Controlling Development – The On-and-Off Connection between Demographic Change and Land Use/Cover Change in Israel: 1948-2002

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Extended Abstract

Land Use/Cover Change (LUCC) has gained a prominent place at the forefront of environmental concerns over the past 20 years, as the scale and magnitude of the aggregated human impact on the planet becomes increasingly elucidated (Meyer and Turner 1992; Vitousek et al. 1997). While there are strong correlations between population growth and rates of LUCC at the global scale, the linkages between population growth and LUCC are nuanced, operating through a range of mitigating drivers through which the effects of population growth are filtered. LUCC is increasingly attributed to the political economy of regions and, in particular, the changing responses of individuals to economic opportunities, as processed through various local and national institutions (Lambin et al. 2001). However, there is general agreement among LUCC researchers that spatial and temporal context may greatly affect the conclusions of studies defining the driving forces of LUCC (Meyer and Turner 1992; Lambin et al. 2001; Lambin and Geist 2002). Thus, researchers emphasize the need for case-specific studies of LUCC at a variety of spatial scales, such that it will be possible to inventory and model the range of potential drivers under various institutional and political conditions (Lambin and Geist 2002, Mustard et al, 2003). This research is presented as a contribution to this global effort as an analysis of the driving forces of LUCC in Israel.

The Israeli case study presents an important addition to the literature on LUCC for three reasons: 1) It has extremely high population growth relative to countries of similar economic conditions; 2) It has high biodiversity in a small area, and in close proximity to human development, and; 3) Urban development and settlement have historically been tightly regulated by government policy. As such, the country presents an excellent laboratory for analyzing the relative importance of various drivers of LUCC. To the best of our knowledge, there has been no comprehensive work done on quantifying LUCC in Israel and exploring the drivers responsible for this change.

This preliminary study analyzes the linkages between LUCC (in particular, transformation of various open-space land uses to urban and suburban development) and demographic change (population growth, internal migration, and changes in household demography) in Israel from 1948 to 2002. The goal is to study rates of land development alongside population data at three spatial scales, national, regional and local, and to assess when and at what spatial scales there is a significant correlation with indicators of demographic change. Where either long-term trends or punctuated changes in LUCC are not adequately described by demographic change, we will explore possible policy and economic variables which may be driving urbanization trends, and mitigating the direct impact of demography. While significant

correlation between population and land use trends does not necessarily imply causation, we will use these results (or lack thereof) as a baseline for continuing investigations.

Israel is a relatively new country where both land (Kellerman 1993) and [Jewish] immigration/population growth (Portugese 1998) are central foci of national ideology. The country's population has grown from less than one million in 1948 to 6.5 million in 2002 (CBS 2003), and it continues to grow at a rate of approximately 1.6% annually (PRB 2002). Immigration has been a significant, if sporadic, contributor to population growth, adding 800,000 people over the last decade. The country has a higher population density than most Western countries, with 300 persons per km^2 or 550 persons per km^2 when the scarcely populated Negev desert is not included. Over its 55 year history, the physical face of the land has changed drastically with prominent trends including intensification of agriculture, widespread afforestation activity, rapid urbanization and the establishment of a network of exurban communities and associated infrastructures.

Ninety-two percent of the land in Israel is directly owned by the government, which has led to a tightly controlled land-use policy regime where decisions regarding land use are made and enforced by government agencies. As such, land-use patterns and policies regarding population dispersal closely reflect ideological positions expressed through government policy (Kellerman 1993). This was especially true during the first three decades following the country's establishment, which was characterized by heavily centralized planning based on a public consensus regarding national goals (Kellerman 1993). In more recent years, rising land prices in the country's center (Werczberger and Borukhov 1999), declining emphasis on farmland protection (Feitelson 1999) and rising individual preferences for suburb-style living conditions have had a profound impact on the rates of land development.

In order to quantify rates of land-use change at three spatial scales, we have selected four 150 km^2 regions in Israel for study. These regions include the hilly northern Galilee region around the city of Carmiel, the semi-arid southern region around the city of Beersheva, and two regions in the center of the country, around Ra'anana to the north of Tel Aviv, and around Rishon L'Tzion to the south of Tel Aviv. These regions were selected to: 1) Represent the gradient of human settlement, which is dense in the central region, and more sparse in the peripheral northern and southern regions; 2) Characterize the sharp ecological gradient crossing the country from north to south, and; 3) Include a diversity of community types in each regional block, including cities, towns, agricultural villages and exurban neighborhoods, Jewish and Arab settlements, and relatively old and newly established population centers. Local trends will be studied using each individual community, nested within regional blocks. Regional trends will be investigated by treating each 150 km^2 block as an independent sample. Finally, national trends will be reflected in the aggregation of the four regions, which together represent all significant national trends.

For quantification of land-use change, we are using 1:50,000 thematic maps produced by the Survey of Israel at approximately five-year intervals, for the past 55 years. These maps

contain information including human-built structures, roads, agriculture, water bodies, and topography. The maps have been scanned and georeferenced, and are being used for a GIS-based analysis of land use change that is ongoing. We assign high and low density development classes to each map, and quantify the rates of development occurring throughout the country's history for each region.

Population data has been collected from the Central Bureau of Statistics in Israel. Relevant data include annual national population estimates, annual regional population estimates, and local population size from national census data and, when possible, from municipalities and secondary sources. In addition, in order to analyze potential input of demographic changes to urbanization trends, we will be using data for average dwelling size and housing density (number of individual per room). We are currently seeking data characterizing internal migration trends.

We hypothesize that the correlation between population growth and rates of urbanization will vary according to the spatial scale of analysis, be it national, regional or local, and that there will be a significant change in this correlation over time. At the national aggregate level, we expect LUCC to be tightly correlated with population growth, but with land development outpacing population growth at a growing rate during the past two decades. This would confirm the results of recent research which claimed that land development in recent years has outpaced population growth by as much as 50% (Shoshany and Goldshleger 2002).

At the regional level, we hypothesize that LUCC in the northern and southern regions of the country will strongly reflect government policies at various periods for population dispersal and frontier development. Kellerman (1993) provides data regarding the establishment of particular communities in the north and south at different times in response to specific government policies, but did not provide quantitative data regarding LUCC. In contrast to the peripheral areas, development in the central region will not reflect the punctuated change that would characterize government policy shifts, but rather, development here will reflect a smoother increase, more highly correlated with long-term national population growth trends.

At the local level, we hypothesize that each settlement type will have its own development dynamic, all with a similar set of drivers, but with different levels of importance according to settlement type and region in which it is nested. We will investigate local development, analyzing land use change patterns in individual settlements as a function of population growth and density, changes in household demography, local and national development policies, and settlement type (rural, exurban, urban, Arab or Jewish). We expect, for example, that the correlation between LUCC and population size in Jewish settlements will be strong, reflecting urban development in response to population growth. In contrast, we predict that Arab settlements, whose physical growth is much more restricted by government policy, will not show a strong population growth – LUCC correlation, because they must respond to growing populations with intensification of development within existing settlement boundaries.

Two recent events may have strengthened the correlation between population growth and rates of LUCC across spatial scales. During the past two decades there has been a marked rise in demand for suburban homes, triggered in part by the establishment of these types of communities to attract settlers to live in the occupied West Bank (Kellerman 1993). Coupled with the declining emphasis on farmland protection and increasing land values in the center of the country, the tight government control of development has yielded to economic and demographic pressures. Low density development has increased, despite government development guidelines which promote high density development. In the 1990's, the large scale influx of immigrants from the former Soviet Union, which increased the population by 12% within three years, precipitated a pulse of development, which led to a reconsideration of some of Israel's classic land use positions, including the sanctity of agricultural land (Alterman 2002). Even while weakening the country's farmland protection policies, this "shock" also led to a strengthening of national open space protection (Feitelson 1994, Alterman 2002).

We expect that the Israeli case study will validate the widespread claim that demography and other single-driver explanations of LUCC are not sufficient (e.g. Lambin and Geist 2002). The impact of tremendous population growth on LUCC is strictly mitigated through government policy and institutional structures through most of Israel's history (Alterman 2002). However, we do not expect to entirely dismiss population growth as a significant driver of LUCC for two reasons: 1) Demographic pressures may have been a recurring influence on policy formulation, especially during crisis periods of mass immigration (1950s and 1990s), and; 2) Demography may play an increasingly important role as Israel's system of land-use planning becomes increasingly decentralized, and consequently subjected to greater pressure from a growing population eager to live in lower density conditions.

We will conclude with a discussion regarding the ramifications of our findings on long-term environmental quality for the local population. A growing population living in an increasingly urbanized country will also place an increasing amount of stress on remaining open spaces and on the ecosystem goods and services provided by those spaces. Significant environmental quality indicators to be considered include the impact of impermeable surfaces on hydrological cycles, the impact of habitat fragmentation and destruction on biodiversity and ecosystem health, and the availability of open spaces for aesthetic and recreational value.

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