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Urban land expansion in India 1992–2012

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ABSTRACT

The conversion of land to urban uses is one of the most visible changes accompanying economic development. Debate about urban expansion and its impact on food security in countries such as India often relies on dated and incomplete evidence. This paper uses satellite-detected luminosity from 1992 to 2012 to examine urban expansion in India, for 47 agglomerations that each had at least one million people at the time of the 2011 census. The trend annual expansion rate is 2.4% and was significantly faster in the decade to 2001 than in the most recent decade. Most of the land converted to urban use had been woodland, shrub, or grassland and just one-quarter was formerly cropland. Expansion rates vary across agglomerations and are fastest in the south of India and for areas with shorter growing periods.

Introduction

The conversion of agricultural land to urban uses is one of the most visible changes that results from economic development. The loss of arable land may conflict with national food security goals, especially if urban areas expand through a low density, sprawling, type of development onto highly productive soils. In fact, over much of the world urban expansion rates exceed the growth rate of urban population, suggesting that cities are becoming more expansive rather than more compact (Seto et al., 2011). The problem with sprawl is that it entails potentially greater loss of productive land – and greater risk to food security – than may be needed for a given level of economic development.

These issues are very salient for India, which is described by the McKinsey Global Institute as having a haphazard and poorly planned urbanization (MGI, 2010, p. 174). There is renewed focus on food security in India (Sastry et al., 2011) although some concerns, such as apparent declines in calorie availability, likely reflect measurement problems in a setting where urbanization and rising incomes are changing food systems (Smith, 2015). Currently, India has one of the lowest rates of urban land cover; Angel et al. (2011) report that urban area is equivalent to just 1.8% of arable land area, which is lower than for three-quarters of countries in their sample. In contrast, the other rapidly urbanizing demographic giant, China, has urban area equivalent to 3% of arable land. India is earlier in its urban transition than is China, and starts from a lower rate of urban land cover, so a big rise in demand for urban land is likely in future. Yet even now, India's land policy is controversial; protests by displaced farmers help to curtail infrastructure investment yet the land acquisition bill passed by the previous Parliament is described as "anti-farmer" and "anti-poor" (Nataraj and Sekhani, 2015). A failure to acquire land caused eight out of 20 major projects, worth 1.65 trillion rupees (US$27 billion), to be shelved in 2011 and 2012 yet the new land bill is argued to have given farmers further power to block development because of the need for 80% of affected families to consent to the land acquisition (Pradhan, 2014).

The contrast with land policy in China is made by Dobbs and Sankhe (2010, p. 3) who note that:

> "...India's urban planning system has failed to address competing demands for space... [while China has] ... developed a set of internally consistent practices across every element of the urbanization operating model: funding, governance, planning, ... and the shape, or pattern, of urbanization, both across the nation as a whole and within cities themselves."

Symptoms of haphazard urbanization in India are claimed to include using agricultural land for unauthorized urban development, and an inadequate supply of suitable commercial and industrial space that causes developers to undertake non-conforming land uses. The claimed result is that the expansion of India's cities occurs in a sprawling, low-density, manner. The projections by

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McKinsey are that more effective land use planning could save 62,000 km^2 of arable land by 2030 (MGI, 2010, p. 27), which is equivalent to about 4% of the existing cultivated area.

Another important contrast between these two demographic giants concerns the source of rising pressure on land. In both China and India agricultural land requirements for food rose about 40% from 1963 to 2009, but the main driver of rising land demand in China was dietary change while in India it was mainly due to population growth (Nath et al., 2015). If major dietary change occurs in future in India as a result of recently higher rates of income growth and the ongoing urbanization, considerably more pressure may be placed on land than has been the case to date, making it crucial for food policy makers to understand the driving forces behind competing land uses, such as urban expansion. Moreover, India is considerably more autarkic in world food markets than is China, so the possibility of augmenting local land with land overseas, in the form of food imports, is much less in India.[1] Consequently, future food prices in India are likely to be quite sensitive to land pressures resulting from urbanization, as noted by Reardon et al. (2012, p. 258):

> "...With increasing pressure on land markets in areas around large cities such as Delhi, the land-related costs of staple food prices will be an increasing factor in food costs."

But the evidence base for debates about urban expansion and its impact on food security in India is inadequate. Most studies are of expansion of particular cities with few comprehensive accounts of urban expansion across all of India. Moreover, studies tend to focus on adverse consequences of agricultural land conversion without paying attention to possible benefits such as increased space for urban residents. A typical example (with emphasis added) is from Fazal (2001, p. 5):

> "As the population of India has become increasingly urbanized, and the suburbs have sprawled even further from the centre of the city, there has been a growing perception that we are losing an unacceptable amount of our prime cropland, since most of the settlements in the country are in the midst of fertile cropland."

These prior studies discount the possibility that urbanization may even save cultivated land, since per capita land consumption in urban areas is lower than in small towns and rural areas. Deng et al. (2015) show how urbanization in China saved cultivated land prior to 2000 but then increased land loss due to changes in the nature of urban expansion. An additional factor ignored by the Indian literature is that urban growth in hinterland areas may enhance the economic returns to cropland expansion, by changing the net prices that farmers pay and receive due to the reduction in their remoteness from markets, and these stronger economic incentives may increase potentially available cropland (Chamberlin et al., 2014). These factors suggest that food policy may best be informed by on-going analysis of urban expansion, and the driving forces behind competing land uses more generally, since these driving forces may shift over time from initially saving land to ultimately becoming a source of pressure on cropland, as occurred in China.

The purpose of this paper is to help inform food policy debates, by providing comprehensive and updated information on the rate of urban expansion in India over the last two decades.[2] The need for such a study is because much less is known about urban expansion in India than in China, yet in little over a decade India will be the world's most populous nation. Moreover, India's economic growth has been far less pro-poor than has China's, and India is home to one-third of the world's undernourished children. Consequently, pressure on staple food prices in India that results from land pressure, which may be driven in part by urban expansion, is likely to have important consequences for food security and for meeting global targets related to poverty and hunger.

The results in the paper show that urban expansion rates were faster from 1992 to 2001 than from 2002 to 2012. We also find that just one-quarter of the land converted to urban area was formerly cropland, contrary to the above quote from Fazal (2001); instead, most of the newly urbanized land had been woodland, shrub, or grassland. Finally, we consider if variables from a standard mono-centric model of urban growth – incomes, population, transport costs, and agricultural productivity – are correlated with the spatial and temporal patterns of urban expansion. To achieve our goals we use satellite-detected luminosity over 1992–2012 to examine expansion of 47 agglomerations that each had at least one million people at the time of the 2011 census. We use this novel technique because administrative data on urban areas are reported too infrequently and are of doubtful accuracy given the claims by McKinsey about non-conforming urban land uses.

Previous literature

Several studies use remote sensing methods to study expansion of certain Indian cities. Examples include Pathan et al. (1991) for Ahmadabad, Fazal (2001) for Saharanpur, Lata et al. (2001) for Hyderabad, Sudhira et al. (2004) for Magalore, Kumar et al. (2007) for Indore, Bhatta (2009) for the Kolkata Municipal Corporation, Bhatta et al. (2010) for the Kolkata-Howrah metropolitan area that spans both banks of the river Hooghly, and Kiran and Joshi (2013) for Vadodara. While these studies may provide valuable planning information to local officials, their specificity and their use of diverse methods and data sources makes it difficult to compare results and prevents systematic study of the determinants of urban expansion rates. Moreover, some of these studies are quite dated and may not reflect current rates of land loss due to urban expansion.

Another difficulty with this existing city-level literature for India is that it presents a somewhat negative view of the costs of urban expansion without considering the potential benefits. For example, according to Bhatta et al. (2010, p. 97):

> "Rapid urban growth in the world is quite alarming, especially in developing countries like India."

Similarly, Sudhira et al. (2004, p. 29) talk about the "alarming rate of urbanization and the extent of sprawl that could take place" and note that "urban sprawl is taking its toll on the natural resources at an alarming pace". But missing from this account is some consideration of the productivity benefits of urbanization, where agglomeration and scale effects make workers in large cities more productive than workers elsewhere, and the greater efficiency of service delivery in cities. The McKinsey Global Institute estimates that the cost of delivering basic services is from 30% to 50% cheaper in concentrated population centers than in sparsely populated areas (MGI, 2010, p. 46) and this matters for a country like India that has difficulty funding the cost of basic services for a large share of its population. The greater density of urban areas compared with smaller towns also offers the possibility of saving cropland (Deng et al., 2015).

In view of these problems in the literature on India, we seek guidance instead in studies of China's urbanization. The relation-

[1] Despite being almost as populous, India's share of global food imports is just one-fifth of China's share.

[2] Even simple descriptive data on the extent of urban areas can be useful for food policy debates. For example, Badami and Ramankutty (2015) combine urban area estimates with yield data for vegetables, in their critique of the potential for urban agriculture in India and elsewhere to make a meaningful contribution to the food security of the urban poor.