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A CADASTRAL MODEL FOR LOW VALUE LANDS THE NSW WESTERN LANDS EXPERIENCE

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ABSTRACT

The operation of the cadastre in the semi-arid lands of Western New South Wales has remained relatively unchanged since settlement. This paper examines the problem of sustainable resource use and how the introduction of a Multi-Purpose Cadastre can provide a more certain future. The development and use of a consistent spatial framework, comprehensive datasets and new rules and procedures for boundary definition and demarcation are proposed as improvements to the existing cadastral system.

INTRODUCTION

Semi-arid lands, which are often regarded as being of limited economic value because of their low production potential, require careful management to ensure sustainable use of land and renewable resources. There are numerous examples world wide where inappropriate land management practices have led to land degradation and desertification;

> *"the impoverishment of arid, semiarid and some subhumid ecosystems by the combined impact of man's activities and drought" (Dregne, 1977).*

and the consequences of social disruption and economic hardship. Globally desertification is revealed as "a pressing global problem of the first order" (Mabbut, 1978).

In mainland Australia, an examination of any atlas showing climatic zones will reveal that more than 50% of the continent is classified as arid or semi-arid. All of the largest States and Territory- namely Western Australia, Queensland, South Australia, Northern Territory and New South Wales, contain large tracts of semi-arid lands, commonly referred to as rangelands.

The Western Division of NSW is a land management unit covering 42% of the State and is characterised by its semi-arid climate, low population density and restricted production potential. This area is the size of Great Britain and Ireland combined. About 95% of the total area is held under perpetual lease for pastoral purposes from the Crown by some 1350 pastoralists.

Western Division of New South Wales

Difficulties faced by low value rangelands comprising the bulk of the Western Division include:

- Land degradation including soil erosion, woody weed infestation and salinity problems as a consequence of past land management practices.
- Declining water quality, evidenced by the occurrence of blue-green algal blooms, increased turbidity and the need for increased water treatment for potable water.
- Low commodity prices coupled with rising production costs have increased economic pressures on farmers which in turn has forced some to adopt unsustainable practice.

No other region in NSW has experienced such a marked decline in productivity in recent times. Gross income in the region has declined by an estimated $200 million in the past 5 years. (Western Lands Commission, 1992)

Similar parallels can be drawn from other low value, marginal lands from around the world e.g. North Africa, and in particular those countries adjoining the Sahara. (Falloux, 1989)

New technology has given us the ability to better collect and use information about the landscape, however the rules and procedures which govern the operation of the cadastre and land tenure are largely unchanged.

The purpose of this paper is to examine the role of the cadastre in the Western Division and the benefits that can be gained by the adoption of a modern Multipurpose cadastre. A new approach, utilizing modern positioning and spatial information technologies and the application of general boundaries principles are discussed.

Historical Development of the NSW Cadastral System

The settlement and early colonisation of NSW followed the English (feudal) system of granting rights to colonists and the recording of those rights by the registration of deeds. In the West, the "Squatting Era" between 1830-1884 was characterised by largely unregulated occupation of the Western Region, accelerated by the discovery of gold. Pastoralists occupied "runs", large tracts of land which were only regarded as suitable for grazing. The Robertson Land Act of 1861, brought some control to settlement by introducing selection before survey with the Crown Lands Act 1884 dividing "runs" into Leasehold Areas (short term leases) and Resumed Areas (available for settlement as smaller homestead leases) and introducing local land boards which took land allocation out of political control.

Legislation was subsequently introduced to encourage closer settlement and more fairer allocation of land by the provision of new tenures, classification of land, survey before selection, and the "one man one selection" principle. The Western Lands Act 1901 was introduced to administer the Western Division after a Royal Commission inquiry. The inquiry followed a severe drought and depression which led to the abandonment of many holdings and the need for a period of financial and environmental rehabilitation.

The demarcation of these leases on the ground followed standards of survey established to support the introduction of the Torrens system of registration of title. These accuracy standards were related to topography and not land value. The scarcity of features or improvements also meant that general boundaries principles could not easily be applied or adopted.

This meant that in theory, a cadastral survey over "flat" land for the purposes of alienation, long-term lease or subdivision had to achieve the same accuracy standards (1:8000 linear misclose ratio) whether it was in the urban area of Sydney or over leasehold lands in the Western Division.

From 1950 to the late 1970's a large number of surveys were undertaken in the Western Division due to pressure for soldier settlement after World War II and the subsequent withdrawal of land from the larger holdings. Other lands also became available from expiring leases held by pastoral companies. These surveys were undertaken by contracted and Department of Lands surveyors. The actual cost of survey was supplemented by the Government with the incoming lessee paying a prescribed concessional survey fee based on area.

Surveys were undertaken in accordance with directions issued by the Surveyor General and the Survey Practice Regulations, 1933. The Department of Lands Survey Directions 1963 for surveys of Crown land were later published as a supplement to the Survey Practice Regulations. Crown land in the Western Division was brought under the Torrens Title system and requirements of the Real Property Act from 1986-1988.

The application of these standards has caused many to claim that survey costs over small parcels or leasehold rural lands are more than the value of the land in many circumstances. Even though photogrammetry had developed as an efficient mapping technique Post World War II, it was not actively pursued as a means of assisting cadastral systems in the West until recently.

Problems in the West

The operation of a uniform cadastral system for the demarcation and recording of rights over land whilst having benefits to the people of NSW in terms of security of title and confidence in the marking of boundaries delineating different interest, poses some problems for the West.

Some of the problems include:

- High costs of cadastral surveys when compared to land value.
- Emphasis placed on marked "artificial" boundaries which represent the legal cadastre as distinct from "as occupied" boundaries which have a greater significance for landholders.
- The nature of the cadastral pattern which, historically, was set out on cardinal bearings forming rectangles enclosing an allotted area was relatively and cheap. This practice however largely ignored natural boundaries such as catchment, soil or vegetation type. Generally only major natural features, such as rivers and lakes were adopted as boundaries. This approach causes major problems to mechanised agriculture and the design and implementation of soil and water conservation measures.

In the early 1990's Government recognised an inherent legal problem in the network of legal roads for the West. In the past, when subdividing Crown land within the Western Division, the practice of ensuring that each subdivided parcel was serviced by a legal means of access in the form of a road, was only partially adopted. Whilst some legal roads were created in the Western Division, in the majority of cases reliance was placed on a covenant in virtually all Western Land leases that the lessee was "not to obstruct or interfere with any reserves, roads or tracks or the use thereof by any person".

This clause was traditionally interpreted by administrators and by virtually all lessees as providing unrestricted rights to members of the public to use any track or constructed road within the boundaries of a Western Lands lease.

There is some doubt as to the legal standing of this clause. As a result, the Government has taken steps towards implementing a program to re-establish a network of legal roads within the Division to provide adequate access for lessees, the general public and for community purposes.

To establish this network, tracks in current use which may be legally established as roads need to be accurately identified, then assessed or adjucated as to whether the track is used solely for internal property management purposes or whether other persons, including adjoining lease holders, have used it from time to time for access.

The re-creation of a legal road network, that is, the "skeleton" of the cadastral pattern is a catalyst for cadastral reform and presents an ideal opportunity to examine and adopt a more relevant system.

A Vision for Managing Low Value Rangelands in Western NSW

Whilst the Western Division historically made a significant contribution to the economy of the State, new sustainable levels of resource use must be found.

It is suggested that any future strategy or vision for low value rangelands needs to include:

1. Sustainable land-use in the long-term bringing together the concepts of economic and environmental sustainability with productivity sustained or enhanced over the long- term. (NSW

Farmers Association, 1996)

2. Comprehensive, integrated datasets related to land markets, land management, natural resources and the "as built" environment for better decision-making.
3. Simplified, cost-effective processes which underpin the operation of the cadastre e.g. "on line" conveyancing and land administration, demarcation/re-establishment of cadastral boundaries using fast and efficient techniques such as the Global Positioning System (GPS) and photogrammetric techniques.
4. System of land parcel boundaries and interests in land clearly defined, easily relocatable, more closely aligned with catchment and sub-catchment boundaries and enclosing areas regarded as viable economic farming/grazing units.

The last three elements listed above form components of a Multi-Purpose Cadastre (MPC) .

A Multi-Purpose Cadastre is defined as:

> A large-scale, community oriented land information system designed to serve both public and private organisations and individual citizens. Its distinguishing characteristics are that it:
>
> 1. Employs a proprietary land unit (the cadastral parcel) as the fundamental unit of spatial organisation;
> 2. Relates a series of land records (such as land tenure, land value and land use) to this parcel;
> 3. Is wherever possible complete in terms of spatial cover;
> 4. Provides a ready and efficient means of access to the data.
>
> (Dale and McLaughlin, 1988)

Technology

The advent and rapid development of information technology which has the ability to capture, process, store, query and display large sets of spatial and textual data has given decision makers powerful tools for resource management.

Digital photogrammetry can be used to create comprehensive three dimensional models over large areas with the ability to spatially locate features on the ground such as railways, dams, fence lines, track centre-lines, waterways, catchments etc which can be used as land parcel boundaries with an estimated accuracy of ˜ 3-5m.

Global Positioning System (GPS) technology can be used to capture spatial information and other attribute information relating to natural resource or the "as built" environment. GPS is also a powerful tool for completing and densifying geodetic networks.

Geographic Information Systems provide a capability to store, analyse and manipulate geographic data and the ability to integrate various data types, particularly where temporal studies are involved.

The combination of these enabling technologies can deliver the comprehensive, reliable information sources required for better decision making.

A Modern Cadastral System for Western NSW

The development of a multi-purpose cadastre suitable for the Western Division rangelands involves the provision of a number of components.

1. Consistent Spatial Framework

A consistent and comprehensive geodetic network, i.e a system of widely spaced marks with known position makes it possible to establish spatial linkages between all relevant land information, so that any features can be related spatially.

Over the past 2 years, the GPS High Precision network which comprises geodetic stations at a 100km spacing has been further densified by the NSW Land Information Centre. The establishment of an additional 100 marks in the Western Division provides a network of permanent marks at a nominal 50km spacing across the whole Division. The majority of these additional marks are along main roads, some of which were placed during the establishment of the Australian Height Datum in the early 1970's and until recently only had accurate heights.

The 50km spacing is based on the expectation that Differential GPS techniques will increasingly be used for positioning applications, including cadastral re-establishment, in the future.

2. Comprehensive Datasets

The spatial framework or geodetic survey provides a basis for digital mapping. In the case of the Western Division, GPS controlled photography is being used to generate photogrammetric models which accurately shows natural and man-made features. It has been shown previously (Kelly and Harcombe, 1996) that this approach is more cost-effective for the capture of road centre-line data in terms of coverage and the ability of the data to be used for a range of other purposes.

Such an approach allows:

- Road and Track centre-lines to be captured to an accuracy of ˜ 3-5m which can then be used to create road casements.
- Fence-lines to be positioned to a similar accuracy, which when shown to be coincident with the "as surveyed" cadastral patterns, and integrated with the Digital Cadastral Database (DCDB) and road casements can be used to create Deposited Plans for legal road definition purposes.

This combination of digital topographic data with the DCDB provides the base mapping components of a modern multi-purpose cadastre. The enhancement or integration of other natural resource datasets relating to fauna, soils, vegetation and water derived from remote sensing or field survey methods with digital topographic data will also provide land managers with the best information for land-use planning.

The estimated costs of providing this infrastructure, including spatial framework improvement and photogrammetry, based on work done to date is $14 per square kilometre.

3. Simplified, Cost-effective Processes

The rapid development of modern communication and information technology such as the Internet provides a means of reducing the problems of isolation and distance, as well as the potential benefits from automation of existing manual processes.

Strategies are being developed for the electronic collection and processing of survey information. Some transactions supporting land markets are already partially handled in digital form e.g. Notice of Sale. The recording and processing of rights, restrictions and responsibilities that people have with respect to the land can be streamlined through further automation and be made more accessible "on-line".

Technical directions are being finalised to facilitate the use of GPS for cadastral surveys which can provide potential savings over conventional methods for the demarcation and relocation of cadastral boundaries.

Cadastral survey accuracy standards for various classes of land however will need to be revised, particularly for rangelands, to be compatible with the value of the land, user requirements and to take maximum advantage of GPS and digital photogrammetry technology.

4. Occupational Boundaries, Land Consolidation

   The re-establishment of a legal road network using digital photogrammetry which enables fence lines or roads or rail lines to be positioned to ˜ 3-5m and when integrated with the DCDB provides a digital "cadastral mapping" solution rather than a system of individual cadastral surveys.

   The adoption of occupations, such as intersection of fences and well established fence lines, roads or railways, which are recorded in a rectified digital photogrammetric model is suggested as an unambiguous, well defined system of demarcation of land rights.

   A further step could be to investigate the application of land consolidation methodologies, which are well-established in Europe, to rangelands. This would involve the re-arrangement of property boundaries to more closely align with catchment and sub-catchment boundaries. Studies in Queensland (Hannigan and Webb, 1995) have identified:

   > *"It has been established that the optimum unit for the management of natural resources is the catchment, therefore Reconstruction Schemes would seek to improve catchment management by re-aligning boundaries to coincide with catchment and sub-catchment divides, and enclosing areas approaching what may be considered a viable economic farming unit."*

   Hannigan and Farmer (1995) have developed a broad social, economic, administrative and legal model for implementing farm reconstruction and boundary re-arrangement in Australia. Their study showed that a boundary re-arrangement can reduce ecological conflicts and better accommodate natures pattern of movement and flows. Further testing will establish the applicability of this model to rangeland Australia. Community/land holder input is an essential component to initiate and drive any re-construction scheme, existing community/landholder environmental schemes such as Landcare may be useful catalysts.

Conclusion

The need for a sustainable future for rangeland Western NSW and the re-establishment of a legal road network are catalysts for cadastral reform.

It is argued that concepts such as a Multi-Purpose Cadastre, use of new technologies, appropriate boundary definition and demarcation rules and procedures and re-arrangement of property boundaries can facilitate better land resource management.

Some components of a Multi-Purpose Cadastre are well advanced or underway, that is,

- Consistent spatial framework
- Comprehensive datasets providing digital base mapping
- Development of standards, procedures and systems to apply modern technology such as GPS, GIS, Internet etc to improve processes underlying the operation of the cadastre.
- Development of appropriate boundary definition and demarcation rules and procedures.

Australian models of land consolidation are available and need to be further tested for their applicability to rangelands. Cadastral reform has commenced, however there is further work to be done to redefine the most appropriate cadastral system for rangelands. Most importantly the people of the West need to recognize the need for change to secure a sustainable future.

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