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## **Spatio - Temporal Analysis of Land Use in Fringe Area using GIS - a Case Study of Madurai City, Tamil Nadu**

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### **Abstract**

Urbanization is one of the most powerful socio-economic components of the modern society. It is a dynamic force since it undergoes considerable spatial and temporal variations. In cities like Madurai this variation is more pronounced in the peripheral areas due to rapid horizontal expansion which has outpaced the vertical expansion of the city. In addition, the rapid growth of India which has triggered the infrastructure development like modern highways, proliferation of more automobiles etc. facilitates such horizontal expansion of the city and more and more people were found to shift from agricultural to non-agricultural occupation. Hence, it is logical to expect that a proper utilization of land in the fringe areas is basic for effective urban planning. Hence, in the present study an attempt has been made to study the fringe areas; particularly their land use modifications.

**Keywords:** Land use modifications, Madurai city, Rural-Urban Fringe, Urban Planning, Urban sprawl

### **1. Introduction**

Increasing population in the already overpopulated developing countries forces a considerable shift of population concentration from rural to the urban areas. Helped by a total array of twentieth century technology such a shift is accompanied by the rapid expansion of cities, especially the metropolitan areas. Since resource constraint restricts vertical expansion of the city to a considerable extent, cities in developing countries experience more horizontal growth swallowing vast tracts of rural lands in this process. Torn between the traditional conservative agricultural base and the dynamic modern urban form, the buffer zones in between city and the village undergo a wide variety of changes in form and character. Changes in land use are perhaps the most dynamic aspect in such areas. Even these are not uniform all along the fringe. Transport and physical conditions bring their own influence. Such an environment creates a set of people who are 'physically rural and mentally urban' (Anderson, 1964).

### **2. Rural–Urban Fringe**

Rapid urban development and increasing land use changes due to increasing population and economic growth is being witnessed in India and other developing countries. The measurement and monitoring of these land use changes are crucial to understand land use dynamics over different spatial and temporal scales. Today, with rapid urbanization, there is increasing pressure on land particularly in the metropolitan cities. Urban sprawl may be defined as the scattering of new development on isolated tract, separated from other areas by vacant land (Ottensmann, 1977). The cities are expanding in all directions resulting in large-scale urban sprawl and changes in urban land use. The spatial pattern of such changes is clearly noticed on the urban fringes or city peripheral rural areas, than in the city centre. This

has made the fringe area of the city to be the most dynamic landscape. In the modern age of urban expansion 'fringe' is of much significance. The term 'fringe' suggests a border – line case between the rural and the urban and it actually lies on the periphery of urban areas, surrounding it and distinguishing it from the truly rural countryside. The rural – urban fringe, in the real sense is a narrow zone with varying width outside the political boundaries of an urban unit which is neither urban nor rural in character. The fringe of an urban complex forms a pattern depending upon the physiography and transportation facilities of the area. Thus rural-urban fringe zone is an area where various rural and urban characteristics are mixed together. Around major urban centres the physical expansion of built-up areas beyond their municipal boundaries has been very conspicuous. As one moves out of a major city along one the roads, one observes new residential colonies and a considerable amount of vacant land with partially developed residential land use. An important problem in the rural urban fringe area is the problem of land use. The pattern of land use in the area is dynamic and changes from rural land use to urban land use over short periods of time and distance.

### 3. Land Use

Land is the basic natural resource of mankind. The people residing and working in the city occupy, organize and utilize space on the land. Bartholomew (1955) states: "The land we are concerned with can be described as land now used for purposes that are characteristically urban". Urban land is defined as 'the built up area with its associated open spaces' (Best et. al. 1974). It has the possibility of being put to multiplicity of uses. The same patch of land can be put to residential and other activities. Land use is the use made of the land by man. Land use refers to 'man's activity and the various uses which are caused on land' (Anderson, 1976). It is the surface utilization of all developed and vacant land on a specific point at a given time and space. Rubenstein and Bacon (1990) defined land use as the type of activity on a piece of land, such as residential, commercial or industrial activities. A notable aspect of land use is its dynamic nature. Over the period of time, there is conversion of one land use type to the other. This is particularly more rapid in urban areas. The use of land changes according to the changing needs of man.

### 4. Land use in Fringe

Traditionally, peripheral areas of the city exhibit more rural character than urban. Location of large industries, which requires considerable area of land, is usually in the periphery. Thus in many urban centres, pockets of industrial land use dot the peripheral areas. Another more common urban land use in the fringe is the residential land use. In the Western cities, there is centrifugal force acting on the high-income residential area, which gets shifted from the centre to the periphery over a period of time. However, the cities in developing countries witness this shift only on a subdued scale. Availability of cheaper land, possibility of ownership of house and provision of loan facilities for house construction are some of the positive factors which aid development of residential colonies outside the political boundary of the city. Such developments have been dominantly controlled by accessibility, thus making transport lines to be more significant.

### 5. Aims and Objectives

1. To study the pattern of selected land uses in the year 1987
2. To identify the change of land use in the year 2000

## 6. Data Base

### 6.1 Secondary Data

The present study largely depends on the secondary sources of information. All information regarding land such as ownership and land use are recorded in the revenue register of village called “*Adangals*”. These are available at taluk Offices and Village Administrative Offices. This source has been tapped and the secondary data has been used to draw the land use maps and to give a clear idea of changes of land use over a period of time. The Census of India has provided data regarding different aspects of population and it includes data regarding total population, sex, literates, scheduled caste and scheduled tribe population and workers in different sectors. These data are collected for 1971, 1981, 1991 and 2001. Such population data helps in the analysis of distribution and growth of population in the study area.

## 7. Techniques Used

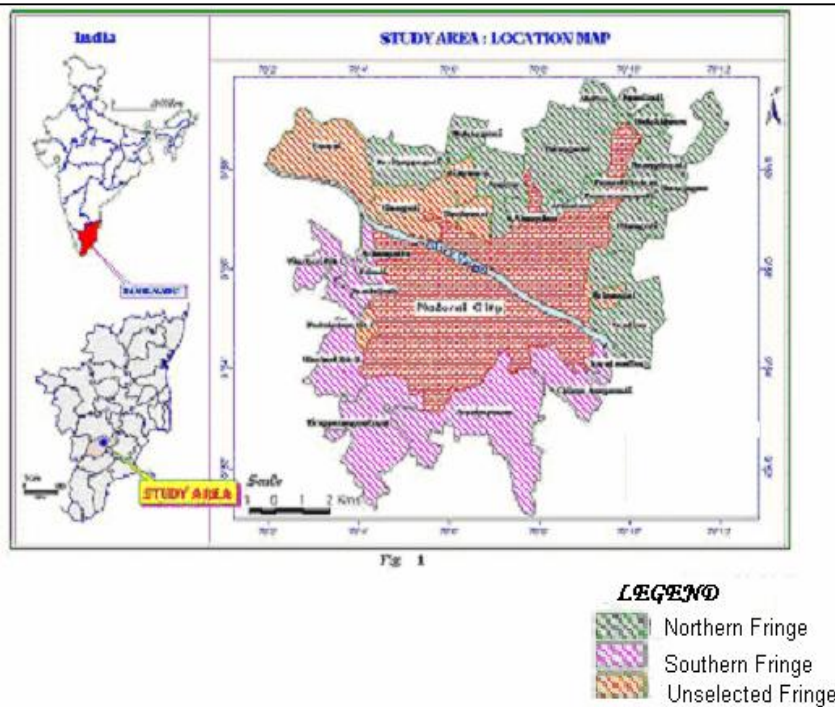
The land use changes are analyzed through simple statistical calculation like percentage change and the results derived are cartographically represented using GIS software. The GIS package used for the study is Map Info 6.5. The data collected from different sources has been classified, analyzed and converted to tabular form before fixing the module of input into GIS package.

## 8. Location

The study area comprises of Madurai City and fringe villages. It extends geographically from 9° 50' North to 10° North latitude and between 78° 02' East and 78°12' East longitude. Madurai city and the fringe villages have spread on either sides of River Vaigai. The River Vaigai is the prominent physical feature, which divides the study area into two halves. The study area as a whole constitutes 29 fringe villages. Of these 20 villages are in the northern side and 9 villages are in the southern side around the city boundary (Figure. 1).

## 9. Fringe Settlements

Settlements in the fringe area undergo changes due to urban growth and with passage of time they are incorporated into the ever-growing urban centre. Settlements located along the fringe offer ideal sites for future urban residential growth. The present day city is divided into north and south by river Vaigai. However, the historical core city, which was built around Sri Meenakshi temple, lies to the south of River Vaigai. It was only after 1889 when the Albert Victor Bridge was constructed across river Vaigai urban influence started spreading to the northern parts. After independence the northern areas experienced rapid urban growth mainly because of various government establishments and residential colonies. Compared to the southern area the northern part has better water availability and a comparatively rich agricultural area. Availability of ground water is better in the northern parts. Further water supply from the Periyar Canal network for the agricultural activities in turn has helped a rise in ground water level. A rolling plain surface with fertile soil and good water supply offers an excellent site for residential developments. The physiography of the southern area is rocky ground. In general water availability is comparatively poor and therefore there are more areas of water scarcity in the southern fringe. Rocky outcrops, tanks and stony waste are the other physical barriers that restricted large-scale residential development.



**Figure.1:** Study Area

There are 29 settlements along the Madurai Corporation boundary limits. Among these, 20 settlements are in North Madurai and 9 settlements are in South Madurai. For the present paper one fringe village Kovilpappagudi located in the northwestern corner of the study area has been taken and analysed the specific land use changes. The main reason for selecting this particular village is due to the following: Madurai city has been rapidly expanding along the north and as a consequence fringe villages located here having common boundary with city area are being urbanized. Besides the analysis of land use pattern in these fringe villages even for the year 1987 does not happen to be typically rural in nature. Kovilpappagudi village which even though located in the rapidly growing northwestern part of Madurai city is not contiguous with Madurai corporation area and the land use was noticed to be typically rural for the year 1987 and also the land value is lower than the other fringe villages. So the fallow lands are purchased low cost by educational institutions and some millionaires for constructing schools, colleges etc. Hence this village has been selected for the present study.

The following types of land classification have been made:

1. Agricultural land
2. Fallow land
3. Residential land
4. Water bodies and
5. Others

### 10. Kovilpappagudi

Kovilpappagudi is located in the northwestern side of Madurai Corporation boundary. The Madurai – Alanganallur road passes through the eastern side of this village. The old settlement is located in the central part of Kovilpappagudi, which is very close to Periyammai tank. The total area of this village is 459 hectares. It is a flat rolling surface.

Tanks and canals mostly mark the drainage of the village. Of the total area, about 90 hectares is under water bodies. The Periyammai tank is a huge tank, which covers an area of 57.24 hectares, and it is located in the northern direction. In addition two canals pass through this village. One is located in the extreme west and the other canal is in the east central part. In addition to this there are two ponds located in the eastern side of the village.

### 10.1 Land Use in 1987

In 1987 agricultural land use was the most important type while government and other land use had the least share. About 68.7% of land area is occupied by agricultural land, which is distributed throughout the village. Water bodies cover nearly one-fifth of the total area of the village and ranks second. There are only two important residential areas. One is along the Madurai – Alanganallur road and the other is the old settlement, which is the central part of the village in the first time point. Added together they had a share of 7.1% to the total area. Fallow land occurs only in 2.6% of the village area. Four small patches could be seen. One patch is located between the Madurai – Podumbu transport line and canal. Another major patch of fallow land is located near the Sikkander Chavadi settlement area. The third patch of fallow land is located near the old settlement. The fourth patch of fallow land is the smallest one and is located in the main part of the agricultural land. Other land occupies 2.1% of the total village area. This includes roads and rivulets.

### 10.2 Land Use in 2000

In 2000, the land use in the village has undergone many changes (Fig.2). Agricultural land use is reduced from the 68.7 to 51% of the total village area. Agricultural land is almost unaffected near the major water bodies of the village but had experienced sizable decline in the eastern part where it is converted more to fallow land or residential areas. Changes in agricultural land use area are also witnessed in and around the old settlement area. During the study period, there has been no change in area with regard to water bodies.

Residential area has become one of the most important land use types in 2000 (18.4). It could be seen as a major type of land use in the eastern part of the village. It may be noted that the old settlement and Sikkandar Chavadi area in the east are now linked. Further the expansion of area under residential use could be seen in and around the old settlement. An important point noted here is that most of the new areas under the land use are residential indicating the growing influence of Madurai City. The population growth of this village supports this point. In 1981, the population is 2177 and it increased to 4253 in 2001. This two-fold increase in population supports that there is more residential development. A small patch of residential land is in the northern part of the village, which is also near the tank.

There has also been an increase in fallow land in 2000 (9%). Some of the agricultural land has become fallow lands throughout the village. One major patch of the fallow land is located in the western side of the village, which is near the canal. In the eastern side also, many patches of fallow land could be seen and these are very close to the residential land use. In and around the Periyammai tank and old settlement there are a lot of fallow lands.

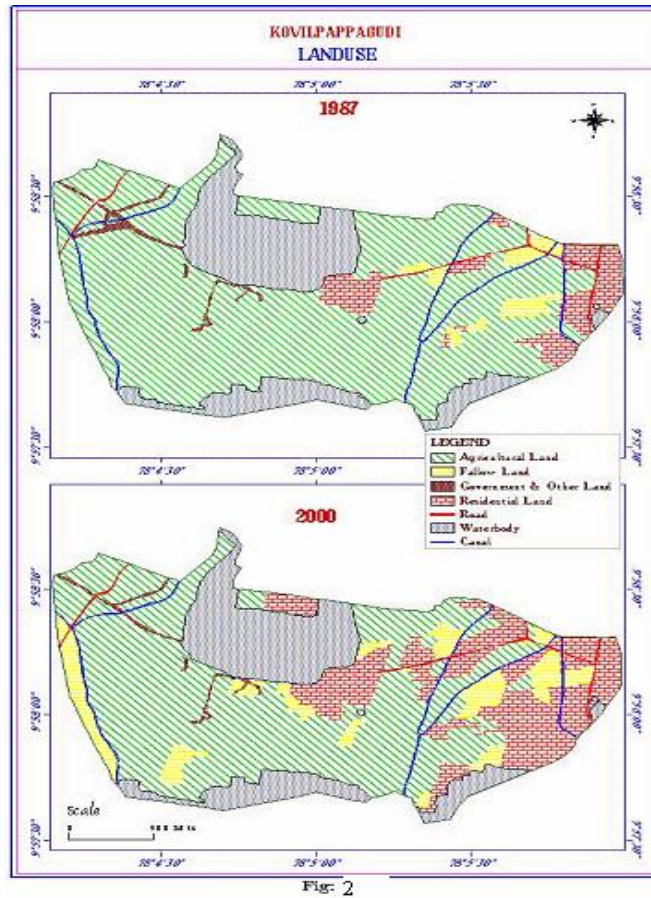


Figure. 2. Land Use Change between 1987 and 2000

There is no change in the other land. It occupies the same 2.1% of the total village area (Table. 2).

**Table. 2.** Land Use Change in Kovilpappagudi

Land Use	1987 (%)	2000 (%)	Change (%)
Agricultural Land	68.7	51	-17.7
Fallow Land	2.6	9	6.4
Residential Land	7.1	18.4	11.3
Water Bodies	19.5	19.5	--
Others	2.1	2.1	--
Total	100	100	

### 10.3. Land Use Changes in 1987 – 2000

The following changes could be observed during the time points of study.

Land use changes are most prominent on the eastern parts of the village, which is adjoining the Madurai city. There has been a major shift from agricultural land use to residential land use validating urban influence and possible suburban development. The increase of fallow land is also indicative of the urban impact because legally agricultural land cannot be directly converted to residential area. It must be left as fallow for a particular period and only after that it can be converted into residential plots.

## 11. Conclusion

The results from the land use changes between 1987 and 2000 the study area has prominent residential conversion from the agricultural land. In the year 2008, the Indira Gandhi National Open University (IGNOU) bought nearly 400 acres for the educational development. Hence this fringe may be becoming an educational suburb in future.

## 12. References

1. Anderson, T.R., and Collier, J, (1956). Metropolitan Dominance and the Rural Hinterland, Rural Sociology, vol.21, pp.152-157.
2. Bartholomew, H, (1955). Land Use in American Cities, Harvard University Press, Cambridge Mass, pp 15.
3. Best, R.H, (1974). The Density-Size Rule”, Urban Studies, Vol.11 (2), pp.201-208.
4. Ottensmann, J.R, (1977). Urban Sprawl, Land Values and the Density of Development, Land Economics, Vol. 53 (4), pp. 389-400.
5. Rubenstein, J.M., and Bacon, R.S, (1990). The Cultural Landscape : An Introduction to Human Geography, Prentice-Hall of India Private Ltd, New Delhi.