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POPULATION, DEVELOPMENT AND ENVIRONMENT IN THE PHILIPPINES: AN INTRODUCTION TO THIS ISSUE

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The past several decades in the Philippines have been characterized by a set of stylized facts: population increase, income per capita increase (although less steadily than population), and environmental degradation, including air and water pollution and overuse of natural resources, such as timber and fisheries. Are these developments linked in some causal fashion, or are they merely manifold outcomes of the underlying process of "development"?

The Malthusian perspective is that resources limit population growth. Malthus said that increasing numbers of people put increasing pressure on the availability of land to provide food. As more and more labor is applied to fixed quantities of land, the marginal product of labor falls below subsistence, making population growth self-limiting. The maximum sustainable population size is determined by the stock of agricultural land available. The more general neo-Malthusian notion says that members of a population require a certain amount of resources, be they agricultural land or other natural resources. This implies that increases in population size will carry concomitant demands on natural resources. Therefore, there is a clear causal flow from population growth to environmental degradation. Furthermore, the process of development is resource intensive, requiring increasing resources per capita as it proceeds. Population growth and economic development occurring together are, therefore, seen to be especially harmful to the environment. Explicitly or not, the maintained view is that the area under study has a finite carrying capacity that is close

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enough to actual or feasible population size to be worrisome. The "Limits to Growth" model of Meadows *et al.* (1972) is an example of this logic taken to the extreme.[1]

Malthusian predictions have not always been good indicators of long-run outcomes. Since Malthus wrote, in Europe, the notion that the available quantity of agricultural land limited population size clearly did not hold, in part because, as economic development proceeded, nonlabor inputs played an increasing important role in agricultural production. Europe is now far more densely populated than when Malthus was writing at the turn of the 19th century. Moreover, while some resource constraints bound very tightly while economic development of Europe proceeded, others did not. This suggests that specific resources may be especially pressed, and therefore that a sectoral analysis of the various relationships between population, development and environment is warranted.

A well-known exponent of a general pattern of adaptation to population growth is Boserup (1965). She argues that increases in population density forced the adaptation of more labor-intensive technologies. For example, at early stages of agricultural development, population growth forced land to be cycled more and more rapidly through slash-and-burn. Eventually, adverse environmental consequences, in the form of lower crop yields, forced farmers to adopt forms of agriculture with different environmental consequences, breaking the rigid tie between population density and environmental change. While some have tried to adapt this process to a specific explanation of the recent history of population growth (*e.g.*, Simon 1981), this has proven difficult to accomplish. Adoption of changes which are beneficial in the long run often are stalled short-run costs, and efforts to break down observed costs into short-run and long-run have been arbitrary enough to leave many observers agnostic.

Nonetheless, the concept that the relationship between population growth and other outcomes, such as income or environmental change, is not rigid or unidirectional, is important. Bilsborrow (1992) has extended this notion to allow for changes in cultivated area, technology or population (through changes in fertility or migration) in response to population growth. These changes are contingent upon government policy, foreign demand for output, land tenure, and infrastructure. This

1. Sanderson (1994) has an excellent summary of the mechanics of this and other simulation models.

suggests a complicated modeling procedure, in which the subtle interactions between a number of different actors in the society, together with the natural processes governing renewal of natural resources, play roles.

Quantitative assessments of such a model rely on simulation. In Lutz *et al.* (1994), an attempt at this sort of model is described. A group of researchers headed by a team from the International Institute for Applied Systems Analysis (IIASA) developed a multisectoral model of the Mauritian population, economy and environment, which they referred to as the PDE (for Population, Development, Environment) model. The researchers began with detailed studies of various "problem areas," which in Mauritius were thought to include population distribution, access to fresh water, and beach cleanliness. Using the baseline information gathered, they next used standard demographic forecasting techniques and an input-output model of the economy, together with models of land use and fresh water systems, to describe a plausible set of future scenarios over the period 1990-2050. They were able to identify problem areas, both geographic and substantive. For example, they found that regions of Mauritius were likely to face fresh water shortages early in the 21^{st} century.

It was in this context that the Commission on Population (POPCOM) took up the PDE question in the Philippines. In 1994, a group of demographic, economic and environmental experts from IIASA, the Philippines, and the East-West Center met under the auspices of POPCOM, the Program on Population of the East-West Center, and the United States Agency for International Development (USAID) to discuss the implementation of a PDE model for the Philippines. The central goal of the conference was to assess whether the intensive modeling exercise undertaken by IIASA in Mauritius, a single island with a population of roughly one million, was feasible in a country like the Philippines, an extensive archipelago with a population of over 60 million. Physical environment, economic infrastructure, and population characteristics show substantial variation in the Philippines, and given that the Mauritius model had taken more than a year to complete, this diversity was a real source of concern. A possible approach considered at this meeting was to focus efforts initially on a restricted geographic area of the country. Cebu, because of data availability and the presence of significant environmental problems (including significant deforestation, development of steeply sloping land, and fresh water shortages), was viewed as the most likely locale for undertaking a pilot study.

The Philippines has a large and active scholarly community. While no work had been done on modeling the full set of PDE interactions in the Philippines, a great deal of work had been done on many of the separate components. A key element of assessing the feasibility of PDE modeling in the Philippines, therefore, involved assessing the current state of knowledge on population, development and environment separately (and in pairs).

Most of the papers in this volume were prepared as background for that conference, and those that were not part of the conference bear directly on these issues. The first two papers set the stage. Flieger describes the demographic situation in the Philippines, with special reference to findings from the 1990 Census and the most recent intercensal period (1980-90). Highlights include the finding that the absolute number of farmers, fishers and forest workers declined slightly between 1980 and 1990. Because of the large number of labor force entrants in the decade, however, the share of the labor force in these occupations fell from almost half in 1980 to less than one-third in 1990. An important question for a PDE analysis to address is whether this is driven by a shortage of the natural resources needed for individuals to engage in these occupations, or because earnings opportunities had increased in other sectors. The decade in question is one of increasing urbanization. Flieger shows that, in fact, roughly half of the increase in population in urban areas occurred not because of migration but because of continuing urbanization. This urban sprawl is exactly the sort of demographic phenomenon that is likely to have significant environmental consequences, and, therefore a candidate for inclusion in PDE modeling efforts.

Orbeta surveys existing forecasting models for the Philippines. One recipe for building a full PDE model is to begin with a model of population and development, and then add environmental interactions.[2] Orbeta discusses several promising alternatives in the process of developing a methodological discussion on economic-demographic modeling. He also discusses several models of development and environmental change. These are sometimes "computable general equilibrium" models, and sometimes less computationally demanding (but typically less aggregated) models such as input-output models. He finds no detailed models of population-environment interactions. This is perhaps an indication that

2. This is not the tack taken by the IIASA modelers, who developed a relatively simple economic model based on an input-output table.

the population-environment nexus, so intuitively plausible as a motivation for undertaking PDE analysis, is indirect enough to require a full-blown PDE analysis in order to isolate its impact. In other words, Orbeta presents some sense of how population affects development, and separately, how development affects the environment. Apparently, a key task of PDE modelers will be to pull these two strands together.

The rest of the papers highlight economic-demographic-environmental "hot spots." Padilla analyzes water quality and fisheries, with specific emphasis on the role of human population and overfishing on yields. He presents results that highlight the geographic diversity of the Philippines. For example, in areas where the density of fishers is high, yields average less than 15 percent compared to areas where the density of fishers is lower. Padilla describes fishing as the employment of last resort. One of the very clear implications for PDE modeling is that, to the extent that job creation is not sufficient to provide for new members of the population, fisheries will suffer. Padilla also discusses the causes and implications of the long-term secular decline in fisheries yields. Padilla also devotes substantial attention to the relationship between population growth and water quality. The evidence indicates that water quality is declining. Less clear in the literature surveyed by Padilla are the relative contributions of population and economic growth to the decline.

Padilla and Janssen continue with a related issue, the costs and benefits of mangrove preservation. Mangroves form important fish hatcheries, prevent coastal erosion, and provide timber resources. On the other hand, they limit land access to coastal areas, and are often cleared to make fishponds. Padilla and Janssen discuss the implications of policies to stem the loss of mangrove coverage. They establish possible linkages between development and population growth, and environmental impacts.

To urban dwellers in the Philippines, perhaps the most obvious PDE relationship is the link from population and economic development to air and water pollution. Israel examines the interaction of industrialization and environmental degradation in a case study of Cebu, with particular attention to the role of government policy. Policy can be either that which is designed to lure investment or that which is intended to limit the potential environmental degradation accompanying subsequent industrialization. He finds that some industries are more harmful to the environment than others, but that in general, the process of industrialization has significantly harmed the environment of Cebu. Israel also finds that government attempts to limit pollution have met with little success. His paper has clear implications for the role of economic development on the environment, and provides useful data for incorporating the sort of development-environment modeling discussed by Orbeta into a full PDE model for Cebu.

Finally, Amacher and Hyde establish the relationship between population growth and migration. They create a model of the determinants of migration, with special emphasis on the characteristics of the receiving regions. Typically, economic models of migration show that measures of economic opportunity at the destination and travel costs play important roles. The Amacher and Hyde study is no exception in this regard. It shows that, for example, destinations with higher than average household incomes or smaller than average proportions of populations living in poverty draw many immigrants. However, Amacher and Hyde also use more environmentally based measures of economic opportunity at the destination, such as the share of forest land classified as public (and, therefore potentially available to be appropriated by migrants), or the share of forest land on steep grades. In a model of deforestation that is partially driven by immigration to forested areas, the indirect consequences of population growth and lack of economic opportunity in the sending regions are of importance. The notion that the population, development and environment components of the PDE model must be treated in disaggregated fashion is reinforced by empirical findings such as these, which relate to specific migration flows between narrowly defined areas.

These papers offer tantalizing glimpses of the sorts of questions that could be addressed with a more complete specification of a PDE model for the Philippines. For example, what would be the environmental consequences of increased manufacture of a product in demand on world markets? Amacher and Hyde might predict that migration to upland areas would be diverted to urban manufacturing centers, improving upland environmental quality, and Padilla might predict beneficial consequences for fisheries, depending on how the demand for fish responds to higher incomes. However, migration to urban areas instead of uplands, according to Padilla and to Israel, would further decrease environmental quality in urban areas. Furthermore, a result of modern-sector employment, especially for women, is lower fertility. This could imply reduced future urban pollution, compared to a scenario without increased manufacturing output, if population size (or density) alone is an important determinant of urban pollution. A complete PDE model would go a long way toward pulling together a unified answer to this sort of multifaceted question.

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