and changes in land use at 2000–2005.[6] This amount cannot be overlooked. Next, the amount of CO_2 emission from human (direct and indirect) and fossil-fuel was compared between developing (China and India) and developed countries (America and Japan, Fig. 3). In China, before 1980 human-derived emission was larger than fossil-fuel-derived emission. After 1990 fossil-fuel-derived emission exceeded human derived emission and it rapidly increased as compared to that of human derived emission. In India, up to 2005 human-derived emission was larger than that of fossil-fuel-derived emission although the latter rapidly increased. In both America and Japan, human-derived emission was quite small as compared to that of fossil-fuel-derived emission, and total amount of emission reached almost plateau. These results indicate that human-derived CO_2 emission contributes much to the total amount of CO_2 emission in developing countries and that as the economy grow fossil-fuel-derived CO_2 emission increases more as compared to human-derived emission. When the fossil-fuel-derived emission per capita was compared among these countries at 2005, those of China (1.16 metric tons of carbon per capita), India (0.35) were smaller than those of America (5.32) and Japan (2.63). In addition, rising income levels have been associated with the increased CO_2 emission.[5] Currently a large number of people are living in developing countries and their numbers are increasing, consequently as the economy grow, in other words as the CO_2 emission per capita increases, more and more CO_2 will be emitted. If we want American and Japanese like life-style at 2005 by limiting CO_2 emission at the level of 1960, where global temperature was not steeply increased, the population should be 0.534 and 1.21 billion, respectively. Therefore, more attention should be paid for the population growth to reduce the atmosphere CO_2 increase.

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