National Conference on Cadastral Reform '90
10th - 12th July, 1990

Department of Surveying and Land Information
The University of Melbourne
A CADASTRAL MODEL FOR DEVELOPING COUNTRIES

D.Jeyanandran
Department of Surveying
University of the West Indies
St. Augustine, Trinidad

&

I.P. Williamson
Department of Surveying and Land Information
The University of Melbourne, Parkville
Victoria, Australia 3052

ABSTRACT

Cadastral systems, related activities and institutions are evolving from arrangements that respond to particular societal and administrative needs of national importance with emphasis on the management of resources. Cadastral models and related studies, during the last decade, have clarified concepts, identified essential elements and broadened their use and value. This paper reviews the evolution and trends in cadastral systems, focussing attention on properties that may be applied universally and in developing countries. Considerations specific to the spectrum of countries, recognised generally as developing, are also analysed and incorporated in a cadastral model. The model facilitates an incremental approach to more refined cadastral systems, at rates of development appropriate to each of a number of localised units within a country, while serving immediate data needs of land policy formulation, and their evaluation.

EVOLUTION

The evolution of cadastral concepts and methods were slow, though their origins are traced to the ancient Egyptian and Greek civilisations; see Toms (1976) for an historical study. Larsson (1977) observed that “the cadastre is still functioning in the same fundamental manner and with the same content as generations ago.” Smith (1985) expressed similar sentiments, when reviewing the cadastral systems of South Australia, New Brunswick (Canada) and New Zealand. Modern cadastres however were influenced by two main systems, namely the European and English systems. The English system was introduced into all Commonwealth countries and had a basis in English Common Law. Williamson (1983) identifies the systems derived from the English system as ‘cadastral systems’, offers reasons for their relatively poor development and inadequacy to support land administration. He states:

“The cadastral concept (European) never reached England and never influenced its land administration system. ... changes come very slowly to land administration systems, ... reforms usually occur during instability in a country, during a revolution or after the occupation of a country by a foreign power. The impetus for western Europe came from the French revolution and subsequent influence of Napoleon I.”

Cadastral System Cadastral Surveying in the private domain, in common law jurisdictions, was almost exclusively meeting voluntary land registration needs. Consequently, each survey was seen in isolation, meeting limited user needs and its significance as a building block of cadastral maps was lost. In the state sector, cadastral surveying was supporting alienation, acquisition and administration of Crown lands. Hence there was a greater measure of standardisation in these surveys and they were recorded on cadastral maps as well. Williamson argues that the term cadastre is inappropriate in common law countries and instead the incomplete and disparate elements of what were not intended to be components of a modern cadastre be referred to as “cadastral system”. Therefore systems of conveyancing, land registration (title and deed), cadastral surveying and their applications to state and private lands constitute a cadastral system. Hensen and McLaughlin (1986) while attempting to develop a conceptual framework for studying cadastral systems define the system “as a record (including
maps) of interest in land, encompassing the nature and extent.” While they emphasise the relationship between ‘a certain man’ and a ‘certain real estate’ as central to the cadastral concept, do not differentiate between cadastral systems and cadastres.

Essential Elements Of A Cadastre Though the understanding and development of cadastres was highly limited for nearly two millennia, considerable strides seem to have been made during the last two decades. There seems to be broad agreement on the definition of cadastre and greater convergence of views on the essential elements of a modern cadastre, see for example McLaughlin (1975), Dale (1976), Williamson (1983), Eden (1988), Dale and McLaughlin (1988). These elements are:

- clear and consistent definition of each land unit within a given area (generally the propriety land unit);
- map showing every land unit in the area;
- related descriptive records (register) which contains, in respect of each land unit, details of legal rights, value, use and other connected data;
- linking mechanisms to relate every land unit on the map to the corresponding unit in the register;
- map and register should reflect all changes affecting every land unit from the time of initial compilation.

Modern Trends Researchers and professionals are now using modern methods and techniques to clarify the complex interactions between the major component elements (Dale, 1979), extend the use and scope (McLaughlin, 1976; NRC, 1983; Larsen & McLaughlin, 1977) and use econometric analysis to validate assumptions regarding land titling (Chalamwong & Feder, 1988). On the user side however, international lending agencies like the World Bank, national governments, planners and administrators are considering reforms to national cadastral systems in developing countries on the belief that they are vehicles for economic growth and social equity, see for example Holstein (1987), Williamson & Holstein (1990), CASLE (1981), World Bank (1989). Developed countries have been initiating reforms with their focus on land information and management of the environment. These reforms appear to be influenced by cadastral models developed during the last decade. Selected models and inherent assumptions are reviewed and analysed in the subsequent sections with the view to identifying features that may be applied universally.

CADASTRAL MODELS

Models are representations designed for specific purposes. The purpose may be as simple as providing visual reminders, representation, simulation, explanation, prediction, hypothesizing or experimentation. Models may be mathematical, physical, descriptive or prescriptive. They may represent processes or normative constructs of essential elements (Hogwood & Gunn, 1988). Basic to cadastral modelling are the essential elements of a cadastre, relevant processes, relationship between component parts and the environment in which they function.

Dale’s Model The application of systems analysis research to model and understand the complex interplay of elements in cadastral systems is relatively recent. Perhaps the first attempt is that of Dale’s (1976), see fig 1. In this model the central processing components are adjudication, demarcation, survey specification, survey methods and boundary descriptions. These are processing elements of cadastral surveying and the land unit recognised is the legal land parcel. The output of the system, ‘boundary description’, may be used for the production of cadastral maps, for recording title or boundaries for valuation and taxation or for planning and development (Dale, 1976). It is significant that in this model the cadastral map is external to the cadastral survey system, and the linking mechanism is the boundary description. The output elements, ‘valuation and taxation’ and ‘planning and development’ are obviously subsystems which require further inputs and their own processing units as well. Dale’s model emphasises the central role of the cadastral survey system in the broader context of a cadastral
Fig 1: Dale's Model

Fig 2: McLaughlin's Model

Fig 3: Williamson's Model
system. The cadastral map is assigned the same status in the system as the fiscal and planning units.

Dale (1979) clarifies the concept of cadastre in the context of the immediate environment - land, law and people, and their interplay. Here again the emphasis is on cadastral survey which is seen to be fundamental to the theoretical perception of cadastre.

McLauglin's Model  McLauglin (1976) and NRC (1983) have conceptualised a multipurpose cadastre in the North American context (fig 2). The need for a base map created on the firm foundations of a reference framework is emphasised in this model. The cadastral map is seen as a combination of an overlay and a base map. The overlay is constructed on the basis of land units "... for which there is a complete set of rights." (McLaughlin, 1976). The major subsystems identified are cadastral base map, title and fiscal records, administrative records (this includes data relating to buildings and their development control), and natural resource records. The land registration system is not assigned a primary position in the system structure and the need for effecting linkages between subsystems using corresponding records is emphasised.

Williamson's Model  Williamson's (1986) general concept of a cadastral system with particular orientation to land information administration is shown in fig 3. The model consists of two major components: the cadastral data base, containing graphical and descriptive information of legal land parcels and a land information system centre, intended to manage data within the overall system. The model emphasises the fundamental importance of cadastral maps and land registration in the maintenance of parcel based Land Information Systems.

Model Features  The models generally agree on the component parts of a cadastral system, though their structure and form reflect different modalities for representation, viz systems methodology in Dale's and traditional modelling in the others. It is also clear that each is influenced by the particular environment: social, economic and technological. The needs and aims are also determined by the particular levels of present development of the component elements and demands on the system. However there is general agreement on the following.

- The critical importance of cadastral maps and their use as input elements for the activities of the subsystems.
- The basic land unit is defined to be the legal parcel in environments where the land registration system is in the government sector and registers are public. The use of the proprietry land parcel as the basic land unit of the cadastral map has the major advantage that currency of the document could be maintained, without additional cost or effort, through the updates of the graphical document of a modern land registration subsystem.
- Cadastral surveying, land registration, valuation and taxation and planning and development are seen to be major subsystems in the broader cadastral system. They constitute the core subsystems in all modernisation attempts.
- The need for integrating the data needs and administration of the subsystems is also implicit in all models. The rather recent centralisation of land based departments in the Australian States and much earlier measures in Switzerland (Williamson, 1986,1981) appear to be in response to this need.

Though the essential features of a cadastre, detailed in the previous section, are ideals that very few countries, even in the developed world have achieved, cadastral models informed by systems concepts, have succeeded in focussing attention on institutional and data arrangements, which are universal. The strategy, mechanisms and technology used for achieving the arrangements may differ. Considerations particular to developing countries, that may influence the design of a model, will be explored in the subsequent sections.
CONSIDERATIONS IN CADAstral REFORM

Cadastral systems are concerned with the individual, collective and societal interests in land parcels and their resource content. Interests in land, define and regulate relationships among individuals and their behavior relative to one another, to space units, and to the resource they contain. Land registration, conveyancing and cadastral surveying are procedures for defining the interests of individuals in specific parcels of land. Land taxation and development planning and control are processes that express the public interest in the same parcel. The relationship and interests may be formal or informal with national, regional or local significance and acceptance. Cadastral reform seeks to change the land-people relationship. As well, reforms include aspects of social, political, economical, legal, physical, technological and administrative sectors of a nation. Such considerations also require an understanding of existing systems, methods and procedures. Studies and guides to evaluate existing systems and formulate improvements in developing countries are in Dale and McLaughlin (1988), Holstein (1987), UN (1968). This study discusses cadastral reform in the context of aspects of component elements of the reform process, particularly the users. Cadastral reform introduces fundamental changes to existing cadastral system (formal or informal) of a country, to elicit particular responses from the users. The reform process involves a network of systems.

The Reform Cycle The component systems of the reform process are: the system that is applied, the system that responds, the facilitating system, the enabling system, the processing system, and the evaluating system; see fig 4.

Reform is initiated and advocated by the professions, facilitated by governments through policy instruments, enabled through the provision of resources by administrative institutions, implemented and processed using technology, chosen by the corresponding agencies, resulting in services and products to which people are required to respond in a manner envisaged by the reform. The evaluating system in the reform cycle is required to assess the success of the reform, establish causal relationship between reform and their effects, identify...
problems and provide information for the design and implementation of new programmes or changes to the system (Rubin & Babbie 1989). As well such information is required to demonstrate to policy makers the social and economic returns that may be expected from cadastral programmes. When cadastral reforms or changes were introduced in the past, it would appear that sufficient attention was not paid to ‘evaluating systems’ and hence there is a paucity of ‘hard evidence’ to support qualitative judgements. In the recent past however, evaluation of aspects of cadastral reform were conducted by the World Bank; see for example Feder & others (1988), Jimenez (1984). Such evaluation provides information for further studies and to bridge ‘weak links’ in the cadastral reform cycle. ‘Weak links’ or ‘soft spots’ may be located in each of the systems in the cadastral reform cycle and their links. The next section analyses items percieved as ‘soft spots’ or ‘weak links’.

‘Soft Spots’ In Cadastral Reform

“If one is trying to alter a system which has some inbuilt buffering, one of the most important first steps is to try to locate these ‘soft spots’” (Waddington, 1977). Soft spots of particular relevance to developing countries are in the responding system and cadastral system. The responding system includes the users of cadastral services and their environment. Social forces and levels of social security are environmental factors that influence user perception of land and their responses to cadastral reform. As well cadastral systems represent relationships between land, people, social groups and the state.

Spatial Distribution Of Social Groups In traditional societies of many developing countries (in Asia, Africa, Europe and Latin America), land-people relationships and interests evolved over many centuries. The evolution was influenced, by the limited mobility of people. Hence the perception of land and connected relationship are dependant on the spatial location of any group, for example: those along maritime regions, in capital cities, new settlement areas. It is also evident that social groups may be identified with particular ‘blocks’ or ‘tracts’ of land parcels. These blocks may be composed of a number of contiguous, individual, proprietry parcels (as in Asia) or communally owned units (as in Africa). Similarly, methods, procedures and institutions required to manage corresponding rights and responsibilities had also evolved. Therefore changes or reform may have to recognise the heterogenous nature of social groups and their relationship to land. The heterogeneity is more marked in developing countries. Singer and Reynolds (1976) who investigated aspects of the distribution of income and wealth in Kenya concluded that wage and salary differentials are very wide, “... large earning differences between the formal and the informal sectors, between towns and rural areas, between racial groups, and between geographical regions.” Therefore, societal responses to changes in cadastral systems may be expected to be dependant on the spatial location of social groups. The spatial locations may not only be identified as urban and rural, for even in urban areas groupings may be characterised by ethnicity, affluence and rural origins. Two major factors that contribute to this difference are the perception of land influenced by social forces and the level of social security. These in turn affect land markets.

Social Forces Models of cadastral systems for developing countries should take cognisance of the differences in the perception of land. The dominant commercial view of land prevalent in most developed countries may not be appropriate. Social forces encourage and foster a sense of belonging and pride in being a member of a family, traditional group or village. Land acts as the conduit for the social process and has great cultural significance. Hence, permanent geographical mobility of individuals is also limited. Further, the imperatives of survival, influenced by the perception of land as fulfilling basic needs of living tend to counter market forces. Thus the volume of land open to market forces is much smaller in developing countries. Therefore, corresponding prices are also relatively very high as observed by the World Bank (Holstien, 1989). Consequently, few have the potential to buy land and this further strengthens social forces.

Levels Of Social Security Another factor that contributes to differences in perception of land and limitations in the land markets of developing countries is inadequacies in social security. Governments in the developed countries spend on the average 40% of their annual
revenue on social security. The corresponding figure for the developing countries is 6 - 20%, (World Bank, 1989). Whereas high levels of social security removes dependance on the family and village groups, low levels increases dependance, resulting in stronger attachment to interests in land. Chambers (1986), investigating poverty in rural Asia notes ‘... large owners are recorded as selling over ten times as much land as medium and small owners.’ Markets flourish in an environment of entrepreneurship which in turn abounds in an atmosphere of greater security. The use of land as collateral to generate funds for investment again in the land or other venture, necessitates a measure of risk of losing the land itself. The consequences of the loss of land, which may be the only source of livelihood or shelter, are less acute, if the state provides social security. Therefore cadastral reform which seeks to alter development patterns by stimulating land markets should recognise the

- nature and distribution of social forces and levels of social security;
- relevance of spatial locations of groups of people and their traditional relationship to land.

Cadastral Systems Soft spots in cadastral systems relate to the need to maintain the integrity of cadastres on a continuous basis. The legal, fiscal and land use cadastres, required to instal and operate each of the subsystem, would in general cover the entire country. (Exceptions may be in passive land registration subsystems or localised systems). The resources required to build even rudimentary cadastres of national magnitudes are considerable. These cadastres should in addition be continuously updated, to mirror all changes in land tenure, value and land use, of every land parcel, in the country. The operations require user cooperation and commitment from the producers of the system.

User Response The process of maintaining cadastres may not be seen as projects or events that, once established are completed. The process involves activities by relevant people and state agencies. The chain of activities for updating the legal and use cadastres should be initiated by people, while those of fiscal cadastres may, ideally, be effected through the legal cadastre. Therefore legal and land use cadastres are by nature user driven. This implies that the integrity of the user driven cadastres may not be maintained without the active cooperation of the people. The response of people to reform may vary from active evasion of relevant laws, to indifference, to compliance; see for instance, Da Costa Lobo (1982) regarding planning controls and illegal subdivisions in South European countries. Singer and Reynolds (1976) report that traditional land use rights continue in Kenya within areas of registered land; Holstein (1989) referring to Belo Horizonte, Brazil; states that many properties had been sold informally and therefore they are not reflected in official land registers. User responses are also likely to correspond to social groups referred to in the previous section. Enforcing cadastral reform may not be an acceptable or resource efficient option. Therefore improving peoples preferences for the products of cadastral systems appears an effective, and perhaps efficient strategy. This implies that a range of cadastral services and products should be made accessible to people. As well cadastral reform should be introduced when the people are receptive to change.

Timing Reform “It is no use trying to act on the system to divert it into a particular branch until it has become competent to respond, by going down the valley towards which you have pushed it. Equally, of course, it is not advisable to leave the push until too late” (Waddington, 1977). In general, if intervention occurs before a group is ‘competent’ to respond, the effect of the ‘push’ will be dissipated. In practice, however, the problem is to determine the appropriate time to intervene. Mechanisms should therefore be in place to monitor ‘competence’ and implement cadastral changes by improving peoples preferences, incrementally. The incremental approach, in the context of spatial distribution of responses, suggests reform measures spread over time and space.

Sustaining Reform Governments facilitate reforms by enacting appropriate laws and apportioning human and financial resources. To be successful, cadastral reform requires the concurrence and continued support of governments at the highest level. Reform involves major resource requirements, policy initiatives, sustained effort and continuity in the maintainance of
the system. Highly evolved systems operating in Switzerland and Germany were developed over six to seven decades (Williamson, 1982). LRIS Canada spent about 10 years to establish the cadastral base (Mc Laughlin, 1989). Thailand project is expected to be completed in 20 years (Angus Leppard, 1989). It is therefore important that policies relating to cadastral reforms be founded on adequate information on all aspects of the reform cycle. Even if policies are well founded policy objectives may not be realised if they are not supported by efficient and effective administration. Further, skilled processing of activities are required to ensure the success of the policy and administrative measures (Rubin & Babbie, 1989). Choice of policies should therefore be also in keeping with the ability and potential of the administrative and operational arms of government. Cadastral reforms or objectives which may not be realised through resources within the control and continued reach of developing countries may be rejected in favour of others which are less demanding.

Objectives Of Reform
Cadastral reform and corresponding modelling are also intended to meet particular immediate national objectives. In developed economies these objectives are mostly in the operation, management and environmental domains as evident by the focus on land information. In developing countries, issues involving the land delivery system, land administration, state land management, unauthorised occupation of state land, squatter settlements, land acquisition, state leases and land tenure systems, land and building taxes, rapid urbanisation and related urban and rural land development and many others engage the attention of governments. The nature and intensity of the issues vary within and between developing countries. Information is required to understand the problems, trends and opportunities for intervention. The policy making process begins with the awareness of the issues (Hogwood and Gunn 1988). Cadastral reform should provide the tools to address these issues. As well, it would appear that in formulating policies, an increasing tendency to distrust national aggregates and prescriptions which do not consider spatial variations, has emerged, and “there is pressure to look beyond these to the pattern of distribution and dependency, (my emphasis) and to problems of inequality, poverty and unemployment.” (UNESCO 1976). Cadastral maps and registers which are invaluable in land administration and management are useful sources of information to understand the nature of land problems and to formulate appropriate policy measures for redress. Such information may however be collected at levels of resolution lower than the legal land parcel, since aggregated information over blocks of few hundred property land units or blocks of occupied parcels would meet the requirements. Similar information is required to intervene in the land delivery systems of developing countries.

Land Delivery System An ideal land delivery system should enable planned access to land to meet basic and developmental needs of the people. National interests demand that those who have access to land, use it productively and in a manner sensitive to development objectives. These objectives may be met through land markets, by state intervention or a combination of strategies. In countries where land markets are relatively inactive, markets may be stimulated; land needs may be met through land acquisition and reform, from state lands or a combination of these options. Fundamental to these options and strategies is the need for data relating to land and their present use, both in the state and private sectors. Cadastral reform and corresponding modelling should be sensitive to this need. As well, trends in urbanisation add further dimensions to the issues relating to land delivery system of a country.

Urban Sector Thirty to sixty percent of the population of developing countries live in urban areas. The lower figure refers to countries with poorer economies and in the lower half of the spectrum of developing countries. The annual urban growth is over twice the population growth. In countries with poorer economies, the number of urban areas with over half million is increasing by hundred percent every ten years, whereas for countries in the upper half of the spectrum the corresponding figure is about thirty years (World Bank, 1989). Therefore there is great pressure and demand on the urban and peri-urban land, infrastructure, services and supplies. The process of urbanisation is stabilising in countries which are in the upper end of the spectrum whilst the growth process may continue for another twenty to thirty years in the others. This implies that in respect of the former group of countries, cadastral systems should
be able to respond, to the urban problems that are being experienced by the people, whereas in the latter, planning for urbanisation may be more important.

**Rural Sector** Cadastral reforms in developing countries must also recognise the changes occurring in the rural sector. Urban migration from rural areas, at rates greater than population growth, affects agricultural production. The effects are noticeable in developing countries in the upper half of the spectrum. They have increased their cereal imports by over 75% with hardly any change in the index of food production. The index of production for countries in the lower half increased by 15% while imports increased 20% (World Bank, 1989). Countries like Poland and Hungary which are in the former category have been attempting land consolidation measures to improve productivity (FIG, 1977). Similar measures may be required in other countries as well. Appropriate land taxation and rural land management measures may require to be introduced to induce increased production in environments where land holdings are small, distribution skewed, and cultural attachment to land so high that owners would not sell.

It is clear that the considerations for cadastral reform in developing countries are complex. Reform which is seen as providing greater security of land tenure to the owner, may be viewed as irrelevant in traditional environments, where land transactions are between relatives within social groups. As well, the motivation to use the security to obtain financial credit may be influenced by risk factors, levels of social security, social and other cultural forces, size of holdings and the amount of credit that may be obtained from formal institutions. In urban centres and areas where security of tenure is questionable, as in unauthorised occupation of state and private land, cadastral reform which provides greater security can be expected to be user driven. It must also be recognised that there are many examples of reversion to informal arrangements after tenure deficiencies were removed through formal arrangements. However the importance of cadastres as data sources to understand land related issues, identify trends, formulate policies for intervention and implement appropriate programmes of land administration is quite evident. Cadastres which are by nature user driven, may not reflect the prevailing land tenure arrangements, in environments described earlier and therefore will have corresponding adverse effects on land administration. Land registration arrangements may be legislated but not enforced unlike fiscal or planning provisions. Therefore an evolutionary approach which meets data needs of land administration while influencing the preferences of people to better land tenure arrangements is proposed.

**THE CADAstral MODEL**

A cadastral model is seen as a particular combination of essential elements of a cadastre, which recognises and incorporates stated considerations and requirements. Considerations relevant to developing countries were analysed in the last section. It must be recognised that developing countries constitute a spectrum of over one hundred countries. The position of any one country in the spectrum depends on the indicator used to characterise them. Therefore the considerations relating to modelling cadastral systems should also be viewed in the same context. The following is a summary for incorporation in the model.

1. In traditional societies land - people relationships are heterogenous, but they are uniform within social groups or corresponding blocks or tracts of land parcels.
2. Perception of land influenced by social factors tends to limit land markets. Social factors have spatial distributions corresponding to social groups and blocks of proprietary land parcels.
3. Cadastral systems, requiring changes in the traditional land-people relationship, may not be received favourably by the people. User responses to such systems are likely to accord with social groups.
4. Improving peoples preferences for more secure land registration systems is a more acceptable and efficient option than enforcing reform.
5. A range of options for recording tenure, sensitive to peoples purchasing and accessing capability, should be offered.
6. Cadastral reform should be affordable, sustainable and appropriate.
7. Cadastral reform should enable data for the clarification and resolution of land issues, particularly relating to land delivery system in urban and rural sectors.

8. The system should facilitate identification of state land, help expedite land acquisition procedures, enable land administration in general and manage state lands in particular.

Requirements derived from the study of models in a previous section are as follows.

9. Agencies responsible for cadastral surveying, valuation and land tax, planning and development, state land management and where possible land registration, should be brought under a single efficient administrative arrangement.

10. The same cadastral base map should be used by all the agencies identified above and their data needs should be rationalised.

In designing a model considerations 3, 4 and 5 above are given prime importance. A framework for understanding the land-people relationship is developed by grouping proprietary parcels into blocks. The cadastral model has features to facilitate an incremental and evolutionary approach. The objective will be to move towards more refined systems, while meeting immediate needs identified in 6, 7, and 8.

FIG. 5: CADAstral MODEL For DEVELOPING COUNTRIES

The essential elements of a cadastre, identified in a previous section, are adopted as follows to correspond with blocks of proprietary land units.
The basic land unit for the purpose of the cadastral map will be aggregates of proprietary land parcels. These aggregates, blocks, enclosures or tracts shall contain about one hundred to four hundred land parcels -lower figure for urban areas -, bounded by permanent natural or artificial features. The delineation of blocks will be on the basis of land value and use in urban areas, availability of infrastructure facilities and development needs in periurban areas, agricultural and social considerations in rural areas. Where possible state land should be separate blocks with lease, vested and reserved land identified.

Cadastral maps will be prepared by recording the block boundaries on available large scale topographical maps or on maps derived from unrectified enlargements of aerial photographs. The accuracy and scale of the maps will correspond to block sizes and available survey and mapping resources.

All land registration records, land and building tax rolls and planning and development data available at present will be re-arranged to accord with the block system. Land parcels without registration records will be identified.

Each block shall be assigned a unique identifier. Every land parcel and corresponding record will be referenced to it.

Changes affecting land units already in the formal system, and those transferring from one tenure system to another, will continue to be recorded in the block system. However changes in the preferences within each block will also be monitored so that the transition of any block unit to individual legal parcel unit system may be effected and maintained thereafter. This transition of blocks may not depend on the status of other blocks but on proprietary units within the block and a set of conditions defined for the purpose.

The requirements identified at 9 and 10 should be implemented as far as possible. As well, rationalisation of electoral, enumeration, administrative and the block boundaries proposed in this model, will provide further benefits.

Special features of the model are as follows.

- Boundaries of the blocks are relatively permanent, identifiable on ground and therefore recognised even without maps.
- Enables preferences for cadastral products through comparison between blocks and selective education of people, who hold rights within a block.
- Enables evolution of cadastral system and facilitates selective intervention in land issues.
- Provides the basis for reorganising land and other data on a geographical - (block) basis.
- Flexibility in, the size of the blocks, use of technology and cadastral practices.
- Involves very little additional resources but provides for orderly improvement of cadastral system in keeping with user demands in specific spatial areas.

The major drawback in the proposed model is the need to monitor, record and administer a number of different land tenure systems in the initial phases. The need to provide financially accessible cadastral products also implies a range of innovative legal and survey procedures, each or few of which, may apply in any one block. The model, however, attempts to meet the land data needs of government agencies while improving people’s preferences for cadastral products. Perhaps both objectives may not be realised without a measure of complexity.

CONCLUDING REMARKS

Land continues to be a major source of concern and contentious issues, both in the developed and developing countries, though its direct contribution to national economies is diminishing. While environmental and recreational concerns are at one end of the spectrum of issues, basic needs of living are at the other. Land information is central to the clarification of these issues, for seeking trends, formulating policies and implementing them. Legal, fiscal and use
cadastres are necessary components of land information. Legal and use cadastres are by nature user driven and therefore require the active cooperation of the people for maintenance. The maintenance of the cadastres is as important as their initial creation. Where requirements are imposed on people without regard to their needs or ability to access cadastral products, maintenance presents increasing difficulty. Cadastral data needs of state and other agencies are dominant factors that generally motivate cadastral reform. Where these needs do not accord with the people’s, compromises are imperative. The cadastral model proposed in this paper attempts to define such a compromise. It prescribes a dynamic arrangement that facilitates evolution of cadastral systems of developing countries.

REFERENCES


