

Do Population Trends Matter to Agricultural Productivity? A Case Study of Bangladesh

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Research Questions

- The paper examines two questions:
 - (i) do population trends impede agricultural productivity? or
 - (ii) it promote agricultural productivity or both?
- There are supporters and opponents in favor and against the propositions.

Theories

- One group that points out to adverse affect of population growth on agricultural productivity is led by Thomas Malthus and his followers (neo-Malthusians).
- The group that points out to positive impact of population pressure on agricultural productivity is led by Esther Boserup and her followers.

Malthus

- Thomas Malthus in his **Essay on the Principle of Population** in 1798 posited that population numbers tend to grow exponentially, while food production grows linearly, never quite keeping pace with population.
- This results in natural checks (such as famine) to further grow.

Neo- Malthusians

- Neo-Malthusians (adherents of Malthus) hold that human populations because of their tendency to increase exponentially, if fertility is unchecked, will ultimately outstrip Earth's resources, leading to ecological catastrophe.
- The most pioneering study based on neo-Malthusianism underpinning , was the Club of Rome World Model in 1972.

Neo-Malthusians

- This is the first computer-based population-resources modeling effort. The model predicted an overshoot of global carrying capacity within 100 years.
- Neo-Malthusianism has been criticized for overlooking cultural adaptation, technological developments, trade and institutional arrangements that have allowed human populations to grow beyond their local subsistence base.

Boserupian Hypothesis

- Boserup holds that agricultural production increases with population growth owing to the intensification of production (greater labour & capital inputs). This is known as intensification hypothesis
- Although often depicted as being in opposition to Malthusianism, Malthus himself acknowledged that agricultural output increases with increase in population density (just not fast enough).

- Boserup also acknowledged that there are situations under which intensification might not take place. One such situation is high population growth
- The main difference between the theories of Malthus and Boserup is that Malthus saw technology as being exogenous to the population-resource equation and Boserup sees it as endogenous.

Boserupian Hypothesis

- The Basic Boserupian hypothesis: increased food demand, a denser network of social and market interactions, labor-intensive agriculture and economies of scale helped to avert a Malthusian crisis.
- The Boserupian or intensification hypothesis has been tested in a number of studies spanning Africa, Asia, and Latin America. The often cited study is by Tiffen et.al in Machakos district, Kenya.

Testing of Boserupian Hypothesis in the context of Bangladesh

- Bangladesh is a land strapped country with limited (33 million acre) arable land and most of it is cultivated. The country has a huge population base and is still growing. This provides an ideal ground for testing Boserupian Hypothesis.
- The present paper aims to test Boserup's hypothesis in the context of Bangladesh using both micro and macro level data, particularly the latter.

Boserup's Hypothesis: Micro-level

- Turner & Shajaat Ali studied time series data (1950-1986) for 265 households in six villages in Bangladesh.
- They found support for the induced intensification hypothesis, with yields largely keeping pace with or exceeding population growth despite high population densities (783 persons per km²).

Boserup's Hypothesis at Macro-level

Evidence of population pressure:

- i) **Rapid population increase:** Population of Bangladesh has increased about three folds during last five decades, from 50.84 million in 1961 to 148.80 million in 2011, registering a 193 percent increase.

- ii) **Increase in population density.** Increase in population size has increased pressure on land in last five decades. This was measured in three different ways: a) **population on total land area**, b) **population on net sown area** and c) **population on cropped area**.

- a) **Population density (persons/acre), measured in terms of population on total land area** has increased nearly three folds, from 1.55 in 1961 to 4.35 persons/acre in 2011.

- b) **Density of population (persons/acre), measured in terms of population on net sown area** increased at least three folds, from 2.70 in 1961 to 8.15 persons/ acre on net sown area in 2011.

- c) **Density of population (persons/acre), measured in terms of population on gross cropped land area** increased by 2.55 folds, from 1.85 in 1961 to 4.72 persons/acre in 2011.

Population Pressure on Land (Continued)

- **Decline in Net sown area** . Net sown area declined by 6.26 percent, from 18.85 million acres during 1960-65 to 17.62 million acres in 2008.
- **Decline in Average Cultivated Area Per Farm.** Average cultivated area per farm declined by nearly 65 percentage, from 3.3 acres during 1960-65 to 1.16 acres in 2008.

Population Pressure on Land (Continued)

- Cultivable land remains almost unchanged at low level
- The ratio of total land area to net cultivated area, ranging from 1.26 to 1.65 , was already very small during 1960-65. There has been very little change from this situation in last 43-48 years.
- The average ratio of total land area to net sown area marginally increased from 1.61 during 1960-65 to 1.73 in 2008. The findings clearly demonstrate the paucity of cultivable land.

Response to Pressure on Land

- Although net sown area and average farm size declined, this was compensated by increased gross cropped area and cropping intensity.
- **Increased Gross cropped area** (repeated cropping on the same land) increased by nearly 13 percent, from 27.08 million acres in 1960-65 to 30.48 acres in 2008.
- Consistent with this pattern we also find **increased cropping intensity**. Cropping intensity, defined as gross cropped land as ratio of net sown area, increased by 20 percent, from 1.44 times during 1960-65 to 1.73 times in 2008.

Response to Pressure on Land

- **Increased Cropping Diversity:** Bangladesh is moving away from mono crop production to multi-crop production, i.e., from exclusive rice based cereal production to other types of cereals (wheat, potato, maize, barley) and other food crops (pulse, oil seeds, fruits, vegetables, etc).
- For example, percentage of gross sown area in rice declined by nearly 13%, from 80% to 70.94%, over last four decades (1960-65 to 2008). During the same period the percentage of gross sown area given to other cereals and food crops increased from 1% to 3 %, and from 14% to 16.32%, respectively.

Response to Pressure on Land

- **Strong Government Commitment to Agriculture Sector:** Government allocation to agriculture in relation to total ADP allocation has increased by 965% from 4.089 billion taka in 1978/79 to 43.55 billion in 2012/13 budget.
- Agriculture accounted for over 8% of development budget of 2012/13.
- **Huge Government Subsidy:** Huge subsidy is given to support various farm activities to minimize cost of production at farmers end. Subsidy accounted for over 60 percent of agricultural budget during 2010-11-2011-12.

- **Other Support to Farmers:** In addition to subsidy various other support is provided to protect farmers. These include: agro-insurance, fair-price, agricultural credit to name a few.

Modernization of Agriculture:

- a) Percentage of gross cropped area under rice given to HYV increased by 572%, from 11.17% in 1971/72-1973-74 to 75.03% in 2005/06-2007/08.

Modernization of Agriculture:(Contd.)

- b) Percentage of gross cropped area irrigated by modern methods increased by 234 percentage, from 12.26 percentage in 1983/84-1985/86 to 40.97% in 2006/07-2008/09.

- c) Sale of chemical fertilizer increased by 425%, from 726,000 metric ton in 1977/78 to 3817000 metric ton in 2010-11.

Agricultural Production

- Agricultural productivity rose up to meet increasing population pressure on land through modernization of agriculture, cropping intensity and adoption of new technology.
- Cereal production was up by nearly four-folds, from 9.76 million metric tons during 1960's to 38.17 million metric tons in 2008/09. This increase is higher than the population increase during the same period.

- The weight of all other foods produced was close to six million tons during 60's and 17 million tons in 2008/09.
- The total foods produced registered an increase by 251 percentage, from 15.65 million tons during 60's to 54.97 tons in 2008/09.
- The calculated available food energy of all crops was 475 billion food calories/day in 2008 against 117.6 billion food calories/day during 60's, registering a four-fold increase. Cereal accounted for 82% and 79% of this during 60's & 2008 respectively.

- Total protein production was 9855 tons/day in 2008 against 2755 tons/day during 60's, registering 3.57 fold increase.
- If we reduce the calorie and protein production by 10% to allow for seed, feed and losses, divide by an estimated population of 52.5 million in 1962-63, and 143.4 million in 2008, we arrive at a per capita intake of 2020 calories/day during 60's and 2981 calories/day in 2008/09.
- A net gain of 1000 calories/day during last 4 decades even though population increased by 3 folds during the same period is a laudable achievement and lend support to Boserupian hypothesis.

- Consistent with these findings we also find that Bangladesh has halved the prevalence of hunger from 34.6 % in 1990 to 16.8% in 2012 (FAO, 2012).
- Consequently food import dips by half. Rice and wheat imports slumped to 2.24 million tons between July and June of 2010-11 fiscal year, from 5.15 million tons during the preceding fiscal year 2009-10.
- As a result import payments for rice and wheat fell by \$1.02 billion or 55% from \$ 1.87 billion during the same period.

Future Challenge

- Although Boserupian hypothesis is vindicated, challenge still remains. Boserup herself cautioned that there may be situations under which intensification might not take place.
- This may arise when population pressure on limited land is further accentuated and scope for further intensification of agriculture is limited. Bangladesh is possibly approaching that situation.

- At present (2010) some 148.80 million population are feeding themselves on about 18 million acres of farm land.
- The area of cultivated land cannot be much extended, but population will be about 194.4 million in 40 years from now, according to UN Medium Variant Projection.
- Number of persons per net cultivated acre will increase from 8.15 persons in 2010 to 11.0 persons in 2050.

Additional Food Requirements

- The country will need 80 Million metric ton of cereals and 115 Million metric ton of food for 194.4 million population in 2050 to provide the same level of calorie as in 2008/09.
- The additional food is determined assuming 0.6 for food-income elasticity (2010-2050). Rate of population increase (.67%)+ (income elasticity for food (0.6) (rate of increase of income (2% per annum))= rate of increase in food demand.

Challenge

- Meeting caloric requirement for additional 45.6 million population will require, among other things, two pronged interventions- slowing population growth as well as boosting agricultural productivity.

Addressing Population Challenge

1. Slowing population momentum effect
 - Increasing age at marriage
 - Increasing birth spacing
 - Reducing adolescent fertility
 - Diversifying methods mix

Boosting agricultural productivity

- Increase soil fertility.
- Increase farm land.
- Combat water-logging and salinity in south-western and drought in northern region.
- Minimizing Food Wastage.
- Removing stagnation in growth rate of share of agriculture to GDP.
- Boosting agricultural research.
- Stopping brain drain.

Thank You