



Economic development and food production–consumption balance: A growing global challenge[☆]

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ABSTRACT

Rising affluence in major developing countries (principally China and India) and increasing diversion of agricultural resources for energy production (USA and Brazil) sharply increase agricultural resource demand. Food consumption and production changes during development are analyzed using resource-based cereal-equivalent measures. Diet upgrades to livestock products require fivefold increases in per capita food resource use, reflecting a consistent pattern which is only marginally affected by land base. Food consumption increases exceed production during early development, leading to imports. Consumption eventually stabilizes at high incomes, but production falls short in land-scarce countries. Pork and poultry consumption increase the most; less efficient beef and dairy production command a majority of agricultural resources.

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Introduction

Increases in per capita food demand in developing economies follow a dynamic growth path that places increasingly strong pressure on food production resources. The claims on these production resources, however, are not evenly divided. To date, only the 15% of the world's population located in high income countries has reached food consumption stability. Yet in reaching this stability, their high income diets, focused on animal products, command 30% of the world's food production resources. In contrast, low-income countries with 15% of the world's population need only 8% of the world's production resources to satisfy their crop-based diets.¹ In the past, technological change against a fairly stable land base has allowed growth in food production to keep pace with rising demand from this limited number of high income diets. Now, given current development and demographic conditions as well as critical environmental considerations, the challenges facing our global food production systems are growing exponentially.

Two large countries, China and India, comprising some 40% of the world's population, are experiencing rapid per capita income

growth. With China approaching the mid-point in the diet change process and India in the early stages, the nascent and expected future pressure on food production resources from diet change in these large population countries is becoming increasingly evident. Further exacerbating the strain on the resource base is the diversion of some food production resources to energy production as fuel prices rise. Note that soon 30% of US corn supply will be used for ethanol production (USDA, 2007), while Brazil is supplying 40% of its energy needs from combustible renewables, principally ethanol from sugar cane (World Bank, 2007).

To better understand the dynamic food changes associated with economic development and prepare for the needed changes in type and quantity of agricultural output, this study documents and provides estimates of the dimensions of individual country and aggregate world food needs caused by both population increases and diet upgrades. Further, the demonstrated ability of countries to meet these dynamic needs throughout the development process is addressed. Within this context emerges the challenge to managers of agricultural resources to provide the needed food production increases against a relatively stable but declining per capita productive land base. While population growth generates higher demand for food overall, diet upgrades place even greater strains on agricultural production, relative to direct grain consumption, in addition to requiring larger quantities of energy and contributing much more significantly to global warming. Combining population pressures, the inevitable diet upgrades, and environmental concerns underscores the magnitude of the challenges ahead.

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¹ See Fig. 2, below.

Development-induced changes in food consumption and production

Per capita food needs and a country's production capability to meet these needs differ significantly across stages of economic development, measured here by per capita income.² Poor countries typically commit a considerable percentage of income as well as a major share of the active work force to the procurement of food. In the early stages of economic development, limited production technology and supporting infrastructure lead to low levels of agricultural productivity, while low income levels also constrain the ability to import food. Hence, most poor countries are of necessity relatively self-sufficient in the production of food.

Despite the large share of income and effort devoted to food, the low levels of per capita food consumption lead to the likelihood that any early growth in income will also be spent largely on food, creating a sizeable impact on food consumption at early stages of development (Rask, 1991; Kydd et al., 1997). Growth in demand for food is therefore generated not only by growing populations, but also by rising income, and in particular, as we argue, by diet changes associated with rising income. The relative importance of population growth and income growth in determining future world food needs is still open to question. However, per capita income growth in developing countries is increasingly seen as a major factor driving world food demand.

Dyson (1999) favors population growth as the major contributing factor. In discussing world food needs in the coming decades, he concludes that among others (poverty, arable land, and food prices), "population growth will be the most important factor influencing the global increase in food production and forcing the world farmers to produce more food in the coming years" (page 3). A recent Chatham House study (Evans, 2009) expands the scope of analysis by highlighting both population growth (projecting a global population of 9.2 billion within 40 years) and rising affluence as sources of increased food demand, while climate change, water shortages and competing land uses serve to hamper supply. Evans concludes that increasing food supply alone would be an insufficient response to these challenges. A true solution requires the development of a more resilient, sustainable and equitable production and distribution system (page 2 of "Executive Summary and Recommendations"). In this study, we concentrate on elucidating the nature of the diet change component within this broader context.

Our study documents the historical importance of population growth on world food needs over the 1961–2002 period (population growth was responsible for two-thirds and per capita income growth for one-third of the increase in world food needs), and thus concurs that population has historically been the principal factor driving world food demand. However, the dynamics of economic development and in particular the current position of major countries (China and India) in that development process point to per capita income growth as a potentially more important and perhaps dominant factor affecting world food needs in the immediate future.

The current and future importance of income growth in world food demand is reinforced by recent Food and Agricultural Organization (FAO of the United Nations) and International Food Policy Research Institute (IFPRI) publications. Von Braun (2007) in a report from IFPRI describes a "world food situation currently being rapidly redefined by new driving forces... income growth, climate change, high energy prices, globalization, and urbanization" (page 1). In describing the food demand aspects of income growth he states that "many parts of the developing world have experienced

high income growth in recent years... especially China and India... This growth is a central force in the demand side of the world food equation. High income growth in low-income countries readily translates into increased consumption of food... The composition of food budgets is shifting from consumption of grains and other staple crops to vegetables, fruits, meat, dairy, and fish... Today's shifting patterns of consumption are expected to be reinforced in the future" (page 2). Pingali (2006) also analyzes the shift in Asian diets, noting their convergence with western consumption choices as globalization progresses. Clearly, combining growth in income and population with such international influences on diet preferences is already having a significant impact on food demand.

A similar scenario is projected in the FAO report (2008), including the possibility of a structural change in agricultural commodity markets, comprising in part a prolonged shift to higher commodity prices. Commenting on the changing structure of world food demand they state, "It is widely accepted that economic development and income growth in important emerging countries have been gradually changing the structure of demand for food commodities (especially in China and India). Diversifying diets are moving away from starchy foods toward more meat and dairy products which is intensifying demand for feed grains" (page 5), since multiple units of grain are necessary to produce single units of livestock products. USDA analyses of trends in food consumption likewise conclude that higher incomes cause major shifts in diets as well as rising demand for quality, both of which impact consumption choices and therefore trade flows (USDA, 2001). These diet shifts also contribute to increased energy use and global warming potential (Williams et al., 2006), creating further strains on the environment and raising serious questions about sustainability of agricultural production.

This income growth – food consumption relationship is not linear, but rather demonstrates a dynamic pattern throughout the development process, including a changing relationship between domestic food production and consumption. As economic development proceeds (incomes grow), the patterns of food consumption and related production resources as noted above change dramatically. The major change is a diet shift from consumption of crop based products to livestock based products, which require considerably greater production resources and generate greater environmental externalities. In fact, we estimate that a stable per capita diet at the highest income levels requires 5–7 times more agricultural resources to produce than does a predominantly crop based diet at the lowest income levels. Thus, as continued population growth is combined with rapid diet change, many countries in the middle income levels of development are no longer able to maintain food self-sufficiency from domestic agriculture and must import a growing portion of their food needs.

At higher levels of development, the diet shift to livestock products is largely complete. The increasing per capita expenditures on food at this point reflect a demand for non-agricultural resources such as processing, packaging and away-from-home eating (Rask, 1991). At this level of development, per capita food resource requirements stabilize and agricultural productivity growth needs only to match population growth to supply a country's growing food needs. At the same time, slower growth in population at these higher levels of income reduces the population-based food demand growth (Perkins et al., 2001, pp. 253–255). With continued growth in productivity, some countries at this level of development are able to close the production–consumption gap, and a few countries with substantial agricultural resources become major food exporters.

This general development pattern has been shown to apply to a wide range of developing economies (Rask and Rask, 2004). Within these broad generalizations, however, individual countries follow

² The analysis in this and the following paragraph draws on Rask and Rask (2004).

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