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Using geospatial technology to strengthen data systems in developing countries: The case of agricultural statistics in India

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A B S T R A C T

Despite significant progress in the development of quantitative geography techniques and methods and a general recognition of the need to improve the quality of geographic data, few studies have exploited the potential of geospatial tools to augment the quality of available data methods in developing countries. This paper uses data from an extensive deployment of geospatial technology in India to compare crop areas estimated using geospatial technology to crop areas estimated by conventional methods and assess the differences between the methods. The results presented here show that crop area estimates based on geospatial technology generally exceed the estimates obtained using conventional methods. This suggests that conventional methods are unable to respond quickly to changes in cropping patterns and therefore do not accurately record the area under high-value cash crops. This finding has wider implications for commercializing agriculture and the delivery of farm credit and insurance services in developing countries. Significant data errors found in the conventional methods could affect critical policy interventions such as planning for food security. Some research and policy implications are discussed.

Introduction

The recent World Development Report on "Agriculture for Development" recognized that agriculture is central to achieving the Millennium Development Goals of poverty reduction and environmental sustainability (World Bank, 2008). However, the quality of available agricultural data and the methods by which such data is collected are notoriously weak in several developing countries. Recent developments in quantitative geography offer robust geospatial tools that provide access to new data and methods for strengthening data systems (Bell & Dalton, 2007; Murray, 2010). Surprisingly, despite the availability of these new tools and methods in these countries, their application has been limited (Miller, 2010). This paper addresses this gap by examining the current data systems and demonstrating the significant potential role for geospatial tools in improving the quality of agricultural data and the methods by which it is obtained and thereby permitting better policy in developing countries.

Although there is general recognition of a longstanding need for strengthening agricultural data availability in developing countries (African Development Bank Group, 2011; United Nations, 1979; World Bank, 2011), surprisingly little research exists on the reliability of agricultural data and the methods by which such data is collected (Beegle, Carletto, & Himelein, 2012; Deininger, Carletto, Savastano, & Muwonge, 2012). One exception is Muller, Muller, Schierhorn, and Gerold (2011), who used spatiotemporal data to study the dynamics of deforestation attributable to mechanized agriculture. Recognizing the lack of geospatial data on land use and land cover in developing countries, Dewan and Yamaguchi (2009) use data from Bangladesh to analyze the spatial and temporal characteristics of urban land expansion. In contrast, developed countries use more advanced geospatial tools that combine global positioning systems with video for field data collection (Mills, Curtis, Kennedy, Kennedy, & Edwards, 2010).

Some recent studies have examined the reliability of household consumption data in India (Deaton & Kozel, 2005; Kulshrestha & Kar, 2005; Sen, 2000) and Tanzania (Caeyers, Chalmers & Weerdt, 2012), but research on the quality of data on the production side of agriculture remains limited. We are aware of only two recent contributions examining the reliability of traditional

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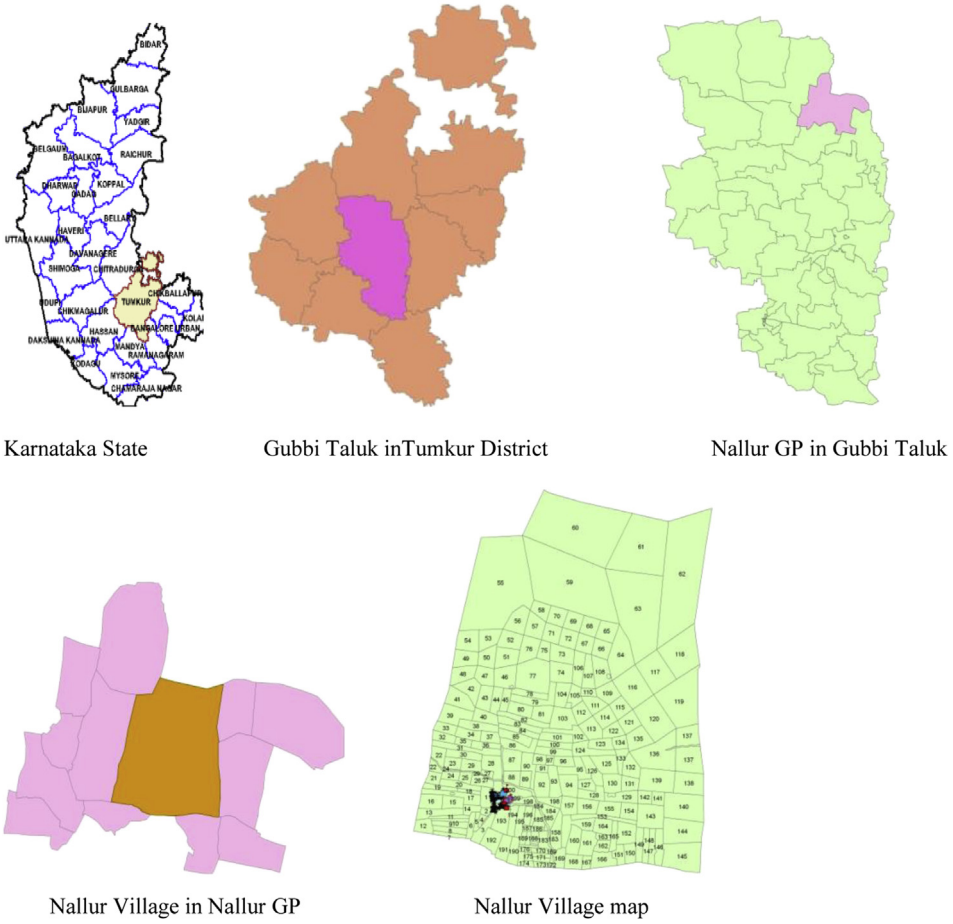

Fig. 1. Map of the Karnataka State, Gubbi Taluk, Nallur GP and village.

recall-based survey methods in the generation of agriculture production statistics. The evidence from these studies is mixed; while Beegle et al. (2012), using data from three African countries, found little evidence of a large recall bias in agricultural data, Deininger et al. (2012), in contrast, noted significant differences between data generated from recall-based surveys and data from production diaries administered concurrently in Uganda. However, it is not clear yet which of these two methods yields the more accurate results.

An advantage of using crop area statistics to examine data reliability is that crop area is both measurable and independently verifiable using existing technology. We use data from India, which has one of the best developed survey capacities in the world and a long tradition of collecting data on a range of economic indicators (Deaton & Kozel, 2005). Although Indian consumption data has been subjected to intense scrutiny, agricultural statistics have eluded the attention of researchers, especially data on crop area statistics. Information on crop area and land use, however, is vital for effective policy planning and designing interventions to fully realize agriculture's potential strengths. In this paper, we extend this literature by drawing on the extensive deployment of geospatial technology in the Indian state of Karnataka to collect crop area statistics in parallel with contemporary data collection methods, thus permitting comparison of the crop area estimates obtained by the two methods.

The objectives of this paper are threefold. First, we document the traditional method for collecting agricultural statistics in India. Second, we develop an alternative data collection method by integrating a geographic information system (GIS) with a global positioning system (GPS) to enhance data quality. Third, we compare the data obtained by the traditional and new methods to assess how well the two measurement methods agree.

Methods and data

Data

The geospatial crop area survey for this study using GIS/GPS technology was carried out in partnership with the specialized geospatial company Zoomin Softech. Zoomin Softech assisted us in gathering and storing crop information for approximately 2700 acres of land in the Indian state of Karnataka. This is a typical region located in the Nallur *gram panchayat* (GP) of the Gubbi Taluk in the Tumkur district.[1] This region has a mix of irrigated and dry crops, land holdings of various sizes and a diverse occupational structure. A detailed map with survey numbers of each plot of land, along with other maps of the Karnataka State, is presented in Fig. 1. Apart from mapping the crop area, the survey also included fallow land, scrub land, water streams, roads, water tanks/ponds and habitation.

[1] GP is the smallest local government unit in rural areas in India, comprising 3–5 villages with a total population of approximately 5000. A Taluk comprises several GP's (generally 30–40 GP's, more or less depending on the size of the Taluk) and is a subdivision of a revenue district, which in turn is a subdivision of a state.