

URBANIZATION, POPULATION PRESSURE AND AGRICULTURAL INTENSIFICATION: EVIDENCES FROM TAMIL NADU IN INDIA

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Keywords

urbanization, rural economies, population density, road networks, literacy rate, irrigation intensity, agricultural wage rate, regression analysis

Abstract

This paper analyzes the phenomenon that the transfer of agricultural land and water resources for urban use with adverse consequences to agricultural production has not been adequately addressed in the Indian context, through a case study of the state of Tamil Nadu which stands in the forefront of industrialization and urbanization. Results show that urbanization and land put to non-agricultural uses have strong negative impact on agricultural sector. Therefore, it is important to give priority for decentralized growth through rural industrialization, and public investment on road network should be increased not only to reduce the growth of urbanization but also to promote rural industrialization. The impact of industrialization especially around a few large cities is undesirable both from the point of view of balanced regional development and also from the viewpoint of the serious negative impacts of the growth of large urban centres on the neighbouring rural economies.

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I. Introduction

Through most of history, the human population has lived a rural lifestyle, dependent on agriculture and hunting for survival. In 1800, only 3 percent of the world's population lived in urban areas. By 1900, almost 14 percent were urbanites, although only 12 cities had 1 million or more inhabitants. In 1950, 30 percent of the world's population resided in urban centers. The number of cities with over one million people had grown to 83. The world has experienced unprecedented urban growth in recent decades. In 2000, about 47 percent of the world's population lived in urban areas and there are 411 cities with over one million inhabitants. It is expected that 60 percent of the world population will be urban by 2030, and that most urban growth will occur in less developed countries (Population Reference Bureau, 2004). The high rates of population growth that accompanied significant strides in economic and industrial development in the twentieth century fed fears about depletion of resources and fouling of the land, air, biota and water in nearly all parts of the globe. Today's intense debate over the relationship between numbers of people and use of available land has resurrected both Malthus's hypothesis and his critics (Indian National Science Academy, et al, 2001). The modern discourse on economic development places an overwhelming importance on reducing the relative contribution of agricultural sector in overall economic output of any country or region. Continuous decline in the share of agricultural sector in the gross domestic product of the countries reporting economic growth is a clear indicator of this phenomenon. Consequent to the declining role of agricultural sector in the national economy vis-à-vis the increasing urbanization and industrialization, there has been a steady increase in the transfer of the three key inputs for agricultural sector, viz. land, labour and water from rural to urban areas. The continuous expansion in urbanization and the increasing demand for agricultural production are in continuous race with each other in competing for scarce natural resources such as land and water. The shrinking resource base for agricultural production on the one hand and the increasing demand for food production and population place severe pressure on both the quantitative and qualitative aspects of land and water resources. The demand for land and water arises out of two basic needs, one as a consumption commodity for housing, recreation, environmental preservation and asset creation, and the other as a factor of production for use

in a variety of agricultural, industrial and infrastructural production processes. Urbanization generates both centripetal and centrifugal actions—the first being the pulling in of the better quality land, water and human resources from rural to urban areas at a macro-scale, and the second being the pushing out of urban poor as well as the problems created by urbanization to urban peripheries and rural areas located close to big cities. The second phenomenon, which is rightly called the dichotomy between urban centres and their peripheries has been analyzed by Kundu et al (2002). The first problem involving the transfer of agricultural land and water resources to urban areas with adverse consequences to agricultural production has not been adequately addressed in the Indian context. This paper is a modest attempt to fill this gap in the literature through a case study of the state of Tamil Nadu, which stands in the forefront of industrialization and urbanization. The paper starts with an overview of the impact of urbanization on agriculture based on a brief literature survey followed by methodology in section III, and results and discussion in section IV. Section V concludes the paper.

II. Urbanization and Its Impact on Agriculture— An Overview

An overview of the process of urbanization and its impact on agriculture is essential to contextualize the urbanization process in India and to specify appropriate econometric models to study the drivers of urbanization and its impacts on rural sectors. The most conspicuous but often neglected tension in the modern development paradigm is probably the competition for land and water resources between rural and urban uses. The growing tension between the interests of vast majority of geographically widely distributed rural communities with very limited political power and the more concentrated urban elites with high degree of political and market power has the potential for snowballing into a major conflict between these two groups (Balasubramanian, 2003). Therefore, sustaining agricultural growth in the context of expanding and intensifying urban pressure has become an important policy issue in recent times. Population pressure together with increasing urbanization and industrialization has considerably reduced the land available for agricultural production, thus forcing agricultural intensification with attendant negative consequences for rural land-

scapes and agricultural environment (Alauddin and Quiggin, 2008). Urban growth is likely to have wide-ranging impacts on rural landscapes including loss of land used in food production, loss of open space for environmental uses, and seriously limiting the farmers' option to remain in farming (Larson, et al, 2001). Through increased pressure on selling their land and water for non-agricultural purposes, urbanization leads to increased opportunity costs of farming. Further, the present institutional arrangement in land, viz. market allocation of land to urban and agricultural uses allows the allocation of land to its highest priced use, rather than its highest valued use. The increased private control over land has led to the loss of rural landscapes in Poland, because both the farmers and the local governments stand to gain from the conversion of land from agricultural to urban uses. Low profitability in agriculture along with high prices of land for urban uses shifts their interest in favour of selling the land for non-agricultural purposes (Wasilewski and Krukowski, 2002). Similar trends are observed in many parts of Tamil Nadu where decreasing profitability in agriculture and increasing price of lands for non-agricultural purposes have encouraged farmers to sell lands for non-agricultural, urban uses.

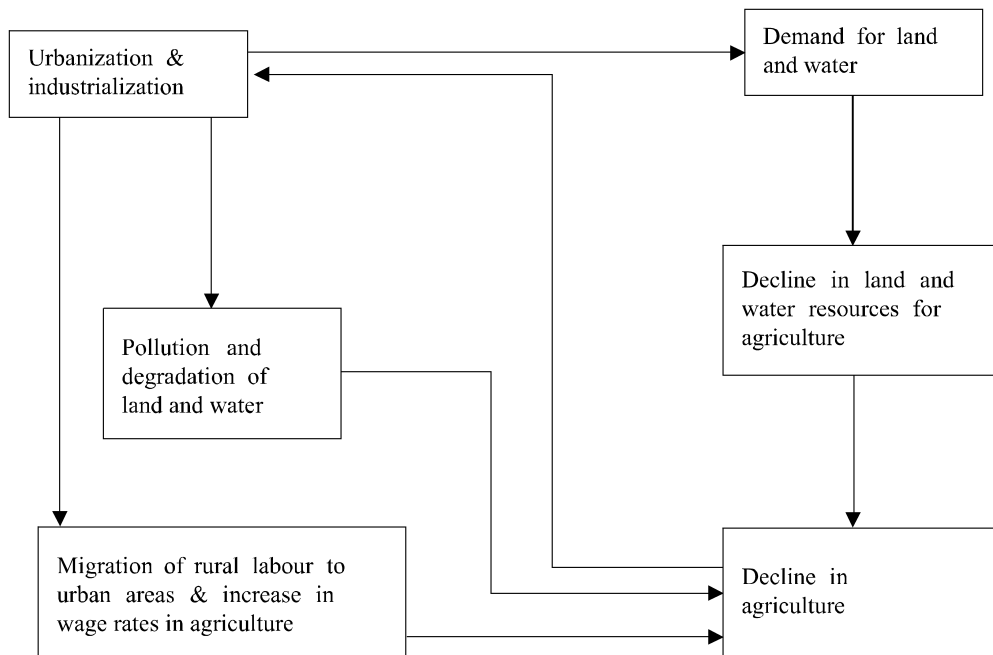
In many areas, pollution and overexploitation of groundwater resources are the direct results of demographic shifts from rural to urban areas. Urban areas form concentrated points of demand for water with relatively little fluctuation [in the demand for water] (Moench, 1992). The loss of productive agricultural lands and water resources causes reduction in food production, which may necessitate food imports. For example, urbanization and industrialization were found to be the important driving forces behind the conversion of farmlands in China (Zhang et al, 2004). In view of the fact that India's population pressure on land and water resources is equally severe as that of China, the Chinese experience is likely to be repeated in India. Further, the process of urbanisation cannot be sustained in the long run since poverty induced expansion in informal sector in urban areas seems to be reaching an upper limit (Kundu, 2000).

Because of the high costs associated with "reconverting" land back from urban to agricultural uses, it is important to consider if the continued loss of farmland to urbanization could exacerbate a possible shortage of productive agricultural land in the future (Plaut, 1980). Even before the actual transfer of land for urban uses occurs there is a tendency for land being idled in anticipation of conversion (Berry, 1978) especially in the suburban areas, which could be witnessed in many parts of the world. In addition to the transfer of

land and water resources, these resources are also degraded due to pollution caused by urban wastes and industrial effluents, thus rendering them unfit for agricultural production. In addition to the direct transfer of land from agricultural to urban uses, urbanization also affects agriculture indirectly through regulatory effects, technical efficiency effects, speculative effects and market effects (See Lopez et al, 1988 for more details on these effects). All these indirect effects are most likely to reduce the efficiency of production, increase costs and reduce the profitability of staying in agriculture. The lands purchased by real estate developers are not put to use immediately and remain idle for several years after the actual transfer took place from the tiller to the real estate operators. In many parts of Tamil Nadu, speculative activities in land markets in the urban fringes have led to wasteful use or sub-optimal use of resources. A kind of urban absentee landlordism is emerging as a new phenomenon due to speculative activities in land market. Secondly, the transfers of water especially groundwater towards urban uses also lead to fallowing of land and / or under use of lands. Thus, the transfer or degradation of one resource (land/water) has a direct bearing on the extent of use of the other resource (water/land). Increasing employment opportunities in urban areas leading to scarcity of labour and higher wage rates for agricultural workers are also the major factors responsible for decline of agriculture in the peri-urban areas. Not only the members of agricultural labour households but also of the agricultural families are increasingly opting for non-agricultural avenues for earning their livelihood. All these factors lead to decline of agriculture in urban fringes. The following diagram depicts the possible linkages between urbanization and transfer and degradation of land and water resources nearer to urban areas (Figure 1).

Apart from these negative impacts, urbanization may also have positive impacts such as increased commercialization and diversification of agriculture and increased demand for fresh fruits, vegetables and other high value crops resulting in increased farm incomes, intensive use of rural resources including labor, and the consequent higher wages for farm workers. Lopez et al (1988) found that vegetable production is the only subsector that benefits from suburbanization. Paucity of secondary data on these aspects limits a comprehensive analysis of these positive impacts of urbanization on rural livelihood. However, we undertake a cross-sectional analysis of positive impact of urbanization on agricultural wage rates that would benefit the labor households.

FIGURE 1. Impact of Urbanization on Agriculture



III. Methodology

Analysis of macro-level data

The major objective of the study is to examine the factors affecting the processes of urbanization and its consequences for agriculture and rural sector in the state focusing on both the temporal and spatial dimensions. Hence, we have analyzed both the time-series and cross-section data on urbanization and related variables. Even though the detailed time-series data on indicators of urbanization and related factors are available only at state-level, aggregation of data at state-level would inevitably suppress some important spatial variations across different regions of the state. These variations could be more effectively captured through the econometric analysis of cross-section data for the districts. Further, we have used both the share of urban population to total population and land put to non-agricultural uses as the key indicators of urbanization and

non-agricultural development in the state so as to capture both the human and geographical (land use) dimensions of the processes of urbanization and industrialization in the state. The time-series analysis is based on the data for the last 47 years for the state of Tamil Nadu from 1960-61 to 2006-07, while the cross-section analysis is based on district-level triennium average (2004-05 to 2006-07) with the districts serving as observations. One of the positive impacts of urbanization on rural livelihood is the increased wages for agricultural work due to the cultivation of labor-intensive commercial fruits and vegetables that are in more demand by urban population. We intend to capture the impact of urbanization on agricultural wages differentials using cross-section data across districts. Our model of agricultural wage differentials using single equation regression models is similar in spirit to those studies which use single-equation regression models to study the factors determining inter-industry and inter-regional differences in equilibrium wages (Chen and Edin, 2002; Edin and Zetterberg, 1992; Foster and Rosenzweig, 1993; Gibbons and Katz, 1992; Groshen, 1991).

A case study of urbanization and resource transfers from agriculture

A case study was conducted to address the specific issue of urbanization and land use changes using cross-section data. The composite Coimbatore district, which includes the present Coimbatore and Erode districts, was purposively selected for the study. The rationale for selecting the composite Coimbatore district is that it is the most progressive district among all the districts in Tamil Nadu in terms of both agricultural modernization and urbanization. Further, Coimbatore district is the most populous district in Tamil Nadu as per the Census 2001 (Department of Applied Economic Research, 2003). The district was ranked second next only to Chennai in terms of industrial development and urbanization among all the districts of Tamil Nadu. Further, the composite index of infrastructure development in Coimbatore district was the highest among all the districts in the whole of India (Balasubramanian, 1998). In addition to the diversion of agricultural lands for non-agricultural purposes, the transfer of groundwater from rural/agricultural sector to urban household/industrial sectors is a serious issue in Coimbatore district. The data were analyzed to examine the factors affecting urbanization and industrialization and the impact of urbanization and industrialization on agricultural development on land transfers.

IV. Results and Discussion

Trends in urbanization in Tamil Nadu

Tamil Nadu is one of the most urbanized states of India both in terms of degree of urbanization (percentage of population in urban areas) and town density (number of towns per thousand square kilometers). Further, the better spatial spread of towns in the state results in strong rural-urban linkages (Rukmani, 1994). The continuous economic growth in the state has led to the declining role of agricultural sector in the state's economy. The share of agriculture in the state's net state domestic product has declined from about 53 per cent in 1950-51 to about 16.65 per cent in 2001-02. This in part reflects the increasing role of urban sector in the state's economy and the consequent transfer of resources from rural to urban areas including human resources. An overview of the trends in urbanization and industrialization in Tamil Nadu is a prerequisite to understand its implications for overall economic development and more importantly its impact on agricultural sector. Over the last one century, Tamil Nadu's population has increased steadily from about 19 million in 1901 to 62 million in 2001, recording an average annual growth rate of 2.22 per cent while urban population has grown at a much faster pace of 9.07 per cent per annum. This has led to a ten-fold increase in urban population from 2.70 million in 1901 to 27 million in 2001 (Table 1). Consequent to the steep increase in urban population, the degree of urbanization as measured by the percentage share of urban population to total population has increased from about 14 per cent in 1901 to about 44 per cent in 2001. In consequence of this phenomenal growth in the share of urban population, Tamil Nadu emerged as the first in terms of degree of urbanization among all the states in India.

Urbanization is taking place at a faster pace in Tamil Nadu in recent years. During the decade of 1991-2001, the rate of migration from rural areas to urban areas has overtaken the population growth rate in rural areas, thus resulting in the decline of rural population in Tamil Nadu by about 5.20 per cent while the urban population increased by 42.49 per cent. The total population in the state during the decade has increased by about 11.19 per cent compared to a decadal growth of 15.39 per cent during 1981 to 1991. The share of urban population to total population in Tamil Nadu has been close to 44 per cent dur-

ing 2001 and the projections for the year 2008 reveal that the share of population should have crossed 50 per cent (Tamil Nadu-An Economic Appraisal, 2006-07).

TABLE 1. Trends in Population and Urbanization in Tamil Nadu

Year	Total Population	Urban population	(Population in million)
			Share of Urban Population (%)
1901	19.3	2.70	13.99
1911	20.9	3.10	14.84
1921	21.6	3.37	15.59
1931	23.5	4.15	17.66
1941	26.3	5.09	19.36
1951	30.1	7.33	24.35
1961	33.7	8.99	26.68
1971	41.2	12.47	30.26
1981	48.4	15.95	32.95
1991	55.8	19.06	34.15
2001	62.1	27.20	43.80
Average annual growth rate	2.22	9.07	2.13

Source: Census of India, Government of India.

The growth rates of key variables relating to urbanization and agriculture are provided in Table 2. There has been a marginal negative growth in most of the decades as well as the entire 47-year period. Net irrigated area has shown a very meagre, positive growth over the 47-year period as well as in all decades except in the 1980s. Land put to non-agricultural uses has shown a positive growth in all decades, and it was about one per cent during the entire period. Total fallow lands has shown a growth rate of more than one per cent for the entire period and the total CPR lands have declined by about 1.50 per cent per annum during the 47-year period. The share of farming population to the total workforce has declined by more than two per cent per annum, while the share of agricultural labour population to total workforce increased by about one per cent per annum. The growth rate of urbanization was about 1.25 per cent during the period 1960-2007, and its growth rate has been more than two per cent per annum during the latest decades, due to rapid progress in non-agricultural sectors in urban areas after the economic liberalization.

TABLE 2. Growth Rate in Important Variables
Relating to Urbanization and Land Use(%)

S.No.	Variables	1960s	1970s	1980s	1990s	2000-2007	1960-2007
1.	Net cropped area	-0.03	-0.03	0.33	-0.49	0.11	-0.41
2.	Net irrigated area	0.14	1.52	-0.71	2.06	1.89	0.27
3.	Land put to non-agricultural uses	0.96	2.12	0.45	0.85	1.58	1.09
4.	Total fallow lands	0.43	2.27	-0.55	0.33	-1.11	1.17
5.	Ratio of net irrigated area to net cropped area	0.39	0.55	-1.44	2.37	-0.08	0.36
6.	Common property lands ¹	-1.53	-4.15	-2.17	0.27	0.34	-1.50
7.	Cropping intensity	-0.27	0.38	-0.14	-0.31	-0.76	-0.07
8.	% of farmers to total workforce	-2.92	-1.27	-1.59	-2.67	-3.38	-2.08
9.	% of agricultural labour to total workforce	5.11	-0.18	0.88	-0.5	0.72	0.91
10.	Literacy rate	2.23	1.82	1.42	1.77	1.21	1.65
11.	Urban to total population	1.28	0.87	0.36	2.55	2.1	1.24
12.	Road length	4.58	3.59	3.77	0.68	1.72	3.04
13.	Population density	2.03	1.62	1.44	1.07	0.7	1.45

Source: Computed by the authors using data published by the Government of Tamil Nadu in its annual statistical publications, viz. Season and Crops Report for Tamil Nadu, and Tamil Nadu-An Economic Appraisal.

Factors affecting urbanization

To examine the factors affecting urbanization and the impact of urbanization on agricultural development, we have analyzed both the cross-section and time-series data on urbanization, agricultural development and the related factors. The cross-section analysis is based on the data for the triennium average (2004-05 to 2006-07) with the 29 districts in the state of Tamil Nadu serving as cross-sectional units, while the time-series analysis is based on the data for the last 47 years from 1960-61 to 2006-07 for the state of Tamil Nadu. The usage of both the time-series and cross-section data for econometric analysis facilitates cross-checking of the results and captures the dynamics of urbanization and the related factors both at their temporal and spatial dimensions. The analy-

¹ CPR lands refer to lands that are practically held as common property resources under the existing institutional regimen in Tamil Nadu. These lands include cultivable waste lands, pastures and grazing lands, barren and uncultivable lands, land under miscellaneous tree crops and bushes.

sis of both time-series and cross-section data helps to capture the factors affecting urbanization and the impact of urbanization on rural sectors in a comprehensive manner, thus adding robustness to the results.

1. Drivers of urban growth

The factors driving the growth of urbanization are investigated in this section using state-level time-series data and districts-level, cross-section data. The independent variables considered in the time-series analysis for the state are one-period lagged urbanization (L_URB_TOT, percentage of urban total population), road density (ROADDEN), literacy level (LITRACY) and lagged agricultural GDP to net state domestic product (L_AGDP_NSDP). The independent variables considered in district-level cross-section regression are literacy level, share of net irrigated area to net sown area, road density and population density.

1.1. Analysis of state-level time-series data for Tamil Nadu

The results of regression analysis using time-series data for the Tamil Nadu state are presented in Table 3.

TABLE 3. Time-series Analysis of Factors Affecting Urbanization in Tamil Nadu

Dependent Variable: URB_TOTP		
Variables	Regression Coefficients	t-value
Constant	-0.008	-0.714
L_URB_TOT	0.972	28.492**
ROADDEN	-2.425	-2.584**
LITRACY	0.001	2.453**
L_AGDP_NSDP	-0.029	-1.089
Adj. R-squared: 0.998	F=5382.25**	N = 46

** indicate significance at one percent level.

All the variables except the share of agricultural sector in the net state domestic product are statistically significant in affecting urbanization. Lagged

urbanization and literacy levels have positive impact on urbanization while road density has negative impact on urbanization. Improved road network leads to the emergence of strong rural-urban linkage and better commuting between rural to urban areas, thus reducing the necessity for migration to urban areas from rural areas. These factors in turn mitigate the process of urbanization. Bhagat (2003) observed that urbanization was highly positively correlated with literacy rate in India, since most of the literate rural elites have the tendency to move to urban areas in search of better employment opportunities, and Schnore (1961) made similar observations. Black and Henderson (1999) provide both theoretical and empirical support to the argument that educational attainment has significant impact on urban growth through human capital accumulation. Rukmani (1994) provides evidences to the argument that road and other infrastructure facilities in rural areas could mitigate/decelerate the process of urbanization. However, Dao (2004) finds that road density had positive impact on urbanization in middle-income countries.

1.2. Analysis of cross-section data for the districts

The results of cross-section regression analysis at district level (Table 4) indicate that literacy and population density (POPDEN) have positive influence on urbanization, while the share of net irrigated area to net sown area (NIA_NSA) has negative impact on urbanization. Dao (2002) found positive impact of population density on urbanization. The districts with better irrigation facilities show low levels of urbanization perhaps due to intensive agricultural activities, higher productivity, and income from agriculture, thus mitigating the process of migration of rural people towards urban centres. Further, higher price of irrigated lands, to a certain extent, deters the progress of urbanization in the districts endowed with higher proportion of irrigated lands. Population density accelerates the process of urbanization due to increased pressure on limited agricultural lands, compelling people to seek alternatives outside agriculture that are much easier to find in urban centres, given the very limited non-agricultural opportunities in rural areas.

TABLE 4. Cross-section Analysis of Factors Affecting Urbanization in Tamil Nadu

Dependent Variable: URB_TOTP		
Variables	Regression Coefficients	t-value
Constant	-47.40	-1.898
LITRACY	1.298	3.348**
NIA_NSA	-0.257	-2.334*
ROADDEN	-3901.64	-1.370
POPDEN	.043	2.562**

Adj. R-squared: 0.518

F=8.509 ***;

N = 29

** indicate significance at one per cent level, and * indicate significance at five percent level

2. Impact of urbanization on rural sector

As in the case of the analysis of factors affecting urbanization, we have used both time-series and cross-section data for the analysis of the impact of urbanization on agricultural sector. The analysis of impact of urbanization on the rural sector took into consideration by three different impacts: i) impact of urbanization on cropping intensity, ii) fallowing of agricultural lands, and iii) agricultural wages. The analysis was carried out using both time-series data for the state and cross-section data for the districts, and the results of these regression analyses are presented in the following sections.

2.1. Impact of urbanization and population pressure on cropping intensity

The analysis of urbanization impact on cropping intensity reveals that road density (ROADDEN) and urbanization (URB_TOT) have significant negative impact on cropping intensity, whereas population pressure on land has a positive impact on cropping intensity, thus supporting the Boserup hypothesis about the relationship between population pressure on land and agricultural intensification (Table 5). Irrigation facilities also contribute for the intensive use of land resource given the undependable rainfall regime in the state of Tamil Nadu.

TABLE 5. Regression Analysis of Factors Affecting Cropping Intensity

Dependent variable: Cropping Intensity		
	Results of analysis of time-series data for Tamil Nadu	Results of analysis of district-level cross-section data
Constant	99.15 (19.59)**	78.74
NIA_NSA	39.53 (4.01)**	0.311 (2.54)**
ROADDEN	-2142.84 (4.00)**	-
RAIN	0.001 (0.746)	0.020 (2.05)*
POPDEN	16.12 (4.44)**	0.034 (2.07)*
URB_TOT	-115.42 (7.20)**	-0.378 (2.19)*
Adj.R ²	0.644	0.541
F	14.85**	9.243**
N	47	29

Note: Figures in parentheses are absolute t-values.

** indicate significance at one per cent level, * indicate significance at five percent level

2.2. Impact of urbanization on total fallow lands

The results of the analysis of impact of urbanization on total fallow lands are presented in Table 6. The analysis of state-level time-series data indicate that all the independent variables considered for the analysis turned out to be statistically significant.

The extent of urbanization, land put to non-agricultural uses (LPNAU) and road density increase total fallow lands, whereas rainfall (RAIN) and trend variable (TIME) have negative impact on total fallow lands. The increase in urbanization and land put to non-agricultural uses indicate a shift in resources away from agriculture, thus increasing the extent of fallow lands. Road density has the effect of increasing fallow lands possibly due to increased outflow of labour from villages and opening up non-agricultural employment avenues for rural workforce, thus reducing their interest in agriculture. The trend variable possibly captures technological advancements in agriculture, which has the potential to increase productivity and profitability in agriculture, thus reducing fallowing of lands. In the case of cross-section analysis for districts, urbanization and land put to non-agricultural uses have positive impact on the share of fallow lands to total geographical area of the districts, while rainfall has negative impact on share of fallow lands.

TABLE 6. Regression Analysis of Impact of Urbanization on Total Fallow Lands

Independent Variables	Dependent Variable	
	State-level time-series data on area under total fallow lands	District-level cross-section data on share of total fallow lands to geographical area (%)
Constant	-1843815 (1.78)	0.432 (4.123)
RAIN	-860 (4.40)***	-0.488 (3.47)***
URB_TOT	4284045 (2.07)**	0.002 (2.27)**
ROADDEN	146500785 (2.27)**	-20.507 (1.46)
LPNAU	1.99 (3.72)***	0.535 (2.77)***
TIME	-71642 (2.55)***	-
AGWAGE	-	-0.002 (1.54)
Adj.R ²	0.778	0.482
F	33.216***	6.207***
N	47	29

Note: Figures in parentheses are absolute t-values.

** indicate significance at one per cent level, * significance at five percent level

2.3. Impact of urbanization on agricultural wage differentials across districts

Urbanization has important consequences for labour supply for agriculture and hence wage rates in agriculture. The wage rates in agriculture showed remarkable variability across districts and the wage rates were higher in districts with high levels of urbanization. In addition to urbanization, road facilities, which facilitate easy transport of rural people to nearby urban areas for non-agricultural works, also affects agricultural wage rates. On the supply side, the actual agricultural labour population per hectare of net sown area is an important determinant of wage rates in agriculture. The impact of urbanization on agricultural wage rates was analyzed using district-level cross-section data on agricultural wage rates and the independent variables affecting wage rates. The results presented in Table 7 below indicate that urbanization has a significant positive impact on agricultural wage rates as also the road density. Density of agricultural labour population (AGLABNSA) has significant negative impact on agricultural wage rates while land put to non-agricultural uses (LPNAUGA) has turned out to be insignificant. Zhang et al (2000) made similar observations when they argue that urbanization absorbs rural labour force, thus increasing rural wage rates.

TABLE 7. Cross-sectional Analysis of Factors Affecting Agricultural Wages

Variables	Regression Coefficients
Constant	0.130 (7.12)***
URB_TOT	0.277 (2.96)***
ROADDEN	3036.10 (1.92)*
AGLABNSA	-6.35 (-2.15)**
LPNAUGA	-36.84 (-1.60)

Adj. R-squared: 0.43 F=6.279***; N = 29

3. Results from case study

Coimbatore district has emerged as the most populous district (4.224 million) followed by Chennai (4.216 million). As explained earlier, the rationale for selecting the district has been the fact that Coimbatore district is not only in the forefront of industrialization but also the rate of urbanization is the highest in the district among all the districts in the state. The data presented in Table 8 reveal that the degree of urbanization has been growing steadily in the district throughout the last century. Though the district had a lower rate of urbanization than the Tamil Nadu state during the beginning of the last century, the pace of urbanization in the district overtook the state during 1940 and since then the process of urbanization in the district started diverging steadily from that of the state as a whole. The rate of growth in urban population on a decadal basis has been consistently higher in the district as compared to the state of Tamil Nadu.

TABLE 8. Decadal Trends in Urbanization in Coimbatore District (percentage of urban population to total population)

	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
Coimbatore	8.04	10.78	12.09	14.72	20.97	28.15	40.03	47.71	50.46	52.59	66.00
	-	(44.82)	(17.01)	(41.45)	(63.63)	(60.88)	(66.67)	(48.69)	(25.64)	(19.48)	(51.13)
Tamil Nadu	14.15	15.07	15.85	18.02	19.70	24.35	26.62	30.16	32.96	34.15	43.79
	-	(15.58)	(8.86)	(23.4)	(22.3)	(41.75)	(22.29)	(38.57)	(28.36)	(19.60)	(42.79)

Note: Figures in parentheses are percentage change over the previous census figures

Results from field study

A field study was conducted to examine more closely the issues pertaining to urbanization and industrialization. Detailed sample studies were conducted across a cross-section of sellers (who are mostly farmers or ex-farmers) and buyers of land (who are mostly real estate business persons and industrialists). The details of land transfer from agricultural to non-agricultural uses are presented in Table 9. The data reveal that the extent of land transfers was higher in Coimbatore suburbs as compared to that around Erode in terms of the percentage of farmers who have sold their land for non-agricultural purposes either in part or in full. In the last ten years, more than two-thirds (68.33%) of the farmers around Coimbatore sold either a part or full of their lands, while a little more than one third of farmers (36.67%) around Erode sold their lands. The average area of land sold per farm was also higher at 1.24 ha per farm around Coimbatore while it was less than half at 0.57 ha per farm around Erode. The share of total lands sold to the total area of land held by the farmers before land sale was more than one-fourth (27.47%) in Coimbatore, while it was about 16.50 % around the urban periphery of Erode town.

TABLE 9. Extent of Land Transfer from Agricultural to Non-Agricultural Purposes

S.No.	Particulars	Urban centre		Average
		Coimbatore	Erode	
1.	Total number of farmers covered	60	60	60
2.	Total area of land owned before five years, ha	270.84	171.06	220.95
3.	Total area of land owned at present, ha	196.44	142.86	169.65
4.	No. of farmers who sold part of their land	37 (61.67)	21 (35.00)	29 (48.33)
5.	No. of farmers who sold all their lands	4 (6.67)	1 (1.67)	2.5 (4.17)
6.	Average area sold per farm household, ha	1.24	0.47	0.90
7.	Total area of land sold, ha	74.4 (27.47)	28.2 (16.49)	54.0(23.22)

Note: Figures in Rows 4 and 5 indicate the number of farmers who sold a part or all of their lands, respectively. Figures in parentheses in these Rows are percentage of farmers who sold part or all of their land to total number of farmers in Row 1. Figures in parentheses in Row 7 are percentages to total land owned before five years (i.e. in Row 2).

The factors affecting land sale decisions by farm households are manifold and they interact among themselves as also with the extent of land sold by a household in many complex ways. Therefore, econometric analysis was conducted to identify precisely the socio-economics variables that have significant impact on land sales. The results of Tobit regression analysis are presented in Table 10. These results are in broad agreement with the field-level observations and the opinions expressed by the farm households and buyers of lands. The total land endowment of households (TOTLAND) has been one of the important factors that prompt the households to sell part of their lands. Distance to city (DISTCITY) and distance to roads (DISTROAD) were the important variables that have a negative impact on land transfers, implying that the increase in distance of the location of lands from the city and the roads would reduce the extent of land sold for non-agricultural purposes. Size of the family (FAMSIZE) has a negative impact on land transfers possibly due to the availability of more family labour for agricultural operations in the wake of increasing scarcity of labour in the hired labour market and higher wages. The percentage share of non-agricultural income to total household income has been found to have a significant positive impact on land sale decisions as the diminution in the role of agricultural sector in household economy reduces the propensity to own lands. The only variable that did not affect the land sale decisions in a statistically significant way is the share of irrigated land to total land endowment of households.

TABLE 10. Tobit Regression Analysis of Factors Affecting Land Sale Decisions by Farm Households in Urban Fringes

Dependent variable: Fraction of land sold to total land owned by the sample households

S. No.	Variables	Coefficient	z-value	Level of significance
1.	Constant	1.812	1.863	0.06
2.	TOTLAND	1.119	2.742	0.03**
3.	IRRIPER	-0.842	-1.478	0.91
4.	DISTCITY	-2.688	2.889	0.03**
5.	DISTROAD	-6.848	1.737	0.08*
6.	FAMSIZE	- 0.152	1.813	0.07*
7.	NAGINC	2.51	3.002	0.01**

Log-likelihood function: -21.62

V. Conclusions

The rate of urbanization has been the highest in the latest decade (1990s) together with the sharp fall in the share of agricultural sector to the net state domestic product of the state. These factors together with the negative growth rates in both the share of agricultural labour and farmers in total population indicate a net out-migration from rural to urban areas at a faster rate in the more recent period, which is primarily due to the industrial boom in recent years. As population density has positive impact on urbanization, policies should be strengthened to reduce population growth. The strong negative effects of road density and per capita net state domestic product on the share of land put to non-agricultural uses point to the need for strengthening the infrastructure facilities, especially roads as of the continual increase in the net state domestic product of the state. Road density has a negative impact on urbanization as measured by the share of urban to total population as it facilitates not only improved infrastructure and other amenities in rural areas but also helps agricultural development, thus mitigating the mass exodus of rural people to urban areas in search of livelihood. Improved road network leads to the emergence of strong rural-urban linkage and better commuting between rural to urban areas, thus facilitating both agricultural and non-agricultural developments in rural areas. These factors in turn lead to the decline in the process of urbanization around large cities. Therefore, the negative impact of road networks on urbanization provides additional justification for improving road networks.

The results of the analysis of cross-section data at district level reveal that both the irrigation intensity and literacy rates have positive impact on the share of land put to non-agricultural uses, while agricultural wage rate has negative impact, indicating that higher agricultural wages tend to discourage urbanization and/or industrialization. Further, population density and literacy rates were found to have positive impact on urbanization while road and banking infrastructure have negative impact on the pace of urbanization. These results point to the need for increasing rural infrastructure, especially roads and formal credit infrastructure, so as to reduce the pace of urbanization. Both the share of land put to non-agricultural uses to total geographical area and urbanization are found to have a strong negative impact on agricultural sector, by reducing the share of gross cropped area in the state, and positive impact on the extent

of fallow lands in the state.

An important message of the study is that urbanization and land put to non-agricultural uses have strong negative impact on agricultural sector. They are together responsible for the decline in gross cropped area and the increase in total fallow lands in the state. Therefore, it is extremely important to give priority for decentralized growth through rural industrialization. It is heartening to note that road density has significant impact in mitigating the growth of urbanization and land put to non-agricultural uses. Therefore, public investment on road network should be increased not only to reduce the growth of urbanization but also to promote rural industrialization. Consolidation of existing irrigation sources is another important step to reduce the extent of fallow lands. The cultivation of water-intensive crops should be discouraged through appropriate policy interventions. Industrialization and the reduction in the economic importance of agricultural sector in the national economy are cited as the indicators of development.

However, the impact of industrialization especially around a few large cities is undesirable both from the point of view of balanced regional development and also from the viewpoint of the serious negative impacts of the growth of large urban centres on the neighbouring rural economies. Therefore, agriculturally underdeveloped areas and dry land areas with low agricultural potential should receive topmost priority for industrial development. The transfer of land and water resources from rural to urban areas, especially in and around high potential agricultural areas, should be regulated through appropriate land and water use policy interventions. Local land and water management institutions with relevant stakeholders having powers to formulate and implement rules and regulations will be more useful to achieve the task than the centralized institutional arrangement implemented through bureaucrats. Unless we immediately address the problems of urbanization and the emerging mega cities with appropriate institutional arrangements, the spatial structure of development would be characterized by regional imbalances, high poverty and a low quality of life in urban centres, excepting the few cities linked to the national and world markets.

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