CHAPTER 2

TOWARDS A METHODOLOGY FOR ANALYSIS OF FRINGE LAND MARKETS

Introduction:

In this Chapter we discuss the methodology we plan to apply to the analysis of the operation of land market in fringe areas. The method one chooses to analyse a particular economic phenomenon depends on the nature of the problem, the way it is posed and quite importantly the objective of the study. In order to understand the suitability of a particular method of analysis for any problem we should be clear about the meaning of concepts like 'statics', 'dynamics' etc., and their relative usefulness in different situations.

At the outset, we must clarify the difference between static versus dynamic, and stationary versus changing. The former refer to a method of analysis whereas the latter refer to characteristics of economic phenomena. A stationary economic phenomenon is defined as one where values of all variables remain constant over-time. When the values of variables change over-time we have a changing phenomenon.  

Note that both stationary and changing phenomena occur over a period of time and thus can be referred to as dynamic phenomena.
A static or dynamic analysis, on the other hand, "is a particular kind of explanation of economic phenomena and indeed both stationary and changing phenomena can be submitted either to static or dynamic analysis." 2

A static analysis is defined as one where the relations between the relevant variables relate to the same moment of time or to the same period of time. On the other hand, if the explanation contains relationships between relevant variables, the values of which do not all relate to the same point of time or period of time, the analysis may be said to be dynamic in nature. The mere fact that variables belong to different time periods, does not however make the analysis dynamic. The critical difference between static and dynamic analysis is that static theory is concerned with analysis of a situation at a point of time whereas dynamic theory concerns itself with analysis of process of change 3 over a period of time.


Normally, "static" and "dynamic" methods carry implications like "simple" and "complex" or "abstract" and "realistic". We, however, do not denounce one against the other. Both have their uses and their plus and minus points and as we shall see below both are required to serve different purposes.

Static analysis may be used as a preliminary approach to dynamic analysis - a simpler method before proceeding to the complications, which dynamic method involves. In some cases the complications may be quite unimportant and the dynamic analysis may not take us much farther. In that case static analysis may suffice. In other cases, however, we may not be able to get all that we require by use of static method or the static method may even be misleading. It then becomes important to apply dynamic analysis.

Static method, however, is important in its own right, in cases, when the problem requires analysis of a situation at a point of time or when the problem is timeless in nature. A dynamic phenomenon can however be submitted both to static and dynamic methods of analysis. As Hicks has stated we have choice of alternative methods and there are multiplicity of instances where static or semi-dynamic methods have been used to analyse dynamic situations. As Hicks has further pointed out, "no one has yet found a single method which is
Thus different methods may be applied according to their suitability to particular problems.

In the following sections we discuss the method we plan to apply to our problem and its appropriateness to the situation concerned.

Fringe Land Market: The Setting:

Our study, as pointed out earlier, is concerned with the working of land market in fringe areas. The fringe land has mainly been used for agricultural purposes. The increasing activities of the urban economy make increasing demands on space available in the city. Part of this increasing demand spills out of the city to the fringe areas. This demand for land in fringe areas may be due to non-availability of land in the city or due to the expensiveness of space available there.

As the city economy continues to grow the demand for space by various users (industrial, residential, commercial etc.) increases. Gradually, more and more agricultural

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land gets converted into urban uses. Areas which were earlier functioning as fringe areas become part of the city. New fringes emerge in this process. In the case of a growing economy, increasing demand for space will engulf these areas for urban uses. This process continues.

It is this process of change over time which we want to analyse. As is clear the dynamic method will be most suitable for analysing this phenomenon. We, however, divide the analysis into two stages. In the first stage, we concentrate on understanding the working of land market at a point of time. In the second stage we analyse the changing situation in land market over a period of time. The analysis in the first stage will give us an insight into the forces operating on both demand and supply side in the land market. This understanding is very important for explaining the process of change over time in the land market.

The method which we apply to the analysis of land market at a point of time will however not be completely static in nature. This is due to the peculiar characteristic of the commodity land. Land is a durable good and the actions of operators in the market are guided not by current factors alone but by expected future variables also. Specifically, the demand for land is determined not by current returns on it,
(they might be nil, negative or very small in the period when the decision to purchase is made) but by accumulated returns over its life-time. Similarly, the decision to supply land also encompasses considerations which extend far into the future.

Thus the concept of time is inherent in the very nature of our problem. At the same time our analysis in its first stage is not dynamic in nature either. This is because we are not analysing the process of change but concentrating upon the land market operations at a point of time. At best the method is semi-dynamic in nature.

**Semi-Dynamic Method:**

We apply the semi-dynamic method as a preliminary to our dynamic method. Analysis of the fringe land market in this framework helps us to outline our approach to the operation of land market. Thus we use this method, with great pedagogic advantage as an introduction to the treatment of more difficult dynamic problems. We also make use of this method for the explanation and exposition of economic motives expressed in the activity of operators in the land market.

As discussed in the first chapter, the fringe land market and its various problems have received attention from

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5Since land is indestructible the returns from it might continue for an infinite period.
various related disciplines such as real estate, urban and
land economics, geography and urban planning. We have
borrowed concepts and techniques developed in these disciplines
and tried to formulate an integrated analysis of land market
in a micro-economic framework. Treating land as an investment
good with a stream of returns which flow far into future,
we apply the principles of finance to derive our demand and
supply curves of land. Both demand and supply curves are
derived on the basis of continuous net present value functions
for urban and agricultural uses of land.\textsuperscript{6}

Thus in Chapter 3 we concentrate on derivation of demand
and supply curves on the basis of postulates regarding
pattern of behaviour of individuals at the micro-level.
Demand and supply curves are first derived for a representa-
tive individual and then aggregated over individuals to get
the market demand and supply curves. The price determination
and allocation of land between the two uses - agricultural and
urban - is seen as a result of interaction of forces of
supply and demand.

Within the semi-dynamic system we start with very
simplifying assumptions like homogeneity of land, no

\textsuperscript{6}Since this technique is not commonly used in economics,
an appendix is attached to this chapter to explain the appli-
cation of this technique in analysis of fringe land markets'
demand and supply functions.
speculation and non-interference by government and a perfectly competitive market functioning independently of surrounding land markets. Subsequently we drop some of these assumptions and analyse the working of land market in a more realistic, though also more complicated - framework. We explain the phenomena of sprawl and speculation in the land market in fringe areas as an extension of our model.

The analysis of land market in a semi-dynamic framework does not expose the intricacies of the system fully. Specifically, the phenomena of speculation and sprawl cannot be analysed properly without explicitly bringing time into the picture. An analysis of these phenomena, as seen at a point of time may fail to put them in proper perspective and may lead to wrong conclusions. In Chapter 4, therefore, we apply the dynamic analysis to explain the behaviour of the fringe land market.

The Dynamic Method:

The fringe land market, except in the case of a boom situation, is seldom very active. Even though changes affecting the land market directly or indirectly take place continuously, the market responds in a very sluggish manner. The sluggish response is due to time lags in the operation of several causal variables. Again, expectations play a very important role in the determination of operator's behaviour.
Demand and supply, in any period, are thus influenced by past performance and anticipated future behaviour of the market. The expectations which are formed by these factors affect the process of price formation in any particular period.

This sort of market is quite amenable to the type of process analysis as enunciated by Lindahl. Starting from the initial period (period 0, when all the land is in agricultural use) we enumerate the sequence of events in successive periods which leads to conversion of this land into urban use. Each period is linked with the previous period through the formation of expectations based on exogenous factors and past prices. Specifically, the demand and supply of land are seen

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8 We here confine ourselves to expectations regarding prices only. The behaviour of buyers and sellers will however be influenced not only by prices prevailing in past periods but also by present and prospective supply and demand situation as envisaged by the operators in the land market. We assume that quantity aspect will reflect itself in price expectations e.g. expectation of scarce supply in future would reflect itself in higher future expected price.
as depending not only upon current land prices (which are expected to prevail during that period) but also upon expected future price of land. The expected future price is a function of both 'autonomous' and 'induced' changes in the system. In the context of our fringe land market, the autonomous factors which influence the expected future price would be rate of population growth and economic growth of the urban community. These factors are exogenous to our system. In our system of analysis we assume a steady rate of growth of urban economy and envisage a 'trend' function for 'autonomous' component of our expectation function.

The 'induced' component of expected price change, however, is endogenous to the dynamic system and depends upon changes in current prices. Various assumptions can be made about the form of this expectation function. In the literature on 'expectations' we come across three popular forms of expectation functions.9

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1. Static Expectations - Under this case the expected price is assumed to be equal to the latest known price.
   That is \( P_t^e = P_{t-1} \)

2. Extrapolative Expectations - In this case expected prices are an extrapolation of trend in current prices. That is
   \[ P_t^e = P_{t-1} + \rho \left( \dot{P}_{t-1} \right) \]
   where
   \[ \dot{P}_{t-1} = \frac{d P_{t-1}}{dt} \]
   and \( \rho = \) constant

   In case \( \rho > 0 \), a certain multiple of the latest change in prices is added on to the latest observed price and expected prices may be described as extrapolative.

3. The Adaptive Expectations - Under these, expected future price is seen as a weighted average of prices prevailing in the past. Normally, more recent past is assumed to exert greater influence on expectations than less recent prices. Under this assumption, weights given to past prices decline as one goes back in time.
Thus, \[ p^e_t = W_1 p_{t-1} + W_2 p_{t-2} + W_3 p_{t-3} \text{ and so on.} \]

\[ \sum_{i=1}^{n} W_i = 1 \]

Depending upon assumptions regarding the relative importance of past prices in the expectation, we can have many variations of our 'adaptive expectations' formula.

Among the three expectation functions discussed above, the extrapolative expectation function seems to fit the situation in land market more than the others. We analyse the behaviour of operators in the market under the assumption of extrapolative expectations. In each period the buyer/seller plans his action for current and future periods on the basis of current and expected prices. At the end of each period he reviews the situation.

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10 The plan of action, however, is more definite for immediate future than for more distant point of time.
and revises his plans accordingly.\textsuperscript{11}

These plans are then aggregated for all the operators in the market and corresponding demand and supply curves derived. The process of price formation over various periods in the land market is viewed as a sequence of 'temporary equilibria' in successive periods. The 'temporary equilibria' are arrived for each of the period as a result of interaction of forces of supply and demand as they appear currently in the market. The price thus reached remains constant over the period. A change in expectations or some external conditions would lead to a revision of plans for next and future periods. This revision would reflect itself in demand and supply curves for the next period and a new 'temporary equilibrium' is established for the next period and so on.

\textsuperscript{11}The rationale for dividing up the dynamic process into various periods of some length is that the operator reviews and revises his plan not continuously but only intermittently. The choice of period thus depends upon these intervals of plan revisions. Thus our periods are the 'plan revision periods'. Note that it is not the same as the planning period which extends over many future periods. The length of the period would vary from individual to individual depending upon his 'plan revision period'. For the sake of simplicity we assume that these periods coincide for all the individuals.

The period thus defined should be long enough so that the plans made at the beginning of the period can be put into action. At the same time it should not be so long that occurrences in the beginning of the period start affecting the events at the end of it.
APPENDIX TO CHAPTER 2

A NOTE ON APPLICATION OF CAPITALISATION TECHNIQUE TO DERIVATION OF DEMAND AND SUPPLY OF LAND

Land is a durable good. The returns from its use continue to occur over a long period of time. The decision to buy or sell land, therefore, is not taken on the basis of returns in any single period alone but is dependent upon the stream of net returns over the life-time of land in that particular use.¹ The technique of deriving demand or supply of goods, based upon a stream of returns which extends far into future is not very common in economic literature.² We will, therefore, devote this appendix to develop supportive concepts required for derivation of demand and supply curves. Demand and supply for land, at a particular point of time are seen as depending upon the present value of stream of returns from land. We use the technique of capitalisation to arrive at the present value

¹The life-time of land in any particular use may be finite or infinite depending upon the perception of the buyer/seller.

²Though the decision to buy or not to buy a capital good is taken on the basis of net returns over-time it is normally a 0-1 decision. Continuous Demand (or Supply) curves have not been derived on this basis.
of the stream of future net returns. We call this Total Present Value (TPV). Corresponding to this we also derive the average and marginal concepts and call them Average Present Value (APV) and Marginal Present Value (MPV) respectively. In the following section we will define these concept more rigorously.

As mentioned earlier, we plan to analyse in this study the conversion of land from agricultural to urban uses. The technological and economic factors which determine the functional relationship of TPV, APV and MPV over time and with plot size will vary according to the use to which land is put. We will, therefore, discuss the shape of these functions as related to land both in agricultural and urban uses.

**Net Returns from Land in Agricultural Use:**

We are interested in returns which accrue to the farmer from cultivation of his plot and sale of the produce
We assume that the farmer sells all the produce at the market price which is given to him. From this we deduct the costs of cultivation to arrive at Net Returns.

Thus Net Returns = \( R - C \) \( \ldots \) (1)

where \( R \) denotes returns and \( C \) costs

\[ R = P \times O \] \( \ldots \) (2)

where \( P \) is the market price of produce and \( O \) is the amount of produce over a given period.

Costs of cultivation can be divided into two major categories - capital costs \( (C_k) \) and recurring costs \( (C_r) \). The former include expenditure on items like pump set,

\[ R = P_0 + \sum \limits_{i=1}^{n} r_i k_i \]

where \( r \) is the return per period from hiring \( i^{th} \) input and \( k_i \) is the amount of that input.

In the above we also assume that the farmer produces only one crop. If more than one crop is produced -

\[ R = \sum \limits_{j=1}^{n} P_j O_j \]

where \( P_j \) is the price of the \( j^{th} \) crop

and \( O_j \) is the amount of the \( j^{th} \) crop.
bullocks, tractor etc., and the latter include costs incurred on account of wages paid to labour, money spent for purchase of seeds, fertilizers etc., and transportation expenses for carrying the produce to the market.

Thus \[ C = C_k + C_r \] ............ (3)

\( C_k \) is discontinuous over time whereas \( C_r \) is incurred year after year.

The normal procedure of dealing with \( C_k \) is to spread it over the life-span of the capital equipment adding an allowance for repair. We will adopt this procedure.

\[ C_k = \sum_{i=1}^{n} r_i S_i \] ............ (4)

where \( r_i \) represents averaged out cost of \( i^{th} \) capital equipment

\( S_i \) is amount of \( i^{th} \) capital equipment. Thus, \( C_k \) is cost of capital equipment per period per land unit.

\[ C_r = \sum_{j=1}^{m} P_j C_j \] ............ (5)

where \( P_j \) is the price of the \( j^{th} \) input and \( C_j \) is the quantity of \( j^{th} \) input used per period.

Thus \[ C = \sum_{i=1}^{n} r_i S_i + \sum_{r=1}^{m} P_j C_j \] ............ (6)
Net Returns per period are:

$$ R - C = P_0 - \left\{ \sum_{i=1}^{n} a_i s_i + \sum_{j=1}^{m} P_j C_j \right\} \ldots \ldots \ldots (7) $$

We now proceed to analyse the behaviour of R and C over time and later on over plot size.

We denote the net returns in the first period by

$$ R_1 - C_1, \text{second period} \ R_2 - C_2 \text{ and so on.} $$

Present value of net returns can be arrived at by discounting the future net returns.

$$ TPV_{Agr} = \frac{R_1 - C_1}{1 + i} + \frac{R_2 - C_2}{(1 + i)^2} + \frac{R_3 - C_3}{(1+i)^3} + \ldots \ldots \ldots (8) $$

We take an infinite time horizon - implicit assumption being that the farmer expects land to continue in agricultural use for ever. The rate of discount (i) is normally taken to be the prevailing market rate of interest. We take i to be higher than the prevailing rate of interest because of the higher risk and uncertainty attached to agricultural production.

Net Returns over time in agriculture are a function of various factors. We assume that $P$, $P_j$ and $r_i$ remain constant over time. Any change in net returns over time, therefore, is to be explained in terms of change in input-output relations.
By efficient management, proper rotation of crops and use of modern methods and better quality seeds etc., the farmer can ensure constant or increasing net returns over time. Technological progress (in agriculture) can also ensure this result. On the other hand, the possibility of net returns declining over time (because of decreasing fertility of land) also exists. Thus, depending upon our assumptions net returns can increase, remain constant or decline over time.

Under Indian conditions, with uncertainty attached to regular availability of inputs and/or the economic condition of the farmer making it very difficult for him to make use of the technological progress in agriculture we would presume that an average farmer would visualise his net returns to decline over time slowly. We assume that net returns decline in geometrical progression at a constant rate such that

\[
\frac{R_2 - C_2}{R_1 - C_1} = \frac{R_3 - C_3}{R_2 - C_2} = \ldots = k. \tag{9}
\]

where \( k < 1 \).\(^4\)

\(^4\)Under different assumptions we could have increasing or constant returns over time. In that case \( k > 1 \) or \( k = 1 \) as the case may be. The assumption does not make any difference to our main analysis.
Thus \( TPV \text{ Agr.} = \frac{R_1 - C_1}{(1+i)} + \frac{k(R_1 - C_1)}{(1+i)^2} + \frac{k^2(R_1 - C_1)}{(1+i)^3} + \ldots \ldots \)

\[ = (R_1 - C_1) \left\{ \frac{1}{1+i} + \frac{k}{(1 + 1)^2} + \ldots \ldots \right\} \]

\[ = (R_1 - C_1) \left\{ \frac{1/1 - k}{1+i} \right\} \frac{1}{1+i} \]

\[ = (R_1 - C_1) \left\{ \frac{1}{1 + 1-i-k} \right\} \] \hspace{1cm} \ldots \ldots \hspace{0.5cm} (10)

Thus \( TPV \text{ Agr.} \) will be a function of \( i \) and \( k \).

\( TPV \) will also vary over size of the farm since both \( R \) and \( C \) are a function of size. Thus,

\[ TPV \text{ Agr.} = [R_1(Z) - C_1(Z)]k \] \hspace{1cm} \ldots \ldots \hspace{0.5cm} (11)

\( Z \) denotes size of farm.

We can derive \( APV \) and \( MPF \) from \( TPV \)

\[ APV = \frac{TPV}{Z} \] \hspace{1cm} \ldots \ldots \hspace{0.5cm} (12)

\[ \text{and} \quad MPV = \frac{dTPV}{dZ} \] \hspace{1cm} \ldots \ldots \hspace{0.5cm} (13)

Now we proceed to analyse \( TPV \) as a function of size which would depend upon behaviour of \( R \) and \( C \) over \( Z \). As the size of plot increases the returns would increase.

Assuming that there is no relationship between size and productivity and also assuming that the farmer remains small
enough not to influence the price of the product the returns will increase in the same proportion as the increase in plot size. We also assume technology to remain same over different sized farms.

Costs would increase with increase in size of farm. There might be some economies of scale due to use of excess capacity of some indivisible items like tractor or bullocks, pump set and sometimes even on labour. The capital costs will however increase sharply once the critical size (at which the equipment is used to its full capacity) is crossed. In case of other items, however, unless there are economies in bulk purchase, costs would increase in the same proportion as increase in plot size.

Thus the net returns would increase in increasing proportion as we proceed from a very small sized farm (say 1/4 acre or less) to larger sizes. The increased average and marginal profitability might be due to better utilisation of labour, bullocks etc. Beyond a critical size, however, the dis-economies in the shape of management problems, sudden increases in costs (due to indivisibilities) might set in. Thus for a certain range of size we might have proportionate increase in net returns followed by decreased rate of increase. The range of constant returns might be quite large in some cases.
The TPV Agr, and corresponding APV and MPV are shown in Figure 2.1. In Figure 2.1 X-axis shows the size of the farm and Y-axis presents value of the stream of returns from agriculture. TPV increases as size increases - first at an increasing rate (till size $OZ_1$) and then at a diminishing rate. APV and MPV both first show an increase followed by a decline. MPV intersects APV at the latters' highest point.

The returns from cultivation will be higher for more fertile lands than for less fertile ones. The corresponding TPV, APV and MPV curves for more fertile lands would lie above those for less fertile ones - the difference in height reflecting the difference in fertility.

We will now analyse the behaviour of returns (over time and over size) for land in urban use.

**Net Returns and Urban Use**

In urban use, land is used much more intensively than in agricultural use. Consequently returns per unit (acre or square yard) are much higher for urban land use as compared to agricultural land use. An urban user buys the land for residential, commercial, industrial, educational or recreational use. We confine our analysis to residential use alone.
FIG. 2.1: RELATION BETWEEN PRESENT VALUE OF NET RETURNS FROM LAND IN AGRICULTURAL USE AND SIZE OF FARM
Returns from residential use accrue to the owner in the form of rental. We denote the rental per annum by $R_u$. The costs associated with the residential use are the costs of construction of house (which are a once-for-all costs), maintenance costs (which are recurring costs) and other miscellaneous costs like insurance costs, taxation, fees etc. Maintenance costs are of two types - replacement costs which have to be incurred every few years like costs of replacing water-machine, pump, taps etc. and others which have to be incurred every year like white washing, minor repairs etc. We bring them both to a common denominator by spreading the replacement of fixed equipment costs evenly over their life-time. The miscellaneous costs also have to be incurred year after year.

Thus costs in urban use have three components:

$$C_u = C_{uk} + C_{um} + C_{uo}$$

$C_{uk}$ are construction costs
$C_{um}$ the maintenance costs and
$C_{uo}$ other miscellaneous costs.

\[5\] In case of self owned houses the market rental is taken to be the rent the\(\alpha\) would have had to pay for a similar house and is taken to be an index of satisfaction they derive from living in the house.
Net Returns per period (year) are $R_u - C_u$. The net returns over time are $R_{u1} - C_{u1}$, $R_{u2} - C_{u2}$, etc where subscripts 1, 2, 3, ..., refer to years. We arrive at the present value of the stream of net returns from land in urban use:

$$TPV_u = -C_{u0} + \frac{R_{u1} - C_{u1}}{(1+i)} + \frac{R_{u2} - C_{u2}}{(1+i)^2} + ... + \frac{R_{un} - C_{un}}{(1+i)^n} + \frac{S_n}{(1+i)^n} \ldots (15)$$

We take finite time horizon in case of residential land use. $S_n$ is the expected sale value of house at the end of $n^{th}$ year, $i$ is the prevailing rate of interest.

In the context of our analysis the residential use is located outside the urban area, where very few urban facilities are available. Rents presumably would be very low in the first few years but would be expected to increase over time. The assumption underlying that 'expectation' is that the city will continue to grow and forces of expansion will lead to an increase in rents. We assume that the buyer expects rents to increase in geometric progression over time.

$$R_{u2} = 1R_{u1}, \quad R_{u3} = 1R_{u2} \quad \text{and so on where } 1 > i$$

On the costs side, as noted before, construction costs are a once-for-all costs. Maintenance costs increase over time as the house grows older. Costs on counts of taxation and
insurance are expected to increase over time. Thus,

\[ C_{u2} = m C_{u1}, \quad C_{u3} = m^3 C_{u2} \text{ and as on where } m > 1. \]

Thus,

\[ \text{TPV}_u = -c_{u0} + \left[ \frac{R_{u1}}{1+i} + \frac{R_{u2}}{(1+i)^2} \right. \]

\[ \left. \cdots + \frac{R_{um}}{(1+i)^n} \right] - \]

\[ \left[ \frac{C_{u1}}{1+i} + \frac{C_{u2}}{(1+i)^2} + \cdots + \frac{C_{um}}{(1+i)^n} \right] + s_n \]

\[ = -c_{u0} + \left[ \frac{R_{u1}}{1+i} + \frac{1^2 R_{u1}}{(1+i)^2} + \frac{1^3 R_{u1}}{(1+i)^3} + \cdots + \frac{1^{n-1} R_{u1}}{(1+i)^n} \right] \]

\[ - \left[ \frac{C_{u1}}{1+i} + \frac{m C_{u1}}{(1+i)^2} + \frac{m^2 C_{u1}}{(1+i)^3} + \cdots + \frac{m^{n-1} C_{u1}}{(1+i)^n} \right] + s_n \]

\[ = -c_{u0} + \frac{R_{u1}}{1+i} \left[ 1 + \frac{1}{(1+i)} + \frac{1^2}{(1+i)^2} + \cdots + \frac{1^{n-1}}{(1+i)^{n-1}} \right] \]

\[ - \frac{C_{u1}}{1+i} \left[ 1 + \frac{m}{1+i} + \frac{m^2}{(1+i)^2} + \cdots + \frac{m^{n-1}}{(1+i)^{n-1}} \right] + s_n \]

Thus TPV_u depends upon R_u, C_u, i, l, m and s_n. The TPV_u will also vary over the size of the plot since these variables are a function of the plot size.\(^6\) We will now

\(^6\)We assume that as the plot size increases the size of house (constructed area) increases in the same proportion. We assume size to be the only variable affecting rent. Location, design of house etc. are either assumed to be the same for all houses or are supposed to have no impact on rental for our study purposes.
discuss the behaviour of \( TPV_u \) over size \( Z \). We assume, for the sake of simplicity that \( i, l \) and \( m \) are independent of size and proceed to analyze the behaviour of \( R_u, C_u \) and \( S_h \) over size.

We hypothesize that as we proceed from a very small sized plot to larger size the total rental increases in an increasing proportion, followed by an increase in diminishing proportions.\(^7\)

On the cost side we analyze the behaviour of each of cost components with respect to size and then generalize about the functional relationship between \( C_u \) and \( Z \). We start with cost of construction \( (C_{uk}) \) which comprises of two main components - labour costs and costs of materials. Material costs include expenditure on items like brick, cement, 

\(^7\)The hypothesis is based on market observations and can be substantiated from both demand and supply sides. From demand side the utility of extra space declines after a point and buyer is not prepared to pay increasing marginal rent for extra space. On supply side also extra costs of building etc. as size increases do not increase in the same proportion. Thus rents which are determined in the market as a result of interaction of demand and supply forces increase at a decreasing rate after a point. Till some point however the increase is greater than proportionate since as we move from very small size, utility of extra space increases in increasing proportion etc.
electric cables, taps and capital equipment like pump machines etc. Expenditure on all these items will increase as the plot size increases. Upto a certain size however there will be economies of scale. These economies of scale derive from advantages in bulk buying of materials as well as from indivisibility of certain equipment like water pump etc. Beyond a certain size expenses on indivisible items will increase in a spurt. Thus rate of increase of total construction costs as size increases will show certain discontinuities but within certain ranges the costs will increase in a diminishing proportion. The economies on side of materials costs are enforced by economies from labour side - especially on count of skilled labour. The fees of architect, of supervisor and mistery remains the same over increasing plot sizes upto some extent. We assume sale price ($s_n$) to increase in proportion to increase in plot size.

Thus as the plot size increases, returns increase - first in increasing and then in decreasing proportion to increase in size. Costs, on the other hand increase in diminishing proportion over a wide range of sizes - though the rate of decrease (of increase) varies over the sizes. As the plot size increases beyond the critical size capital costs increase in a spurt. This increase may not offset the
decreasing rate of increase in other costs but will definitely reduce it.

From above we can deduce about the behaviour of net returns over the plot size. As the size increases net returns will first increase in increasing proportion (R increasing in increasing proportion and C increasing in decreasing proportion) followed by an increase in diminishing proportion (assuming the rate of increase in R to be less than that of C). We show the above result graphically in Figure 2.2.

As can be seen from the diagram $TPV_u$ increases first at an increasing rate and then at a diminishing rate. The corresponding $MPV_u$ and $APV_u$ curves are inverted U-shaped curves - increasing as we proceed from a very small size to larger sizes. After a point, however, both average and marginal curves start declining.

In case of urban use of land, it will be useful to define another concept related to Present Value. The concept is that of Net Present Value which is derived by deducting the amount of money paid for purchase of land ($P_1$) from Present Value ($TPV$). Thus

$$NPV = TPV - P_1 \quad \cdots \cdots \cdots (17)$$

Assuming that price of land remains the same for different
FIG. 2.2: RELATION BETWEEN PRESENT VALUE OF NET RETURNS FROM LAND IN URBAN USE AND SIZE OF PLOT OF LAND
plot sizes, $P_1$ would increase proportionately to increase in size

$$
\frac{dP_1}{dZ} = \tilde{m} \text{ (a constant)} \quad \ldots \quad (18)
$$

Thus NPV would lie below TFV and as size increases it would increase in increasing proportion followed by an increase in diminishing proportion. The shape of NPV, MNPV and ANPV is shown in Figure 2.3.

MNPV and ANPV will lie parallelly below MPV and APV curves respectively. The difference between them reflecting the price of land.
FIG. 2.3: RELATION BETWEEN NET PRESENT VALUE OF NET RETURNS FROM LAND IN URBAN USE AND SIZE OF PLOT OF LAND