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Land-use Decision-making and Landscape Degradation: a case study in the American Southwest

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Abstract

This study examines the role of land-use decision-making of different actor groups, including land developers, politicians, residents, NGOs and city planners, in contributing to land degradation in the American Southwest. Perceptions of different actor groups of the desert landscape are first explored then the motivations and priorities of actor groups to make land-use decisions are investigated. It was found that perceptions of landscape are connected with its functional and intrinsic values. Different groups appreciated functional values with their specific needs and interests. Also, an appreciation of intrinsic values of landscape is partly associated with functional values. By taking a political ecology approach, this study investigates the complex relationships between human land-use decisions and environmental changes and between different actor groups. Issues of power were found to be significant in land use and management practice, and a small number of actors were perceived by others to have more power to control the use and access to the resources. Relationships between and within different actor groups are complex, and conflict when special interests and needs of actors are apparent with some actors considering their rights and power to be limited and diminished by others. Decisions made at local scale are often affected by the regulations and policies operating at regional and national scales. Results also revealed that historical and cultural influences played a role in the decision-making process. In addition, it was found that poor communications exist between actor groups and between different levels of government, and misunderstanding and lack of negotiation between each other can result in conflicts and competition. Land managers and planners need to incorporate opinions and expectations from a wider public and balance the complex diversity of needs of different actor groups.

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Table of Acronyms and Abbreviations

BLM	Bureau of Land Management
CAP LTER	Central Arizona-Phoenix Long-Term Ecological Research
CDD	Community Development Department
CDRRC	Chihuahuan Desert Rangeland Research Centre
CNDP	Chihuahuan Nature Desert Park
CWA	Clean Water Act
EHA	Enlarged Homestead Act
EPA	Environment Protection Agency
ESA	Endangered Species Act
FLPMA	Federal Land Policy and Management Act
GPCD	Gallons Per Capita Per Day
GRT	Grocery Receipt Tax
LTER	Long Term Ecological Research
MoNaS	Museum of Nature and Science
NEPA	National Environmental Policy Act
NGO	Non-governmental Organisation
NMSU	New Mexico State University
NMWA	New Mexico Wilderness Alliance
NRCS	Natural Resources Conservation Service
NYC	New York City
PUD	Planned Unit development
SCPEA	Standard City Planning Enabling Act
SES	Soil Erosion Service
SSZEA	Standard State Zoning Enabling Act
US	United States
USDA-ARS	United States Department of Agriculture – Agricultural

	Research Service
USDC	United States Department of Commerce
USDD	United States Department of Defense
WRCO	Water Resources City Ordinance

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Chapter 1 Introduction

1.1 Introduction

This research focuses on the relationship between land-use decision-making and land degradation in drylands. The American Southwest is used as a case study to explore the decision-making process and its related land degradation problem. This chapter provides an outline of the research. It starts with a brief overview of the background to land degradation as a critical environment issue, and the importance of land-use decision-making. It then presents the approach, aim and objectives of the research and ends with an outline of the thesis structure.

1.2 Background to land degradation

Dryland covers about 41 percent of the surface of the earth (UNCCD, 1994), and is inhabited by more than two billion people (UNCCD, 1994). A total of 70 percent of dryland is affected by land degradation (UNEP, 1992). The causes of dryland degradation are generally considered to be a complex interplay of biophysical and anthropogenic factors that operate at different scales (Geist, 2005; Ravi et al., 2009). Human inappropriate land uses are the primary causes of land degradation, but climatic factors such as drought and rainfall variability have increased the levels of stress in dryland ecosystems (UNCCD, 1994).

Human inappropriate land uses and land management practices include overgrazing, overcultivation, deforestation, poor irrigation system and other inefficient water uses (Hethcote, 1983; Mainguet, 1991; Middleton, 1991; Thomas and Middleton, 1994; Walls, 1980; Williams, 1996). Each of these actions degrades vegetation and soils in different ways. Through overgrazing, for example, whereby too many animals are grazed in one particular area throughout the year, there is a decline in valuable perennial grasses which are good at holding the soil together; vegetation density declines, soil compaction and sealing occurs due to trampling by livestock near waterholes, and soil erosion is increased. Cropping has a more intense effect on the soil as it requires clearance of vegetation and cultivation of the soil, and hence the soil is exposed for long

periods of time each year. Overcultivation reduces soil fertility and water-holding capacity, and increases surface runoff and soil vulnerability to water and wind erosion. Organic matter also reduces as crop residues are cut to feed animals rather than being ploughed into the soil. Deforestation degrades the vegetation cover, and increases the vulnerabilities of soil to water and wind erosion by subsequent overgrazing or overcultivation. That is because in the drylands trees are important in preventing the soil from being blown away by wind, and their roots prevent the soil from erosion by water (Grainger, 1990). Poor irrigation can cause soil waterlogging and salinisation if water is not drained properly. In addition, poor irrigation practices can make the water table fall dramatically if too many wells are drilled. Consequently, it may result in the land being abandoned if the wells become dry.

1.3 Land degradation in the American Southwest

For this study, one of the American Southwest cities, located in the state of New Mexico, was selected as a case-study area as it is experiencing severe land-degradation problems and lies within the Chihuahuan Desert eco-region. In the American Southwest, a dramatic change of the dominant vegetation and landscape has occurred over the past 200 years (Duran et al., 2005; Grover and Musick, 1990; Mainguet, 1991). Early explorers of this area depicted it as a fertile landscape with lush perennial grasses. In later times, this area was considered a desert and currently this shrubland- dominated area is depicted as being covered by creosote-bush and mesquite. Together with the vegetation change, soil erosion has increased remarkably (Grover and Musick, 1990).

Since the 1950s, the American Southwest has experienced dramatic urban growth. Land-use patterns have undergone great changes. Rangelands and irrigated fields are replaced by roads, malls and housing developments in the study area (Fredrickson et al., 1998; Wilshire et al., 2008). These activities become threats to the dryland landscape in the study region. These pressures are further exacerbated by climatic changes, population increase, and lack of effective land management.

The effects and problems of land degradation in the study region have been explored in a number of studies. Most of them are field-based and/or use

modelling approaches to investigate the dynamics of the physical processes of grassland to shrubland transition such as hydrological processes (Schlesinger et al., 1999; Wainwright et al., 2000), and ecological processes (Brown and Archer, 1999; Peters and Herrick, 2001). However, studies that have examined urbanisation and sub-urbanisation are very limited, although urbanisation is now an important driver for the degradation processes (Alig et al., 2004; Batisani and Yarnal, 2009; Kennedy and Zube, 1991; Vogt and Marans, 2004).

Land degradation is a complex interplay between the environment and socio-economic activities. As noted above, human mismanagement of land use results in land degradation. Historically people have used land for cultivation and as pasture for livestock. At present, due to rapid urbanisation, land is used for roads, industrial estates, residential buildings, recreational activities and many other purposes (Fredrickson et al., 1998). The question that remains here is why and how people make particular land-use decisions. People's decision-making determines their behaviour, and therefore what impact they have on the land and how the landscape may change. As human actions are important in land degradation, it is important to understand these actions and their motivations. Previous studies focus on traditional land uses such as agriculture and pastureland, and investigate how these activities induced the landscape degradation (Ispikoudis et al., 1993; Kerley and Whitford, 2000a; Zhao et al., 2005; Zhong et al., 2005). Building on existing works, this research extends its scope to contemporary land uses such as residential, commercial (shopping malls, factories), industrial estates and recreational uses. This research also acknowledges negative impacts of land use other than land degradation, as mismanagement and inappropriate land-use decision-making may induce other environmental consequences, such as water pollution, air pollution and loss of biodiversity. In addition, this study devotes particular attention to the residential landscaping practices. In a desert environment, residential landscaping practices have been considered as disturbance events on the ecosystem, although these practices are often operated at micro-scale, which can have significant environmental impacts and influence habitat, water resources and water quality (Martin, 2001). Due to these

environmental implications, residential landscaping behaviour impacts on public policy and the environment in the American Southwest (Yabiku et al., 2008).

People's decision-making is not a simple process as it involves economic, social, political and cultural considerations. Nevertheless, the effects of land-use decision-making and environmental consequences have received limited attention (Maconachie, 2007). Thus, more research is needed to emphasise the nexus between decision-makers and environmental changes in contemporary urban contexts.

This research employs a political ecology approach to explore the complex human-environment interactions in different scales and contexts. Because of the European encroachment and the colonial history and the land-use culture in the American Southwest, it is important to consider power relations over resource control and use, and a political ecology perspective provides the theoretical ground for these to be investigated. Power relations, property right concern, and resource use in historical times will considerably impact on land-use and management practices today (Stringer, 2004) .

1.4 Overview of the research

The aim of this research is not only to improve understanding of the complex mutual influences between decision-making and environmental changes, but also to examine the interactions and power relations between social actors, which could inform new ways of sustainable land management.

This aim is addressed through three objectives:

- To investigate perceptions of relevant actors (residents, land developers, city planners, politicians, and NGOs) of desert landscape;
- To understanding of how relevant actors (residents, land developers, city planners, local government, and NGOs) make decisions to use and manage land;
- To explore the complex interactions of the social and political elements of decision-making processes and their implications on land degradation.

1.5 Outline of the thesis structure

This chapter has introduced the fundamental objectives, concepts and background of this study, which considers concepts and ideas from a range of social and natural sciences disciplines including environmental management, geography, and cultural studies. It also has presented a brief introduction to the land degradation problem and its causes, and considered the need to investigate the problem and its driving forces rooted in the social, economic and political context.

Chapter 2 presents the background of the land degradation problem in the American Southwest both in historical time, and at present under rapid urban sprawl. It puts the problem into a social and political context, and considers how its colonial history, the cultural influence, and the changing of land-use regulation and policies influenced the power relations and patterns over resource use. It then moves on to examine the land-use regulations, mainly zoning and subdivision, as these are the primary local regulations in influencing land-use patterns. It then discusses power relations and decision-making to inform subsequent analysis and explanations of the resource use and manage in later chapters.

Chapter 3 first describes the political ecology concept and a range of its applications in exploring the relationships between environment and society. It then moves on to present and discuss the theoretical framework of political ecology that is used to frame this research. The emphasis is placed on the role of power relations on control and influence, the use and management of natural resources in the urban environment, social-environmental interactions, and multiple temporal and spatial scales of analysis. It then returns to the review of different approaches and settings in studying the land degradation problem and critically evaluates the values of these differing approaches for this study. It concludes with a list of research questions and these are returned to throughout the thesis.

Chapter 4 describes the methods and fieldwork processes used in this research. It starts with a brief overview of the case-study area in order to provide the justification for the selection of the study area. It then describes the land-use patterns and introduces the current land-use issues in the study area. It proceeds to

illustrate the advantages of combination of qualitative and quantitative methods in this research. Two phases of research fieldwork are presented, and different methods are detailed, followed by analytical procedure of collected data. In the final sections, issues of positionality and reflexivity such as gender, nationality, and cross-cultural research are discussed. Ethical considerations are also highlighted.

Chapter 5 explores the perceptions of different actor groups of the desert, including land developers, residents, planners, politicians and NGOs, to explore how these perceptions and valuations may influence actors' decision-making over land uses. By integrating quantitative questionnaires and qualitative interviews, this chapter investigates and compares different perceptions of actors toward desert landscape and its ecosystem. Chapter 6 examines driving factors of actors' land-use decisions, and this links to Chapter 5. The similarities and differences of decisions over land-use between and within actor groups are presented and discussed, and conflicts emerging from these are considered and analysed.

Chapter 7 investigates the impacts of different actors' land-use decisions on land degradation and environment, and presents key negative influences caused by the land-use decisions as perceived and understood by local actors. It also considers the issues of different scales of decision-making effects, ranging from residents' decisions at micro-level to land developers, planners and politicians at macro-level.

Chapter 8 integrates the historical, social, economic and political aspects of land degradation in the American Southwest. The key themes that emerge from previous analysis, including power, resource use, society-environment interactions, dominate this discussion. It discusses the findings from previous chapters and compares them against those of the wider literature, which is to explore the complex interactions of the social, political and historical elements of decision-making process and its implications on land degradation.

Chapter 9 presents a summary of research findings. It then discusses the contributions to the political ecology of land degradation study by this research. It then moves on to consider the theoretical and analytical consideration of using

political ecology in the study of the land degradation problem. It also discusses the policy implications of resource use through evaluating existing land management strategies in the study area, as well as taking into account of power relations in a wider context. This chapter finishes with considerations for future research.

Chapter 2 Background of the study

2.1 Introduction

This chapter presents the background settings of this study. It starts from the definition of land degradation, and then places land degradation into historical, socio-economic, and political context to demonstrate how these factors shape the decisions and practices over resources use, and examines the current debate on resource use and land degradation. It presents a brief overview of the land degradation problem globally, then it moves on to present historical land-use problems in the American Southwest, and it discusses the causes of land degradation in particular concerning the historical land uses. It then illustrates contemporary land-use problems under rapid urbanisation. It considers the land-use regulations and property rights. The chapter concludes with a discussion of political power and decision-making.

2.2 Overview of land degradation

Land degradation has been identified as one of the most major environmental problems in dry-land area (CCCD, 2008; Ravi et al., 2009). Dry-lands are limited by soil moisture and defined as "arid, semi-arid and dry sub-humid areas". Dry-lands are not uniform, they differ in the degree of water limitation (Safriel et al., 2005). Based on UNEP World Atlas of Desertification Aridity Index (UNEP, 1997; Parsons and Abrahams, 2009), the value of precipitation (P)/potential evapotranspiration (PET), dry-land can be classified into four subtypes: Hyperarid regions – $P/PET < 0.05$, Arid regions – $0.05 < P/PET < 0.2$, Semi-arid regions – $0.2 < P/PET < 0.5$ and Dry-sub-humid regions – $0.5 < P/PET < 0.65$. There are a larger number of dry-land ecosystems within the subtypes, and these are aggregated into higher-order units known as biomes, which are characterised by distinctive life forms and principal plant species. Dry-lands can be categorised into four broad dry-land biomes: desert, grass-land, Mediterranean scrubland, and

forest. These dry-land biomes may replace each other with increased or decreased aridity (Safriel et al., 2005).

Land degradation is defined by the United Nations Convention to Combat Desertification (UNCCD) as a "reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as soil erosion caused by wind and/or water; deterioration of the physical, chemical and biological or economic properties of soil, and long-term loss of natural vegetation". Broadly considered degradation processes include vegetation degradation, water and wind erosion, salinization, soil compaction and crusting, and soil nutrient depletion (FAO, 2005). When land degradation happens in the world's dry-lands, it often creates desert-like conditions, also called desertification (UNCCD, 1994). There is a fine line between dry-lands and deserts – once crossed it is hard to return (UNEP, 2006). For instance, studies carried out in Jornada Experimental Range in southern New Mexico found that any process that causes an increasing heterogeneity of soil resources in space and time is possible to cause the degradation of semi-arid regions dominated by grass-lands to the increasing spread of arid regions dominated by shrub-lands (Schlesinger et al., 1990; Turnbull et al., 2008).

Drylands throughout the world are all facing threats of degradation. Global dryland is estimated to be approximately 5,160 million ha, and 70% of drylands experiences some degree of degradation (Geist, 2005). According to Adams and Eswaran (2000), in total up to 2.6 billion people are potentially threatened by land degradation in over 110 countries around the world. In Sub-Saharan Africa, landscape degradation is considered to be extremely widespread and affects about 200 million people (Geist, 2005). In Asia, North America and Latin America, dryland degradation is also deemed to be as extensive as elsewhere in the world.

Land degradation is driven by climate factors and human inappropriate land uses such as overgrazing, over cultivation, deforestation, poor irrigation system and

other inefficient water use (Grainger, 1982, 1990; Hethcote, 1983; Mainguet, 1991; Middleton, 1991; Thomas and Middleton, 1994; Walls, 1980; Williams, 1996). The land-use mismanagement that relates to dryland degradation has a long history and has been examined extensively. Landscape degradation induced by overgrazing, for instance, according to Olson (1981), was responsible for the collapse of ancient civilisation in Sardis of Turkey. In the Coquimbo region of central Chile, the advent of the Spanish led to increasingly overgrazing of livestock on the land, which resulted in the land gradually becoming less productive and degraded (Thomas and Middleton, 1994). Examples of over cultivation related to landscape degradation existed from historical time; for instance, Bunney (1990) provided evidence that devastating land degradation resulted from early human maize cultivation in the area around Lake Patzcuaro in Mexico 3500 years ago. In the Coquimbo region of central Chile, in addition to overgrazing, over cultivation of wheat also contributed to the landscape degradation (Thomas and Middleton, 1994). Poor irrigation practice as one of the main causes of landscape degradation can be shown from ancient records and archaeological excavations. Salinisation and siltation due to the overuse of water for irrigation and subsequent salinisation has harassed Lower Mesopotamian irrigation systems since 2400 BC and were related to the collapse of the Sumerian civilisation (Thomas and Middleton, 1994). Inefficient water use in the irrigation system led to the collapse of agriculture and abandonment of the Khorezm oasis in Uzbekistan in the first century AD. It was also the reason to explain many ancient oases that have been covered by the shifting dunes of the Taklamakan Desert of north-western Tarim Basin in China (Thomas and Middleton, 1994). Taken together, one can see that land degradation is a longstanding problem, and human land-use activities play significant roles in inducing such a problem.

2.3 Land-use problems and land degradation in the American Southwest

2.3.1 Social-political settings of land-use problems in history

Land degradation is not a new phenomenon to the American Southwest. Fredrickson et al. (1998) remarked that a notable vegetation change happened between 7000 and 9000 years ago. The climate became drier, and desert shrub vegetation emerged to increase in areas formerly dominated by grasses. Between 4000 and 800 years ago, there had been three periods signifying increasing aridity that desert shrub vegetation increased in the grassland area. Since the 1500s, European explorers started settlements in the Southwest. Colonisation of the Southwest was not widespread until after the United States Civil War of the 1860s. A great number of people sought their fortune and arrived in the West. Cattle and sheep numbers grew quickly as a result, and shrub cover has increased dramatically in areas that were predominantly grassland in the mid-1800s (Beltra ń-Przekurat et al., 2008; Buffington and Herbel, 1965; Gibbens et al., 2005).

2.3.1.1 The Homestead Act and early settlers

The problem of land degradation in the American Southwest was associated with the Spanish migrations in historical times (Branscomb, 1958; Grover and Musick, 1990). In the 1500s, when the Spanish introduced livestock grazing in northern Mexico and southern Arizona, momentous human impacts on the ecosystem commenced. By the late 1700s, hundreds of thousands of livestock arrived in the southwest, and the number of cattle and sheep increased rapidly in the late 1800s. After the United States Civil War, many Anglo soldiers and their families settled in the Southwest (Liverman, 1998). The Homestead Act (THA) of 1862 granted settlers 65 ha if they occupied the land for five years. Alternatively, they could buy land for $3.88 per ha after inhabiting on the claim for six months. Management of these lands relied on private effort or state-level regulation at the most (Logomasini, 2008). 65 ha of land was inadequate for pastoralism in the arid lands of the West, and allotments were later expanded to 130 ha in 1909 when the

Enlarged Homestead Act (EHA) was passed. The larger livestock owners purchased many pieces of land, and they tried to obtain public lands as well (Fredrickson et al., 1998).

In New Mexico, the cattle numbers increased from 200,000 in 1870 to 1.4 million in 1889; sheep numbers increased from 619,000 in 1870 to 5.4 million in 1884 (Grover and Musick, 1990; Schickedanz, 1980). Since the late 1880s and early 1890s, the grazing industry was devastated due to climate variations in the Southwest, and sheep and cattle numbers decreased steadily. In the early 1900s, transition from sheep grazing to cattle grazing led to a reduction of stocking rates. The Taylor Grazing Act of 1934, was introduced to control the public rangelands for the first time. It aimed to "stop injury to the public grazing lands by preventing overgrazing and soil deterioration; to provide for their orderly use, improvement, and development…" (BLM, 2008). This Act established grazing districts and used a permitting system to manage livestock grazing in the districts (Center for Wildlife Law, 2009), and it consequently resulted in livestock numbers declining. However, as the high historical stocking rates and lands continued to be grazed for more palatable plants such as grasses, considerable changes in the composition of vegetation throughout the Southwest occurred (Buffington and Herbel, 1965; Grover and Musick, 1990; Mac et al., 1998).

2.3.1.2 Extensive land-uses and climate variability in history

The influx of cattle to the Southwest led to extreme grazing pressure on these fragile rangelands (Pieper, 1998). There are several reasons for the 'livestock rush' during the late 1800s and early 1900s. One is because the land was not suitable for farming, raising livestock became the main means for maintaining a living for the majority of people (Fredrickson et al., 1998). It is also because people sought quick profit from the free ranges of the Southwest. Much of it was open, without fences or control, and had limited restrictions. The range was grazed as a commons and there was little incentive for conservative grazing as the forage would belong to those who had their livestock on the range first. In New Mexico, early ranchers were used to more productive areas of the mid-West and possibly overestimated the productive ability of desert rangelands. There was limited

knowledge of the long-term costs of heavy stocking in this area with volatile rainfall (Pieper, 1998).

The climate is highly variable in time and space. Long-term rainfall records at a few locations in southern New Mexico differed from 77mm to 507mm annually (Wainwright, 2005). The variation ranges in southern Arizona from 102mm to 544mm yearly. A severe winter in 1885-1886 in parts of New Mexico, and a succession of drought years during 1886, 1891-1894 and 1901-1904 caused the decline of cattle numbers in this region. A great number of cattle died, and rangelands were left overgrazed (Fredrickson et al., 1998). Nevertheless, there was no incentive to improve the range. The lack of legal control also left the range overgrazed without definite responsibility. The ineffective regulation of grazing resulted in continuous degradation.

2.3.2 Relationships of land degradation and society

Environmental changes are broader and reflect any change of environment, either positive or negative change. Land degradation is a small part of environmental changes. It is important to note that, as discussed by Blaikie and Brookfield (1987), environmental changes may or may not be perceived as degradation, depending on the use to which the land is put. Building on this, it is argued that land degradation can only be judged in the context of a specific time frame, temporal scale, economy, environment, politics and culture (Warren, 2002). As such, land degradation is socially constructed and ultimately a social problem (Blaikie and Brookfield, 1987). It may be perceived differently between social actors in different places at different times and in different socio-economic, environmental, political and cultural contexts (Reed, 2005). For instance, soil erosion adversely affects some peasants in the upslope areas, peasants who cultivated the land at the base of the slope may benefit from the transfer of soil fertility (Blaikie, 1985). In another example, Thomas and Twyman (2004) found that land managers in southwest Botswana considered the bush encroacher as an important forage resource. While it is contrary to views in South African literature that bush encroachment is a key land degradation problem in this area (van Rooyen, 1998). Hence, examination of land degradation processes calls in the

need for consideration of the diversity of perspectives of all social actors in the area concerned, and the perspectives of both the individual social actors and collective actor groups should be considered (Rocheleau et al., 1995; Stringer, 2004). In better understanding the dynamic interaction of environmental changes and social-political forces, an examination of the interfaces and links between actors and scales is needed that is to link the local actors to the wider forces operating at regional and national scales across time and space (Bryant, 1992; Jones, 2008).

Humans' direct land-use practices cause land degradation, but at a deeper level, the structures in social, economic and political systems facilitate, encourage or force these practices (Thomas and Middleton, 1994). In the American Southwest, the incursion and settlement by migrants was broadly recognised as the reason for the commencement of landscape degradation in historical times.

The indigenous people including a small numbers of hunters and gatherers resided in the Southwest before the arrival of the Europeans, and settled around the places where water was abundant and agriculture could be supported. Since the 18th century, livestock raising and mining had become the main land uses under the control of the Spanish crown. By the end of the colonial period, human land-use activities impacted on the land such as accidental use of fire in the grasslands, domestication of maize and other crops, introduction of cattle by the Spanish, and forest destruction for mining. European control changed "attitudes to nature from a relationship based on use values and flexible or communal definitions of property to the view of resources as commodities to be bought and sold, and to private, often enclosed, property" (Liverman, 1998:3). Largely unregulated livestock grazing during the mid-1800s and the 1930s resulted in severe devastation to forests and rangelands. Loss of natural vegetation and the consequent increase in expose of bare soil enlarged the soil erosion problem (United States National Report, 2006).

2.3.3 The changing landscape: ecosystem response to human activities

Land degradation in the American Southwest generated extensive changes in the structure and function of the desert ecosystem. The most pervasive structural

changes deriving from the land degradation process are transitions from desert grassland to shrubland (Jackson et al., 2003).

Currently, desert shrublands and semi-desert grasslands form a diverse and complex mosaic of vegetation across dryland landscapes (Grover and Musick, 1990; Schlesinger et al., 1990). The construction of the railroad and introduction of cattle to the drylands in the late 1800s significantly altered the ecosystem functions. The landscape has less vegetation cover, water and nutrients become unevenly distributed in space and time, and there is less forage production (Mac et al., 1998; Pieper, 1998; Schlesinger et al., 1990). Although livestock numbers in this region are well below historical levels, continued topsoil erosion is possibly sustaining an irreversible decrease in which much of the remaining grassland is being shifted to desert shrubland (Dick-Peddie, 1999). The present mosaic of shrublands and grasslands in the American southwest is mainly the reflection of continuing land degradation process in concert with urbanisation and conversion to agriculture (Mac et al., 1998).

2.3.4 Land ownership and land management

As Wiebe et al. (2003) summarised, land-use management and land policy in United States consisted of three phases. In the first phase, from independence through the mid-1800s, the Federal government acquired approximately 809 million ha of lands to extend its territory as a growing nation. In the second phase, beginning in the 19th century until the 20th century, the Federal government disposed of lands to states, settlers, railroad corporations and others to encourage westward settlement. In total, the Federal government granted 445 million ha of lands to states and other non-Federal agencies, with many lands going to private ownership (Wiebe et al., 2003). Moreover, the Federal government offered incentives such as agricultural commodity price-support programmes and wetland conversion for private landowners to use their lands in more intensive ways. These policies and management practices facilitated the westward expansion with the costs such as soil erosion and vegetation loss. The bottomlands with fertile soil and easier access to water were mostly homesteaded and adjacent uplands were left in Federal ownership. Consequently, ranchers had used the unrestricted

access to these public lands to graze their livestock until the beginning of the 20th century, when the rangland appeared in poor condition exacerbating by cumulative effects of drought and overgrazing. In the third phase, over the course of this century, the Federal government replaced the incentives for land-use intensification with restrictions on land use and incentives for land preservation (Wiebe et al., 2003).

In the Southwest, the majority of rangelands were not in private ownership. The Bureau of Land Management (BLM) currently manages most of the Federal rangelands in the Southwest. In 1903, wildlife reserves were introduced, which are currently managed by the Fish and Wildlife Service. The early regulations were established to fight against land degradation through managing commodity uses such as timber, livestock use and mining of the land and conserving the landscapes and wildlife habitats in the American West (United States National Report, 2006). Land degradation was first recognised as a national problem with the drought (e.g. Dust Bowl) since the 1930s, which drove the identification of the results of land misuse and soil and vegetation loss. This drought event played an important role in shaping American policy on dealing with land use and degradation as a whole. In 1935, Congress established the Soil Erosion Service (SES) to aid landowners to undertake proper soil and agricultural practices. In 1994, it became the Natural Resources Conservation Service (NRCS, 2010). Although these conservation policies and activities have improved the land since the 1930s, there were still concerns about degraded lands in the American Southwest.

2.4 Social-political settings of contemporary land-use problems in the American Southwest

From the above evidence, it is clear that landscape degradation in the American Southwest is a longstanding problem associated with the interplay of climate factors and human activities that act at different scales (Geist and Lambin, 2004), particularly agricultural activities in the historical time. Since the 1950s, a dramatic urban growth has heightened great concern in the Southwest (Alig et al., 2004). Urban population grew as a dominant force in the Southwest (Fredrickson

et al., 1998). Urbanisation in New Mexico occurred extremely quickly in the 1950s when urban population increased 15.7%, which is nearly three times the rate of increase for the United States (Johansen, 1971). Currently, approximately 73% of the population live in the New Mexico urban areas (US Census Bureau, 2000).

2.4.1 From overgrazing to urban sprawl

Despite continuing grazing on the rangelands, with rapid urbanisation land is increasingly used for new urban functions such as industrial facilities, transport infrastructure, residential buildings and recreational activities. It is believed that urbanisation leads to significant impacts on land-use transformation (Heilig, 1994; Lin, 2007), and these activities threaten the dryland landscape. Since New Mexico has experienced rapid growth in the past four decades, there is much debate over the causes and impacts of the urban transformation and the consequent social and ecological deterioration of the urban landscape.

Urban expansion encroaches on and influences natural and agricultural ecosystems (Liverman, 1998). Rangelands were replaced by malls, roads and residential developments. In addition, recreational activities deteriorated large areas of land, increased water demands for supporting new settlements lowered water-tables in some areas considerably, and decreased agricultural potential gradually (Fredrickson et al., 1998). The construction of road networks, powerlines and pipelines results in the fragmentation of landscape, and consequently causes numerous negative ecological impacts such as habitats disturbance for plant and animals and water pollution (Mac et al., 1998). Recreational vehicle use by urban dwellers in the desert is also one of the destructive activities, including destruction of soil stabilisers, increase of water and wind erosion and destruction of vegetation (Lovich and Bainbridge, 1999; Thomas and Middleton, 1994).

This new trend of land use led to a number of land use policies, which regulated land-use patterns. One of the major ones is the National Environmental Policy Act (NEPA) passed in 1969, which aimed to constrain the environmental impacts of development by entailing that all Federal policies and actions be subject to an

environmental impact assessment (Dowall, 1989). This Act stimulated the acceptance of similar state laws covering state policies and actions. The outcome of these laws was that they changed the pattern and scale of development, and projects tend to be smaller and less obtrusive. Moreover, in many cases local government's land-use plans are cautiously assessed to take potential environmental impacts into account. The passage of the NEPA of 1969 established the US Environment Protection Agency (EPA), which was intended to regulate the natural environment. In order to regulate local growth, cities and counties in most states of the US are required to prepare and update community master plans. These plans need to give an overview of anticipated population and economic growth, and designate which areas of the community are appropriate for development. Zoning is the primary means of implementing the master plan in most communities. This is illustrated further in Section 2.5. The permission for development is denied if the proposed project is not consistent with the zoning code. However, requests for re-zonings and appeals can be made if the permission has not been approved.

2.4.2 Land development and resources competition in the desert

Low density, spread-out development is a nationwide, post-World War II phenomenon developed to satisfy increasing housing demands. It is also the case in New Mexico. On the one hand, this phenomenon responds proficiently to market demands; on the other, the pattern of urban growth has created many environmental problems such as air pollution, social problems including excess traffic, loss of open space and social inequalities (Condrey and Guillen, 1997). Growth brought a number of benefits such as tax revenues, job opportunities, new businesses and economic growth. However, new infrastructure such as road networks and sewers are required to serve these land developments. Neither Federal nor state funds are able to provide necessary infrastructure for spread-out growth to happen as it has in the past. In particular, the old existing infrastructure needs more money to be maintained. Economic benefits brought by growth can be seen as temporary relief from unemployment, however, there are also increased costs associated with growth, and growth cannot sustain a solution to unemployment in the long term (Condrey and Guillen, 1997). Residential

development may cause diminished quality of services to the existing residents and future newcomers, and newcomers cannot guarantee the economic boom. In-migration can create benefits for land-rich, cash-poor landowners, but "at a cost of political and cultural restructuring" (Condrey and Guillen, 1997:4). This cost is too high for many traditional New Mexico communities to bear. It is often difficult to manage the tension between economic and physical development and the resultant need to manage natural and cultural resources.

Continued expansion often leads to natural resource competition, one of the keys is water resource in New Mexico. Agriculture in New Mexico is the largest water user, which takes up 85 percent of total water use. Depleting groundwater basins and lack of surface water indicate a water crisis in the future. The drought in 1995-1996 heightened critical concern on this natural resource. Accompanying rapid urban growth and lack of effective planning, the availability and quality of water is a critical issue to New Mexico. Water resource becomes the limiting factor to sustainable growth, and competition for water use results in particularly serious challenges in New Mexico because it does not have a large Federal project to support future growth or an alternative source of water that can be tapped (Condrey and Guillen, 1997; Lucero and Tarlock, 2003).

Open space is another valuable asset in New Mexico as it attracts and holds workers, retirees, tourists and investors. The beauty of the landscape is an essential part for local people and people who want to come. Residential homes replaced many of the open spaces, and extensive development removed farmland, rangeland and wildlife habitats (Alig et al., 2004; Riebsame et al., 1996). This situation might not only create conflicts to the land development, but also threaten the quality of life in the dryland landscape.

Continuing economic development, expanding populations, urban sprawl and competition of scarce resource further contribute to the extensive degradation in the dryland landscape (Brian and Joshua, 2004).

2.5 Land-use regulation and property rights

In the United States, local governments regulate and control the type of location of land uses within their borders through zoning and subdivision primarily (Dowall, 1989; Munroe et al., 2005). Zoning is based on a comprehensive land-use plan, and intends to regulate permissible uses in particular on agricultural, forest and conservation reserve lands.

2.5.1 Zoning and subdivision

Zoning

There was no formal land-use control in local municipalities in America until the late 19th century. During the late 19th and early 20th century, a rapid urban growth took place, and its associated fire and health hazards called for public control and the need for establishing a system that would separate the city's land area into residential, industrial and commercial sectors. New York City passed the nation's first comprehensive zoning ordinance in 1916, primarily to protect influential Fifth Avenue merchants (Berry, 2001). This is because they were afraid that uncontrolled mixing of land uses threatened the success of their retail businesses and devalued their parcel's worth. In order to prevent this, businessmen pressed the passage of zoning ordinance (Listokin, 1974).

In the 1920s, many states passed statutes empowering local municipalities and other local governments to enact zoning ordinances. The Standard State Zoning Enabling Act (SSZEA) published in the mid-1920s by the U.S. Department of Commerce granted local governments the right and power to zone as long as zoning supported the health, safety, morals or the general welfare of the community. By the late 1960s, zoning had become nearly a universal municipal regulation, in particular in those larger municipalities and townships in the United States. Currently, all 50 states have approved these local regulations (Kivell, 1993).

The basic purpose of zoning is to regulate land use and development intensity. Zoning codes designate permitted uses; most of these uses are divided into three categories: residential housings, business and industry. These three categories can

be subdivided into subcategories, for instance, residential housings include single-family houses and town houses; industry category distinguishes between heavy and light industry. Most zoning ordinances also set limit of the number of families per acre[1] or a minimum required size for each lot. In addition, zoning ordinances also set requirements such as layout, building height, usable open space, off-street parking and minimum house size (Listokin, 1974).

Subdivision

Zoning is not the only regulatory means for controlling local land use in the United States. There are other regulatory tools, such as subdivision. The current form of subdivision regulation, like zoning, was widely used as a tool to guide urban growth in the 1920s. In 1928, the Department of Commerce established the Standard City Planning Enabling Act (SCPEA), which granted local planning entities most responsibilities for administering subdivision (Listokin, 1974). Local subdivision regulations also became widespread regulatory means after the 1930s. Within a zoning district, builders are subject to subdivision regulations. The land developers have to meet certain requirements put by the planning commission in order to continue their developments. These subdivision regulations normally seek to ensure that the subdivision be consistent with a comprehensive plan for the areas, subdivisions are appropriately related to their surroundings, and can have access to utilities such as water and sewers (Listokin, 1974). The developers are commonly required to put in public facilities, at their own cost, to serve the development including roads, sidewalks, sewers, utility lines and street lights (Fischel, 1985). Hence the significance of subdivision regulation is that it allows the community to force the developers to pay for some of the community infrastructure costs of the development (Fischel, 1985).

The fundamental difference between zoning and subdivision is that zoning is more powerful than subdivision as it permits the community to exclude many uses altogether. Subdivision regulation requires that land developers must bear certain costs, and if they do that, they normally have the right to develop and construct.

[1] 1 acre is equal to 0.4 hectare

Under a zoning ordinance, land developers do not have the right to build any structure if it does not follow the zoning code, regardless of how much they are willing to pay. Community and local planning administering bodies may deny the attempt to modify a valid zoning code, but they may not "impose arbitrarily large subdivision exactions on permitted uses" (Fischel, 1985:24).

2.5.2 Zoning and power control

Zoning is considered as highly political and received many critics. For instance, regulations fail to care for established neighbourhoods and to prevent sprawl on the fringes of cities, and the administration of regulations is often associated with favouritism and corruption (Listokin, 1974). As Munroe et al. (2005:122) argued "zoning plans generally reflect a variety of political interests and stakeholders. Local government also faces a balancing act in attempting to maintain broad political support, keep service costs low, and maximize the residential tax base". Moreover, Fischel (1985) noted that the antipathy of wealthy suburbanites to low-income housing areas is not based on the physical nature of the land use, but lies on social and economic status and a fear of crime. Silver (1998) considered that southern cities were employing racial zoning ordinances, meaning that they separate Black zones and White zones for residential and commercial purposes.

All of these critics highlighted the political character of land-use planning and the power control issue. The zoning regulations are essentially the function of the local governments, and probably the most significant municipal function in many communities, which means that zoning is placed in the local political arena. When it was introduced, it was the product resulting from influential and powerful individuals to protect against their property, i.e. New York City merchants.

Planners in general should control zoning since they have the technical knowledge to solve the problems (Fischel, 1985). However, planners who know what is good planning and zoning often do not have power to make decisions, instead, elected officials decide what to do according to planners' recommendations. They may, or may not, follow what the planners consider the most important depending on whether these suggestions match their political preferences. In many places, local government encourages local participation such as public hearings in major

amendments. However, in many cases, zoning or re-zoning are strongly influenced by land developers and neighbourhood interests are disregarded (Fischel, 1985). Or, the decisions maybe influenced by some home-owning voters, since these small groups of people can sometimes influence the political campaign.

2.5.3 Property rights

The significance of private property rights and the operation of the free market direct most land-use regulations and policies in the United States. But it needs to take into consideration that some individuals may be negatively influenced (Kivell, 1993). It means that it is important to protect the interests of individuals from negative impacts of development, while also to ensure that the rights of property owners not to have their rights overly constrained (Wiebe et al., 2003). Property rights are always at the central position for the citizens in the United States. Ownership of detached homes on large lots is the heart of the American dream (Condrey and Guillen, 1997).

Disputes over property rights date back to the late 18th century. The Fifth Amendment to the United States Constitution limited the power of Federal and state government take private property for public use stating that "nor shall private property be taken for public use, without just compensation" (United States Constitution, 1791). After that, in the 1920s, the U.S. Supreme Court stated that while property may be regulated to a certain degree, if regulation goes too far, it is considered as a taking. Since then, Federal courts have taken the consequence of a regulation on a property's value into account when judging whether a taking has happened. This rule played an important role in balancing public and private objectives, and preventing actions that may harm individuals (Wiebe et al., 2003).

Kivell (1993) remarked that in the United States zoning is essentially about protecting individual property rights and diminishing investment uncertainty by transferring some of the risk to the local community. For the vast majority of Americans, the primary economic asset is ownership of a lot and a house. Land defines the nature of communities, local people will turn out on a zoning public hearing about a controversial land development proposal, since it might threaten their property values and sense of community (Jacobs, 1998). Condrey and

Guillen (1997) argued that urban growth has a high regard for individual property rights as it has been directed predominantly by private decisions to subdivide and sell land. Hence private landowners and developers have much power to decide the location of growth.

At present, urban land use and development policy is a critical issue in many places. Most of governmental policies regulating land uses are implemented by local governments, and the country lacks a coherent and explicit land-use policy to regulate land use and development (Dowall, 1989). Although it has improved since 1970, when local zoning control was the main land-use regulation, and regional, state and federal intervention has increased with the growing environmental concerns (Kivell, 1993)

2.6 Political power and decision-making

With rapid urban growth and more people moving into the 'sunbelt', intensity of land use increases which puts increasing pressure on natural resources in the fragile dryland ecosystems, hence the dryland landscape faces increasingly critical challenge (Miller and McCormick, 2002; Solh et al., 2003).

Land use and management is inevitably related to the social and economic forces that shape everyday life in the city (Kivell, 1993). Most land-use decisions are primarily local and individual, however, the regional and national land-management agencies own a considerable amount of land in the study area, thus land is the key to planning and control at broader levels regulated by state and national governments. In this respect, the land-use decision-making process is inherently political (Saint et al., 2009).

Property rights, including private property and public property rights, are the key in shaping resource use and access in the United States (McCarthy, 2002). Rights can be bought, sold, leased and traded, however, key rights can be separated from the land. For instance, someone is the owner of a piece of land, but he sells the mineral right to a mining company, leases the development right to a private land developer, and hence it is difficult to define who owns the land and is responsible for decision-making. The use and ownership patterns are associated with social

and political power, and community diversity and vitality (Jacobs, 1998). Therefore, land-use issues are not only based on the ownership of the land, but also how multiple interests are distributed among individuals and groups, and the complex relations of control, access and use (Wiebe et al., 2003).

To some extent, the owners may decide how to use the land, but these decisions are also constrained by their own motivations and interests as well as other people such as adjacent owners, neighbours, voters, and the broader society. Urban land use in a market economy often goes toward the most profitable use. However, profit for some people does not mean profit for all, in this sense, it may create conflicts and oppositions between these benefit receivers and those who believe it to be at their expense. When these conflicts appear in the local political arena, local government may stand out to attempt to resolve it by public intervention. Land use and development plays a key role both to satisfying individual lifestyles and to the successful functioning of urban areas (Kivell, 1993).

2.7 Chapter summary

This chapter has presented the background of land degradation in the American Southwest and its associated historical, social and political settings. Under rapid urbanisation, land use and development is intimately connected with resources competition, which may result in conflicts in the community. Land-use planning and regulation are political, although most of these are implemented by local government, different levels of government at broader scales are also important shaping forces in the study area as the regional and national government own a great amount of land. As demonstrated above, centralised planning played a significant role in regulating macro-scale urban development in the early days. One of the key land-use regulations from the past till present is zoning, which is criticised as a political means to serve some influential or powerful groups. In addition, zoning is a political process in the sense that local government approves or denies land developers' proposed master plans based upon different interests revealed in the community, and then either find the balance between these interests, or implement it to favour some certain groups, often powerful ones.

Land use and land ownership are associated with social and political power, however, due to the ambiguity of property rights in the United States, land-use concerns cannot be solely based on the ownership of the land, but rather on the complex relations of control, access and use (McCarthy, 2002). Individual land-use decisions are shaped by their interests, but other social and political forces are also important in influencing one's decisions.

Chapter 3 Theoretical and Empirical Context

3.1 Introduction

This chapter introduces the key conceptual ideas in existing empirical research, which underpin this research. It focuses on the linkages between land degradation and society that are the central concern in this study and investigates the ways in which environmental issues are embedded in a broader social, cultural and political matrix.

There are two main segments of literature that relate to the research: that concerning political ecology theory; and literature on the issues and problems of land degradation, particularly land-use by humans. The first part of this chapter starts with a description of the theoretical approach of political ecology and a range of its applications in examining the relationships between society and environment. Political ecology theory as a theoretical framework for the study of land degradation is then discussed, and issues in applying this framework are considered.

The second part of this chapter introduces a wide range of studies using different approaches to the investigation of land-degradation problems, and assesses the value of these differing approaches for this research. This chapter concludes by proposing four research questions.

3.2 Framing the research: the political ecology approach

As a result of calls for more theoretical and practical integration between nature and society, in particular acknowledging environmental, social and political aspects of environmental problems, many theorists have drawn on the work from ecological and social studies to achieve that integration. One concept which achieves this union is ‘political ecology’. The term ‘political ecology’ was first used in the academic context in late 1960s and 1970s (Miller, 1978; Russett, 1967:911; Wolf, 1972), and it emerged from the growing concern about human impacts on the biophysical environment. In particular, political ecology is a

response to the theoretical need to integrate understandings of land-use practice with local-global political economy, and as a reaction to the growing politicisation of the environment (Peet and Watts, 2004). Blaikie (1985) and Blaikie and Brookfield (1987) viewed that political ecology "combines the concerns of ecology and a broad defined political economy", and perceives nature-society as a relationship that "encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself" (Blaikie and Brookfield, 1987: 17).

Forsyth (2003: 2) states that the concept of political ecology refers to the "social and political conditions surrounding the causes, experiences and management of environmental problems", which is a key theme that this research addresses. Political ecology arises out of cultural ecology, political economy of development, Marxism and post-structuralism. Political ecology is very broad and encompasses a wide range of theoretical and methodological approaches (Nightingale, 2002; Peet and Watts, 1996). While some authors in political ecology research focus on the explanation of biophysical change by broader structural processes (e.g. Blaikie and Brookfield, 1987), others focus on narratives about that change (Bassett and Zueli, 2003).

Political ecology is characterised by attention to issues such as sensitivity to the role of the national and global economy in shaping environmental change. For instance, Bell and Roberts (1991) applied political ecology in a comparative analysis of regional differences of the practice of small-scale cultivation of Zimbabwe's dambo wetlands. They found that the patterns of resource use in developing countries reflect (i) the structural demands of the national and global economy, and (ii) local interactions between rural communities and their natural environments. Others focus on the diverse responses of decision-makers, for example, Bassett (1988) used a political ecology approach to investigate the peasant-herder conflicts in the northern Ivory Coast. He observed that the herders' presence is welcomed by the Ivorian government as their cattle contribute to national beef production, but herders are opposed by peasant farmers due to uncompensated crop damage. Bassett concluded that it is at the intersection of Ivorian political economy and the human ecology of agricultural systems in the

region, that one can examine the processes of micro- and macro- level decision-making behind the conflicts. Political ecology also includes explorations of socio-economic inequality as a cause of ecological deterioration. Morre (1993) examined environmental resource conflicts in Zimbabwe, and found the culturally constructed role of gender in producing inequalities in access to resources ultimately led to environmental change.

Some studies have applied political ecology to explaining environmental problems in terms of the phenomenological linkages between ecological processes, human needs and political systems (Blaikie and Brookfield, 1987; Forsyth, 2003). Other studies use political ecology as an analytical device to discuss the politics of environmental problems without specific discussion of 'ecology'. For instance, Bryant (1991:165) describes political ecology "as an inquiry into the political forces, conditions and ramifications of environmental change". Bryant focuses on the interactions of diverse socio-political forces, and the linkages of those forces to environmental change. Although political ecology has been applied to a variety of theoretical and methodological approaches, two key relationships are central concerns to this approach: (i) between humans and the environment, and (ii) between individuals and social groups within society. Both of these relationships are of interest in the research presented here.

Stringer (2004), an advocate of political ecology, considers that due to its flexibility and broad-ranging character, political ecology is particularly appropriate for multi-method and interdisciplinary research at the interface of society and nature. It is argued by many authors (e.g. Jones, 2008; Moore, 1993; Robbins, 2004; Stringer, 2004) that political ecology has a strong base to examine the human-environment interactions, and the process of social and power relations to drive environmental changes in a nested[2] social, political and cultural context. Now the following text details four central theoretical tenets of political ecology.

[2] 'Nested' in this study means that many scales are relevant and influence each other, and smaller ones fitting within larger ones.

1. Political ecology considered that the "environment is not a malleable thing outside of human beings, or a tablet on which to write history, but instead a set of relationships that include people, who, more radically, are themselves produced" (Robbins, 2004:209). It recognises that the natural environment is not separate from the human world, but that both humans and environment influence processes through a web of networks. Hence, political ecology is considered as an approach that views society-environment relations as mutually influential and considers that previous scientific assumptions of biophysical equilibrium and linearity are not correct (Brown, 2009).

2. The Marxist roots of political ecology contribute a sensitive aspect to unequal economic power and exploitation. Blaikie and Brookfield (1987) commented that power over resource consumption is accumulated by dominant groups and marginalises the losers. The articulation of different localities with capitalist production is inevitably related to the exploitation of natural resources both for subsistence by marginalised producers and for profit (Nightingale, 2002). This insight emphasised political-economic pressures on resource consumption. It has also highlighted the inter-relationship between ecological impacts and socio-economic power relations. The power over access to and use of resources are defined, negotiated and contested within the political arenas of different levels (e.g. household, institution, the state) (Peet and Watts, 2004), which is often unequally distributed, and in turn shapes the social and political configurations and the natural environment where we live (Swyngedouw and Heynen, 2003).

3. The next closely related issue that has been explored by political ecology is the environmental conflict between diverse groups defined often by gender, class, or ethnicity who struggle to maintain the rights to use certain natural resources (Gezon, 1997). Access to and use of resources and the ways in which local actors assess threats to these resources (as of land degradation) are functions of the production and accumulation of wealth, social status and power over time (Warren et al., 2001). Some groups secure access and control of the natural resources at the expense of others by influencing management interventions. The analysis of articulations between nature and society to identify relations of power and practice in the context of ecological changes thus have become increasingly

important in political ecology research (Minnegal and Dwyer, 2007). As Robbins (2004:173) argued, "existing and long-term socio-economic conflicts within and between communities are "ecologised" by conservation or resource development policy".

4. Political ecology also acknowledges the potentially positive, generative outcomes of environmental struggles. Political ecology has been used to investigate the role of changes in environmental conditions to mobilise social movements (Obi, 2005; Peet and Watts, 1996). Such environmental changes create opportunities for diverse groups of people to secure and represent themselves politically as their ecological strands link them across gender, class, race and ethnicity. In this way, the political nature-society interactions potentially modify the global political and economic power forces (Robbins, 2004). However, as noted above, political ecology does not neglect issues of power negotiation. Power plays a central role in the human-environment relationships, and is usually unequally distributed as different actors have different capabilities in struggles over access to, and use of, natural resources (Bryant and Bailey, 1997).

Having identified the central tenets of political ecology, we can see that this broadly defined and flexible approach enables a highly flexible framework and embraces a range of analytical and methodological perspectives from both social and ecological sciences. However, it is criticised by Peet and Watts (2004:11) as lacking a coherent theoretical core, as well as being "radically pluralist and largely without politics or an explicit sensitivity to class interest and social struggle". Peet and Watts propose an alternative concept, 'liberation ecology', which engages political economy, power, knowledge and critical approaches to ecological science itself. Liberation ecology aims to theorise the linkages between capitalist development and land management, and gives greater attention to social and power relations at a variety of scales. However, others maintain that liberation ecology is simply a shift of emphasis within political ecology (Stringer, 2004). As we have seen above, political ecology is already a fundamentally critical theoretical approach.

3.2.1 Political ecology of urban environments

Urban environments are increasingly of interest for research into contemporary environmental change and conservation (Zimmerer and Bassett, 2003). As urban populations have grown rapidly and the balance of the world population from majority rural to majority urban has shifted, and over half the world population lived in urban areas (UN, 2007), the consumption of natural resources is increasingly driven by urban centres, and people have become more aware of the role of cities as engines for transforming the environment and as places of vulnerability to environmental changes (Pelling, 2003). With the rapid urbanisation process, the cities are increasingly becoming the sources and centres of air, soil and water pollution, ecological degradation and environmental injustice (Friedmann, 2002). As such, expanding cities and sustainability discourses currently play a significant role in the debate on urban environmental futures (Keil, 2003).

In an important paper on political ecology and cities, Swyngedouv and Heynen (2003: 899) described cities as "dense networks of interwoven socio-spatial processes that are simultaneously local and global, human and physical, cultural and organic". The myriad transformations and metabolisms that support and enhance "urban life always combine physical and social processes as infinitely interconnected" (Swyngedouv and Heynen, 2003:899). The material, social and symbolic elements together construct particular socio-environmental surroundings that unite nature, society and the city in a heterogeneous, complex and conflicting whole (Swyngedouw and Heynen, 2003).

The socio-ecological impacts of the city are increasingly becoming a global issue. The urban process "harbours social and ecological processes that are embedded in dense and multilayered networks of local, regional, national and global connection" (Swyngedouw and Heynen, 2003: 899). Urbanisation, as a socio-ecological change process, leads to the continuous production of new natures, of new urban social and biophysical environmental conditions. All of these processes take place "in the realms of power in which social actors strive to defend and create their own environments in a context of class, ethnic, racialised and/or

gender conflicts and power struggles" (Swyngedouw and Heynen, 2003: 900). These changes and processes within urban environments are of key concern to current political ecology research, and these processes need to be understood within their social, cultural, economic and political context.

These ideas are particularly useful for this study. Land degradation in the urban environment is not simply a result of social factors or human land-use activities, but rather a complex interplay of political, social and economic power relations that shape the uneven socio-ecological conditions. Because the underlying economic, social and political processes are inherent to urban landscape production, urban landscape changes tend to be uneven and varied spatially (Swyngedouw and Heynen, 2003). In the context of land changes and degradation, marginalised residents tend to bear the negative environmental costs of land changes, while residents who are relatively more wealthy will benefit from the growth or enjoy environmental resources (Swyngedouw and Heynen, 2003). In the American Southwest, urbanisation has changed the way the land is being used, i.e. from historical pastoral and agricultural uses to residential, commercial and recreational purposes, and put increasing pressure on the land and environment (Fredrickson et al., 1998). The problem of how to maintain the balance between rapid urbanisation and resources use has become an issue of great importance, and need to be examined in a wider context.

As mentioned in point 1 in the preceding section, human and social beings construct nature, and nature becomes a socio-biophysical processes infused with political power and cultural meaning (Swyngedouw and Heynen, 2003). The transformation of nature is embedded in interwoven social, political, cultural and economic relations, operating at a variety of nested spatial scales. The interlinked web of socio-environment relations creates uneven urban environments, so while environmental quality may be improved in some places and for some people, they might result in a deterioration of social and physical qualities elsewhere. The ones who lose out are usually already marginalised people, both within cities and between cities and other distance places (Swyngedouw and Heynen, 2003). These uneven social processes can often be attributed to uneven economic (i.e. income) and political (active or marginalised) conditions. That is to say, environmental

changes are “not independent from class, gender, ethnicity, and tend to be explained by these social” and political struggles (Swyngedouw and Heynen, 2003:911). The political-ecological perspective on urban processes can detect the inherently complex nature of the socio-environmental change and identify the conflicts that infuse socio-environmental change (Swyngedouw et al., 2002), which is the central concern of this study.

3.2.2 The conceptual framework

The earlier part of this chapter discussed various aspects and applications of political ecology as a theoretical framework. This section set out to illustrate how the political ecology approach is applied to form the basis for this study.

In this study, the political ecology approach focuses on the examination of linkages of decision-making and environmental changes among different social actor groups. Decision-making is organised and transmitted through social relations, in relation to wider political, social and economic factors operating at different scales (Blaikie and Brookfield, 1987; Paulson and Gezon, 2005; Zimmerer and Bassett, 2003). This study places the emphasis on understanding contemporary land-use practices and the driving forces of decision-making, rather than focusing on measurement of distribution of land resources and land loss. The investigation of land-use decision-making processes related to environmental changes is the central concern of resources management and conservation. As discussed above, human-environment relationships are complex and multifaceted, so it is essential to examine the land-use decision-making process in its wider political and social context, and the patterns of social relationships, cultural forms, and political practices are all involved in the production of environmental change (Moore, 1996).

Historical context

Research into land perceptions and decisions must take into account “the historical, societal and political contexts which determine how people interact with their environments” (Maconachie, 2007:31). Using this rationale, my research puts the land-use issue in the study area into historical context, noting

that it remains difficult to investigate the process of environmental change separately from the historical forces that influence it. As Batterbury and Bebbington (1999:281) stated: "it is difficult to understand the dynamics of land-use change at a point in time if these are not analysed within the context of longer histories of society-environment interactions" (1999: 281). This perspective embraces the notion of temporal scale, which is the key concern of the examination of the land degradation issue.

The US Southwest has a long history that land use created conflict between different actor groups, for instance, long-term residents living in the areas around public lands struggle against environmental groups, newcomers and government agencies to protect historical access and use rights in these lands (Robbins, 2004). The history and the right of property influence people until now, urban expansion brings new struggle and conflicts to the contemporary land-use patterns. Different actor groups are in competition and conflict in their use and management of natural resources.

Power and knowledge

Some groups have more control and power over the others because of their relative wealth, higher social class and institutional positions. Some groups may stand out such as environmentalists fighting for the access and control over the ecological goods and services, and representing them politically to gain political power.

Although all land-use decisions are made at local levels (Turnbull, 2005), different levels of actors come into play, influence and are influenced, which means the decision-making process situates individuals and groups within wider political and social structures. This is part of the character of multi-layered nature of political ecology, which is of high relevance to this study due to the inherent complexity of the land degradation problem as discussed above.

Power relations are important in the interactions of different actors, and conceived as a process by which influence on others is mediated by social interaction (Giddens, 1976). Foucault (1977: 27) draws the connections between power and knowledge, and remarks that "knowledge linked to power, not only assumes the

authority of 'the truth' but has the power to make itself true". This concept of power is relevant to this research, which is focused on land use and management, which tends to be influenced by powerful actors, or at least actors perceived to be powerful, who have more knowledge of the land. It is also recognised that the understandings and analysis of power may be socially constructed and differentiated, and thus diverse (Brown, 2009; Paulson and Gezon, 2005). Power is defined by Rouhana and Fiske (1995:53) as the "perceived control over allocation of resources and over the outcome for the other party". Power has been described as a relationship defined by the perception of the party over whom power is held. Beier and Stern (1969) described that the power "of O depends on the perceptions of P in terms of O's ability to satisfy P's desires" (1969: 94). Hence, it may be more appropriate to regard the perception itself as the source of power (Gaski, 1984).

Power is a relative term, and the power of one actor can only be evaluated relative to the remaining actors in the environment (Rousseau and Garcia-Retamero, 2007). However, actors rarely have perfect information about their own and the others' power (Bacharach and Lawler, 1976). Some may perceive others have more power in the same community, hence have more control and influence over the allocation of resource.

Michener et al. (1973, cited in Bacharach and Lawler, 1976) stated that perception of power is a function of the control people exercise over their own and others' outcomes. Their study examined the power in the relationship of attacker and attacked, and control was reflected by offensive capabilities of the attacker (i.e. damage potential, attack probability) and the defensive ability of the attacked (i.e. attack blockage, retaliation). They found that the attacked perceived self has less power and the attacker has more power when the attacker's damage potential was high. On the other hand, the attacked perceived self has more power and the attacker has less when the attacked had a high blockage or retaliatory ability. The results also implied that one's perception of power shifts depending on the ability they valued to control selves' and others' outcomes. Therefore, the power and perception of power of actors is ambiguous, it is probably related actors' social, economic status, ability to access information and knowledge, ability to access to

resource, ability to express opinions and institutional affiliations (Morris, 1987; Scotts, 1994), and if one needs to examine the power relations in the resource use, one needs to examine it in a wider context.

Other considerations

This study focuses on the decision-making of different actor groups of contemporary land uses and also devotes specific attention to the increasing concern over water consumption in the study area. Local people's land-use decisions in the desert connect with their water-use perception and environmental values, and are influenced by local culture (Brian and Joshua, 2004; Larsen and Harlan, 2006). Water is increasingly becoming a key topic in discussing resource use and growth in the desert. Places with water are the most inhabitable places in arid environments. The ability to use water is not only an individual issue, but also relating to securing the long-term security of a community (Whiteley et al., 2008), and associated with a larger part of political, economic and social conflicts (Whiteley et al., 2008). Water is especially facing challenges in the American Southwest, and much research has warned about its scarcity and insufficient supply in the future in the desert (Casagrande et al., 2007; Condrey and Guillen, 1997; Lucero and Tarlock, 2003).

In many cases, water is the restraining resource to human development and population. Because of its scarcity, water is the key element for many physical and biological processes. Therefore water is one of the most vital environmental management concerns, and often is the driving concern for many other social and environmental issues (Burmil et al., 1999). However, scarcity is differently perceived or experienced by different social actors, some actors worry about scarcity, whereas others may not (Ohlsson, 2000). Land use decision-makers, who perceive water as a scarce resource, might plan and use it with caution. Those who do not perceive water as a scarce resource, might act with water scarcity in mind or not process their actions with the water consideration. However, perception related decision-making is highly political, one can only examine and understand the perceptions and decisions in the context of political, social, economic and cultural background. Politically driven decision-making often involves inequities and a highly political negotiation processes (Whiteley et al.,

2008). The consequence can be favouring powerful actors and neglecting marginalised users, and so those with the power to allocate water use may be a small subset of the community. The use of water resources is influenced by national policies and global geopolitics (Brown, 2009). With rapid urban growth, resource use becomes one of the most complicated issues in the urban ecosystem, because both old and new relationships of nature and society interact, including unequal power between individuals, institutions and social groups operating at various scales. Because the power of making decisions to allocate resource is often unequal, it is unlikely that those suffering from uneven allocations of resources can have re-allocation in their favour. Harvey (1973:51) remarked that "if it becomes explicit as to who will lose and who will benefit, and by how much, from a given allocation decision, then we must anticipate far greater difficulty in implementing the decision". These unequal power relations shape the socio-environmental processes of the urban environment, and also often the powerful decides who will have access to or use over the resources.

It is argued here in applying a political ecology framework, with the focus on the shifting and dialectical relationships between social and power relations and environmental changes under the urbanisation process, it is possible to capture the complexity of human activities and environmental change in the urbanisation process and tease out the conflicts that infuse the socio-environmental change.

3.3 Political ecology and geographic scale

In studies of land degradation, scale has often been an issue (McCusker and Weiner, 2003). Blaikie and Brookfield (1987) remarked that environmental changes may or may not be perceived as degradation, depending on the use to which the land is put. Blaikie (1985) commented that when soil erosion adversely affects some peasants in upslope areas, peasants who cultivate the land at the base of the slope may benefit from the transfer of soil fertility. Hence, it is important to clearly define the scale of interest in discussions of land degradation (Blaikie, 1985; Maconachie, 2007). Warren (2002) argued that when one crop is lost, degradation is rarely seen as the cause. Instead, degradation is perceived as being a much larger in scale and longer-term process. However, Lambin (1992)

remarked that "an analysis of the environmental consequences of decision-making often requires a broadening of geographical scale" (1992:5). Further, he observed that "an approach that employs a nested set of spatial scale has proven to be appropriate to understand the behaviour of land managers" (1992:4). It is recognised that the capacity of local actors to engage in land-use practices in a given location is shaped by decision-making forces that are often situated far away. Decisions made at the local scale are influenced by state or national scale policies, and longer-term vision is often associated with higher-level of management, and actors can trigger larger scale institutional and policy change. Hence, "an understanding of the dynamics of regional land use change requires moving from correlations at socially abstracted spatial scales toward political-ecological studies that not only focus on explanations for local land use changes but consider the aggregate effect of these changes at the level of the region" (Turner, 2001:192). Political ecology analyses can detect complex interactions of diverse socio-economic factors and environmental changes operating in nested scales.

3.4 Approaches to the mechanisms of land degradation

The discussion in this section turns back to land degradation to examine the relative importance of political ecology to the approaches to the mechanisms of land degradation. The political ecology approach that investigates a multitude of influential factors operating at various scales is regarded to have relatively limited effect on the literature of land degradation studies (Jones, 2008). The literature is extensively dominated by studies that focus on the particular causal relationship between one or a few variables and land degradation. These studies are reviewed below.

An extensive range of studies has emerged to investigate land degradation and its biophysical and anthropogenic causes. Research into the biophysical processes of land degradation investigates the patterns and processes of climate variations, hydrological cycle and vegetation dynamic related to land degradation (Ma et al., 2009; Ravi et al., 2009; Schlesinger et al., 1999; Wainwright et al., 2000). On the other hand, many studies examine the human activities associated land

degradation, which is the focus of this research. Some of them explore the relationship between one social variable, usually population, and land degradation (Ayoub, 1998; Grepperud, 1996; Jones, 2008; Tiffen et al., 1994). Others attempt to investigate specific land-use activities related land degradation, such as agricultural activities, overgrazing, and urban land uses. These studies of human-induced land degradation are reviewed below. Section 3.4.1 presents the studies that examine one-way causal relationship between human activities and land degradation. Section 3.4.2 evaluates the studies on one-way causal relationship of human and environment and proposes a research direction toward a multiple-direction causal relationship. Section 3.4.3 illustrates studies that explore social perception of landscape that relates to the way people use and manage the land.

3.4.1 One-way causal relationship

Several studies focus on the specific relationship and causal mechanisms between social variables, such as population and land-use activities, and land degradation, for instance, Grepperud (1996) tested the population-pressure hypothesis which associates landscape degradation with population pressure in the Ethiopian Highlands from 1983 to 1984. His results showed that all physical variables, for instance rain intensity, slope and soils factors displayed insignificant correlations with the soil-erosion level whereas the population pressure, exhibited significant relationships with the erosion level. He concluded that when the population exceeds some threshold, population pressure exacerbates a rapid landscape-degradation problem.

In another work, Ayoub (1998) reviewed statistical data from 1977 to 1991 and examined the contributing factors of land degradation in the Sudan. He observed significant correlation between human population densities and soil degradation in arid areas. Nagdeve (2007) examined the relationship of population growth and land degradation. By conducting the analysis of changes and trends of population from 1951 to 2001, he found that the population growth is continually degrading arable land in India. Cam (1992:25) simply stated that “as population pressures mount, the degradation of arable lands increases … population growth has clearly aggravated the grinding poverty and the environmental destruction that has kept

people from growing or getting enough to eat". However, Sen (2007) has pointed out that grinding poverty and famine cannot simply be analysed at the smaller scale, because they are influenced by the wider economy. Likewise, where populations have the capability to command food from a distance, as most urban dwellers do, they would exert less pressure on their immediate surroundings. As such, we cannot simply locate population as the cause without questioning the economic structures that marginalise these people and force them to over-farm what little land they have.

In addition to the above studies exploring causal links between population and land degradation, some examined the effects of specific land-use activities and associated land degradation. Ispikoudis et al. (1993) investigated the influences of human activities on Mediterranean landscapes in western Crete. They considered that agricultural and grazing pressures as well as inappropriate tourism development are the major threats to the landscape of Crete. They concluded that wildfire followed by overgrazing and overstocking are the main causes of landscape degradation. They suggested that landscape preservation needs people to understand the long-term land-use evolution and vegetation history. Lovich and Bainbridge (1999) reviewed the major human-induced impacts on the Mojave and Colorado Deserts of southern California. They identified several factors that contribute to land degradation in these two deserts including overgrazing, construction of linear corridors such as roads, powerlines, mining, off-road vehicles, and anthropogenic fire. They concluded that desert lands disturbed by human activities may take centuries to recover without active intervention, and they call for the minimisation of human disturbance.

3.4.2 Toward a multiple-direction causal relationships

The studies above examined the causal mechanism between the actors' activities and landscape degradation. Warren et al. (2001) noted that by its very nature, scientific research often isolates one or a few factors from an extremely complex mix of factors of production. They offered an example that if soil loss were to contribute 10% of loss of yield, its impacts would be difficult to detect where rainfall, crop and fertiliser process and labour costs have greater variable impacts.

It seems to have been the case in the studies reviewed above that one or a few factors have been isolated. However, the relationships they addressed are one-way, positing population growth and human land-use activities as the driver of land degradation, whilst not investigating the impact of land degradation on human populations.

These studies neglected the existence of alternative paradigms, and the simplicity of this one-way causal relationship is increasingly being called into question (Mortimore, 1993). For instance, Boserup (1965) argued that population pressure can act as a stimulus for increased agricultural production, which indicated a probably positive relationship between population growth and environmental improvement (Jones, 2008). A study carried out by Mazzucato and Niemeijer (2002) examined the relationship between population growth and land degradation in Burkina Faso. They found that the soil degradation in cereal cultivated fields was not linked to growing population density, partly because local people adapted to increasing resource scarcity by spatial reorganisation and changes in local informal institutions. Jones (2008) also stated that the focus on one-way causal relationships may hide a more complex dynamic. Population and human land-use activities and associated environmental degradation need to be examined in a complex socio-economic, cultural and political context.

In addition, people's actions impact on the environment, and the environmental degradation may in turn affect people. For example, according to Grepperud (1996) and Ayoub (1998), population growth results in extensive land use, and inappropriate land-use decision-making leads to soil erosion level increase. Nevertheless, population growth can also lead to extensive technology innovations, and hence increase the options of effective repair of the landscape in the affected region (Boserup, 1965). In another way, landscape degradation impacts the people who live in the afflicted area and even impacts on future generations. However, if these people and future generations can migrate elsewhere, population growth may slow down. Migration possibilities again show the importance of considering the multiple relevant geographical scales.

One-way causal studies lack insights into how land degradation impacts upon people, in particular the way people use land. Moreover, the studies above did not explore the complex ways in which the landscapes are negotiated and influenced by actions in different scales such as the household, the community and the institutions (Paulson and Gezon, 2005).

The relationship between human activities and land degradation can be said to be interactive and two-way (Blaikie and Brookfield, 1987). This means that people make decisions to use land, and, when inappropriate, this use may cause degradation, and degraded land in turn affects people. For instance, overgrazing may cause land degradation, consequently the land can no longer be used to graze animals, and increased grazing intensities on remaining land may lead to pastoralists migrating and population decreases as a result (Niboye, 2010). In a similar way, land degradation can undermine economic development, while low levels of economic development can in turn have a significant causal impact on the occurrence of land degradation (Blaikie and Brookfield, 1987).

In pursuing such two-way analyses of the relationship between people and environmental change, there is a need for land degradation studies to contextualise actors and their decision-making environments (Long and Long, 1992). Such an approach focuses on diverse local actors who are key decision-makers, probably trying to transform the landscape to fit their perceptions, needs, values and agendas (Verbole, 2000). This actor-oriented approach can help with the "unpacking of local meaning and culturally specific perceptions and behaviour" (Jones, 1999:213). Moreover, Long (1992:5) noted that the actor-oriented approach is grounded in "everyday life of men and women, be they poor peasant entrepreneurs, government bureaucrats or researchers". Such an approach is valuable to explore the reasons behind various responses to the environmental and social problems that local actors face.

It is essential to note that although land-use decisions are often made locally, many other socio-economic and institutional factors influence local actors' decision-making abilities and shape local practices. Warren (2001: 85) observed that land degradation is affected by political and economic marginalisation,

struggle, and complex decision-making. Further, Warren provided an example that in a study carried out by De Graaf (1996), it is difficult to find variables that had any significant effect on Mossi farmers' conservation behaviour. Part of the reason is that decision-making among the Mossi who lived in Burkina Faso is extremely complex and variable "due to the very variable socio-economic circumstances". Linking micro-scale analysis to wider perspectives is important in exploring the relationship between land degradation and human actions (Maconachie, 2007). Hoben (1995) analysed land degradation problems in the Ethiopian highlands, and he found that environmental degradation affects local people at the micro-scale, but may result from wider political and economic influences. As Tolba et al. (1992:132) noted, land degradation is "the result of complex interactions between physical, biological and socio-economic and political issues of local, national and global nature". In this light, an approach that is directed by a "nested set of scales" is needed to improve the understandings of the relationship between human activities and environment (Blaikie and Brookfield, 1987).

Humans' activities are key driving forces in the land-degradation process and their decisions affect it. Studies of one-way causal relationships between actors' decision-making and land degradation are insufficient to investigate the complex social-political driving forces in influencing human actions in diverse spatial and temporal settings. Blaikie noted the "formidable problems when attempting to make causal connections between social and environmental processes" (cited in Forsyth (2007:759). Rocheleau (2007:9) remarked that "the centre of gravity is moving from linear or simple vertical hierarchies to complex assemblages, webs of relation and rooted networks ... to embrace complexity without losing the explanatory power of structural relationships".

It is important to link the local scale land-degradation issues to their wider and nested social, economic and political context, and also examine how landscape changes take place by the understandings, negotiations and interactions of actors in the decision-making process. Different actors may make different decisions about how to use and manage the land, hence have different impacts on the landscape. In addition, their decisions may affect one another as well. In order to

better understand how people's land uses contribute to landscape degradation, and the underlying factors of how these decisions are formed, there is a need to consider the role that wider social, economic and cultural linkages play in environmental change, as well as how individual actors behave in their specific decision-making environment (Maconachie, 2007). Furthermore, it is worth acknowledging that landscape degradation in turn affects actors, and an awareness of possible feedbacks between environmental changes and people can help us to improve our understandings of the interactions between nature and human activities.

Blaikie claimed that the environment is 'constantly in a state of being conceived of, learnt about, acted upon, created and recreated and modified' (Blaikie, 1994:12). Leach et al. (1997:4) further noted that in evaluating land-society relationships what one needs to consider "starts from the politics of resource access and control among diverse social actors, and sees patterns of environmental change as the outcomes of negotiation, or contestation, between social actors who may have very different priorities". Maconachie (2007:29) stated that understanding local perceptions of the environment and landscape change is "imperative in understanding how structural factors are mediated and transformed internally". Therefore, the way in which local actors perceive the landscape drives their behaviour at the micro-level, and also remains important in understanding how local perceptions mediate responses to the social and political structure.

Decision-makers base their decisions on the environment and landscape depending on how they perceive it, not as it is, independently of human perception. As such, the understandings and perceptions of actors on landscapes will guide the way they use it, and determine either appropriate or inappropriate land-use decision-making. Numerous studies point out that it is essential to investigate the social perception and valuing of the landscape in order to understand how human actions affect landscape construction, landscape change and landscape degradation (Chokor, 1990; Gomez-Limon, 1999; Palang, 2000; Kaltenborn, 2002; Kaur, 2004; Iosifides, 2005; Klintenberg, 2007; Buijs, 2006; Larsen, 2006; Lewis, 2008). The next section will present studies that examine

social perception of landscape, due to its important role in land use decision-making.

3.4.3 Social perception of landscape

Many studies investigate social perception of landscape in a great diversity of settings. Researchers often use empirical investigations aimed to measure landscape preferences from the perspective of different actors. These studies are conducted in different countries located in Africa, Europe and North America. The environmental contexts range from islands, forests, and mountains to urban areas.

3.4.3.1 Functional values of landscape

The literature suggests that different population groups perceive the landscape differently, which is associated with their functional ties to the landscape (Buijs et al., 2006; Kaur et al., 2004). Perception of landscape is influenced by past experience and socio-economic and cultural background. Studies concerning the functional values of the landscape are reviewed below.

Gomez-Limon and Lucio Fernandez (1999) examined preferences in the agricultural-livestock landscapes in the Madrid region of Spain. They found that livestock farmers prefer open landscapes, whereas people doing recreation and managers prefer landscapes with denser vegetation. These preferences have cultural implications and are related to the types of use on these landscapes. Their study also suggested that environmental impacts, which have often been neglected, should be taken into account in landscape planning and management.

In two case studies from France and the Netherlands, Buijs et al. (2006) found that the ways farmers, urban residents, hunters and conservationists perceive the landscape are strongly related to their functional ties with the landscape: the same concept has different meanings to different groups. For example, when thinking about freedom in a landscape, young urban residents perceive *freedom* as the capacity of the landscape to provide freedom from social constraints. *Freedom* to the farmers means that it can offer them opportunities to plan their work, so they think of freedom in terms of entrepreneurship. All these different perceptions

need to be valued and considered, as such consideration may enhance public involvement in, and positive influence upon, landscape management. In addition, social need for open space is increasing. The way many people perceive landscapes is shifting from a functional image of nature to a more hedonistic desire for wilderness. They considered that urbanisation is a driving force in this shift.

Buijs et al. (2006) show that urbanisation does not only change the landscape physically, but also influences the perceptions and requirements people have of landscapes. For example, with the rapidly increasing buildings and residential houses in the urban areas, people demonstrated a desire to have more contact with nature, and perspectives tend to change from production landscape to consumption landscape. People previously valued the landscape for more traditional functions, but now are moving toward more modern functions, which means a marked change from dominant significance of agriculture to an increasing importance of leisure industry. Hence, more investigations and literature on the relationship of urban growth and environmental changes are needed in order to improve the understandings of contemporary land practices and their subsequent social and environmental impacts.

3.4.3.2 Intrinsic values of landscape

Apart from the functional values of the landscape, some studies considered that people's landscape preferences related to the landscape's intrinsic values (which is related to personal perceptions and affections) (Chokor, 1990; Kaltenborn and Bjerke, 2002; Kaur et al., 2004).

Kaur et al. (2004) chose the Saaremaa Island in Estonia as a case study, where they found that both school children and adults appreciated the landscape's intrinsic value. School children perceive landscape more as a natural environment, whereas adults conceive the character of landscape as being culturally constructed and list cultural features. In their study, they also carried out media analysis to review the values held by different stakeholders and acknowledged the functional values of landscape. Valuations of the island landscape also vary and subjects to the interest of different stakeholders. Professionals such as nature conservationists

have dissimilar criteria from the general public, and valued the landscape as an affective meaning of the building and the place (built environments that offer social interaction). Local users appreciated the landscape as a constant background for their activities, and their most valued landscape is the local neighbourhood.

Kaltenborn and Bjerke (2002) selected a Norwegian mountain region as a case study area, results revealed that significant positive correlations existed between the ecocentric (intrinsic value as an ecosystem) values and a preference for wildlands with water, and for cultural landscapes. Their investigations illustrated that the majority of people in the area are responsive to ecocentric arguments when development plans are presented. Undoubtedly, the work of Kaltenborn and Bjerke (2002) has made a contribution to understanding how landscape preferences and attitudes towards environment can relate to each other to aid future management of landscape for decision makers, policy planners and other stakeholders.

Chokor (1990) carried out an investigation of landscape preference in the city of Ibadan, Nigeria. He found that residents had high preferences for suburban landscapes with modern, planned characteristics. In contrast, unregulated old buildings of the central inner city were the least valued landscapes as they were poorly maintained, crowded and of low quality. Chokor (1990) attempted to find out the key features (i.e. the abundance of social amenities or facilities, healthiness, functionalism and comfort of designs, spaciousness, bright, planning and adequate maintenance of the physical environment) that contribute to residential aesthetic quality; thus Chokor's work has been crucial in providing a basis for understanding and improving urban landscape in Nigeria, and it also has implications for other urban areas. Chokor (1990) found that if the landscape degraded to diminish the aesthetic values, local people are more sensitive to realise that and be influenced by that. Long-term residents are especially sensitive to landscape changes and degradation, as well as to changes in tradition and customs.

All the above studies have investigated the landscape perception of different actors, and these perceptions are closely related to both the functional and intrinsic value of the landscape. Perhaps the belief in the intrinsic value of nature itself has a functional value, in that people have a responsibility to protect this and a sense of co-existing with something beyond the meeting of human needs. These perceptions and values are associated with motives of individuals' decision-making, not only experts, but also those of the wider community. Such investigations can improve our understanding of the ways individuals interact with landscapes and help us to uncover their decision-making process on how to use and manage the natural resources.

3.4.3.3 Landscape perception and landscape degradation

Another area of research is people's perceptions and actions as related to landscape degradation (Iosifides and Politidis, 2005; Klintenberg et al., 2007; Maconachie, 2007), and key driving forces which are inappropriate land-use decision-making were identified (Iosifides and Politidis, 2005; Klintenberg et al., 2007).

Iosifides and Politidis (2005) investigated the human activities and socio-economic factors contributing to the persistence of land degradation in western Lesvos, Greece. They examined the socio-environmental interaction processes as well as local attitudes, perceptions and actions associated with these processes. They found the complex links among socio-economic dynamics, local development disadvantages and land degradation, as perceived and experienced by local people. Inappropriate land uses, relying on the livestock sector as well as inadequate sources of income were perceived by local people as contributors to land degradation.

Maconachie (2007) examined the social, economic and cultural aspects of land degradation in peri-urban areas in Kano, Nigeria. He attempted to discover how local actors' perceptions influence their land-use decisions in the rural-urban interface. He found that indigenous perceptions of land degradation from local actors as opposed to scientific knowledge are framed by local livelihood concerns and differed both spatially and temporally, and urban pressures influence how

different actors envisage and construct their landscapes. He concluded that increasing urban pressure becomes a challenge to the sustainability of land management and impacts on land degradation, thus suggested that a new approach is needed to emphasize the nexus between decision-makers and environmental changes in different contexts.

All of the above studies have investigated the social perceptions of the landscape held by different actors, and they have contributed to the understandings of the landscape in diverse social and cultural settings. However, the studies of Chokor (1990) and Kaltenborn and Bjerke (1990) have limitations in terms of classifications of actor groups. Chokor only classified actors into two groups: rich and poor. Kaltenborn and Bjerke selected respondents randomly without any defined groups. The aggregate level of observation may hide a more complex dynamics. Actors may appreciate functional value and intrinsic value of the landscape simultaneously, and so it is important that a differentiated definition of a group be adopted to fully understand what is valued by actors who have similar social practice over the landscape, i.e. similar decision-making over landscape, and similar social and economic goals. In particular, actors who carry out similar social practices may have different perceptions and values of the landscape, especially key decision-makers of landscape who have specific needs and whose perceptions are important in influencing their decisions.

In fact, preferences and environmental values of various actors are subject to many factors, for instance background, past experience, socio-economic status, and ways they use the natural resources (Swanwick, 2009). In addition, the broader environment also plays a significant role in influencing people's perceptions and values. It is also shaped by cultural patterns and societal influence of perception (Görg, 2007). For instance, people in the same community might have similar values for certain landscapes. Therefore, it is important to consider these influential factors when examining one's perception of the landscape, such examination can improve our understanding of the interactions between landscape and individuals. It is increasingly recognised that people have different needs, it is essential to maintain a range of different landscapes to meet these needs for a diversity of landscape experiences (Swanwick, 2009).

3.4.3.4 Landscape perception and landscape management

In contrast to the above studies, research is increasingly focusing on exploring the role of different actors in landscape management and land-use decision-making process (Kaur et al., 2004), and attempting to develop alternative management frameworks for the future (Lewis, 2008; Palang et al., 2000). All of the studies examined local landscape preferences and suggested that successful management means that interests of locals and specific interest groups should be taken into account.

In the study of Kaur et al. (2004), they found that conflicting interests exist among locals and non-locals toward the landscape perceptions. For instance, visitors have different needs from local residents. When the visitors are interested in private-access land conflict emerges, because individual property owners want to protect their investments and visitors want to enjoy more of the recreational potential of the landscape. They recommended that to solve the conflicts among interest groups should find balance between different interests, and differences can be resolved by institutional tools. They pointed out that the most powerful actors have more time and resources to impose their perceptions, but there is a presumption that it is possible to find acceptable weighting of different values.

Palang et al. (2000) applied a landscape model to construct four scenarios based on policy analysis to predict future landscape changes in Obinistsa, Estonia. After the construction of scenarios, local people's preferences of these scenarios were tested and reflected by a willingness to pay for the desired landscape. They concluded that a decision of landscape management should not be made at the top of a political hierarchy, but future landscape is an agreement between the users of the landscape. The results of their work sought to investigate further the future alternative options of landscape change and management; particularly they have been concerned about land users' perceptions of these future scenarios and recognised that future landscape-management approach is from a bottom-up rather than a top-down approach.

All of these above studies have been instrumental in suggesting that landscape management needs to engage local communities and incorporate perspectives of

different interest groups into the land management. However, it also needs to be highlighted that the relationship between environmental change and society is dynamic and complex. Many of the parameters of choices that local people face may be determined by others who operate at greater scales (Maconachie, 2007). Local land practice and management is heavily constrained by regional, national and international factors. It is important to consider those wider social, economic and political forces, and link the local issue to a broader scale as decisions made region- or nation- wide can inevitably affect local practice (Jones, 2008).

Further, as power is not equal in the decision-making process, some actors may have more political and economic power or perceived by others to have more power to realise their goals. It is important to examine how power is negotiated and contested within the local and wider community. Therefore, an approach is needed to investigate both actors' social perceptions and their complex interactions with the environment. It is also important to explore the diverse perceptions and valuations of actors and actor groups towards the landscape which are shaped by socio-economic and cultural factors. It is also necessary to find out the balance of different interests among actors through examination of similarities and differences of their perceptions. Further, it is essential to explore these perceptions and actions in a wider social and political context as individuals' perceptions and actions may be constrained by larger structural forces in greater scale (Siddle and Swindell, 1990), and hence to improve the understandings of the complex interfaces between human actions and environmental changes.

Land management requires a balance between different land-users' needs (Muchena and Van der Bliek, 1997). From the above analysis, in recognising the problems of causal mechanism of human and environment relationships, research into people-environment relationships necessitates a theoretical perspective that is constructivist, multi-faceted, diverse and flexible. It needs to be able to provide a richer analysis of complex processes of environmental changes situated in political, social and historical context, as this research seeks to achieve. In addition, this research aims to reveal power distributes in the decision-making process over the resources use and management, as such the investigation can

help us detect the complex interactions and relationships between groups, and thus achieve the balance of power amongst different groups.

Research Questions

Taking the above discussions together, a political ecology framework is appropriate to this research, which concerns complex relationships between human society and environment, and between and within social groups and individuals, which are of high relevance of this research. The approach of political ecology in this research is based on the foundation of the examination of decision-making process, which is organised and transmitted through social relations, in relation to political, social and economic factors operating at different scales. These central concerns generate a number of questions that are returned to throughout this research:

- How do relevant actors (residents, land developers, city planners, politicians, and NGOs) perceive and understand the urban landscape?
- How do different actors make and influence the land-use decisions? Do they take environmental implications into consideration?
- What are the power relations between local, regional and national levels in the decision-making process?
- How does environmental change relate to social interactions?

These questions cover both biophysical and social process, local communities and higher levels of government between and within groups, therefore allowing a holistic understanding of the interrelated human-nature system.

3.5 Chapter summary

Land degradation is a complex problem as it involves many facets, interactive relationships between human land uses and landscape, and cannot be well explained and understood by one-way causal mechanism. Political ecology is an appropriate theoretical framework for this research, as it includes the key concerns of human-environment relationships, power relations, environmental changes and

social interactions. It not only allows the examination of decision-making process related environmental changes situated in broader cultural, social, and political contexts that linked in scales (Robbins, 2004), but also enables better understandings of interactions between individual actors and between actor groups, and allows the better analysis of power relations operating at different scales in the decision-making process. Having presented the theoretical and empirical context of the research, the next chapter moves on to present the methodology that is employed to investigate the interrelationship between decision-making and land degradation in the case study area.

Chapter 4 Methodology

4.1 Introduction

This chapter describes the empirical research process and presents the methodology applied in this study, linking the practical approach with the theoretical framework of political ecology addressed in Chapter 3. This research employs a mixed-methods approach, as qualitative interviews and quantitative questionnaire methods are used to enable the triangulation of results. Mixing methods is considered to bring together the strengths of different methods within the same project (Morgan, 1998). This chapter begins with a justification for adopting a case-study approach, followed by a detailed description of the case-study area in Las Cruces, New Mexico. I present a thorough account of the research process, and justify why the choices made suit the main research questions. This chapter also addresses researcher positionality and discusses the challenges and limitations of the empirical research undertaken.

4.2 Fitting the research questions to suitable methods

As stated in Chapter 1, the aim of this study is not only to improve understanding of the complex mutual influences between decision-making and environmental changes, but also to examine the interactions and power relations between social actors, which could inform new ways of sustainable land management.

This aim is achieved through a number of research questions:

- How do relevant actors (residents, land developers, city planners, politicians, and NGOs) perceive and understand the urban landscape?
- How do different actors make and influence the land-use decisions? Do they take environmental implications into consideration?
- What are the power relations between local, regional and national levels in the decision-making process?

- How does environmental change relate to social interactions?

A case-study approach was employed to complement the political ecology perspective of this study by focusing on people in place, which enables an in-depth understanding of real-life phenomenon (Yin, 2009). Researchers have found that case studies are able to provide explanatory insight into causal mechanisms and relationships that large-scale studies overlook (Gerring, 2007; Pare, 2002; Yin, 2009). Working with a case-study approach also enables the incorporation of temporal and spatial dimensions into the context-specific processes and events within broader social, political and economical structures, as called for by the political ecology framework of this study (Blaikie and Brookfield, 1987). Focusing on one case study enables an in-depth understanding of the complexity of the issues in question within a real-life context (Soy, 1997; Stake, 1995). This research aims to improve understanding of how people's land-use decisions impact on the land degradation, which means multi-scale factors need to be considered and analysed under the complex social, economic and political context. One case study was selected to explore the decision-making process in-depth. This single case study research is designed with the time and resource availability of a PhD research project.

Stringer (2004) remarked that research which investigates the interplay of society and environment is methodologically demanding because it needs to consider the diversity of ecological, socio-political and cultural factors. As such, a multi-methodological approach needs to be employed to allow the triangulation of data sources and lead to robust conclusions (McKendrick, 1999). The integration of qualitative and quantitative methods used in this research aimed to achieve a more in-depth and comprehensive understanding of various perceptions of both individuals and groups with diverse backgrounds, their motivation and priorities of making land-use decisions, and their interactions with each other.

Qualitative research methods, when done well, can investigate people's life-worlds from the inside (Flick et al., 2004b). In their approach, qualitative methods are often more open and 'more involved' than research techniques that deal with large quantities and are strictly standardised (Flick et al., 2004a). On the other

hand, quantitative research approaches provide comparative statistical evaluation for the topic of investigation. They rely upon highly standardised designs for data-collection, and could be seen to provide relatively objective data.

Sieber (1973) and Madey (1982) remarked that qualitative and quantitative methods can aid each other in three different stages of research: design, data collection and analysis. Quantitative methods can complement qualitative data by providing a fuller picture and correcting for elite or gatekeeper biases during data collection. Quantitative data can be used to help substantiate the generality of qualitative observations, they can verify qualitative interpretations, and can even cast new light on qualitative findings. In addition, quantitative methods enable researchers to see patterns in data more readily. Qualitative methods can help with the quantitative side of a research project, by enhancing the sampling strategy during the design procedure, and providing explanatory insights to the quantitative findings as well as illustrating quantitative results. In short, benefits can be gained by a combination of qualitative and quantitative methods in one study. Quantitative methods can aid in precision; they can provide reliable instruments for evaluating relationships amongst variables of interest; and they assist a researcher in gaining a broader view of patterns amongst variables. Qualitative methods widen the focus on concepts and problems of interest, can enable a greater in-depth understanding, and can provide explanations to help in the interpretation of quantitative data. This triangulation strategy can lead to a deeper understanding of the issue under investigation, and towards greater knowledge of the research questions addressed (Greene et al., 1989; Tashakkori and Tedddlie, 2003).

In this study, the qualitative interview method was chosen as it is often used to provide ‘rich’ or detailed description of ideas that are relevant to the research participants (Lewis, 2008). In order to gain the most insightful information about the land-use issues in the desert landscape from the perspective of those engaged within it, qualitative interviews with five key actor groups were conducted. Semi-structured interviews were carried out as they frame a structural dialogue, and at the same time allow flexibility for tailoring to individual respondents depending on the nature of responses already provided during the course of interview (Kvale

and Brinkmann, 2009). Through a dialogue, the participants can share their expert knowledge about the research field in question, provide their subjective perspective, and supply data relating to their life stories. Qualitative interviews not only provide the opportunity of openness about the informants' motives for action or everyday theories and self-interpretations, but also the opportunity of discursive understanding through interpretation (Hopf, 2004). For instance, social actor groups have various motivations for their land-use decision-making for the desert, and this information can be better captured through an in-depth loosely structured interview, whilst quantitative questionnaires can provide information on assessing and comparing the differences of how actors perceive the desert landscape. Analysis of this combined information can help to quantify the opinions and understand how perceptions and values of the desert landscape influence the decisions and actions of land-use in the political and socio-economic context which underpins the conceptual framework of this study. In addition to the primary data-collection methods, secondary data collection was also used to elicit information to enhance the understanding of the local issues through analysis of documents and other secondary data such as leaflets, news media, and other information packs such as government documents, reports and local magazines.

4.3 Case-study area: Las Cruces, New Mexico, USA

4.3.1 Selection of case-study area

Las Cruces was selected as a case-study area for this research for the following reasons:

- This area has its typical southwestern socio-economic and political character as well as its specific history to provide the ground to learn about the problem of land degradation. It is located in Southern New Mexico, which is experiencing severe land-degradation. A dramatic change of the dominant vegetation and landscape has occurred over the last 200 years (Duran et al., 2005; Grover and Musick, 1990; Mainguet, 1991). The present mosaic of shrubland and grassland in the Southern New Mexico is

mainly the result of continuing land degradation combined with urbanisation (Mac et al., 1998). With the rapid urbanisation in the American Southwest, contemporary land uses have generally been determined by human choices. Having vast lands influences people's character, their social and cultural values, and their political beliefs.

- There is a well-established ecological research site, which is adjacent to Las Cruces: the Jornada Basin Long Term Ecological Research (LTER) site[3]. It is a long-established research network in the Chihuahuan desert, which has a wide range of scientists from different research disciplines, including two of my PhD supervisors. This research site includes the Jornada Experimental Range, and land is owned by the United States Department of Agriculture – Agricultural Research Service (USDA-ARS); Chihuahuan Desert Rangeland Research Centre (CDRRC), and land is owned by New Mexico State University (NMSU) (Jornada Basin LTER, 2007). The LTER site was identified as a key network institution due to the overlap with my own research interest. They agreed to host me for the duration of my second fieldwork period, and provided support for conducting the research in the form of desk facilities and IT support. I benefited greatly from discussions about ongoing research in their institution and suggestions about how to access local research participants; recruitment is discussed in a later section.
- The study area was easy to access, not with good public facilities such as public transport, but where I could easily hire a car and be safe working alone. Las Cruces was a feasible option in terms of financial costs and my research timescale.

Identifying Las Cruces as a case-study area enables the exploration of the general problem of land degradation within its wider political and socio-economic context, while at the same time the case-study approach also invites observations of

[3] The Jornada Basin Long Term Ecological Research program, in collaboration with the USDA ARS Jornada Experimental Range, studies the causes and consequences of desertification: the broad scale expansion of woody plants into grasslands that results in more "desert like" conditions (Jornada Basin LTER, 2007).

particular local characteristics. That is to say by zooming in on an example of a general problem, I can understand more of the diverse facets and influences, and future studies of the general problem can take into account the factors that this study shows are important for this case.

4.3.2 Description of case-study area

This study was conducted in northeastern part of Las Cruces located in Doña Ana County, which comprises of 977,642 ha of land, in New Mexico (Figure 4.1). The study area is along US Highway 70 to the east of Las Cruces. The area is locally referred to as 'East Mesa' area. Las Cruces was founded in 1849 in the Mesilla Valley of New Mexico, and since that, early buildings, businesses and mining industry started in Las Cruces. In 1881, when the first train arrived in Las Cruces, the population tripled to 3,000 residents. In 1890, the New Mexico College of Agriculture and Mechanic Arts were established. In 1912, New Mexico became a state. By this time, Las Cruces had its first water system, electric power and a few factories. By 1920, population in Las Cruces reached 4,000 residents, and by 1940, it grew to nearly 9,000. From 1950 to 1960, the population of Las Cruces increased from 12,000 to over 29,000. Hundreds of hectares of land were developed and many houses were constructed on the East Mesa (City of Las Cruces, 2010b). This area has been the fastest growing community in the West of United States since 1950s (City of Las Cruces, 2007).

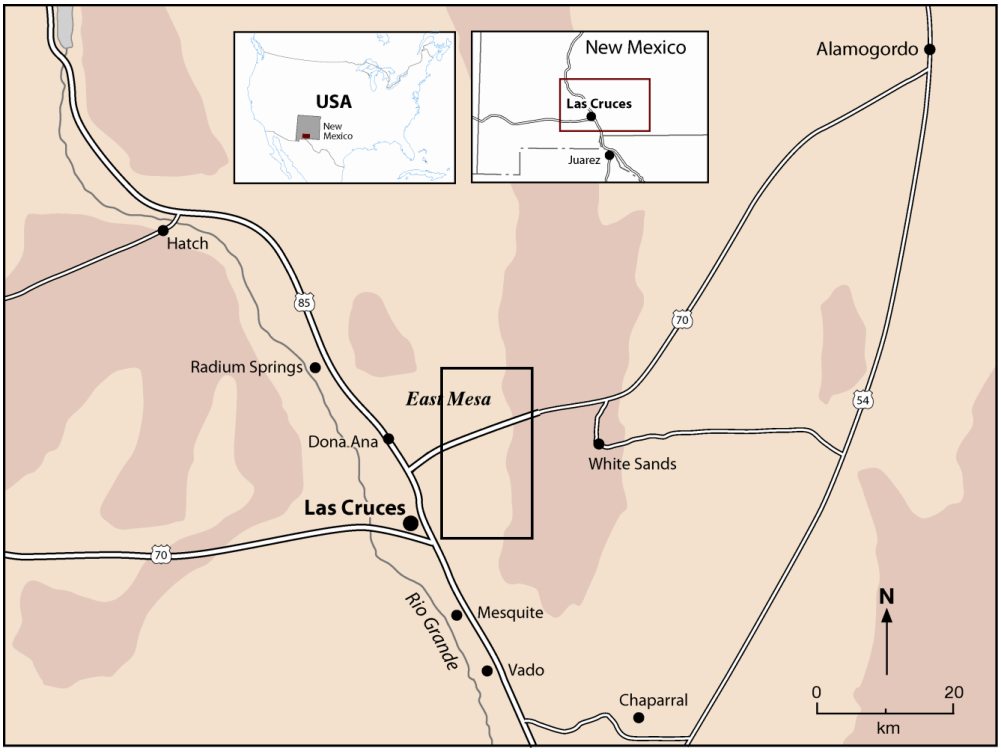

Figure 4.1: Map of study area in the City of Las Cruces, Doña Ana County, New Mexico

In the Doña Ana County, only 13.3% (130, 000 ha) of land is privately owned. Most of the other land is owned by three government agencies: US Bureau of Land Management (BLM) (46%), US Department of Defense (USDD) (20%) and State of New Mexico (12%) (City of Las Cruces, 2010c). The three government agencies have different control and management systems over these public lands. The BLM reserves the right to dispose of and sell land at fair market value or make other land exchanges. USDD manages its land and these lands are not available for private ownership. The State of New Mexico can exchange some of its land for BLM or sell it to private owners, however, State Trust land must be used for education or public services purposes. Doña Ana County is unique because large tracts of public land stand in the path of future development. These high value tracts are increasingly being used to support land exchanges statewide. In the past few years, BLM has exchanged, granted Recreation, Public Purposes and sold approximately 1,619 ha of public land in response to requests made. However, little interactive planning has been implemented to deal with urban development utilising publicly owned land (City of Las Cruces, 2008a).

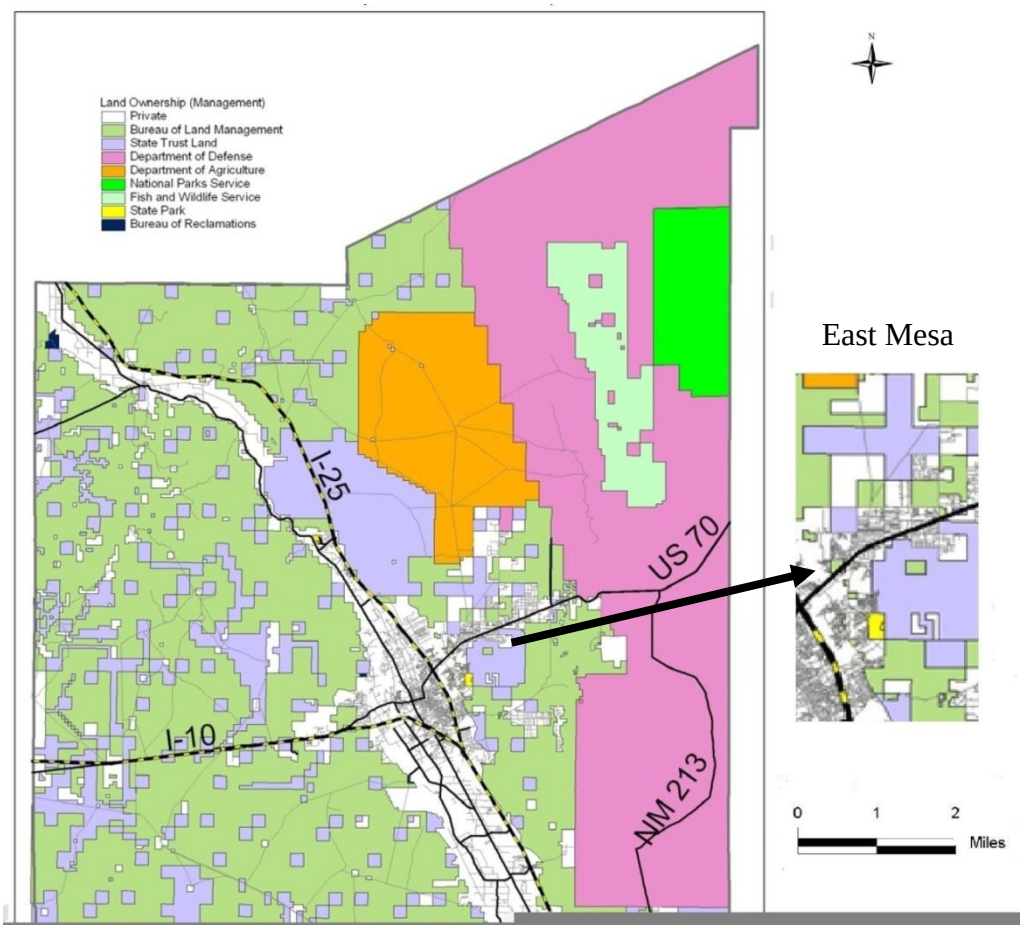

Figure 4.2: Map of land ownership in the study area in Las Cruces, Doña Ana County

In the City of Las Cruces, the total land area makes up to 19, 909 ha, and 65.5% of land is owned privately. The BLM manages 10.9% and the State Land Office manages 23.4% of the land. Most of the land managed by the State Land Office and BLM is located in the newly annexed[4] territories of Las Cruces, and much of this land is in the East Mesa (Figure 4.2). On the east side of the city, a large amount of this public land has already been master planned for development and will be transferred to private ownership ultimately. In 2000, half of the land in the city was vacant. Residential land was 2,536 ha and it accounted for 21.6% of total land. Many residential developments were occuring in the East Mesa along US Highway 70. Land for Public Services such as the airport and flood control facilities used 13.0 % of the area in the city. Commercial land used approximately

[4] The purpose of an annexation is to re-designate property outside the city as being within the city limits (City of Las Cruces, 2008)

822 ha and accounted for 7.0 % of the area of Las Cruces. The rest of land was used for Community Services (4.0%), Recreation (2.0%), Agricultural purposes (2.8%) and Industrial uses (0.3%) (City of Las Cruces, 2008a) (see Table 4.1).

Table 4-1: Land-use types and distributions in 2000 and 2007 in the City of Las Cruces

Land Use	Hectares		Percentage (%)	
	2000	2007	2000	2007
Agriculture	326	131	2	1.1
Residential	2,536	3,106	21.6	17.5
Commercial	822	934	7.0	5.3
Industrial	40	40	0.3	0.1
Community	471	471	4.0	4.2
Public	1,523	1,362	13.0	7.7
Recreation	236	236	2.0	1.7
Vacant	5,762	11,116	49.2	62.5

(City of Las Cruces, 2008a)

Distributions of land uses have changed from 2000 to the present. In 2007, vacant land stands at 11,116 ha, accounting for 62.5% of the area in the city. Approximately 3,106 ha of land is residentially developed. Most of new residential developments are being built in the East Mesa area (Figure 4.3). Public Services land has increased to 1,362 ha, and commercial land grew to 934 ha. Agricultural land has decreased by 131 ha due to the conversion of several agricultural properties to residential developments.

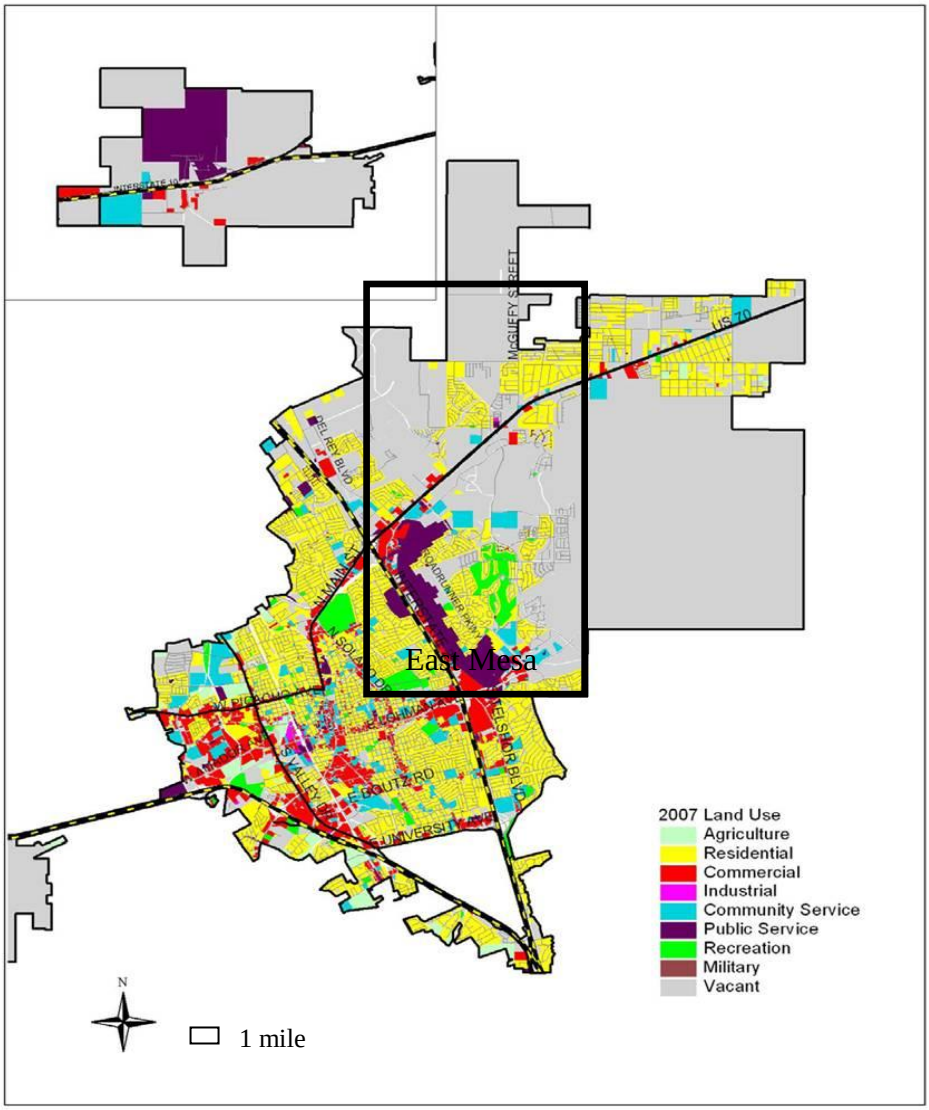

Figure 4.3: Land use in 2007 of study area, the main land-use function is for residential purposes (City of Las Cruces, 2008a)

In 2000, there were 5,762 ha of vacant land that accounted for almost half of the area of the city, and the majority of vacant land was located on East Mesa. Residential land accounted for 2,536 ha of land. Since 2000, there were 16 annexations approved by the city council. Consequently, Las Cruces has grown in size from 132 km^2 to 199 km^2 through land annexation. Land adjacent to the city boundary can be annexed by the city. As most of the area outside the city is owned by the government agencies, the land can be annexed simply by receiving their permission. If property is privately owned, the territory can be annexed through a majority vote of the property owners. All annexations are subject to

review and comment by the Doña Ana County Board of Commissioners, however, the decisions lie with city council (City of Las Cruces, 2010c).

The vacant land increased to 62.5% of the city's area due to annexation of new land into the city. A considerable amount of this land is located on the eastern side of the city. There are currently 3,106 ha of land that are residentially developed (City of Las Cruces, 2008a).

In the City of Las Cruces, two of the five largest annexations were within the East Mesa: one in 1986, which comprised 1,080 ha; and another annexation in 2006, which comprised 795 ha. In 2007, most major subdivision land-uses activities for Las Cruces have taken place within the East Mesa. One of largest annexations comprises 1,707 ha which provided 30,000 to 44,000 residential units, public facilities such as a fire station and public schools as well as recreational places including a golf course. This subdivision contains the facilities of a small town, making it a city within a city. Many housing-development projects in the East Mesa are either in progress or already complete. New businesses start-up each month, and developers are constructing new homes, as such some expect the East Mesa to continue to grow in the foreseeable future (Las Cruces Magazine, 2008). Of course, business people have a financial incentive to predict growth.

The total population in Las Cruces was 73,539 in the 2000 census (US Census Bureau). According to US Census Bureau, population in Las Cruces reached 86,268 in 2006 with an average annual increase rate of 2.7% between 2000 and 2006, while the rate in the State of New Mexico increased by 1% during the same period of time. Continuous growth of population is expected in the City of Las Cruces. Its projected population will be 109,862 by 2020 and 145,327 by 2020. This figure represents a 98% population growth between 2000 and 2040 in Las Cruces (City of Las Cruces, 2008a).

Like other desert cities, Las Cruces receives limited rainfall. The annual average rainfall is 245 mm (Wainwright, 2005). July is the warmest month of the year with an average temperature of 27 ℃ and January is the coldest month during of the year with an average temperature of 6 ℃ (Gibbens et al., 2005; Las Cruces

Weather, 2011). The warm climate and mild winter attracts many retired people to move to the area (Money Magazine, 2005).

4.4 Data-Collection Process

4.4.1 Sampling procedure

The overall objectives of this study were to explore possible relationships between landscape perceptions, land-use decision-making and land degradation. The aim was not to predict phenomena or make generalised statements, so it was not necessary for respondents to be randomly sampled. The sampling strategy used to select suitable participants was purposive; in other words a sample is chosen so that it offers the most relevant information and deepest insights into a specific phenomenon (Johnson, 1990; Lewis, 2008; Miles and Huberman, 1994). Purposive sampling is a widely used technique in qualitative research, partly because qualitative researchers often work with small samples of people and study in-depth. As Miles and Huberman (1994:27) suggest, there is a tendency for qualitative research to use purposive sampling "because social processes have a logic and a coherence that random sampling can reduce to uninterpretable sawdust ... and can deal you a decidedly biased hand." Moreover, purposive sampling is rooted in the concept that a sample needs to be chosen that offers the most relevant and perceptive information and knowledge in order to obtain the most insight into a specific phenomenon (Johnson, 1990; Lee and Tang, 2001; Lewis, 2008; Miles and Huberman, 1994). A few criteria were applied in this study to ensure the sampling procedure was focused, systematic and manageable. A summary of the sampling criteria and strategies is listed in Table 4.2.

Table 4-2: Criteria and strategies in the sampling procedure

Criteria	Strategies
Sampling relevant to the research questions	The respondents selected are central to the phenomenon, those actors who are involved in land-use activities and in contact with the landscape.
Sampling feasible in terms of time, access to people and own work style	Contacts were established prior to the researcher's arrival in the field, pre-appointments were made and extra time banked to allow flexibility and reflections.
Sampling ethical to the respondents (consent, confidentiality)	Consent forms were signed by both informants and the researcher, all of the information can only be accessed by the researcher and will be erased after the research is completed.
Sampling at ease for communication with respondents	Informants were sought who have expressed willingness to take part in the research and would be comfortable to share their perceptions and descriptions of the world in a believable and honest manner.

Prior to the research field trip, a literature review was undertaken to identify key discourses of land-use issues in the study area. In line with the political ecology framework of this study, emphases were given to the construction of land-related problems in the desert, the discussion of the local and wider context, and related policy documents. In addition, key actor groups involved in the land-use issues construction were identified through reviewing literature on land-use decision-making and landscape perceptions (Kaur et al., 2004; Larsen and Harlan, 2006; Lee and Tang, 2001; Lewis, 2008). Further information such as the 'key' actor in the key actor groups were sought in order to target the respondents and obtain the contacts for the pilot study. The knowledge and understandings derived from the literature review (Chapter 3) were used to generate research questions that informed the objectives, and then led to a list of themes and questions that were used to guide the interview. Moreover, the literature review also identified the mixed-method approach as appropriate and suitable to this research, which was elaborated earlier (Section 4.2).

Respondents were selected from five actor groups due to their significance on the land-use decision-making process, namely residents, land developers, city

planners, politicians, and NGOs. Their contact details were partially sought from online sources, such as official government website, neighbourhood association website. The others were obtained from the pilot study.

Residents were selected, based on neighbourhood association referrals; they were from different neighbourhoods and fell into different age, gender and ethnic background categories. Most of the neighbourhoods selected are located in relatively new subdivisions, developed over the past 5 – 15 years. The neighbourhoods were visited prior to the interview in order to gain an initial sense of the place and people. Careful observations were recorded.

After the target groups were located and email contacts obtained, email enquiries which explained the purpose of the study were sent out to invite target groups or actors to take part, then a few key contacts were chosen who provided me with suggestions of whom to contact. This assisted with access to different actors. The 'snow-balling' technique, where respondents were asked to recommend people who are interested in land-use issues and are able to express their opinions and perceptions articulately, was applied carefully to increase the number of respondents whilst trying to avoid bias. For instance, residents were asked to provide contacts who are from different background or who live elsewhere within the study area rather than just offering their close neighbours as potential new contacts. In order to know the interviewees and establish rapport and trust quickly, prior research about the interviewees (such as background and job descriptions) and relevant organisations were completed. This technique is suggested by Dundon and Ryan (2009), who found that it is useful to prepare the knowledge about the interviewees and organisation before beginning the interview schedule, which means that relevant web-based research about the organisations and respondents before researcher meet them for the interview is helpful. Lastly, with the information that came out from the respondents, further identification of more actors was undertaken and recruitment of interviewees was carried out. Although respondents who are involved with, and interested in, land-use issues may not be entirely statistically representative of the larger population, as Lewis (2008) states, they are influential in local planning practice. Active and involved respondents can offer appropriate and relevant data that can shed light on similar populations

in other local contexts. Hence the respondents who are most interested in a given subject also tend to be the most accurate and reliable in the reporting of issues and perceptions.

Accessing different actor groups imposed different levels of difficulties for me. Residents were relatively easy to access, as they are keen to talk about their yards and day-to-day experience with the yard and the area. Most of them showed me around in their yards, and especially those who were doing well in their yards expressed willingness to illustrate their opinions further and in more detail. Politicians were relatively difficult to meet because of their busy schedule. One politician agreed to meet, but did not confirm with me about his availability again, however I met him at the Builders' Association event by accident and he agreed to meet straightaway. The same situation also happened with one NGO. When I emailed him twice and invited him to my interview, he did not respond. However I met him in someone else's office and invited him again and he demonstrated an interest to be interviewed immediately. City planners were comparatively easy to access. All of them I contacted were available to meet and talk, some of them also offered me help such as providing a local land-use map. Developers were quite difficult to access. A few people were contacted, but not all of them were interested in this research.

As outlined in Table 4.2, pre-appointments were made after the respondents agreed to take part to make sure the time was used efficiently and the sampling plan was organised. In total, 40 interviewees consented to participate in this study, including five land developers, 23 residents, three NGO members (only two completed quantitative questionnaire), five city planners and four politicians.

4.4.2 Data-collection

The study comprises two data-collection trips to Las Cruces. The first one was carried out in August, 2008, which lasted for one month; the second one was undertaken from July until September, 2009. The first served two purposes. It was a pilot study which aimed to understand the place, the community and the language. Briggs (1986) suggested that the first item on a field worker's agenda is to understand the communicative norms of the society in question. Hyndman

(2001) stated that the field is not naturalised as a place or a people, instead, it is located and identified as specific political objectives that cut across time and space. A field worker has to take part in the field and interact with the people to understand the field and to share the common language and cultural acts. Hence, while in the field, the primary tasks for researchers are to gain an initial acquaintance with the native community, learn the community language and to build trust and rapport (Hyndman, 2001). Another purpose of the pilot study was to enable a preliminary analysis, reflection and preparation for follow-up, iterative research. The data collected in the first field trip were analysed and reviewed, thus the interview questions and questionnaires were refined, and the analytical techniques were revised and improved. These outcomes fed back to the second journey and resulted in more successful follow-up research. For instance, the length of interview for the pilot study was later considered too long, as it took about two hours for the qualitative interview questions. Inevitably the interviewees lost concentration during this process. Therefore during the second research period I refined the interview questions. In addition, after the pilot study I identified a need to design a questionnaire to quantify desert perception and evaluate the statistical relationships of difference between social actor groups, in order to answer Research Questions 1 and 2. The first pilot study also enabled me to establish a few key contacts and increased my confidence to recruit informants for follow-up research.

In the first few days of the first fieldtrip, I mainly drove around in the study area familiarising myself with the area and community. I had meetings with colleagues from the Jornada Basin LTER. Support had also been provided by the LTER site, which was located close to the study area. As mentioned above (Section 4.2.1), two of my PhD supervisors are part of the research network and because of the nature of my research methods, permission for research on human subjects had been granted before I carried out the field research as part of the ethical procedure involving in human-related research. Ethical approval for this research was also granted by the University of Sheffield. The benefits of being part of this research network are two-fold: since it has been a long established research network in Chihuahuan desert, which has scientists from diverse backgrounds and different

research disciplines. A few meetings with key researchers from the Jornada Basin LTER provided me insights into the ongoing research about the desert area and they offered me suggestions about how to access to the local community.

Meanwhile, emails of confirmed appointments were sent out to the agreed informants and the exact time and venue of the interviews were arranged. As in the earlier email inquiries, only rough dates were given in order to give both informants and myself some flexibility after they demonstrated willingness to take part in the study. Another consideration was that I wanted to observe the field first and select a few possible and appropriate interview venues. Based on the strategy that to select an interview venue where interviewees feel comfortable to communicate and in addition it is a good enough environment to pursue the conversation (Dundon and Ryan, 2009). However, interview venues suggested by the interviewees were often used, unless the venues were unsafe or noisy. The interviews took place in several venues, including cafés, an interviewee's office, and residents' yards or homes.

Two cafés in the study areas were used frequently and I found that cafés provide a relaxed and friendly environment to conduct interviews. In fact, interviews completed in cafés are quite effective, although background noise was a problem occasionally. The interviews conducted in the interviewees' offices directly remind interviewees of their work. Thus, in this business setting environment, interviewees were very keen to talk about their job, organisation and business and land-use issues; they often can find some tools such as maps and documents to explain more details about the issues of concern to me. While in the residents' homes, interviews had also been successful because it became a very interactive activity, residents showed me around their yard and talked about something they can visually experience. Every part of their yard seems to remind them of the present or past moment they spent in their yard. In addition, residents in this setting most likely feel that they are the host, and showing guests around the yard and sharing the experience of designing and maintaining it, rather than feeling uncomfortable about being asked questions by a stranger. Hence power was distributed equally between the interviewees and me as the researcher.

Photographs in the residential yards were taken in order to assist for future analysis with the permission of the residents.

The setting of interview stage is important to prepare the ground for a successful and informative interview, which encourages the informants to express and describe their point of view and experience in their life-worlds to a stranger. The first few minutes of an interview are often decisive (Hurd and Smith, 2005; Kvale and Brinkmann, 2009). The interviewees are reassured to know the interviewer before they start to talk freely. The interviewer then needs to demonstrate interest, understanding and respect for what the informants say with what she wants to know in mind. I found that the opening introduction is particularly important. By briefing interviewees on the purpose and context of the research, relating this to the respondents background information, assuring the confidentiality of the dialogue and asking the permission for digital recording, and showing a willingness-to-learn attitude as an outsider and a foreign, female and non-threatening research student, initial trust and comfort between the interviewees and me was established.

All of my informants who agreed to take part in the study demonstrated willingness to provide information and answer my questions, hence the interviews generally ran smoothly. Although a few informants were quite reserved at the beginning, they all completed their interviews. Eventually, many built up interest and confidence in my study, and gave me some insightful suggestions. One resident also invited me to take a tour in a soup kitchen where she was volunteering, making free lunch to poor people every Friday. It was an interesting experience to see the diversity of the community, and it gave me a greater understanding of the socio-economic context of this research.

Another person who provided support is one politician during my second journey. She is one of my key informants, who not only assisted me for network referrals, but also provided me opportunities to get involved with the local people. I also demonstrated interests in those non-agenda opportunities to expand interaction with more people and engage more with the local community (Kvale and Brinkmann, 2009).

An active research strategy to maximise contact with those key informants was pursued, not only in order to improve my understanding of the social context of the land-use issues relevant to the local actors, but also to build up a rapport of trust and familiarity with participants and the community. Such familiarity can potentially improve the quality of the subsequent interviews and fieldwork. Hence in order to achieve maximum interaction with both local people and institutional members, events and meetings were attended. In addition to the soup kitchen and council public meeting mentioned above, others I attended were as a Builders' Association event in the local park, and a Quality Alliance meeting held in the Southwest Environment Centre.

4.5 Carrying out research: interviews and questionnaires

4.5.1 Interview process

The interviews were based on guides with a list of topics to be covered, with suggested questions and also prompt themes, as well as being open to ideas as informants arose so as to explore more fully the perspectives of them (Lewis, 2008). Therefore, as the main land-use activities vary between actor groups, five sets of interview scripts have been produced, which contained different concerns and issues to be explored. All of the five interview scripts are attached in the Appendix (I). Kvale and Brinkmann (2009) stated that interview questions needs to embrace both a thematic and a dynamic dimension: thematically links to producing knowledge, the questions link to the 'what' of an interview, theoretical conceptions of the research topic, and later analysis of the interview; dynamically connects to the interpersonal relationship in the interview, the questions relates to the 'how' of an interview, encourage a positive interaction, keep the flow of the conversation going and give confidence to the informants to talk about their experiences and feelings. One research question can be explored through several interview questions to gain rich information by approaching a topic from different angles. On the other hand, an interview question may provide answers to several research questions, hence attention needs to be paid here to avoid excessively repeated questions and consuming extra time. The question of why the actors make their land-use decisions is a primary task for me to evaluate, and I

understand that here I may need go beyond the actors' self-understandings. However, research questions are not the same as interview questions (Hermanns, 2004). Instead of asking 'what motivations influence your land-use decision-making', concrete facts from the respondents' daily life were asked such as 'why did you choose this piece of land rather than the other in x location'. It is also significant to know the decision-makers' own explanations of their conditions and to ask questions about why to obtain pertinent and reliable information from which to portray the interpretations. Different types of questions have been asked such as introductory questions (e.g. can you tell me about your role within your organisation?); follow-up questions such as repeating key words of an answer which can lead to further elaboration, and also be sensitive to unusual signals and intonations which may imply a complex picture related to the informants; probing questions (e.g. could you please tell me more about it?) to pursue the answers. However, at the same time, leading questions and statements of my own position were avoided in order not to bias respondents. After the answers have been offered, clarification of the meanings relevant to the research was asked if there is anything insufficiently clear or specific terms and jargon have been used. Such efforts will establish a more secure ground for later analysis, and also help to improve the communications and promote the conversation with the respondent demonstrating that I am listening and interested in their stories (Kvale and Brinkmann, 2009). In addition, as I am not a native English speaker, I paid particular attention with the context of the conversation and made sure I have respondents' clarification and illustration if there is something unclear to me. I could not assume the meaning of a word by my own understanding and my cultural background. In fact, I feel there are a few advantages of not being a native English speaker: first, my 'naive' follow-up questions and clarifications were seen as a learning process, and rather than a repetitive questioning process, I was seen as an interested listener rather than an 'information greedy' researcher. Second, a different cultural background and institutional system helped me to obtain detailed information and descriptions of the issues. The respondents demonstrated patience and interest to explain things in relation in their own expertise.

The first part of the interview (Section 1) briefly explains the project to interviewees, and Section 2 aims to obtain background knowledge of the interviewees, including their occupation, how long they have worked in the organisation or company; how long they lived in the study area and why they moved there and things they like and dislike about the area. As mentioned above, the information and questions are slightly different between actor groups. For instance, some residents have retired and moved into the study area, their previous organisation or occupation may not be considered as a main factor in influencing their landscape perceptions or land-use decision-making. As for the planners' group, some of them are not living in the study area, hence they may not have sufficient experience to tell which kind of aspects they like or dislike about the area.

In addition to the basic background of respondents, focus was placed on a few topics: their relationship with the study area (Section 3), i.e. where they live, work, shop, and carry out recreational activities; and their recent land-use activity in the study area. To explore people's perceptions in detail, quantitative questionnaires were conducted in the last part of interview during the second research journey. Section 4 is about the drivers of their land-use decision-making, Section 5 explores the decision-making impact on the desert and Section 6 investigates the desert influence on actors' land-use decision-making in turn. Section 7 is the quantitative questionnaire. The last section is to obtain additional demographic information about the respondents (ethnicity group, political side, occupation, age group, education**)** although most of the information has been obtained throughout the interview. More sensitive information, such as some political discussions about the land-use issues, was also asked in this later stage of the interview after the trust has been built. At the end of an interview, they may have some tension or anxiety, because the interviewees have been open about personal and sometimes emotional experiences and may be wondering about the purpose and later use the interview. There may also be feelings of emptiness, the respondents provided me much information about his or her life and may not have received anything in return (Dundon and Ryan, 2009). That being said, a common experience after research interviews is that the respondents have experienced the interview as

genuinely enriching, have enjoyed talking freely with an attentive listener, and have sometimes acquired new insights into important themes of their life worlds. A debriefing after the interview was also implemented. I often asked if the respondent had anything more to add, and repeated briefly what they had told me. I repeated some of the key points that I have learnt from the interview and provided the opportunity for the interviewees to comment or re-address or discuss the issues they have been concerned about during the interview. I also asked if the interviewees have anything more to say, or have some questions about this interview and my research. Further discussion also continued sometimes after the voice recording was turned off. This practice provided opportunities to clarify issues that have been discussed, anything they have been thinking or concerned about during the interview. I found that by doing this, it improved the respondents' comfort and trust, hence many of them still kept talking after the interview and some of this information was very important to inform this research from different aspects. I gave myself at least 10 minutes of quiet time after each interview to reflect on what has been learnt from the particular interview and what could be improved. After each specific group of actors interviewed, new knowledge and terminology emerged. I used these terminologies in my following interviews.

4.5.2 Questionnaire

A quantitative questionnaire was used to assess how actors perceive the desert landscape and explore how these perceptions influence actors' decision-making. The questionnaire was designed as a result of the pilot study carried out in the case study area in 2008, revolving around the value of the landscape, many of the issues were derived from local people's repeated concerns, such as water crisis, space, land development, and landscaping, reflecting topics of local interest and debate.

The first section of questionnaire contains a series of five-point Likert-scale statements about respondents' views of East Mesa area. The respondents scale each statements from: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree, except statement 3, which is coded differently as 0 = no, 1 = once, 2 = A few times (more than three), 3 = Often

(weekly). To assess further respondents' understandings and valuations of the desert, in the second section of the questionnaire, respondents were asked about their opinions of desert ecosystem, they are asked to choose the statements they agree with and rank their choices by numbering 1= the one they most agree with, 2 = the one they agree with the second, and so on. The questionnaire is attached in the Appendix II.

4.5.3 Secondary data supplement

In addition to the primary data, secondary data provide an important source of information for this research. In fact, the pre-research of the field draws largely on published secondary data and those data improved my understandings of the case study area and increased my awareness of local hot discussions and issues. Key types of secondary data contributed to this research include:

- Local news media such as Las Cruces Sun-News, one of the most important local newspapers, which is also available online;
- Policy documents e.g. Bureau of Land Management Exchange document;
- Research project outputs such as presentation slides and papers, e.g. presentations in the dust control public meeting;
- Locally distributed leaflets, e.g. land developer's leaflet.

Using the secondary data serves two purposes for this research: one is to help me to plan the primary data collection and another is to help me to analyse and interpret the data. Prior to the primary data collection, the literature review and methodological design were largely informed by published secondary data. Secondary data was also collected to provide background information of the historical, physical, socio-economic and policy context of land-use and the problem of land degradation in the study area. In terms of analysis and interpretation of data, secondary data adds credibility to the primary data offered by the interview respondents (Stringer, 2004), and provides a wider perspective to reflect on information I obtained from individual respondents and enables a critical analysis of the data. It is also recognised that a critical approach is needed when using the secondary data, since the collection of such data incorporates

subjective selection process, inaccuracies and agendas (Brown, 2009; Swart, 2005). Hence, errors might exist in interpretation of meanings and explanations. However, it is argued that because this research is primarily using my raw interview transcripts, and my empirical fieldwork enables the objectivity of the respondents' physical and social settings, hence the concern is minimised. The use of secondary data can yield fruitful explanations for the questions under investigation in this research.

4.6 Data analysis

The interviews were fully recorded and notes were taken throughout the interviews. In general, the interviews were interactive with the help from maps, documents, leaflets, and yard tours.

Qualitative interviews were transcribed, and transcripts were analysed by iterative readings and by following a five-stage analytical strategy informed by Schmidt (2004). This approach was selected because it "postulates an open kind of theoretical prior understanding but does not reject explicit pre-assumptions and the relationship with theoretical traditions" (Schmidt, 2004:253), and brings together different analytical techniques that are appropriate to the analysis of semi-structured interview. These five main processes include: set up categories for the analysis based on the material; bring together the categories in an analytical guide, revise and refine them; code the data according to the analytical and coding guide; produce case interviews and select the individual cases for in-depth single-case analyses. This strategy applied in this research involves interchange between data and prior theoretical knowledge, which is informed by an awareness of pre-existing literature (Schmidt, 2004). This interchange occurs not only after the transcription of interviews, but at the start of the data collection, which means that theoretical considerations in response to pre-existing literature as well as experience and observation during the fieldwork. Hence, theoretical pre-assumptions may be refined and modified during the interchange process.

The first phase of the analysis is material-oriented, which refers to the transcribed interviews in this research. It starts from repeated reading of the material to identify the analytical categories. My prior theoretical knowledge and the research

questions guided my attention in the reading of the interview transcripts. Bearing in mind the openness of the interviews, it is important to note whether new topics, which were not covered in the guide, emerged in the collected data. In addition, attention was also paid to note similarities and differences between the interviews for the preparation of the single-case interview analysis. Due to the openness of the semi-structured interviews, it is important to be aware that text passages did not always appear in the direct context of the question that was asked, but these aspects sometimes turned up in more explicit form later or in answer to a different question within a different context. This situation occurred in many cases in all of the actor groups especially in the early stage of the interviews. Repeated reading of the interview transcripts also helped me to note not only those text passages that fit well with my prior expectations and assumptions, but also those parts that correspond less well or contradict my previous expectations.

This first stage of iterative reading of transcripts is time-consuming due to the number of interviews. But it is essential to do so, as research categories were formulated in parallel with the reading of interview transcripts based on the theoretical and empirical concepts. Categories were also modified and supplemented during the process of data collection and preparation of the analysis based on experience and observations in the field trips, as well as reading carefully through the transcripts and comparing the topics and individual aspects in the interviews.

The second phase is to assemble the categories into a draft guide for coding. I used a draft guide here because some categories or codes were revised and deleted in a later stage of the analysis according to the data itself. As suggested by Bryman (2004), initial coding could be more detailed as at this stage it is crucial to be open-minded and to generate as many new ideas to encapsulate the data. Coding, which will be elaborated fully in the next stage, refers to relating particular passages in the interview transcripts to one category that best fits these passages within the research objectives. In other words, coding is to develop a list of thematic headings that summarise specific quotes in the interviews. In the coding process, categories were further refined.

The next phase is coding the interview transcripts according to the categories developed in the coding guide. The passages in each interview transcript were assigned to a category, and all categories were applied in succession to one interview at a time. The coding under one category remained unaffected by the codings under other categories. If there is no textual material for a specific category, or too little to be used for analysis, it might suggest that the existence of this category was inadequate to describe the data and it was deleted or revised. On the other hand, by iterative reading of interview transcripts, new codes might be generated either through more understandings or by combining initial codes.

All those codes then become key elements for analysis. As this process encompasses data storage, retrieval, comparison and linking, it is suggested that it be assisted by computer software (Patton, 2002). Computer software Nvivo 8.0 is used to organise the data, assist the coding and analyse the data. This software is relatively easy to use, also training was provided by the University of Sheffield. Secondary data was analysed through iterative readings and was not coded because of the variety of the data and not all sources are suitable for coding.

The fourth phase of the analysis is to quantify the survey results in the form of tables, which are able to present an overview of material indicating frequencies in individual analytical categories. Although the indications of frequency do not constitute the result, they rather provide information on the database and outline of distributions of categories within the material. Quantifying the survey results in a table also helped to find the exceptions, which is useful for further analysis of individual cases.

The last phase in the strategy involves the detailed case interpretations. The aim of this stage is to enhance the understandings of the topics discussed, discover new ideas and possibly revise existing theoretical frameworks. According to the database table established in the previous stage, a motivated selection of cases was made for more detailed analysis. The selected interview transcripts were read again and interpreted fully with reference to specific questions.

The quantitative data were analysed using statistical packages including SPSS and Microsoft Excel. The first section of questionnaire involves the analysis of

respondents' agreement or disagreement of each statement on landscape perception (Appendix II). These answers were measured and analysed according to different actor groups, and exceptions were also captured within the same group. For the second part of questionnaire, the answer to the questions were grouped by the groups of actors and given a score, i.e. if 1st rank = 12, 2nd = 11, and the statement obtained the highest score will be the most popular one and will reflect the actors' opinion. The purpose of performing this part is to investigate further actor groups' opinions, and devote specific attention to its intrinsic value. Williams (2003) stated that the validity and reliability of the data collected by questionnaire needs to be tested to ensure that the data collected is meaningful. In order to do so, analysis of variance (ANOVA) test was used to establish significant differences between difference statements held by actor groups in SPSS, with a p-level of <0.5 used to determine statistical significance.

4.7 Positionality

The social roles assumed by the interviewer and respondents were important to the success of the interview. It is important for the researcher to recognised their own place within the social relations they are studying and consider how the relationships of power between themselves and the respondents may influence the production, interpretation and representation of knowledge (Rose, 1997; Stringer, 2004). The positionality of an academic researcher is characterised by their gender, age, race, nationality, social class and insider/outsider situation, in particular in the field in other cultures (Herod, 1999; Mullings, 1999; Stringer, 2004). Mullings (1999) observed that researchers should critically reflect on the positionalities of themselves and their subjects and the consequent power relationships that develop between them. The relations of power during the research that are encountered with elite groups are considerably different from those encountered with non-elite groups (Mullings, 1999). In line with these suggestions, I recognised that my positionality may affect this research. Respondents are likely to provide some responses that they would expect me to hear or they assume I want to hear. I need to evaluate critically all the responses whist trying to be neutral and respecting the answers.

The way in which I was perceived as a female foreign research student in the United States may be greatly different from the way I would have been perceived had the research been carried out in China. Partly because the cultural and political differences, I was viewed completely as an 'outsider' in the United States. However, as I stated earlier, I feel that I was not always negatively positioned by being an 'outsider'. Research has found that 'insider' status is not necessarily privileged (Herod, 1999; Stringer, 2004). Because both the interviewer and respondent participate in knowledge creation and although the status of 'outsider' and 'insider' may shape this process differently, it does not make more sense to presume that one version of this knowledge is necessarily truer in some absolute and objective sense.

In fact, I made an effort to get to know the locals and tried to become involved in the community. My presence at the public meetings, visits to the soup kitchen, social interaction with the land developer and NGO, all increased my knowledge and opportunities of being some kind of 'insider' rather than a complete 'outsider'. Hence, the positionality of me has changed from the beginning of my arrival to the later stage of the field work. I benefited from the change of positionality. For instance, more trust has been built because I showed interest to take part in the local events and interacted with local people. I also found this interaction helped me to gain more understanding of local issues such as dust control and land development. When I presented at the public meetings and listened to the discussions, I put myself in the local context and understood the local issues from different perspectives. All of these experiences helped me to understand more about the place and people as well as providing me more insights to help analyse the data.

In addition, my positionality has been changed from interviewing different actor groups. In the interviews with key decision-makers in the land management and planning, my positionality as a young, non-threatening foreign research student will have helped me to gain more information and help. For instance, a couple of politicians demonstrated interests in my study. They said that they would like to help me because I am doing an important and interesting study and also they hope I like the city as a foreigner. Therefore, I was benefited from this help in a number

of ways. Both politicians provided me good information about the area and the issues about growth, they suggested other key informants to talk, and assisted with the contact. A politician was kindly drove me to the sampled neighbourhoods and gave me some information about those areas. These kinds of interactions were important to improve my knowledge about the field and increase my sense of being part of the field that I was welcomed by the local people and have some experience of what local people do. I also took some photos as part of the field observation during the tour to help me understand and analyse the data.

This situation might exist for land developers. They might not worry that the information shared with me would have been disseminated to the locals and created competitors or enemies. As one developer said: "it is ok (to tell you this information), because you are not from here…" Hence, I might have been seen as a one-way information receiver. The developers were patient during the interviews and demonstrated willingness to spare the time to talk with me. One developer showed me around his land development area, and gave me detailed information of land development process. I was invited for dinner by another land developer and had a chance to meet his family. He told me some stories about his family and his work, which helped me to understand more about the land development industry in general and increase a greater personal insight into the land development issues that land developers face. This social event also helped me to understand more about how local people interact with each other, and increased my confidence to build rapport with the local community.

I was also offered a tour by a director of local NGO in the mountain areas which this NGO group is trying to protect from being developed. The trip provided me an overview of what wilderness areas look like, a real feeling of the area he was talking about, and a chance to get close to the Mountains which were considered as important scenic areas by local people. Although I did not expect such experience prior to the second journey, reflections and understandings of the field resulting from the first journey have played an important role in building such a relationship (Twyman et al., 1999). My interests of the local culture and interviewees' background and work have also been considered as factors to establish the relationship.

Gender is also an important element of the researcher-researched relationship. Studies found that female researchers may be excluded or marginalised (Robson and Willis, 1994), or by contrast, be advantaged for obtaining information (Warren, 1988). In particular, challenges may be imposed when interviewing male interviewees. As Schwalbe and Wolkomir (2001) stated that all men have similar patterns of self-presentation, when men feel compelled to abide by it, and it will create a number of problems in interviews. That is to say the important task for men is to signify possession of a masculine self with more abilities and desires to control and autonomy. The interview situation can be considered as an opportunity for men to signify masculinity as they are allowed to depict themselves as in control and autonomous. It might also be considered as a threat because the interviewer controls the interaction. The interview situation is often defined as one in which a stranger sets the agenda, asks the questions, controls the flow of talk, and probes for information. To agree to participate in an interview, no matter how friendly and conversational, is to give up some control and to risk having one's public persona stripped away. Thus, a lot of men and women consider interviews discomforting. However, as male privilege is staked on demonstrating a masculine self, men may see a greater threat and may act in ways that give rise to predictable problems. Some other differences such as race, class and age in conjunction with certain topics can also increase the threat potential of an interview. In recognising the issues which might exist in the interview, some strategies suggested by Schwalbe and Wolkomir (2001) were born in mind when I carried out the interviews. For instance, let the interviewee suggest the interview venue, appreciate the interviewee as expert, take a newcomer's licence not to understand and presume. By iteratively reading the interview transcripts, it was found that my gender was unlikely to have negatively affected the data-collection process. In addition to the above strategy, I also paid attention to my dress code and timekeeping, which means I always made sure to turn up as a professional researcher, and arrive at the interview venue on time.

4.8 Ethical considerations

All the interviews followed an interview guide, which carefully took ethical issues into account. Individual interviews took place only after the prospective respondents had been introduced into the research. Respect was shown to all those involved in the research from the beginning till the end of empirical research. Honesty regarding the purpose of research and the later use of data was sustained throughout the research. Any publications resulting from this study can be obtained by directly contacting me if they are interested. The respondents had rights to deny participation, deny answering any questions or stop the interview at any time. All interviews were guaranteed confidentiality and anonymity. In a small study community like Las Cruces, although the interview transcripts will not be disclosed, informants may still worry that people can identify them by some quote. The respondents were assured that their identity would not be revealed by the study and only collective terms will be used to present the quotes. The transcripts or any individual details are kept in a safe environment and password protected file. This research was informed at all stages by the University of Sheffield code of practice on research ethics. I have filled in the ethics review form requested by New Mexico State University (NMSU). The consent form was also approved by NMSU and signed by both interviewees and myself, which will be the further reference if anything is of concern.

Participants were not remunerated for the information they offered and gained no direct benefits from this study. A small gift (a box of English tea) was given to each participant as thanks for his or her time.

4.9 Chapter summery

This chapter has presented the research process including preparations for the fieldwork, data collection methods and data analysis after the fieldwork. This chapter justified the selection of case study at the beginning, and described the mixed-method approach to achieving the research objectives. It highlighted the considerations, possible problems and solutions in the empirical data collection. Applying the mixed-method approach and drawing on multiple sources of data enabled an in-depth understanding of land-use issues and land degradation

problems within the broader physical, socio-economic, cultural and political context (Brown, 2009; Twyman et al., 1999).

This chapter also described the data analysis strategy involving the coding of data into themes and categories to structure the following results analysis chapters and the analysis of quantitative questionnaire. In the latter part of this chapter, I discussed my positionality as a female and foreign research student who carried out research in the Southern United States. Ethical considerations were also taken into account, with the aim of providing safe and respectful setting for the participants and the researcher.

Chapter 5 Perception of desert landscape

5.1 Introduction

Human decisions are the primary driving force behind the landscape and environmental changes in urban ecosystems (Alberti et al., 2003). Different actor groups, such as land developers, residents and environmentalists, have different needs and priorities over land uses, and competition often exists between these groups for advantageous land uses. Because of these different needs and priorities, perceptions toward landscape held by different groups are complex (Allendorf et al., 2007), sometimes conflicting, especially where there is a lack of communication between local communities and policymakers (Suckall and Fraser, 2009). Conflicting interests often hide two distinctive motives: functional and intrinsic aspects of the landscape (Kaur et al., 2004). The former is related to the use of land: as a place to live and work, as a place to visit, and a space for the enjoyment of a range of recreational activities, the assignment of one person's specific needs to the land sometimes lies at the expense of others. The latter is related to personal perceptions and affections, which are often influenced by one's past experience and culture (Gomez-Limon and De Lucio Fernandez, 1999; Kaur et al., 2004).

This chapter investigates the differences in perceptions rooted in functional and intrinsic motives of landscape held by different actor groups. In addition, this study devotes attention to water issues because water is especially important and critical in arid environments. Insights derived from this chapter are related to an analysis of drivers of actors' land-use decision-making in Chapter 6, and provide the basis for further discussion of policy implications of how a new approach towards resource management in the study area might be achieved in Chapter 9.

5.2 Perceptions of desert landscape

5.2.1 Functional values

The results of the perception questionnaire suggest that perceptions of the landscape are predominantly connected with the functional values of the landscape, and different groups demonstrate appreciation on the different functional values and conflicts were observed between groups.

5.2.1.1 Perception of desert landscape

Table 5.1 illustrates the perception statements and their abbreviations (1=strongly disagree, 5=strongly agree). Figure 5.1 presents the percentage of agreements and disagreements on different landscape perceptions, and Figure 5.2 displays Likert mean scores for each statement of landscape perceptions for all of the groups, respectively. From Figure 5.1 and 5.2, it can be seen that overall, respondents agreed or strongly agreed with the statements: "I would like to see more public open space" (87% of respondents) with a mean score of 4.55, "native plants are the best for desert landscaping" (87%) with a mean score of 4.68, and "houses should be built in a water- and energy-efficient way" (88%) with a mean score of 4.29. Over 63% of the respondents agreed that the study area has plenty of land capacity for development with a mean score of 3.95. Over 55% of the respondents fear a water crisis (mean score of 3.41). More than half of the respondents (51%) disagreed with the statements that they would like to see more development (mean score of 2.89) and that the study area has plenty of water capacity for development (mean score of 2.50). About 45% of the respondents disagreed that houses are spaced too closely together with a mean score of 2.18. Respondents disagreed or strongly disagreed most with the statements that "I see little value in desert vegetation" (89%) with a mean score of 1.14, "When I look at the desert, I see, for the most part, an empty wasteland" (77%) with a mean score of 1.50, "I would prefer not to stay in a desert" (74%) with a mean score of 1.80 and "I would prefer to move out of the desert in the near future" (74%) with a mean score of 1.88.

Table 5-1: Illustration of perception statement and abbreviation

Statement of perception	Abbreviation
I believe that East and Northeast (NE) areas have plenty of water capacity for development.	Water capacity
I have been to the Chihuahuan Desert Nature Park (CDNP)	CDNP
I believe that the East and NE areas have plenty of land capacity for development.	Land capacity
I think the houses are spaced too closely together in the East and NE areas.	House close
I would like to see more development in the East and NE areas.	More development
I would like to see more public open space (park, children playground etc.) in the East and NE areas.	Public open space
I fear a water crisis in the East and NE areas in future.	Water crisis
Native plants and trees are the best for home landscaping in the desert.	Native plants
I see little value in desert vegetation.	Little value
When I look at the desert, I see, for the most part, an empty wasteland.	Empty wasteland
Homes should be built in a water and energy efficient way in the desert.	Water energy
I would prefer not to stay in a desert.	Prefer not to stay
I would prefer to move out of the desert in the near future.	Move out

Note: the statement of "I have been to the Chihuahuan Desert Nature Park" is assessed by the number of visits, but not measured by the five-scale agreement score.

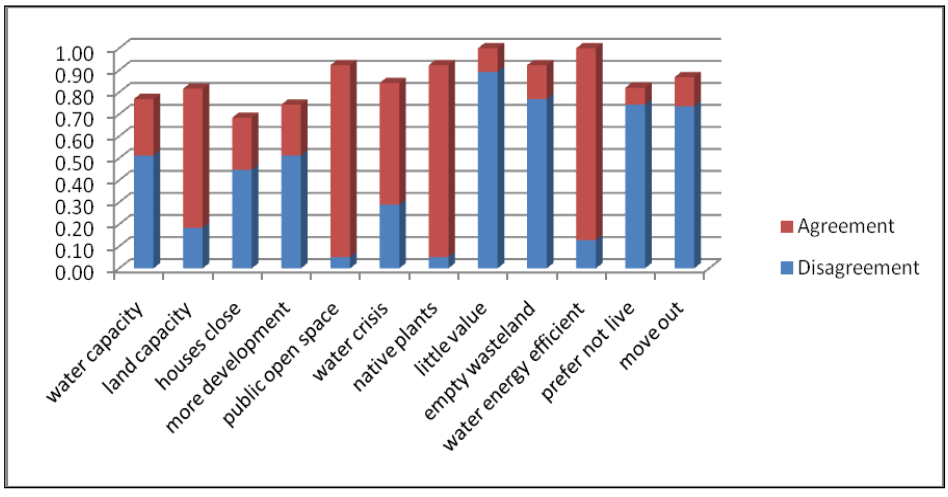

Figure 5.1: Percentage of agreement/disagreement on different perceptions

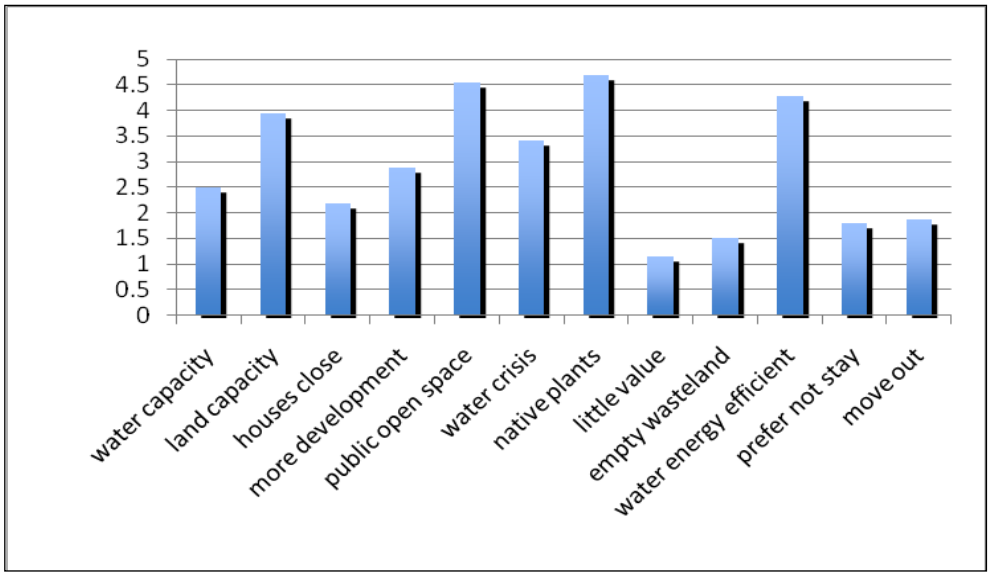

Figure 5.2: Mean Likert scores of perception of desert landscape by all of the actor groups

Table 5-2: Perceptions of desert landscape (Likert mean scores of perceptions of desert landscape for each of actor groups)

Group/Likert-score	Land Developer (n=5)		Politician (n=4)		NGO (n=2)		Resident (n=23)		Planner (n=5)		Overall (n=39)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Statistical (AVOVA) test
Water capacity	3.40	1.82	3.40	0.89	1.00	0.00	2.39	1.12	2.25	1.12	2.50	1.29	0.1>p>0.05
CDNP	0.60	0.89	1.33	1.09	1.50	0.00	1.30	1.06	1.00	1.29	1.23	1.08	p>0.1 (p=0.18)
Land capacity	4.80	0.45	4.60	0.89	3.00	0.00	3.45	1.30	3.75	1.30	3.95	1.27	0.1>p>0.05
Houses close	2.20	1.30	1.80	0.45	2.50	0.71	3.18	1.05	1.25	1.05	2.18	1.19	p<0.05
More development	3.40	1.14	3.20	1.30	2.50	0.71	2.04	1.33	3.25	1.33	2.89	1.35	0.1>p>0.05
More public open space	4.20	1.30	4.80	0.45	5.00	0.00	4.26	0.96	4.5	0.96	4.55	0.95	0.1>p>0.05
Water crisis	2.80	1.79	1.50	0.58	5.00	0.00	3.52	1.34	4.25	1.34	3.41	1.47	p<0.05
Native plants	4.40	0.89	4.60	0.55	5.00	0.00	4.39	1.12	5.00	1.12	4.68	0.95	p>0.1 (p=0.6)
Water energy efficient	3.40	1.82	3.80	1.64	5.00	0.00	4.48	1.16	4.75	1.16	4.29	1.29	p>0.1 (p=0.27)

Note: S.D. is Standard Deviation, AVOVA is analysis of variance

- ***"Native plants and trees are the best for home landscaping in the desert".***

Table 5.2 presents Likert mean scores for each statement for each of the actor groups. From Table 5.2, the statement that "native plants and trees are the best for desert landscaping" received the highest level of agreement from all of the actor groups with a mean score of 4.68. There was no statistical difference on responses to this statement between actor groups (p=0.6). This result was broadly confirmed by qualitative analysis. Interviews revealed that the majority of respondents agreed with this statement and respondents normally think the native plants are the best for the desert because these plants are generally water-saving ones. However, only one person who is an expert in landscaping and gardening disagreed with this statement. In addition, results demonstrated that some respondents have contradictory behaviour with their perception.

One resident stated that:

> "I think that the plants you have, would be more, what, might be called native plants, or plants [that] don't require water." (and similar comments were expressed by five other respondents.)

However, only one resident – who has a Masters degree in horticulture and is now a master gardener – made an apparently opposing statement that "Many native plants [to New Mexico] use huge amounts of water. That is the only reason I answered 1". However, by way of clarification, he added "desert-adapted plants are the best for the desert". When he was asked how he can provide expert support to the local residents, he commented that:

> "A lot of times we have drought problems, it's too dry, they don't water enough, they can be emotionally upset, their plants are dying. I tell them over the phone, they need to water, they are not listening, sometimes I have to go to their house and talk to [them] face-to-face … Then they say, 'I water it, it's dying, but I water it.' And I asked when did you water it, 'six months ago', six months ago is not enough, and that's a difficult situation, and you plant new plants from the nursery, it's grown in this soil and this pot, which is a different environment when you plant in the ground, you know, so the plantation from this to the ground is different, most of people don't know how to do that, so the water, the soil is not going to the roots, so I will go there and tell what they need to do, it's a transition. The soil

> is so different here, you have valley, you have clay, and you got adobe clay to sandy clay and you got from the mesa, you could have pure sand or cliche, so I normally ask where you live, so if I know where they live, I know which soil it is."

This statement revealed the knowledge gap between general public and experts, and it calls for a need for more education of residential landscaping in the study area, especially for newcomers who move to this area. As the master gardener later commented:

> "I wish we had a magazine for this area, [like] you have in Tuscon, Phoenix. I wish we have something to do with this region, because gardening is different with Tuscon. I really like one magazine *Botanist*, it comes out quarterly, and it's more about home based [magazine], it deals more with homes, but it has a small section that deals with gardening, but it hasn't so much about educational component, it's more, it's interesting to read."

This statement highlighted his expectations of having more education programmes about residential landscaping in the study area. A lot of the residents have limited knowledge of which kinds of plants are suitable for the area and what to plant in their yards to suit the soil. The horticulture expert also provided a reason for why the knowledge is not distributed enough to residents in Las Cruces. He considered that a newspaper article is a good way to disseminate the knowledge about plants to the public, but it is difficult for him to work with the key local newspaper, because the newspaper has its own agenda, and they are not interested in his stories. He suggested that the City of Las Cruces can have a magazine about gardening to educate more people. Therefore, the absence of a good knowledge source is also a constraint for local people to obtain enough information to choose plants and manage yards. It implies that micro-scale decision-making is affected by the availability of resources and macro-scale management. In addition, not only local residents but also land developers need more knowledge and education of which kind of plants are better in their yards, as interviews revealed that land developers often complete residential landscaping before residents move in, and hence these macro-scale land-use decisions can have greater impacts on the local community. Land developers often have an entire team to plan for them, they may need more accurate knowledge to be responsible for the community and reduce potential negative impacts on residents.

However, it was found that respondents' behaviour does not necessarily match their perceptions from the qualitative analysis. Some respondents strongly agreed that native plants are the best for desert landscaping, but they do not always use them exclusively in their yards. They may still use some exotic plants for various reasons such as considerations based on practical or cultural values or for visual enjoyment. For instance, the master gardener said that:

> "You may like exotic plants, but don't fill in your yard with exotic plants: we have really bad winter, they will freeze and die. You can mix some exotic plants, so I wouldn't plant my whole yard with lemon trees, but lemon trees would grow here. For many years, I can enjoy lemon trees because I love to eat lemons."

and another resident commented:

> "I had 10 different books about landscaping, xeriscaping, so I prepared the soil first, and planted them, and then the plants I planted in the front yard, just one plant needs water, everything else doesn't need water. But in the back, now I put roses, and I grow tomato, squash, and then some of the plants here need water so in the back yard, I will water it, probably in the summer, I will be watering twice a week."

These statements revealed that respondents sometimes combine with native plants and their own preferences and interests, although they perceive the native plants are the best for landscaping in the desert. Some of them put different plants in the front and back yards, which means they put desert plants or rocks in the front yard, and have exotic plants in the back for their own fantasy. Similar behaviour has been observed in a few cases in other interviews. Inconsistency exists between the questionnaire answers and interview responses, and contradictions were observed between their desert perception statements and behaviour. It probably can be explained that the front yard is on public display, and most residents want to demonstrate that they follow the local fashion or probably have peer pressure as the majority consider the desert landscaping is appropriate in the study area. However, in the more private back yard, only visited by invited guests, the appearance and management may prioritise the homeowner's comfort and fantasy over public impression.

- ***"I would like to see more public open space".***

From Table 5.2, it can be observed that the other statement that has the support of a large majority of all those interviewed (87%) was "I would like to see more public open space". There was no statistical difference between groups on this statement (p=0.5). Respondents from all of actor groups demonstrated agreement as confirmed by qualitative analysis. The interviews revealed that these opinions were often based on perceptions of recreational values and opportunities in the desert.

For instance, one resident expressed the idea that:

> "There are a lot of places to [go to], you feel, I pinch myself when I drive, because I cannot believe how beautiful the views are here." (and similar comments were expressed by three other respondents.)

Developers considered that it was a benefit from their developments to provide open space for the local community. As one land developer highlighted: "We said one of the community benefits was that we included a lot of open space" (Land developer A). However, this developer admitted that this example can help them gain permission for the approval of the development[5] (PUD), noting that:

> "You have to show the city that the planned unit development (PUD) provides certain benefits for community, so we have this benefit, this benefit, and you have enough benefit, then they will say ok, you are eligible for a PUD."

From the statement, it can be observed that the developers are required to demonstrate how their development benefits the community, rather than a self-motive. In addition, they can probably gain economic benefits of including more open space in their developments, as there will be more residents attracted by this advantage.

[5] A PUD is a designed grouping of varied and compatible land uses, such as housing, recreation, commercial centers, and industrial parks, all within one contained development or subdivision (Wikipedia, 2010b).

- ***"I have been to the Chihuahuan Desert Nature Park".***

Regarding the question of visiting Chihuahuan Nature Desert Park (CNDP), which is located in the study area, over a quarter of respondents had visited the park a few (more than three) times. There was no statistical difference on responses to this statement between actor groups (p=0.18). Some respondents sought out peace and tranquillity and/or knowledge of the desert ecosystem from the park, and acknowledged its accessibility positively. As one NGO commented:

> "When you get there, you feel very peaceful, and you don't see houses around, and everything, so you feel like you are in the middle of the desert. It is a safe place to go to explore and learn about the desert. And of course, leaflet booklets, people can learn a lot [from the leaflets]. So it is a really accessible place people can go and learn a lot in the relatively short amount of time."

These statements demonstrated the appreciation of desert functional values (educational and recreational) by respondents. Different from perspectives of recreational functions, some NGOs demonstrated appreciation of the intrinsic value of the desert, which is part of the reasons that they gave the high score on this statement. This point is illustrated in Section 5.2.2.

- ***"Homes should be built in a water and energy efficient way in the desert".***

Over 88% of respondents agreed that "homes should be built in a water- and energy-efficient way in the desert". There was no statistical difference amongst groups on this statement between groups (P=0.27), although the NGO group gave the highest score (mean score of 5), while the land developer group gave the lowest score (mean score of 3.40). However, variation exists within the groups (overall S.D. score is 1.29), for instance, the developer group has divergent views between each other (S.D.1.82). The questionnaire revealed that three land developers strongly agreed with this statement, whilst the other two strongly disagreed with it. However, interview data found that for those developers who were keen to promote energy-efficiency buildings, their motives are not entirely altruistic.

As one developer noted:

> "My emphasis is energy-efficiency buildings, it did not used to be called green building, it's only just been a few years …for me is more important for my environmental attitudes." (and similar comments were expressed by Developer C.)

In the later stage of interview, he constantly focused on energy-efficient ideas, and introduced some practical examples. It was found later that these two developers in fact are working together to construct energy-efficiency buildings, the former is helping the latter on designing energy-efficient elements.

It is positive to see that the developers were willing to play an active role in the energy-saving projects. Nevertheless, they admitted that the government provides subsidies for energy-efficient buildings. As one developer noted: "[subsidies] from the government, from the state and the government. But our governor is very pro-environment, probably in energy. He wants New Mexico to be the greenest state, so the state has more green buildings. The whole state, everywhere" (Developer B).

Not only did land developers demonstrate interests in energy-efficiency buildings, but so did the politicians. One politician stated that:

> "We are now working on our new strategic plan in the city. Now we are trying to do one and emphasize how you grow a sustainable city. You may create a strong neighbourhood, you know, we are doing very differently this time, including energy efficiency, and we are putting solar on the new city hall, and on the new Convention Centre."

This statement also implied that land developers probably build up their interests to fit into the priorities of local government, which means that developers were aware of the local government's new agenda, and tried to match it to increase the chance to get development permission.

In fact, in 2007, Senate Bill SB463 (sustainable building) was enacted to establish a tax incentive for sustainable buildings on both personal and corporate levels, and the tax credits apply to both commercial and residential buildings (DSIRE, 2010). Buildings that have been certified as sustainable buildings by the US Green Building Council at certain levels are eligible for a tax credit. According to Las Cruces Sun-News, the local newspaper, U.S. Representative Harry Teague said that southern New Mexicans would benefit from renewable energy-related

funding in the form of tax credits. As he stated in the news article: “There's money in the stimulus bill to retrofit homes with solar, renewable energy. There's money in there for buying more energy-efficient heat pumps, to give investment credits for that” (Alba, 2009). In addition, Teague told the newspaper that there is a pool of $8 billion in loan money to help municipalities construct ‘green’ buildings. Other loan money would be available for wind, solar, biodiesel and other renewable energy projects.

Because of these available funding opportunities, the developers might seek a win-win scenario that constructing energy-saving buildings to increase the likelihood to get development permission and attract more homebuyers at a higher price, while at the same time, they can claim tax credits for their projects. In addition, these projects can help to create an environmentally friendly image for them and build more community support.

From the statement of the politician, a positive sign was seen that the local government takes actions to develop new strategies to achieve a more sustainable city development. It was found later that for the first time, the City of Las Cruces indeed incorporated renewable energy into three of its new buildings. The new City Hall is designed to use geothermal energy to heat or cool air. Both the Convention Center and Museum of Nature and Science (MoNaS) will have photovoltaic systems, and MoNaS will also have a small wind turbine. These projects were made possible by Federal funding (City of Las Cruces, 2010a). Hence, from these evidences sources, it can be observed that there are incentives for people in promoting and constructing energy-efficiency buildings. This can partly explain the motivations and high agreements on the statement of water- and energy-efficiency homes of land developers, politicians, builders and homeowners.

- ***“I believe the study area has plenty of land capacity for development”.***

With regard to the statement “I believe the study area has plenty of land capacity for development”, although the statistical test suggests a marginally significant difference ($0.1>p>0.05$), the S.D. (1.27) is fairly big on this statement and it suggests variations between groups (Table 5.2), which means that different actor groups held different perceptions and valuations on this statement. The land-

developer group agreed the most with this statement among all of the groups (mean score of 4.8), followed by the politician group (mean score of 4.6), in opposition to the NGO group who agreed the least with it (mean score of 3.00), and followed by resident group (mean score of 3.45). Qualitative analysis found evidence to support the variations between groups on these views.

Space means profit, as one developer stated: "Especially in the Southwest, it's all about money." Another land developer expressed the similar view, and he further commented that "[t]here is a hope of future profit." One politician said that: "[w]e have lands." However, another politician commented that: "There is a lot of land out there, but we have to provide infrastructure and take care of it. Can we get money to do that? No." One politician described that people have the attitude that there is no need to plan when land is plentiful, and he added that "that's been the attitude, and in United States, and particularly in the western United States, property rights, land ownership, are the big deal."

In contrast from the above opinions, one NGO said "our group is about protecting large pieces of land, natural, important natural land, diversity."

From these statements, it can be seen that different groups appreciate functional values with their specific needs and interests. The land-developer group desires the most with the development function of the landscape and its subsequent or potential economic benefits.

- ***"I would like to see more development".***

The appreciation of the landscape to be developed can also be observed from the statement of "I would like to see more development" (Table 5.2). Divergent views were observed between groups as well as within the same group. The land-developer group has a mean Likert score of 3.4, similar preferences are shown in the city-planner group with a mean Likert score of 3.25, and the politician group with a mean Likert score of 3.20. The resident group disagreed most with this statement (mean score of 2.04). Statistical test suggests a marginally significant difference ($0.1>p>0.05$). Variation scores, however, showed fairly divergent

opinions between groups (S.D. is 1.35), and within group – especially in the case of the resident group (S.D. is 1.33).

These results were supported by qualitative analysis. As one city planner explained, their department could deny the developers' proposals, but it will result in the land being developed in the county, consequently they will not obtain any tax revenue from these developments. This issue is also discussed in Chapter 6.

One politician stated that "I would like to see more commercial development". Another politician expressed a similar view and added that they enjoy the tax benefit from all the construction activities, which can increase the population and subsequent sales tax. According to the local newspaper, the Las Cruces tax burden is among the heaviest in New Mexico based on taxes as a share of personal income (Rio Grande Foundation, 2007). The high Gross Receipt Tax[6] (GRT) rate is an important factor, together with property tax, Las Cruces residents pay a high percentage (13%) of their incomes in total. This situation has a negative impact on the city's sustained, long-term economic growth (Rio Grande Foundation, 2007). This evidence showed that the local government has more tax benefits from the local residents compared to other cities in New Mexico. Increasing sales tax is probably a means to balance the budget, as a local newspaper reported, the governor suggested to increase sales tax to balance budget in New Mexico (Massey, 2010). Hence, it probably can be considered as a contributing factor to the drive of local government wanting to see more developments in the study area.

However, it also needs to be noted that with the population growth, the city needs more money to maintain the infrastructure such as roads and services including fire, police, waste collection and other municipal services. This amount of money might even exceed the benefit the city gained through the newcomers' sales tax. Nevertheless, in the City of Las Cruces, developers, politicians and city planners still debated the real costs of long-term services and maintenance for new

[6] Gross Receipt Tax is a tax on the total gross revenues of a company, regardless of their source. Although the gross receipts tax is imposed on businesses, it is common for a business to pass the gross receipts tax on to the purchaser either by separately stating it on the invoice or by combining the tax with the selling price (NMTRD, 2010).

subdivisions. There is a lack of cost-benefit analysis on the long-term impacts of new developments so far in the study area (Smart Growth Online, 2008). Hence, whether or not the GRT generated from new developments can fully support the maintenance and services fees remains uncertain. Such encouragement of land development might not be a sustainable option for the city in the future.

By contrast, conflicting views are observed from the resident-group. The majority of residents disagreed or strongly disagreed with this statement (14 out of 23), some of the reasons given included overdevelopment and dust problems. One resident complained "I think there is too much development". Another resident commented that:

> "[land development is] causing dust, in those developing area in East Mesa, just dusty, dust is hanging in the air. Now it even has a lot more dust because of construction and noise as well." (and similar comments were expressed by five other residents.)

Only two residents demonstrated strong agreements with this statement. Qualitative analysis confirmed this agreement. One resident considered that more houses could reduce the dust, as she said:

> "The more houses are built, the better is. When we just moved here, the dust just kept coming into the house, dust came into the open windows. And our house was just dusty, oh my god, we shouldn't have our windows open." (and similar comments were expressed by another one resident.)

This statement revealed partially, if not all, the resident's motivation to see more developments, which can help to keep the dust away. They believed that houses and buildings can prevent dust moving around.

- ***"I think the houses are spaced too closely together in the East and NE areas".***

Regarding the statement of 'houses are spaced too closely together', respondents have divergent views (Table 5.2). Statistical tests suggest a significant difference between actor groups on this statement ($p<0.05$). Divergent views were observed between groups. In addition, variations of perception exist within the same group. The mean Likert score for resident group is 3.18, followed by 2.50 for NGO

group, and the lowest value is 1.00 for the planner group. Results were supported by qualitative analysis. One resident explicitly commented that “I do not like the fact that the houses are close together”.

Results revealed clearly that most residents considered that land development has negative impacts on their daily life. Many of them repeatedly commented that the land development causes dust problems and inconvenience for their daily life. For instance, one resident noted that “the worst dust comes from the lands that they prepare for development. There is a dust-control ordinance, but it’s meaningless, it doesn’t work”.

Only the two residents, who considered that more houses can help to reduce dust by preventing it to be blown away between houses, expressed a contrary view. It also suggested that one person’s benefits derived from the land may lie at the expense of others (Kaur et al., 2004). As the evidence showed here, when land developers constructed homes for their economic benefits, the dust problem was created to affect residents.

Some residents were disappointed with the environmental management in the city, for instance, the ineffective dust-control ordinance, which implied this group’s desire to have more effective government policies to mitigate the environmental problems. However, studies found that strong commitments to the environment and conservation do not always seem to translate effectively into action to conserve resources. One possible reason is that people may consider it is difficult to act on their inclination to protect the environment when facing the challenge of higher prices or the need to forego convenience and comfort to do so (Thompson and Barton, 1994). This study found that local government has pressures from builders and developers to implement a dust-control ordinance, because builders and developers argued that the dust problem is not solely their fault. Adoption and implementation of a dust-control ordinance means the builders and developers have more responsibilities and restrictions, such as a dust control plan is required when they apply for a subdivision; they are not allowed to disturb the topsoil or remove ground cover on any real property; and wholesale clearing of ground cover is forbidden (Lubbock, 2000). Therefore, local government has difficulties

to introduce a new dust-control ordinance in the study area. This issue is illustrated further in Chapter 7.

In contrast to the majority of residents who are against the development, some exceptions, such as potentially increasing value of housing investment and improving accessibility, were also observed from the interviews. As one resident considered that:

> "I think Sonoma [a relatively more expensive neighbourhood nearby] is actually helping our property value, because there is so much more expensive than here. And people like this area many can't afford houses in the Sonoma and they would come here."

One NGO from CNDP also considered that:

> "I think overall it's [eastwards development] probably a good thing because it means the park (CNDP) is even more accessible to people, more people live [in] that area. So in some ways, it's good to have more people live in that area, know that the facilities are close to them."

From these exceptions, we can see that different groups appreciate different functional values of the landscape. However, divergent opinions not only exist between groups, but also reflect within groups. For instance, some residents perceive that growth brings inconvenience and environmental degradation such as dust, while the others consider development potentially increase their property investment values and reduce environmental problem. It also depends on how the respondents view the function of land individually, as sometimes respondents within the same actor group have different perspectives.

- ***"I fear a water crisis in the East and NE areas in future" and "I believe that East and Northeast (NE) areas have plenty of water capacity for development".***

From Table 5.2, regarding the statement of "I fear a water crisis in the East and NE areas in future", more than half of the respondents agreed. Statistical analysis suggests a significant difference between groups ($p<0.05$), and different groups demonstrated divergent and conflicting views. Contradictory responses were also observed from the respondents.

The NGO group agreed the most with this statement (mean score of 5), followed by the planner group (mean score of 4.25). By contrast, the politician group disagreed with a mean score of 1.50, followed by the developer group with a mean score of 2.80. Similar results can also be seen from the statement of "I believe that East and Northeast (NE) areas have plenty of water capacity for development", with which the NGO group disagreed the most (mean score of 1.00), and politician group agreed the most (mean score of 3.40). The evidence can also be seen from Table 5.3 NGOs perceive the desert landscape as a place lacking of water, while the other actor groups have similarly and relatively lower ranking scores (which is analysed in more details later in this section). These results were supported by qualitative analysis, and respondents from different groups expressed concerns for water.

One NGO stated that:

> "We tend to have much drier (climate), farmers have a difficult time, they shift to surface water more and more, we don't have enough water to support development in the future."

Concern about water supply was also expressed by one planner:

> "You can't make water, and so if growth were to continue unrestricted, then the question we would have is what would the impact going to be on the water table…"

There are a few residents expressed their concerns, for instance, one resident commented that:

> "They [other people] have to use certain amount of water so they don't over use the water. If they over use, there is not enough for us. Because water is a real problem in the desert area." (and similar comments were expressed by another two residents.)

It is interesting that the mean Likert score of the responses given by politicians were the lowest. One politician commented that "There are also some storm-water control opportunities, we can actually use that water for different ways to offset the challenges of living in the desert."

Another politician critically commented that:

> "So you could say, yeah, we have plenty of water, but it doesn't mean you could take it all away from the ground. In the west, people tend to say 'we will be fine, we will be fine', [but] there is a really serious problem."

It can be seen that contradiction was observed from this politician's statement, who agreed the least with the water crisis in the future, but admitted the water is a serious problem. The attitude of the two politicians also revealed a typical attitude in the American Southwest that people living in the desert are not willing to acknowledge water scarcity (Ingram et al., 2008). Espeland (1998) states that among the desert residents, there is always a collective unwillingness to admit that water supply is finite, and they prefer to assume that new sources of water will be found rather than to learn to live with limits. The contradictions between the rhetoric of scarcity and crisis and the unwillingness to admit of the shortage of supply make water a paradoxical political and cultural issue in the Southwest (Espeland, 1998). In their role as elected officials, they probably preferred to believe that there are other ways to get more water or conservation can make the water last longer. It probably reflects that as elected officials, they need to ensure that their opinion serves the voters' interests to have a secure water supply in future.

By contrast, one land developer was very positive about water supply in the future, he said:

> "Well, if you ask people, a lot of people will complain that there is not enough water, well, what I know is we get water from the city, the city has 12,000 acre feet [14,801,782 m^3] of water rights, the city has enough water to supply new developments for years and years, decades and decades for the future. If people come and say we don't have enough water for additional development, I am sorry, just don't let them talk about it." (Develop A)

From the opinions of the different actor groups, we can observe that in the desert the competition for land is also the competition for water. NGOs and planners are concerned about the water shortage, and they are in doubt about the water supply for the future of the City without a careful plan to use this resource. The politicians demonstrated optimistic attitudes because they considered that if they could plan well, they will have sufficient water supply for the future, so did land

developers. Water problems are often part of political issues (Ingram et al., 2008). In the arid Southwest, water is the fundamental element for all subsequent development and all profit depends on water supply (Espeland, 1998). It is related to power and social status. As such, water's link to wealth and power makes it 'emotionally potent' (Espeland, 1998). Water "appeals powerfully to local sentiment. Water is seen as wealth: a boom is bound to occur if an area has water and can develop it. A locality sees benefits in water beyond any specific uses; water carries a guarantee of a prosperous future" (Ingram 1990:32). Ingram (1990:5) points out that "a sense of lineage and inheritance are among the emotions stirred by control over water. Strong communities are able to hold on to their water…Communities that lose control over their water probably will fail in trying to control much else of importance". Therefore, the rejections to acknowledge the water scarcity from both land developers and politicians probably can also be explained because they do not want to lose the power to control water resource and the opportunities to gain economic benefits.

However, residents of New Mexico are highly dependent on groundwater resources. Over 90% of the population relies on groundwater for its drinking water, and almost 50% of the total water used for all purposes in New Mexico is groundwater. In some areas with extensive groundwater use, groundwater levels have already declined due to extraction rates exceeding recharge rates (Li et al., 2005). The hydrology is highly variable in New Mexico, and the availability of groundwater also varies from place to place. The Rio Grande, a major water source in New Mexico, has been over-extracted to supply water for agriculture, industry and the growing population of the border region. On the US side, the allocated water rights are in excess of the amount of water available (Kelly et al., 2001). Population has grown rapidly on both sides of the international border. In particular, in New Mexico, the projected population may possibly more than double in the next 20 years (Li et al., 2001). The Mesilla Bolson is a deep aquifer that serves household and industrial water to Las Cruces, but it has only enough water resources for the next 20 years (Li et al., 2001), which is different from the projection of water availability over the next 40 years by Las Cruces Utilities Department (Alba, 2007; City of Las Cruces, 2008b). The utilities director for the

city Garcia claimed that the water plan will account only for city utilities customers, the population number is not equal to the city's population, and some other private companies and water associations will supply water to Las Cruces residents (Alba, 2007). The Lower Rio Grande Basin is considered closed by the state engineers, because there is no new water rights can be issued. However, currently, 90% of groundwater and river water used in the Lower Rio Grande area goes to agriculture, if the city continues its population growth, the agriculture needs to cut back. The Mesilla Bolson is depleted each year for farming and municipal use, and recharged by the Rio Grande. However, a net decrease is caused in a short-water year, and continued short-years could lead to serious strain on the basin (Alba, 2007). In addition, in New Mexico, the annual average precipitation is much less than the amount lost to evaporation from open water surfaces including lakes, reservoirs, rivers and streams (Li et al., 2001). The water situation will get worse with population growth. Moreover, increasing population will impact on the water quality and threatens public health. For instance, more municipal wastes will be generated to add risks of pollution to treatment plants and mix pollutant with water supply. Increased urban uses have resulted in insufficient supply to agriculture, and a decline in agricultural activities in some regions has already occurred (Li et al., 2001). With rapid population growth, the supply of additional water required for the agricultural, urban, and industrial uses is becoming more and more constrained.

Competition over resource use has also been shown from the qualitative analysis in the case of water use. Environmental conservationists demonstrated their strong concern about water supply, but they are from a more common welfare point of view: for future generations. It is clear that competition among different actor groups over land use is competition not only for space but also for resource use and way of life.

Interestingly, divergence in perception among actors in the same group was observed in a few cases (see Table 5.2 S.D. scores). The quantitative questionnaire results revealed that it is surprising to see that two land developers considered that the study area does not have plenty water capacity. However, for the later part of the questionnaire, both of the two developers disagreed that

"houses should be built in a water- and energy- efficient way". These results are very contradictory, and it probably again revealed the contradiction between scarcity of water and the unwillingness to admit the shortage of water supply (Espeland, 1998). Perhaps this disagreement demonstrated that land developers are not willing to accept the water crisis in the future, which could limit their opportunities to make profit. Fear of a water crisis does not mean houses should be built in a water- and energy- efficient way, although in the interview, one developer expressed a 'community-based' idea towards land development which means that he considered it is their 'responsibility to the community to do things right'. His perception of responsible development means that:

> "I think the developers have earned a negative perception by the public, as far as the greedy developers develop some lands, take money and go. But if people really understand what takes to develop and how you can do that in a way that really adds to the area. Responsible (development) means putting the land to its highest and best use, [for instance], I wouldn't take an area that has million dollar homes, and right its next door putting a trailer on it, that's not the highest and best use of that land, they are not going to get along, because that expensive homes are being devalued by the price of its next door. You have to match that stuff." (Developer D)

From this statement it can be observed that the land developer has his own rationale of responsible development, in which water and energy efficiency is not considered to be a priority. Although Developer D's opinion is different from the general perception that developers are not concerned about the community considered by residents, his approach of land development is more consumer-based rather than resource-based.

Table 5-3: Perceptions of desert landscape (Likert mean scores of perceptions of desert landscape for each of actor groups)

Group/Likert-score	Land Developer (n=5)		Politician (n=4)		NGO (n=2)		Resident (n=23)		Planner (n=5)		Overall (n=39)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Statistical (AVOVA) test
Little value	1.00	0.00	1.00	0.00	1.00	0.00	1.70	1.36	1.00	1.36	1.14	1.13	p=0.38
Empty wasteland	2.20	1.79	1.00	0.00	1.00	0.00	2.04	1.61	1.25	1.61	1.50	1.45	p=0.45
Prefer not live	1.20	0.45	1.60	0.89	1.00	0.00	1.78	1.13	3.50	1.13	1.80	1.15	P<0.05
Move out	1.00	0.00	1.60	0.89	1.00	0.00	1.74	1.25	4.25	1.25	1.88	1.37	p<0.05

Note: S.D. is Standard Deviation, AVOVA is analysis of variance

- ***"I see little value in desert vegetation" and "When I look at the desert, I see, for the most part, an empty wasteland".***

From Table 5.3, it can be observed that statements of negative perceptions of the desert received high disagreement scores from all groups. The statements of "I see little value in desert vegetation" and "When I look at the desert, I see, for the most part, an empty wasteland" received the lowest scores for agreement. Statistical analysis suggests there is no significant difference between groups on either of these two statements (p=0.38 and 0.45 respectively). These results are supported by the qualitative analysis, which means that respondents demonstrated appreciation for the intrinsic values as well as the functional values of the desert landscape. Variations of opinions revealed within groups such as the resident group and planner group.

5.2.1.2 Perception of desert ecosystem

Responses from the second part of the questionnaire provided much evidence about the divergent and conflicting opinions between groups. From Figure 5.3, it can be seen that functional values of the desert landscape – such as "I perceive the desert as an inhabitable landscape", "I perceive the desert as a profitable landscape to be used or developed" and "I perceive the desert as a place good for ranching" – were highly acknowledged by all actor groups. From Table 5.4, divergence in the perception of desert ecosystems by different actor groups can also be noted in certain cases. Statistical tests have not shown significant differences between groups on the statement of "I perceive the desert as an inhabitable landscape" and "I perceive the desert as a profitable landscape to be used or developed", and suggest a significant difference on the statement of "I perceive the desert as a place good for ranching". However, the variation (S.D.) score revealed major differences in these statements. For instance, the planner group highly perceived the desert as inhabitable (mean score of 7.50). By contrast, the developer group gave a mean score of 1.40. This different perception probably indicated different understandings of the landscape. For instance, for planners the desert is uninhabitable because one needs to plan to be able to occupy it, whereas the developers see it as inhabitable because they are used to building on it and

making it inhabitable. The politician group highly perceived the desert as a profitable landscape (mean score of 10.80), and good for ranching (mean score of 11.20), as opposed to the developer group who gave the lowest scores of 3.80 and 3.00 respectively.

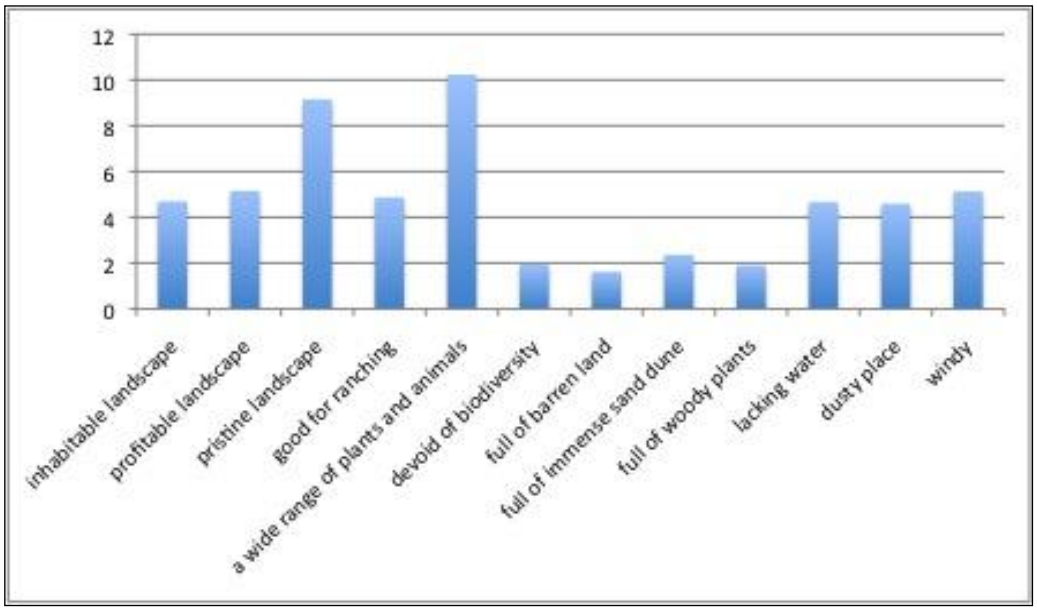

Figure 5.3: Overall mean scores of perceptions of desert ecosystem from all of the actor groups (score indicates a collective perception)

Table 5-4: Perceptions of the Chihuahuan desert ecosystem
(mean scores for each statement of perceptions of desert ecosystem for each of the actor groups).

Group	Land Developer (n=5)	Politician (n=4)	NGO (n=2)	Resident (n=23)	Planner (n=5)	Overall Mean (n=39)	Overall S.D. (n=39)	Statistical (AVOVA) test
Inhabitable landscape	1.40	4.40	6.00	4.87	7.50	4.69	5.27	P=0.51
Profitable landscape	3.80	10.80	5.50	4.30	4.50	5.15	5.21	P=0.10
Good for ranching	3.00	11.20	5.50	3.74	5.50	4.87	5.05	P<0.05

Note: S.D. is Standard Deviation

Parts of these results were supported by the qualitative analysis. As mentioned earlier, politicians expressed a view that land development can generate large tax revenue for the local government, and they demonstrated an interest in more development occurring in the study area. Only one developer gave the full score of 12. However, it is surprising that most of developers did not highly perceive the desert as a profitable landscape, nor as it inhabitable. It probably implied that land development right now does not make more profits for most developers given the current difficult economic situation in the US, but there might be a hope for future profit as one developer said earlier. These results were quite contradictory with those of the qualitative analysis. An interview with one land developer revealed that land prices in Las Cruces are cheaper than in other cities in western United States, therefore, the land development in this area is probably more profitable if prices of development are the same as other cities. One developer commented that:

> "For the most of part, land prices in Las Cruces are less than the major cities in the country, if you go around Los Angeles, New York, land is much more expensive, therefore, it's harder for developers, because you need so much money just to buy the raw land." (Developer A)

Another developer expressed a similar view, noting that:

> "I think that one of the advantages of Las Cruces is the price of land is less than it could be, compare to the east coast or California, so theoretically, the price of houses is less. So let's say the average house cost 200,000 [dollars] here, in Massachusetts the house prices will double the amount; the other factor is the building cost is less than Massachusetts, labour costs less, so land is cheaper, housing is cheaper, labour is cheaper." (Developer C)

However, later on, he provided his reason of putting interests on this particular piece of land that:

> "Because it was an existing mobile home park, they have got 80, or 90 mobile homes before, and by the time we talked to the gentleman, they have about 12. So it is a mobile home park, the city has a lot of issues, permit issues, code issues, but it's zoned already for multiple units, so that's one of reasons we picked it up that we want to do a project to have multiple homes. Why multiple housing is important to a developer, if you put that many units your cost should be less, because of more units that you can put in."

This statement revealed that not solely because land is cheaper in Las Cruces, but they can have more economic benefits. The latter land developer expected to generate more benefits because the city has already zoned the land, and he can put more units to reduce the development cost. Hence, there is an opportunity for them to generate more profits from different approaches.

On the other hand, a number of respondents considered that the landscape is more profitable for others. For instance, one resident observed that "developers make a lot of money [out of land development in the desert]". One NGO member considered that the receivers of benefits are not only land developers, but also the State, by selling the land to developers.

Apart from the NGO member who complained about the close links between the State Land Office and developers, one politician also mentioned the poor communications between local government and State government:

> "The state land office allowed [a] developer to get all that land, in a way that seems to us that's not legal, and they did not advertise it properly, and it's a deal, and so fights are still going on."

In a later stage of the interview, the politician also admitted that "the city is a home-rule city, which means we don't need to do what the State tells us to do". Indeed, "the City of Las Cruces operates under a Home Rule Charter, which was adopted by city council in 1985, and the purpose of the Charter is to provide for maximum local self-government" (City of Las Cruces, 2005). Therefore, the city can perform self-governance, which means that:

> "The citizens of a home rule city are free to choose their own form of municipal government, choose between a large or small city council, fix the terms of office of council members, decide on the method of election of the Mayor, provide for creation of more boards and commissions which they feel is essential for proper city functioning, etc. In US, most of the states have home rule cities." (US Legal, 2001)

This evidence implied that the city can make its own decisions without notifying the State government, and also the residents can have the power to choose their Mayor and city councillors. It can also explains why poor communication exists between the city and State government in mutual ways, which means that the local government does not negotiate with the State government effectively or they

do not feel there is a need to inform or discuss with the State government about their decisions.

Later, the NGO also added that they have ineffective communications with the city council, as:

> "This is the most important part for BLM to hold on and not to dispose…One person in the city council lied to me all the time, we have to adjust our actions every time he lies. No one wants to protect it, so we want to do it."

Not only the local government, but the way BLM administers the land was also debated and criticised. Another NGO considered that BLM office in the State did not fulfil their missions and generated profits by selling public lands to land developers and finance the state governments. As the NGO asserted, generally, BLM sells the land and the money goes to the federal office to their general fund. They then use that money to buy other lands in environmentally sensitive areas and protect land in these areas. Nevertheless, in Las Cruces, BLM attempts to change national policy that outline BLM's mission and requirements, and the money would indeed go to the state BLM office, and some of this money would even go to the local government and the county government. Therefore, he considered that Doña Ana County is the only county in the United States whose open space was used to finance the government, like a small bank. The officials in the BLM in the state have much power, and they are able to make decisions to dispose or exchange the public land. On the other hand, in the interview with one expert working for BLM, he commented that they try to work together with local government, the city and the county, however, he admitted that if there are any disagreements between them, it is federal responsibility to make these decisions, as mentioned above. These different opinions indicate a lack of trust in the BLM as the NGO questioned that BLM might not meet their own requirements to protect the environmentally sensitive areas and attempt to generate more money instead. These opinions also reveal a lack of transparent land-transaction procedure between BLM and other parties to the public, consequently local communities are not aware of the BLM's activities. These examples highlighted the poor communications between different levels of government, and between local government and NGOs. From the above statements, it is not difficult to see

that land developers are not the only receivers of benefit, there are some mutual benefits associated with other groups as well, such as the resident group, politicians and other land management entities as evidenced from above. The above statements also implied that the developers benefit from good communications with the State government to get good deals for themselves. Some residents can also be potential receivers of benefit. As one resident noted, the nearby land developments are helping them to increase the value of their own property, so that residents potentially considered their houses as financial investment. Salamon (1998:176) noted the important role of a house in the US that a house is a major investment for middle classes, "when house values are threatened by another's actions, one's basic identity is also assaulted" .

The functional component of land is always associated with other benefits or values. Kivell (1993) considered that land means access – access to transportation, infrastructure, public services and information. Land also means power, ownership of land is always important as an indicator of economic power, and "a more subtle form of social power and status may also be exercised by individuals or groups who hold land in select locations" (Kivell, 1993:X). Because land use is the key to planning and management by government and other institutions, land use and ownership is inherently political. This point is illustrated further in Chapter 8.

Results presented above demonstrated that perceptions of different groups towards growth and development functions in the desert are rather complex, contradicting and conflicting. These results about the statements regarding functional values of landscape highlighted the complexity between the actor groups in the community and implied that there might be a tension between different actor groups currently in the study area. It also implied that some actor groups might have a quite negative image perceived by others - for example, the developer mentioned that he was perceived as 'greedy' by other people. It is partly because other groups such as NGOs and residents consider that other entities are generating benefits from the common goods and services (e.g. public open space), and prohibiting them from benefitting from the common good or decreasing the intrinsic value of the landscape. Condrey and Guillen (1997) noted

that people living in New Mexico appreciate the feeling of wide open space, and this feeling reflects a life style, and open space involves psychological benefits to residents of more open space. Condrey and Guillen (1997:26) commented that "the beauty and drama of the landscape is not a luxury but an essential part of the land of enchantment". Moreover, in the Southwest, open space and land is always related to opportunity and economic benefit since the Europeans arrived dates back to the 18th century. Since the 1890s, the Federal government tried to prevent public lands from the rapacity of market forces and to balance private economic interests with the provision of recreation, wilderness and environmental conservation for an increasingly urbanised country. Private ownership, access and use of common land, and the free market have always been issues in the United States. This point is illustrated in more detail in Chapter 8.

5.2.2 Intrinsic values

Questionnaire results demonstrate that actors appreciate the intrinsic value of the landscape, which relates to personal affections. As mentioned in Section 5.2.1, the majority of respondents from all groups disagreed that the desert vegetation has little value (89% of respondents), and the desert is an empty waste land (77% of respondents), with mean Likert scores of 1.14 and 1.5 respectively (Table 5.3). Statistical analysis suggests there is no significant difference between groups on either of these two statements, which means that they have a high level of agreement on these statements but may have different reasons and motives. Most of respondents considered desert vegetation to have great values such as scenic and environmental values. These values are tied to their personal affections, and they can get enjoyment just being within the desert. Some respondents highly appreciated the historical and cultural values of the desert, for instance, one NGO noted: "[a piece of land close to Organ Mountains] it is a cultural site, it is a historical site, so [we want to protect it]". These examples acknowledged the importance of the desert just as it is, and are very different from perspectives that considering it in a variety of functions. However, it also needs to be pointed out that some respondents might disagree with these two statements since they consider the deserts functional values.

With regards to the last two statements, “I would prefer not to stay in a desert” and “I would prefer to move out of the desert in the near future”, statistical analysis suggests significant differences between groups, and divergent views appeared mainly within two groups (NGO and planner). One planner gave the highest score of these two statements. It was discovered later from other interviewees that this planner got another job and moved out this area. These results were confirmed by the qualitative analysis, which means that respondents demonstrated an appreciation of the intrinsic values of the desert landscape. Or it is also possible that some of respondents do not want to move out because of their functional ties with the landscape.

Table 5-5: Perceptions of the Chihuahuan desert ecosystem
(mean scores for each statement of perceptions of desert ecosystem for each of the actor groups)

Group	Land Developer (n=5)	Politician (n=4)	NGO (n=2)	Resident (n=23)	Planner (n=5)	Overall Mean (n=39)	Overall S.D. (n=39)	Statistical (AVOVA) test
Pristine landscape	7.00	9.60	5.00	9.74	10.00	9.15	4.46	p=0.36
A wide range of plants and animals	9.40	9.40	11.00	10.87	8.25	10.23	3.58	p=0.77
Devoid of biodiversity	1.20	6.60	0.00	1.04	3.25	1.95	3.76	0.1>p>0.05
Full of barren land	1.20	6.00	0.00	0.57	3.50	1.62	3.35	p<0.05
Full of immense sand dune	2.60	4.20	0.00	1.83	4.00	2.36	4.14	p=0.59
Full of woody plants	2.80	2.40	4.00	1.26	2.75	1.90	3.63	p=0.34
Lacking water	5.40	6.80	5.00	4.09	4.25	4.67	5.01	p=0.7
Dusty place	4.80	6.80	4.50	4.22	3.75	4.59	4.89	p=0.83
Windy	5.40	6.80	3.50	4.74	5.75	5.13	4.91	p=0.82

Note: S.D. is Standard Deviation

Respondents also appreciated the intrinsic value of the landscape. One NGO said "the mountains are amazing". When asked why they want to protect that particular area, another NGO stated that "Because of that biological and scenic value". One politician concluded these values as "tremendous". People from all of actor groups clearly appreciated that the landscape is a habitat for both people and wildlife and enjoyed the natural features of the landscape.

Results also revealed that respondents demonstrated appreciation of the landscape as an ecosystem in its natural form. From Table 5.5, it can be observed that overall, the majority of respondents from all of the groups perceived the desert landscape as a place with a wide range of plants and animals (mean score of 10.23), and followed by a perception of it as a pristine landscape (mean score of 9.15).

Qualitative analysis confirmed these results. One resident said that "we get a few (animals) around the yard." (and similar comments were expressed by other four respondents.)

One politician concluded that "and the same thing in the desert, people like this pristine desert."

The common perceptions of the desert ecosystem, such as full of barren land, devoid of biodiversity and immense sand dunes, are not supported by this study as the majority of respondents disagreed with these statements. Statistical analysis suggests significant differences ($p<0.05$) between groups on the statement of "I perceive the desert as a place full of barren land", and the politician group gave quite high scores (mean score is 6.00) on this statement. It is interesting to see this result, because the politician group simultaneously considered the desert as 'barren' and 'profitable', it perhaps implies that the barren land can be turned into a profitable landscape, or has more potential for future growth as the land might not be productive enough for agricultural purposes but it is suitable to build houses on it.

NGOs perceived the desert landscape as full of woody plants, however, the other actor groups did not perceive it in such a strong way. Their perceptions of woody plants may be connected with the pristine character of landscape ecosystem, or

this perception probably tied into the discourses of degradation. NGOs noticed the sign of land degradation, and tried to conserve the desert from being further developed and degraded.

The statement of "I perceive the desert as a place lack of water" received higher score by the politician group (mean score is 6.80) and followed by the developer group (mean score is 5.40). This result is quite contradictory from the first part of questionnaire, as these two groups expressed little fear of a water crisis. With regards to the statement of "I perceive the desert as a dusty place" and "I perceive the desert as a windy place", statistical analysis reveals no significant difference between groups on these two statements. However, overall, the politician group gave high scores on both statements (both mean score is 6.80), followed by the developer group (mean score is 4.80), and the planner group (mean score is 5.75) respectively.

One developer made an explanation about this statement:

> "It [dust] is blown away. So that's another situation we developers sometimes get bad name, 'you caused this dust blow', if there won't any development here, and it were 120 degrees [40 ℃], and dry and windy, the dust is blown. When we are developing here, they are not." (Developer A)

This statement reflects another reason for the conflicts between local people and land developers. Land developers, at least, in this case, would not consider dust emission is their fault but it is the nature of the desert. However, this explanation is not supported by scientific research. Gillette (1999) found that sparsely vegetated surfaces have more potential for dust emission than dense vegetation. According to Kelly et al. (2004), in the 11 years of measuring dust flux from loamy sand soils in the Jornada Basin, they found that removal of vegetation has triggered wind erosion by increasing particle saltation and suspension processes. Land developments need to clear vegetation on the vacant lot to prepare the ground for construction, hence according to the above studies, these empty lots without vegetation are likely to generate more dust emissions. Moreover, once constructions have happened, the situation may get more complicated, in that there may be flow constrictions between buildings, leading to flow acceleration and thus more emission in the spaces between buildings. Many studies have found

the link between the dust emission and construction in land-development areas (Lee and Tang, 2001; Lee et al., 2001; Stefanov et al., 2003).

Interestingly, qualitative analysis revealed a different approach from the above developer's argument, which represents most of the developers' perspective. Unlike most of the developers within the group, one developer applied another approach to reduce the disturbance to the desert, and he was not reluctant to admit the development activities related dust problem, instead, he commented that:

> "You have to mitigate (the dust), because the desert is so sensitive to be disturbed, on the top layer of the soil, even a foot step can disturb … so what we do to deal that is we build a path for houses until [we] begin the construction, about 30 days to build a path, and then you start to construct a house." (Developer D)

These results here partly support the outcomes of the first section of the questionnaire. Another aspect of conflicts among NGOs, residents and land developers is that they all have their own logic. From most of the developers' perspectives, if you move to the desert, you have to accept the fact that it is windy and dusty. From the NGOs' and residents' points of view, if you keep building on and disturbing the desert, then the situation gets worse. These conflicts revealed a poor understanding and communication between different actor groups. They blamed each other and expressed the unwillingness to understand each other. Land developers were unwilling to take the responsibilities to change the way they are developing the land and mitigate the dust. The fights between different actor groups could not solve the dust problem, and instead, fights without willingness to understand or negotiate with each other could result in the situation getting worse.

The message behind this conflict seems that a behavioural change of land developers and an open dialogue might be needed so that residents and NGOs are aware of their efforts. Local government might need to improve their performance in opening the dialogue with both top and grassroots levels. Not surprisingly, people's perceptions to support or be against the growth are related to the trust of the government, both state and local. If people are suspicious, and the decisions that have been made are not transparent enough, people would have a very

negative attitude towards them and consequently, conflicts are generated between actor groups.

Interview also revealed that the current development patterns of Las Cruces might reflect a trade-off between the powerful groups. As one politician commented:

> "The City of Las Cruces has its own bureaucracy, that's all complicated rules, you know, if I work by a day as a lawyer or a doctor or a construction worker, I don't have time to go in [public meeting] during business hours, but the big developer he has paid for his staff who do nothing but that, so the rules tend to favour that developer. And those rules are not taking place by accident, they are getting there because these big interests have a lot of money and a lot more access."

This statement provides an important insight into the politics of landscape and revolves around the question of who 'owns' the landscape or decides what it should look like in relations of social power. It also draws attention to the power relations between actor groups, and reveals the unequal distribution of power among different groups. Some groups have more power and control over resource access and use, while other groups are relatively weaker in influencing the decision-making (Robbins, 2004). Competing social groups struggle through a political process to limit or redirect the change toward a goal is that consistent with their respective visions and expectations. One NGO provided an example of how they try to protect some public lands from development and described the process. He said that:

> "He [one politician] wants to force to sell it [public land] off, about 65,000 acres of land, to presumably developers. So it is very controversial here in the county. We understood that a lot of land was going to be here, some of them is gonna be in the Organ mountains. So what we did as an environment group was even though we want to protect these lands, we actually thought it is against the proposal, because we are totally against the land sold off. And we mobilize a lot of members of community quickly, and it stops his tricks."

This example highlighted that when the trade-off of land has little attention to environmental concerns, a group of educated activists and environmentalists will stand out to challenge this decision and even display desires of realignment of power (Walker and Fortmann, 2003). Balancing this trade-off between powerful groups and general public will be inevitably challenging and the ramifications

among actor groups need to be carefully considered. This point is illustrated further in Chapter 8.

5. 3 Summary

This chapter has presented that perceptions of different actor groups towards the desert landscape and its ecosystem are sometimes rather complex, contradictory and conflicting. These perceptions are closely related to both the functional and intrinsic value of the landscape. Different groups held similar views toward the desert landscape sometimes, for instance, "I would like to see more public open space (park, children playground etc.) in the East and NE areas", "Native plants and trees are the best for home landscaping in the desert", and "Homes should be built in a water and energy efficient way in the desert". Although similar views on these statements were expressed by most respondents, qualitative analysis revealed different motivations and drivers on these opinions between groups. For instance, the residents and NGOs groups would like to see more public open space related to the recreational functions of the landscape; land developers, on the other hand, may consider creating more public space can help them get development permission from the local government, attract more people to buy their houses and increase their housing price, and improve their market competition ability. Studies found that natural resource and open space features are of great importance for homebuyers' decisions as these can offer both rural and environmental values as such elements can increase the homebuyers' feelings of being closer to nature and having space (Kaplan and Austin, 2004; Vogt and Marans, 2004). In addition, qualitative analysis also found that residents' opinions do not necessarily match their behaviour. For example, most residents considered that native plants are the best for desert landscaping, however, their houses are not full of native plants, and have many exotic plants for their own enjoyment. This result is consistent with the study of Larsen and Harlan (2006). The motivation behind the 'water- and energy-efficient homes' might be the state government tax incentives and Federal funding, not solely environmental orientation.

In addition to the similarities, various functions of the desert were appreciated by different actor groups and conflicts were observed between groups. Residents appreciated much of the recreational value that the landscape creates. The

development function of the landscape was favoured the most by the land-developer group, followed by the politician group. By contrast, NGOs and residents agreed the least with this statement. The land-developer group appreciated its functional and associated economic values, and the politician group desires the economic benefits as well as having more power to control the growth patterns. Nevertheless, it also needs to be pointed out that there is a need to carry out a cost-benefit analysis on the long-term impact of growth in the study area. Encouragement of growth without a balance of cost and benefit might not be a sustainable option for the city in the future.

Divergence of perceptions does not only exist between groups, but also appear within the same group. Some residents recognised that the land developments are positive for them, as opposed to those residents who were strongly against the land development. For example, it may be beneficial from a long-term financial investment perspective. Similarly, some NGOs considered that the current development pattern is beneficial for the development of their organisation, as more public utilities will be closer and more accessible for people to come to visit. In contrast from the common image, it is surprising to see that some developers are different from the rest of their group and are environmentally minded. However, qualitative analysis revealed that the environmental perspectives were probably based on the economic incentives provided by State and Federal government. Therefore, it implies that different groups appreciated functional values with their specific needs and interests, and different actors have their own preference and agendas as well. Hence, this study also pointed out that perception of landscape might need to be investigated individually as well as 'collectively' categorising into different actor groups. This can be achieved successfully by the combination of qualitative and quantitative methods.

In addition to the functional values of the desert landscape, intrinsic values were also appreciated by actors such as its biological and cultural values, habitat for a wide range of animal and plants, and pristine landscape. The results are also consistent with the study of Kaplan and Kaplan (1989), they also suggested that people find natural scenes aesthetically pleasing because of their cultural and symbolic significance. Actors realised the need to conserve the natural resources that provide them important eco-services as well as other benefits. Most of them

disagreed with the statements “I would prefer not to stay in a desert” and “I would prefer to move out of the desert in the near future”. Contradictory views appeared in a few cases. For instance, land developers and politicians considered the desert as lacking water. But they do not fear a water crisis. This contradiction may reflect a typical attitude in the American Southwest that residents living in the desert are not willing to admit the shortage of water supply. Especially, land developers are not willing to accept the shortage since it might limit their opportunities to make profit; politicians prefer to serve their voters’ interests of ensuring that there are plenty of natural resources to support the continued growth.

There are some reasons which can explain the conflicts as discussed above. First of all, someone’s benefits may lies at the others’ costs, for instance, many residents complained about the dust problem resulting from the land development activities, and other people’s irresponsible water-use behaviour might lead to insufficient water supply for them. Competition over water use observed in this study was consistent with the findings of Larsen and Harlan (2006), Hurd et al. (2006), and Hurd (2006). Secondly, undistributed benefits, for instance, some respondents perceived the land developers generated more profits from land developments. Other studies have found that people can have a conflicting relationship between each other in terms of gaining undistributed benefits from natural resources (Allendorf et al., 2007). Thirdly, social power inequality, for example, as the politician group mentioned, land developers have more access and power over land trade. Last, poor communication exists between local government and community and local government and state government. In particular, in this study area, tension between local government and NGO is apparent as NGO feel cheated by the promises of some government officials.

These differences of perceptions have important implications for landscape planning and management. First, more effective ordinance and policies need to be introduced and enforced from top-down level to mitigate environmental problems. Second, at the same time, public involvement needs to be improved so that different actor groups understand each other’s expectations and concerns. Third, public knowledge of the desert ecosystem and balance between resources availability and use needs to be improved. The difference of perspectives between experts and the general public needs to be noted. Apparently because experts

normally have specific knowledge that the general public may not recognise. For instance, in one case, the majority thinks that the native plants are the best for the desert, while the expert pointed out the limitation of this general perspective. In another case, land developers and politicians stated that there is plenty of water availability versus residents and NGOs are afraid of shortage of water resources by rapid growth. Local government and experts need to disseminate more information and knowledge to a wider community so that people are aware they actually do what is right to do beyond their knowledge in their own judgement, but also they understand the issues from a broader perspective.

Chapter 6 Driving factors of land-use decisions

6.1 Introduction

This chapter investigates driving factors of how multiple actors make decisions to use the land at different scales, and how these decisions are influenced by their perceptions of landscape. Insights derived from this chapter are later linked to an analysis of how land-use decision-making influences land degradation in Chapter 7, and provide the basis for further discussion of power relations and social interactions between different actor groups in Chapter 8, which are based on the theoretical insights in Chapter 3.

6.2 Driving factors of multiple actors' land-use decisions

Throughout the world, human land use is a formidable cause of change, shaping the distribution of land cover and influencing fundamental ecological processes and the persistence and extinction of species (Theobald et al., 2000). Land-use decisions are a key determinant of the social, economic and environmental health of our communities, and land use in the United States is predominantly a local issue (Giannotti and Arnold, 2002). Decisions governing these land use changes take place exclusively at the local level, but at different scales, ranging from individuals' landscaping choices to the designing of an infrastructure for urban development (Flamm, 1996). It is recognised that development of farms, ranches, forests and deserts will noticeably change the landscapes of western US in the coming decades, and these changes will manipulate strong and lasting consequences on the quality of life (CAP LTER, 2003; Theobald et al., 2000). Such recognition has given rise to the concern of how to shape the course of change in such a way that natural systems are conserved in the face of rapid environmental change. Land-use decision-makers play important roles in these changes by making decisions with insights into the consequences of land use choices for the ecosystem of the region (Theobald et al., 2000). Decisions made at different scales such as residents' landscaping choices, and local government land use planning, have different impacts on the landscape changes. In this study, residents' landscaping choices are considered as micro-scale level of decision-

making because their decisions concern their individual yards. Land use decisions made by land developers, NGOs, planners and politicians are considered as macro-scale level, as these decisions concern larger scale of land and have wider implications. It is important to understand how these land use decisions are made, not only why but how to improve the management of the land and achieve a more sustainable land use practice. The way people make decisions is complicated (Flamm, 1996). To achieve such a task, it is essential to investigate driving factors of multiple actors' land use decisions operating at diverse scales. This section therefore elaborates these factors according to different actor groups involved in the land use issues.

6.2.1 Residents

Residential landscaping is an important part of people's daily life in the western US, and decisions made about their yards are important land-use decisions in their daily life. Residential landscaping as the practice of creating and managing outdoor living environments for enhancement of everyday quality of life, is shaped by complex interwoven factors of socio-economic values and the needs of society and environmental values (Martin, 2008). Intrinsic or functional orientation may affect individuals' decisions about landscape choice in a desert area (Yabiku et al., 2008).

Outdoor landscaping behaviour is the primary factor in causing high water consumption per capita in the desert Southwest (Martin, 2001), and the treatment of the residential landscaping can cause land subsidence due to over-extracting groundwater, interference with surface hydrology and flood pathways and soil erosion (dust production and storage) (Larsen and Harlan, 2006). In particular, traditional lawns are found to cause significant environmental problems such as high fossil energy use, high water use, water pollution and decreased biodiversity (Helfand et al., 2006). Alternative yard design, which incorporates environmental concerns into a visually pleasant design, needs to be encouraged.

In this study, several key factors were identified in motivating residents' decisions in designing their yards. Table 6.1 summaries these influencing factors and

illustrates the total numbers of residents who mentioned these factors in the interviews.

Table 6-1: Factors and total numbers of residents who mentioned these factors as their motivations to design their yards

Factors	Supporting interview evidence (total number of residents who mentioned these factors)
Time required for maintenance	Six
Money	Five
Cultural influence	Five
Water consumption	Seven
Others (visual enjoyment, privacy, children playground, relax)	Eight

Table 6.1 shows that there are four key driving factors: time of maintenance, money, cultural influence, and water consumption. Other factors such as visual enjoyment, privacy and recreational reasons were also reported by respondents. The next sections illustrate each of them in more detail.

6.2.1.1 Time required for maintenance

Many residents, not only full-time professionals but also retirees, considered that working in the yard is not very pleasant especially in the hot summer in the desert. Hence plants requiring low maintenance become their priorities to use in their yard, and the natural character of the desert plants has been valued. As residents stated:

> "We didn't want any flowers in the front yard, just in the back yard, something that [requires] low maintenance." (Resident, retired, and similar comments were expressed by other two retired residents.)

A young professional shared her experience of planting palm trees, but she admitted that:

> "I think it's just kind of easy, easy to grow, easy to take care of, I don't know, when I think about desert, I think about a palm tree." (Resident, professional)

One resident commented [translated into English]:

> "Because we lived in the East before, there are all grasses in the yard, it is a problem, we need to water and mow the grass. So my husband said that I don't want to mow the grasses any more. Also we have the condition here that other people have rocks, so we decided to have rocks too." (Resident, professional)

These statements revealed that many residents prefer low-maintenance yards and are not willing to spend much time working in the yard. In particular, the desert climate provides the privilege of having low maintenance plants such as palm trees and rocks.

As well as interviewing residents about their decisions directly, the owner of one landscaping company was interviewed in order to ascertain the expert view reflecting on the wider population in the area. It is important to recognise that role of landscape companies plays in influencing the local community, as residents increasingly hire landscape companies to design and maintain the yard. The owner of one landscaping company mentioned that:

> "The big consideration for many of the customers is how much [work] the actual customers want to put into the yard work."

He added that some of his customers' concerns are typically "this plant I need to clean a lot, I am not really big in terms of doing gardening, I don't want to plant that one, we don't want to put in something requires a lot of attention, so that's a big thing".

A large number of residents are not willing to spend a great amount of time working in their yards. However, results also showed that some residents enjoy working in their yards, and yard work becomes a hobby for these people. As one resident commented:

> "This is my hobby. I enjoy my yard, and I got a lot of out of it, and I would be happier to live there than live in an apartment. I need a yard." (Resident, professional, and a similar comment was expressed by another resident.)

In a few cases, time is identified as a limiting factor in realising residents' preferences of their yard choices. One resident claimed that indirectly, and she made comments about her neighbour spending much time on yard work: "she doesn't work, she has time really. But, you know … [I don't]." (Resident, professional) Hence, the amount of time to maintain the yard as a driving factor

involves both how much time residents are willing to spend in their yard and the availability of their time in their day.

Many residents (nine out of twenty-three) moved to the desert from elsewhere in the US, such as New Jersey, Tennessee; they used to have lawns in their previous homes and spent a considerable amount of time working in their yards. Once they moved into the area, most of them followed the locally typical desert landscaping. Partly because desert landscaping, e.g. rocks and cactuses, normally do not require high maintenance such as mowing and watering (examples see Figure 6.1).

Figure 6.1: Photographs of typical desert landscaping in the study area

Figure 6.1 shows some examples of typical desert landscaping in the study area. From these examples it can be observed that the desert landscaping that local residents used mainly consists of rocks, cactuses and other desert plants. Another possible reason for residents choosing desert landscaping is that when their neighbours have desert landscaping, they want to fit into the neighbourhood appearance. This factor is illustrated further in Section 6.2.1.3. In fact, some residents admitted that they did not like or accept it at the beginning; as one resident commented (translated to English): "I didn't like here when I just arrived, it's green there [New Jersey], many trees, but here is yellow [desert]." And a lot of residents added some similar elements as they used to have before, for instance, flowers and partial lawns, and they just liked it now, i.e. "it is better than I thought, we need to adapt it [desert]".

6.2.1.2 Money

Money is another major driving factor that impacts on residents' landscaping choices, and has been mentioned frequently in the interviews. As one resident stated:

> "It's a money thing, you try to save as much as you can, and my son did most of the yard work. We had a couple of times we hired people,

> but now we try to do it ourselves, because we try to save money." (Resident, housewife)

Another resident reflected that "having trees for shade, costs money and maintenance" (retired microbiologist). The young professional therapist stated that "one day when I make a little bit more money, I will [put more on the yard]. I love travelling, now I spend a lot on travelling."

One couple acknowledged the benefits of a desert yard requiring low input in terms of time and money, the wife also admitted that they would rather spend money on travelling than in the yard; as they said:

> Wife: we certainly do spend a lot more [money] on travel than on the yard.
>
> Husband: right, because we are going to California, two weeks, then we are going to the east coast in about six weeks, then we will be in California for two weeks. We have children there, and then in October I am going to the Midwest on a bicycle ride then in November we are going back to California, San Francisco, so we do travelling quite a bit. And I guess one thing is that I think the desert yard doesn't require much work, or isn't expensive if you leave it pretty natural and they can be very pretty. (Residents, both retired)

Residents also considered that saving money is one of the most important benefits that their yards bring them; as one explained:

> "It's great, I don't have to pay somebody to maintain it. I don't need to, because I don't want to put money on it. That's an initial plan. I normally spend money on music, I need to fly some place to play with the bands somewhere, or to go to a concert or opera. I have limited income. I am retired. And also travel, I have children live out of town, one is in New York, one in California, I need to go to see them, so …"

The owner of a landscape company also said:

> "The higher social economic status, you will see more diversity and, it tends to be planting trees and things like that. Where people who don't have income to [put on it]. We try to make everyone happy, we try to match."

In addition, according to the responses from the horticulture specialist as mentioned in Chapter 5, who was interviewed to provide expert knowledge as well as the owner of landscape company, money is a primary reason for residents to make their landscaping choices especially in the study area; he explained:

> "Price would be the most important thing, in this area, you know, here is not an affluent neighbourhood, here people don't have very much money, so price is the primary thing, so you are off from choice, from small plants or bigger plants for more money, the bigger plants for more money are not going to sell if you are in a nursery. And it depends who you are selling to, if they are younger people, they are willing to wait until they grow up. If they are in their 60s, and 70s, they say I don't have that much time left in my life to wait, I want bigger ones now… And I think the economic time too, you don't have much money to go to big vacations, so people spend more time at homes and in their gardens, and you know."

These instances indicate that residents were constrained by money when they made choices to use types of plants in their yards. When money is limited, they have to prioritise its distribution. Some residents would rather spend money on their hobby, such as travelling and music, except for those whose hobby is their yard, or to spend on families and other social activities. It also needs to take residents' willingness to pay for their yard into consideration. As one resident commented: "how much your yard matters [to you], which priority". However, as the horticulture specialist said, "due to the economic recession in recent years, more and more people are not able to afford to go to holidays, and they choose to entertain themselves in their yards instead. Hence, economic recession could bring a little boom in the landscape and nursery market if people have to stay at home and they might be willing to spend more money to improve the surrounding environment".

Difference in social economic status was also acknowledged, as comments from the owner of the landscape company showed. Wealthier people can afford to hire landscapers to maintain their yards and/or purchase more diverse plants, trees and grasses. It makes sense that residential landscaping reflects homeowners' social economic status. It implies that these residents put a fashionable and ecologically sensitive landscape to the street, but they enjoy much more greenery in the privacy of their back yards. On the other hand, lower-class homes have much less greenery in their backyard than in their front yard. In this study, although there is no clearly distinct investigation in terms of front yard and backyard landscaping, from data and photos gathered, it can be seen that in wealthier neighbourhoods, backyards are much greener and colourful than in those less wealthier neighbourhoods and homes. Figure 6.2 shows contrasting photos of landscaping

from wealthy and less wealthy homes. From Figure 6.2, it can be seen that there was less diversity in a less wealthy neighbourhood. While in the front and back of the wealthier homes, the landscaping is more diverse and greener (see also Figure 6.3 and 6.4).

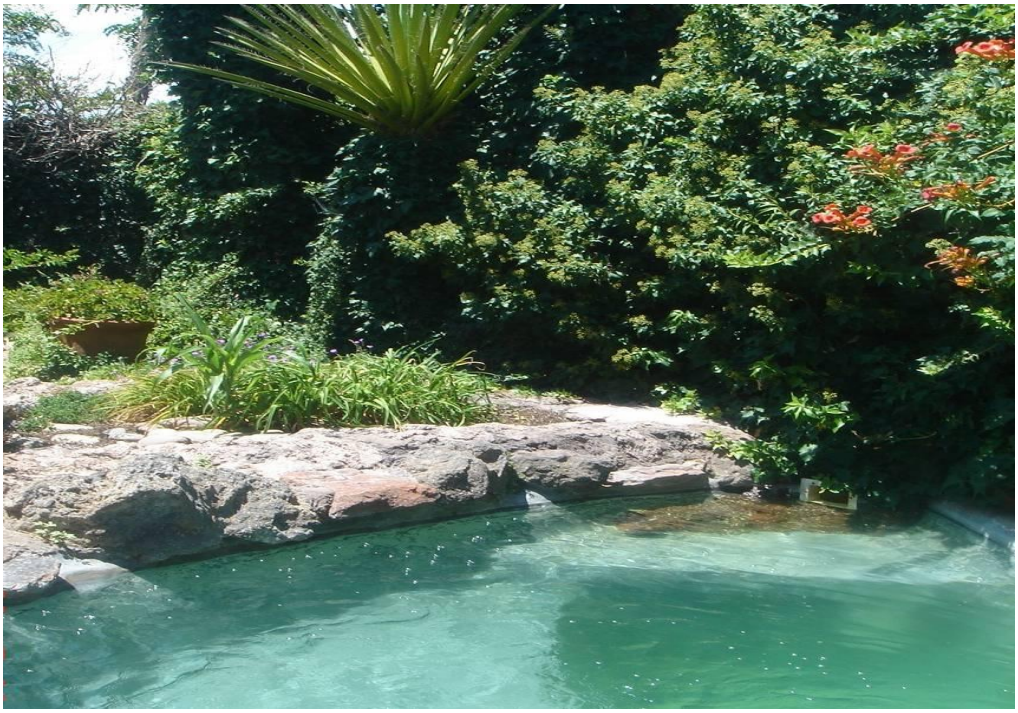

Figure 6.2: Contrast photographs of wealthier and poorer homes and neighbourhood landscaping

6.2.1.3 Cultural influence

Cultural influence has played a role in motivating residents' decision making. From interviews it was found that not only the cultural background where they are from, the surrounding environment when they grow up, but also the broader local cultural norm impacts on actors' decisions.

There was one respondent in a local community school, originally from China, who reflected on the fact that the trees she has now are the same as the ones her parents had when she was a child. She knew this kind of tree and was familiar with the smell of the flowers, and she decided that she would have them when she had her own house. She moved to New Mexico from New Jersey, and admitted that it took her a while to get used to this yellow, hot and dry desert. She has a mix of landscaping, desert plants, rocks as well as trees and flowers. As for the front yard design, she believed Chinese Fengshui achieve a harmony between heaven and humans. She gave an example of there being one tree that did not grow well compared to others; however, it is not appropriate to cut it off and plant new ones. It is not harmonious because they will not match each other. She has a vegetable garden with a wide range of varieties in the backyard, and some climbing vegetables grow against the yard wall. Figure 6.3 is an example, a picture taken from her backyard. It can be seen from the photo that the vegetables were planted rather randomly and there was not a clear boundary between each variety.

Figure 6.3: Photograph from resident's vegetable garden

She called it 'Chinese practicality', which means that the vegetable garden is practical in a way making good use of space, saving money on installing a pergola and providing fresh vegetables for the family. She considered that Americans

would not design the garden in such a simple way, they would rather install a proper pergola or concrete base instead.

Another resident also provided an example to illustrate her family influence, stating:

> "I grew up, my dad always had flowers since I was a child, and so I really want to have flower beds. We used to have huge beds, you couldn't even see the dirt, and they are just solid, you know. And so that's why [I have them in my yard]." (Resident, housewife, and a similar comment was expressed by another resident, professional.)

The career of the horticulture specialist has also been heavily influenced by his family. He said:

> "Originally, I grew up in Arizona, my dad was a landscape architect in the state of Arizona, so I grew up with landscape design… and I grew up in a [landscape] nursery, and we also had a [landscape] nursery for a while, my dad planted a lot of plants and sold them, as a kid I grew up in a property with plants, so I always been surrounded by plants. It's just lots of plants, I love the different textures, and colours and sizes, and plants and leaves and things like that. I love this job, because I go visit people's homes to help them with plants.

Another master gardener also admitted, "my mother was a horticulturalist", and he "pretty much was influenced by my mum". These statements demonstrated that cultural influence is associated with some respondents' childhood memories and family environment, the influence leaving a significant mark on these respondents' thinking of landscape style and design, and even impacting on their career choice. Perhaps because of the experience in the respondents' early days, they developed an interest in doing something similar with their grown-up environment.

One respondent also considered that local culture played an important role in encouraging her to use desert landscaping elements. As she said:

> "The more important reason is that nobody has it [lawn] in this area, some homeowners have, but only small area in their back yard, not full of lawn from the front to the back. The desert landscaping is the basic landscaping in this area, that it is. If we move to other places, if people there all have grasses and flowers, I wouldn't do [something else]. There wasn't this kind of concept in my mind. So we need to fit into local context, so your ideas change. Before I came, I didn't think to use rocks as landscaping. People all have grasses there [New Jersey].

This statement revealed that cultural norms internalises beliefs about what other people prefer, and impacts individual values and behaviours on the landscape choices, which means that residents' preferences tend to conform to neighbourhood norms. Result showed that one or two residents mentioned that the same plants grow well in their neighbour's yard, where they obtained the idea. My field observation photos corroborate this by showing that two or more houses have similar elements of landscaping in the front yard (Figure 6.4). In addition, one resident mentioned that the landscaping needed to match the neighbourhood by saying "I mean we have to add on our house, we have to get permission to make sure it fits the neighbourhood." However, it is noted that although the consistent neighbourhood appearance might be imposed by local ordinance or development covenant, as a few residents reported that their front yards are designed by builders and land developers prior to their settlement, and the choices of some land developers' initial landscape appearance function as a macro-level force (Larsen and Harlan, 2006), but most residents changed some elements in their yards. Hence the responses from interviews sufficiently provided individual motives or preference for the landscaping choices.

Figure 6.4: Photographs of neighbourhood landscaping. Two or more houses have similar features of landscaping in the front yard.

Yabiku et al. (2008) further suggested that landscape preference also reflects the socilisation process which means that an outsider to a group learns the behaviours, knowledge and skills to become a member of the group. As it relates to landscape decisions, socialisation processes might suggest that individuals appreciate native and desert landscaping learnt and have developed through the residence in this area. Hence, the influence coming from a wider environment plays a significant role in residents' landscaping choices.

6.2.1.4 Water consumption

Water consumption is also claimed to be an important reason for landscape design. Water concerns have been expressed in two different ways. One is environment oriented, which means people are solely concerned about the water resources and consumption in the desert and value the desert in its own nature; the other is money driven, which relates to people's water bills.

One resident expressed her reason for not having lawn in the yard, although she moved from England and used to have lawn in the previous home:

> "Because you shouldn't have grass in the desert, there is not enough water. It is a desert, they should have rock and desert plants." (Resident, retired)

In addition, some residents did not have chance to decide which kind of plants to put in the yard, because sometimes the developers and builders had already finished the yard for them. One resident provided an example: the builder had put plants in their yard when they bought the house, but they would like different plants; he stated:

> "If we redid some of this, we would like to choose plants that almost need no water. I think the desert, we should maintain the desert." (Resident, retired)

In contrast, different reasons regarding the grass yard installation were also expressed:

> "It is lots of work especially here, instead of putting down dirt and grass for the whole yard, you put rocks, because otherwise, you could put grass in the whole area, that will be awful lot of grass and lot of water, that will be very costly to water it all the time" (Resident, retired)

Similarly, the owner of the landscape company observed:

> "The water is a big consideration, some people don't want high water bills, so we use plants that require less water, we don't want high water bill, so if they want a lawn, there are different types of grasses put in, and some types use less water than others, we will use the ones, you know, that require less. We will ask customers what they want."

These statements revealed divergent concerns regarding water use. The former is more perceptive and appreciates the intrinsic value of the desert. The latter is more practical and thinks about the economic costs. It is not always easy to realise that water concerns are from an economic point of view or an environmental perspective. However, both motivations can have a positive effect on water resources and reduce water usage.

It is a contradiction that some respondents claimed they want to save water, yet still use a great amount of water. Quite a few residents have grass in their backyard, although they follow the culture in the area of having desert landscaping in the front. This contradiction might also be explained by the fact that these respondents provided answers that they would expect me to hear. Figure 6.5 shows some examples of residents' greenery backyard in contrast with the rocks and few plants in the front.

Figure 6.5: Photographs of front yard desert landscaping and back yard greenery

One respondent mentioned that the yard should not be a place for wasting water, but she admitted that she watered the vegetable garden every day to make sure the vegetables grow and not die off. This practice does not square with the city ordinance that residents in the city can only water the yard every other day

according to the house numbers. According to the Water Resources City Ordinance (WRCO):

> "Even-numbered addresses can water outside vegetation on Tuesday, Thursday and Saturday. Odd-numbered addresses can water outside vegetation on Wednesday, Friday and Sunday. No watering on Monday" (City of Las Cruces, 2008b).

However, this ordinance is mainly achieved on residents' initiative; there is no monitoring scheme to guarantee that people follow it. A few respondents have grass in their backyard so even if they do not always follow the ordinance, no one will be aware. The result of lack of the monitoring scheme for the City Ordinances means that residents follow them on their initiative and moral responsibilities.

6.2.1.5 Other factors

In addition to the above key driving factors, a few other factors have been mentioned in influencing their decision making. The first of these is visual pleasure as an intrinsic value of the yard. As one resident observed:

> "The closer you plant, there is less weed. In the morning, these are really pretty, yellow, chocolate flowers, they smell really fragrant, smells good," (Resident, housewife)

and:

> "I like them [roses]. They smell good, they look nice. And then around them are chocolate flowers, that one is native to the area." (Resident, professional)

Another resident commented that:

> "It [flower] breaks the plainness, it dresses it, you know, some clothes on the yard." (Resident, professional)

These statements demonstrate that visual pleasure has been taken into account when residents design their yard, and they can get enjoyment just by looking at the yard or smelling the fragrance. Further, trees and flowers can have additional functions as well as the ones residents mentioned so the second motive is having privacy. Residents reflected:

> "And this we like because the trees separate us from neighbours and total privacy. Privacy, and comfort, that's about it. I love my yard, I

> enjoyed a lot. You see just sit here, how relaxing it is." (Resident, professional)

and:

> "Partly the privacy, I did not want to look at that house." (Resident, professional)

It is obvious that residents value their private space, and the yard can be seen as a little kingdom just for them. They have the power to organise this kingdom and keep it away from the outside world. The yard performs its special function and realises this American personalism to some extent.

During the interviews, it was revealed that the knowledge of specialists played an important role as an influence and information source for residents to get ideas to design their yard. As in the case of the horticulture specialist, he acted as an advice giver to help people to maintain and design their yard as mentioned earlier.

The horticulture specialist potentially influences people's choices. Some people may take into his advice into account when they seek plants for their yards especially when they are new to this desert area.

6.2.1.6 Summary

This section has investigated the driving factors behind residents' micro-scale decision-making in their yard. Decisions made in actors' yards reflect their opinions, past experience and values toward the landscape. Four factors were identified as key driving forces: time required for maintenance, money, cultural origin and water concerns. Other factors such as visual pleasure and the desire of privacy were also acknowledged by some of residents.

The results of this study are consistent with other studies. Other studies also observed that lack of money and time are barriers to realise residents' preferred landscapes in New Mexico (Hilaire et al., 2003; Hurd et al., 2006). Difference in social economic status was acknowledged, and it was shown that residential landscaping to some extent reflects homeowners' social economic status. CAP LTER (2003) found that in Phoenix, the greenery in residential landscaping is attractive to almost all of the desert dwellers, including all social classes from upper-income to lower-income. Regarding the front yard, the majority of upper-

class and middle-class residents use desert landscaping, less than a quarter lower-income homes used lawn and more than a quarter have pavement or dirt. However, in their backyard, less than a quarter of the higher-income and middle-income homes have desert landscaping, and more than half have much greener (more grass and trees) choices.

In terms of cultural influence associated with landscape decision-making, Hurd et al. (2006) stated that cultural preconceptions or familiarity and comfort with traditional lawn landscape are important aspects of cultural constraints in choosing residential landscape in New Mexico. Martin (2008) found that people who relocate to Arizona from less arid climates such as in the eastern United States would prefer lush landscapes due to the legacies of a former home which causes them to be reluctant to accept the principles of desert landscape that are more popular among long-standing Arizona residents. Yabiku et al. (2008) suggested that the environmental experiences earlier in life can remain as a lifelong imprint on an individual. The factors that cause these long-term influences involve the familiarity and repetition of the experiences and the affective and emotional context (such as family) in which the experiences occur.

In addition, residents were also influenced by expert knowledge and local culture when they made yard choices. A lot of people want to make sure that they are socially correct in the front yards, i.e. having desert landscaping while at the same time being able to enjoy their privacy and greenery in their backyards. The results in this study are consistent with some other studies. Zmyslony and Gagnon (1998) found that residents in a street section are influenced by the shape, colour and location of the vegetation they observe in the front yards of nearby neighbours. Further, Nassauer et al. (2009) considered where neighbourhood norms emerged to conflict with broad cultural norms, neighbourhood norms had a far more powerful influence on individual preferences. Further, they found that residents wanted their front yard to match the neighbourhood if their neighbourhood had uniform norms.

Desire for privacy in choice of landscape found in this study is also observed in a few other studies. Ryan (2002) found that privacy was rated extremely important in residential design. Larsen and Harlan (2006) found that landscape preferences

and behaviours for front and backyard residential landscapes vary in a way that reflects the symbolic presentation of self. They found that in the front yard, desert landscaping was preferred by most respondents as more socially correct. In the less visible backyard, water intensive landscape was much more favoured, and many people used this space for recreational purposes. Here they could invite family and friends to come to enjoy themselves freely in their small kingdom. Hence, many respondents preferred their yards to be kept private and to provide personal space.

Discrepancies between perceptions and behaviour were observed in a few cases. From the above analysis, there is an indication that residents' yard choices are connected to their appreciation of both functional and intrinsic values of the desert landscape. When it comes to practical actions, their decisions are predominantly related to the functional values of the desert landscape. It requires less amount of water, less money and low maintenance. They also appreciate the intrinsic value of their little landscape. Their yard is part of the desert, they can enjoy it whenever they like. The desire to save water also reveals their appreciation of the desert ecosystem, which is lack of water in its own nature. Even though, in several examples, saving water in their yards is related to their water bills.

6.2.2 Land developers

It is surprising that in the study area, land developers were identified by respondents as the most powerful group in driving development patterns. Respondents repeatedly expressed a similar opinion of how this group manipulates their power to influence growth in the city. The land developers are the group who probably make a living by their land-use decision-making, unlike the residents who make decisions in the yard as entertainment or leisure or other groups which protect the land as concerned citizens (Setterlin, 2008). Their understandings, perceptions and behaviours of the land might be different from the rest of the groups. Their influence on the land-use patterns and natural environment might be larger than the rest of groups, as throughout the United States, single developers often build large residential subdivisions, which is considered as a macro-scale land-use activity (Larsen and Harlan, 2006). Broadly speaking, decision-making processes of land development involve finding suitable

locations, taking into account characteristics of the land, accessibility conditions, utilities and interactions with the other land uses across space as well as socio-economic, cultural and political factors (Aalders, 2008; Ma et al., 2007). During these processes, a few driving forces have been found to motivate land developers to make decisions in the East Mesa area. Table 6.2 summaries these influencing factors and illustrates the total numbers of land developers who acknowledged these factors in the interviews.

Table 6-2: Factors and total numbers of land developers who mentioned these factors as their land development motivations

Factors	Supporting interview evidence (total number of people who mentioned these factors)
Profit generation and making a living	Five
Community creation	Three
Consideration of the environment	Two

6.2.2.1 Profit generation and making a living

Profit generation stands out as the main driving factor. The desert landscape functions as a useful profit producer. When asking about why they started land development, one developer stated his motivation as being money (also mentioned in Chapter 5) and gave a brief overview of what he had completed before and during his decision-making:

> "That's not a hard question, especially in the [American] Southwest, it's all about money. A piece of property is a simple calculation, land trust, entitlements, entitlements mean your zoning, your ability working on the land, so zoning, utilities, roadways, so you start with land cost, it's distance from infrastructure, where that means entitlement process, and that's your calculation (Developer E)."

Another developer expressed a similar view, admitting money is a key factor in making decisions:

> "It's mostly, money. There are other things arise, but there are also unknown challenges that arise, and both can be significant, and that's gonna be trade-offs. Some of those things are, the city and county as we develop, that they might ask for additional infrastructure that we

were planning on, so there are additional costs to our development that we were planning for, and things like that." (Develop D)

Another developer elaborated his own meaning of profit:

> "The business purpose is profit. Try to have your sales, more than expenses, so you can make a living, the businesses keep going, keep growing." (Develop A)

These statements show that although money is attractive enough to do the land developments, it is not as easy as many people think. It entails much work and knowledge to plan and manage things right at all stages, it requires a good market to sell the products, and some preparations for uncertainty and risks because of unpredictable market and institutional policies. As Developer D reflected:

> "There are so many things to learn here. Real estate development, it's not just a piece of land. To develop a piece of land, has so many different parts. You got to have knowledge of land, values, some engineering basis, as well as how water flows, how do people live, so land-use planning, how many properties, lifestyle choices, distances that people would walk average a day …"

He was asked to elaborate further on the 'values' he mentioned. He added:

> "Profit, your businesses, what you can pay for land, what raw land is where, and then what products that you can put on it, then sell it, and then you have costs associate with it and you know you are gonna make profit on."

From the statements of the developer, and the land development process flowchart (Figure 6.6), it can be observed that the function of profit generation of the desert is not as straightforward as it may seem. This uneasy process involves many stages, and each of them requires a great amount of work with different actors.

Developer D further added: "… and the reviewing agencies that decide they approve my plan or not, and those are the zoning committees, engineering committees, all kinds of government agencies like that". This statement highlights the importance of interactions between land developers and other actors such as local government during the land development process, and the power relations in influencing and determining the land-use activities. If the government agencies reject the developers' proposed plan, pattern of use and functionality regarding that piece of land, the future might be different from what these developers

proposed. Because other land developers might have different plans, and the same piece of land will perform different functions.

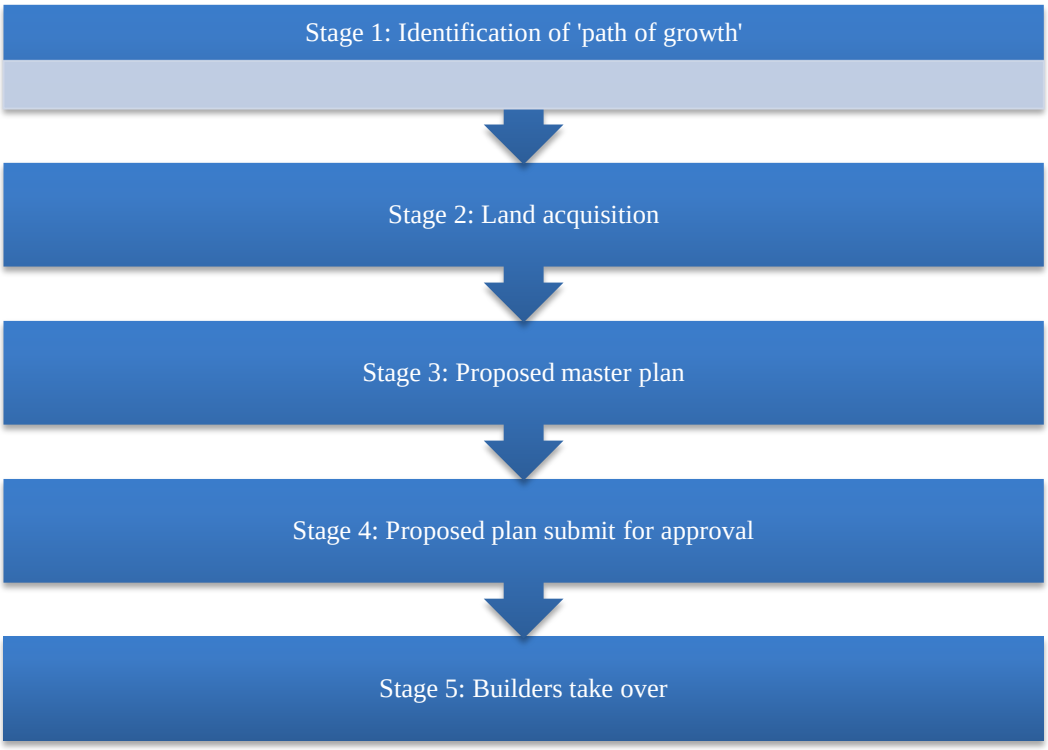

Figure 6.6: Land development processes *Source: (Hanlin, 2007)*

Despite the uneasy process of land development activities, many developers are keen to pursue their interests in this business. Profit is one of the most important motives for the developers. Although the current economic situation is not good, and the developers sometimes hardly make profit at the beginning of the sales. Developer D exemplified this: “So this is phase one, 67 lots, I sold most of those, and I made zero dollars profit.” However, he admitted, “There is a hope of future profit.”

In the study area, rapid growth is taking place and continues to move the urban area outward (Tallman, 2009). Residential development is the dominant growth pattern in the study area, and the urban fringe expanded considerably through annexation of land to the city. Market demand with more people moving in and expectation of making profit drives this development pattern northeastward. It was also mentioned that other actors can also make profits other than land developers, which is discussed further in Section 6.3.

Nevertheless, although making profits can be beneficial from certain social and political relations and negotiation, it is also constrained by the broader economic situation. It was mentioned frequently by the land developers that due to the current economic recession in the United States, it is hard to make money and sell the products (residential houses). Land developers have to adjust their decisions and build more affordable homes and make their products competitive in the market. Hence, all of social, political and economic factors come into play in the land development activities, and land developers need to take these all into account.

6.2.3.2 Community creation

From the responses of land developers, community creation is another motivation in their land development decisions. According to Developer D:

> "We can create community among the residents, maintain to, build on such a way that that's pleasing, pleasing the eye to look at, something we have a great deal control over, that's expectation that as long as it's under control." (and similar comments were expressed by Developer A.)

These quotes are different perspectives from the previous profit-driven thought. Land is not solely a profit generating ground for the developers, but also can be designed pleasant and accessible for local people. Developer D further explained:

> "You have to have people that specialize in understanding human natures. You need cultural anthropologists to know how people function together as a community, so that you can build in that physical hardscape[7] that encourages the social interaction, because it's not just the words that we say and actions that we have, it's also the environment that we live in that impacts that how you develop relationships. For instance, walking trails, we have walking trails because it's something that builds the community, and you don't really recognize that it as a community building feature. Feature you see that as a recreation feature, but really, when you are out of the worlds, you meet someone on the walking trail, and you know that's your neighbour, it's easy to say hi, it's easy to communicate in a frank manner, it kind of starts of relationship process, you can take slowly, you can build meaningful connections that way, you don't have a set

[7] Hardscape, in the practice of landscaping, refers to the paved areas like streets and sidewalks, large business complexes and housing developments, and other industrial areas where the upper-soil-profile is no longer exposed to the actual surface of the Earth (Wikipedia, 2010a).

> of rules, unwritten rules. But if you both are outdoors, there is really, you are more freer to be yourself, there is all kinds of things like that."

He also pointed to the negative image residents held about land developers:

> "I think that the developers have earned a negative perception by the public, as far as it's just the greedy developers that develop some lands, take money and go. But if people really understand that it takes…to develop, really adds to the area, developers are part of economic base of the city and county… because there is a tax base that is created by developers develop housing. So we are kind of very much involved in the community, and they may not recognize that it's not really a greed driven. It's we are responsibility to the community that do something right.

This land developer defended their group, and he tried to tell me that the perception held by general public is not completely correct. These quotations highlight the fact that the local community often do not trust land developers, and conflict exists between the local community and developers. These quotations also indicate that some developers' attitude and behaviour is community-oriented or they believed and claimed so. The statements are rather persuading in a way that Developer D described a communicative and relaxed living environment, and it may persuade people to believe that creating community for the local people is as important as making money for the developers themselves. It is different from the common impression that land developers are greedy with money (Condrey and Guillen, 1997). Developer D's statement demonstrates his sense of commitment to the community. As a developer, he also holds a consumer's point of view, and considers himself part of the local community. As Setterlin (2008) suggested, developers can make a profit and still do things right and have a relatively modest negative impact on the community. However, the willingness is a precondition for the responsible behaviour; a consistent action needs to be implemented.

The importance of building community support was also identified by Developer D, he observed that it is not only about the land; it is about how they build the community support and how they work with city and county to build support. However, it needs to be pointed out that building and improving the community is the mission of the Community Development Department, which is the key review panel for the developers' master plan (Community Development, 2009). It is not

surprising to see that land developers claim that creating community is their prime motive, as it is part of the requirements of their land development proposals to get approved. Hence, the claim of creating community from the developers might not be altruistic, as it can help them to get permission for the development.

6.2.2.3 Consideration of the environment

It is surprising that in their decision-making process, some land developers took environment and the nature of the desert into account. Key considerations were given to water, which is the most deficient resource in the desert. As Developer D considered:

> "Some of those things are about, this area, desert, firstly is water. Because the way of lack of rain, the way of lots of water at one time, we don't get enough water throughout the year, about 7 inches [178mm]."

This quote revealed Developer D's understanding and appreciation of the desert ecosystem, which is lack of water, and he demonstrated his environment-oriented opinion throughout the interview. He was the only one land developer who mentioned the water shortage first before this sensitive question was asked. Concerns regarding the dust in the desert were also expressed by Developer D as mentioned in Chapter 5.

There was another developer (Developer C), whose environmental concern focused on energy saving. He spent a considerable amount of time talking about his energy efficient houses, as he described his newly proposed development plan, and commented:

> "This will be a very green and energy efficiency community, so on every town house roof, there would be a solar panel ... 90 percent will be green and saving energy, that's substantial. The other part of being green means that you are more sensitive to the environment, when you are building the products, you have more clean indoor air or better clean indoor air, meaning that you select products that don't have a lot of that odour gassing, you have a better ventilation system, you have a better filter system, which is very important for people who have asthma or other problems, so energy part is being green, health is part being green, the other factors is dual billing, so part of the green here is that house can last longer, it is going be more durable. So the energy efficiency, is more energy efficient, is healthier, is more durable. And

> the final thing that it comprises the energy efficient problem as well is the smaller carbon footprint ..."

This quotation revealed that Developer C has planned a great amount of work in terms of energy efficiency in residential homes, and he has been motivated by the environmental respect. When asked about his water efficiency plan, he answered:

> "It's a good question. That's part of, you look at the green criteria, it's called Building New Mexico, there are several different pages, that you have to conserve more water, use less energy, you have to be environmentally more conscious, so we are going to use native plants and use the minimum volume of water, that's outside. Inside the house, we are going to have energy efficiency plant, we have plumbing that uses less water, there is less heat involved to heat the water, and yeah, definitely use less water, and these people put non-native plants that requires a lot of water, well, that's not very efficient. So we are going to make sure we minimise the amount of water, that pools are also heated by solar, so we save that too. And then we are creating concrete sidewalk, that the concrete allows the water, natural water, to go down, so the advantage to the city is that we really have to do less ponding on the property."

Although Developer C's statements sound more like evidence that water savings result from energy savings rather than they are putting water first on the decision-making list, the water-saving results yield benefits for the environment. Nevertheless, if everything is going to be implemented as the developer described, the concrete pavement might cause increased storm water runoff, which means a greater volume of water carrying pollution into surface waters and less water soaking into the ground. In residential areas, these polluters may include litter, motor engine oil, settled air pollutants and yard wastes. Less water getting into the ground also can lower ground water levels (Omuto et al., 2010). It is obvious that Developer C has a different focus from Developer D; the former is concerned more about energy consumption whereas the latter is worried about water resources. Both attitudes can be seen as environment-oriented, which shows positive signs of behaviour change for land developers, who are influential in land-use and land-management practices. In addition, Developer C mentioned the green building, and they are required to meet certain criteria. As mentioned in Chapter 5, once the buildings have been certified as sustainable buildings, they can apply for government tax credits. The benefits are tremendous: 8-9 percent lower operating cost, 7.5 percent increased building value, 6.5 percent improved

return on investment, and 3.5 percent increased occupancy ratio (McGraw-Hill Constructure, 2008). Therefore, Developer C might have economic interests other than the environmental orientation he claimed. Most of his statement focused on the energy efficiency, and the majority of the requirements were specified to meet the green building criteria.

Others disagreed with the above two respondents, claiming that there is lack of water in the desert as discussed in Chapter 5, and they argued that the city has plenty of water to supply new development for years in future. The representative for one land developer observed:

> "According to the utilities director, we got enough water here and it sustains forever. I argued that they [residents] just use it as an argument, there is not existent, there is plenty water, there are two huge basins, we have got that Mesilla basin and there is so much water there, it constantly recharges. They [residents] don't understand this, the process, the system and, because they don't understand, they started listening to fear, and people put fear in the head, we don't have enough water, the utilities director says you know, we got enough water."

This statement revealed contradicting perspectives among actors in terms of water availability. Some actors worried about running out of water in the future, and some argued that they have enough water for decades. As this developer indicated, the water will get recharged constantly and last forever. The water dispute is always associated with urban growth in the desert area (Larsen and Harlan, 2006; Yabiku et al., 2008). Water in the arid environment is not only an environmental good, but also becoming a pressing political issue between multiple actors (Lucero and Tarlock, 2003). From the developer representative's point of view, residents use the water issue as a tool to fight against their land development. Despite this developer representative claiming that the city has enough water supply for the future, according to the City of Las Cruces 40-Year Water Development Plan, the water-use situation for the future is facing a striking crisis. The City of Las Cruces has set the target of decreasing total gallons[8] per capita per day (GPCD) water use from the current (2001-2005 average) of 222 GPCD to 180 GPCD by 2045. This figure is lower than other regional cities with water

[8] 1 US gallon is equal to 3.8 litres

conservation programs. For instance, the neighbourhood city of Alamogordo's total GPCD water use target is 165 GPCD with wastewater reuse, and 216 GPCD without wastewater reuse by 2045 (McCoy and Peery, 2008). Standards for all new residential constructions and reducing water losses to meet the target of single-family residential GPCD use is to 121. However, according to the current population growth rate of 3 percent the city is experiencing, it is projected that the growth rate will continue at this figure or even higher (population achieves 267,101 based on 3 percent growth rate), hence the city's water management plan needs to be made based on the high-growth projections. The projected future demand in the 40-Year Water Development Plan is 53,891 ac-ft/yr (66,474 billion m^3/year) and the water right is 32,022 ac-ft/yr (39,499 billion m^3/year). However, the gap between high-growth projected future demand and existing rights and permits is 16,822 ac-ft/yr (20,750 billion m^3/year). The city thus needs to acquire 16,822 ac-ft/yr (20,750 billion m^3/year) in ground-water permits and 20,000 ac-ft/yr (24,670 billion m^3/year) of surface-water rights by 2045. If there is not enough surface water available, the city needs to acquire up to 6,945 ac-ft/yr (8.6 million m^3/year) in water rights to meet offset requirements. This calculation is based on the high growth projection. If the additional demand over the next 40 years occurs, the demand needs to be met from alternative sources such as desalination, deep wells, importation, and aquifer storage and recovery (McCoy and Peery, 2008). Moreover, rapid commercial and industrial developments are likely to take place, as the city has proposed to develop a 728 ha West Mesa Industrial Park over the next 40 years; therefore the water use for commercial and industrial purposes is likely to increase, but this does not mean that residential use is likely to reduce. The climate uncertainty puts additional pressure on the water situation.

One politician commented that the amount of water is a serious problem. They should do an underground water plan other than the proposed 40-year water plan. They have enough water, but for how long and who gets to use it, they have to be careful about it. Thus, how to efficiently use the water becomes an important issue in supporting future growth. Meeting future water demand will need a significant change in individual lifestyle expectations (Yabiku et al., 2007). In terms of the programmes mentioned above, part of these needs work together with land

developers to achieve the target. The developers' tendency to think they are not responsible for the water use will clearly become a barrier to realise the water conservation target.

6.2.2.4 Summary

This section has illustrated the key motivations of land developers in making their decisions. Generating profit and making a living was the main driving factor for the developers. Functional values of the desert have been fully expressed in their decisions, desires and expectations pertaining to these values. The results are consistent with the study of Vogt and Marans (2004), and they also considered that most land developers seek opportunities to maximise the return on their investment, and under many land use and zoning regulations; this results in development patterns that urge the urban fringe outward.

Creating community was also indicated as an important motivation for the developers to realise their goal. Making the desert a popular destination for more people to settle in and building more houses in the desert were considered as their responsibilities. They would also receive economic benefits if more people moved in. In addition, the motivation of creating community seems to be the most important requirement in getting their proposed plan approved. It probably explains part of the reason for community building being the developers' highest priority.

Some developers claimed that they are caring about the environment and taking energy and water savings into account. However, it was found that energy saving buildings can also bring land developers tax credits and increase their building values. Therefore, economic benefits might also be the key motivation alongside their claimed environmental-orientation. Due to their macro-scale decisions made over the land use, it is important for them to incorporate environmental considerations into their decision-making process and minimise the environmental consequences.

In particular, water use is increasingly becoming an issue in the desert. The City of Las Cruces has set the target of decreasing total gallons per capita per day (GPCD) water use from the current (2001-2005 average) of 222 GPCD to 180

GPCD by 2045. This target is necessary, as the city "must maintain the ability to serve future commercial and industrial accounts that will develop in the 728 hectare West Mesa Industrial Park over the next 40 years, thereby regulating industrial development to ensure environmental sustainability and protect water quality" (McCoy and Peery, 2008). This target means that single-family residential GPCD needs to reduce from 153 in 2005 to 121 by 2045. Water conservation can cut demand by 20 percent in 2045; however, this figure of reduction is not enough to accommodate the city's future growth and demand, which means intensive abstraction of ground water will be necessary and the threats to ground-water contamination will increase. Water, as a limited resource, cannot be used forever, especially as there is not enough surface water recharge in the desert area (Sonnett et al., 2006).

This section also considered the complex relationship and power distributions between different actors and called for a need for more transparent land-development process, and interactive communications between land developers and the local community.

6.2.3 Politicians and city planners

A hierarchical power structure normally applies when considering Federal, State and local levels of government, with the Federal government at the top and local government at the bottom. However, in the case of land-use decisions, the order is reversed, and local regulations are the most expansive (MLULC, 2002). The same situation applies to the State of New Mexico, land-use decisions have traditionally been entirely local ones (Lucero and Tarlock, 2003). In the City of Las Cruces, in addition to the politicians, city planners are also key players in the local land-use decision-making. Land developers are required to submit proposed master plans, and city planners need to make recommendations. After their recommendations, the city council makes the final decision through voting to approve or deny the proposed development plan (City of Las Cruces, 2007). In the City of Las Cruces, the Community Development Department plays an important role in the development-review process. Interviews with five city planners provided important insights into the local government decision-making process of land-use.

Table 6.3 presents these influencing factors and illustrates the total numbers of people who mentioned these factors in the interviews.

Table 6-3: Factors and total numbers of people who mentioned these factors as their land-use planning motivations

Factors	Supporting interview evidence (total number of people who mentioned these factors)
Tax revenue generation	Six
Make a better community	Seven

6.2.3.1 Tax revenue generation

From the perspectives of politicians and city planners, one of the key driving forces of land-use decisions is generating tax revenue for the city, which is seen as an important functional value of the desert land. One politician commented:

> "The benefit for the city is we get grocery receipts tax, and so every construction material and all those things added tax income to the city, but if you understand smart growth, you cannot keep doing it, because then we got more to take care of. And so then what happened is the city goes out to annex some more, they have more to take care of."

The tax system in the State of New Mexico is different from other states. As the politician explained, the City of Las Cruces receives most of the sales tax, otherwise known as Grocery Receipt Tax (GRT). The Doña Ana County obtains the majority of the property tax, which is very low, hence the county does not have much any money. The money the city used to maintain the public infrastructure comes mainly from how much people spend in the stores. The city has no right to tax the property. Furthermore, this politician commented that the system in the State of New Mexico is very strange, as the amount of money people pay in the stores is unstable. As a result, the city is not able to obtain a steady income to plan with. It makes sense that the city is going to approve a high school project; as the politician observed: "It is a huge project, multi-million dollar project, we [the city] will get a lot of grocery receipt tax from them [the project]."

Another politician expressed the same view, and reflected:

> "We enjoy the tax benefit from all the construction activities, we got part of that grocery tax, then we get the population, we get the tax, people live there they pay us. If they live outside the city, they use our roads, pools, but we don't get the tax from the property."

These quotations revealed that large development projects can generate considerable tax income for the city; although it means that the city needs to take the responsibilities to provide services and maintenance, these projects appeal the city to approve them. These quotations also imply that both the city and outside of the city (i.e. county) have different income sources to support infrastructure and other public services. There might be competition between the city government and county government to obtain more tax revenue. Sokolow (1993) noted that county governments were more dependent on the property tax than cities, and they are much less able than city governments to substitute revenues from other sources. The relationship between overlapping governments can easily become competitive when scarce resources are at issue. Land-use planning and tax-based problems result in conflicts between counties and cities. Local revenue competition is becoming closely related to rapid urban growth. Hence, with the population growth, the competition is likely to get worse without any controls and rules established by state government.

Interviews with city planners also support this point of view.

One senior planner stated:

> "The city benefits at the time, the building takes place, we get the review fees, we get more permits issued, we get more money, and then there is also in New Mexico city primarily gets the grocery tax, like all the building materials we sold, we tax on that, on services and goods, then the money comes back to the city, and therefore we operate on it. So the groceries are benefits for us to [generate revenue]." (and similar comments were expressed by another planner.)

Reflecting on the politician's opinions, the senior planner was asked whether the city needed to spend money to provide services if they annex the land. The director stated:

> "That's the thought, because it also might be used for fire protection, and police protection, the park and ride, street maintenance all those things, the tax goes towards that also. So there is, the new development brings money in, and also requires those services and

> maintenance of the roads, so everything is taking place, but all of these people, every time they buy other goods and services, they continue to pay that. It's not just the building, you know."

The politician is concerned that the more subdivisions belong to the city, the more infrastructure the city needs to provide. He considered the continuance of growth will put a substantial burden on the city, it is essential to control the growth within the city limits. The senior planner offered his justification that the tax benefits are a constant income for the city, hence the benefits might be more than the costs.

It is interesting to observe different opinions regarding the same concern. The politician is more critical about the way the city grows, and the senior planner is more positive about the issues the growth may create. The extremely divergent attitude was observed continually in the rest of the questions. The difference revealed in their opinions probably arose because the senior planner attempted to present to an outsider a positive image of the city, its system and policies. For example, he late gave a considerable amount of praise to the city, its achievements and successes, which are criticised by many other actors. It is also possible that he did not want to express his real thoughts to a researcher, and was concerned that some of his opinions might be disclosed, which might affect his position, although he was told that his responses would remain anonymous. Perhaps he considered this research interview as an education about what their department does, rather than discussing real problems and issues of current land-use planning and management that exist in the city. He was probably also worried that if he drew attention to many land-use problems, their department would be criticised by the public for not doing well. The politician worried more about the future of the city and criticised many policies and systems in the city, and compared them to other states and countries. He adopted a wider perspective and put the City of Las Cruces into a bigger picture. This politician's responses also indicated his desire to make some changes to the current land-use management, as in the later stage of the interview he continually talked about things needing to change and the possible ways of achieving this.

In terms of approval or denial of land development plans, one city planner commented that:

> "There is always the possibility to say no. There are some policies on annexation, on our revised comprehensive plan. We tried to get more policies. If someone comes in with an annexation, we try to predict what the costs versus benefits are, and see the balance."

This example highlighted the city government's preference regarding the land development activity. The balance between benefits and costs is critical in determining whether to approve or deny the development plan. Nevertheless, it is agreed that generating tax revenue is the main motivation of most respondents amongst politicians and city planners. But this decision-making might not always be supported by all of the actor groups in the local community, such as NGOs and residents. It was mentioned by another politician that the local land-use decision-making is extremely political and powerful, and a small group of people are always against the annexation, and these people can exert control over election campaigns. He described this group of people thus:

> "Very powerful, politically, in American terms, very active locally in politics, new people moved here that haven't lived here very long, generally very wealthy, generally retired, not working, they did not want Presidio [one of the largest annexations in 2007] coming to the city. I think they were intimidated by the 3, 000 acres [1214 hectare]. Again, a lot of issues that, they want more planning, they worry about the water, the water is a different issue. The people, they are scared them, very aggressive politics, they sent emails to hundreds of people, so very political. But I think basically they want more control of how this will be laid out and signed, and how it will be done. That's a big issue, it's very political, they have a lot of money, a lot of factors, just complicated. The annexation has been done, but the people oppose it and told us if we support the annexation they will throw us out of office. They really did, they threw one councillor out, they threw the mayor out, they were very successful."

This statement illustrates that the local land-use decision-making involves complex political factors. It can be observed again that power is distributed unequally within different actor groups even within the same group such as the resident group, which will be further illustrated in Chapter 8.

Although public hearings are open to receiving different perspectives from local residents during the land-use decision-making process, due to individual interests and available resources such as time, not all of the residents in the city will come to the public meetings. Thus, only a small number of people get involved in the decision-making process and make arguments or comments in support of or

against certain land-use activities. Public opinion in this sense might not be entirely credited. In addition, due to the mutual benefits for the land developers and the city, the city tends to approve the developers' proposed plans to attain more tax income if they see costs are less than benefits. In fact, media data revealed that Las Cruces local residents called for more public input and participation in the development process in particular on annexation and subdivision requests (Smart Growth Online, 2008). In the news article, one city counciller of Las Cruces stated: "We need to find ways to add public value at the earliest parts of projects." Another city councilor stressed: "public input is an important component but we need the entire public to participate, not just selected groups" (Smart Growth Online, 2008). This news article demonstrated that more residents started showing a desire to take part in the local land-use decision-making process, and the city council realised that there is a need to find better ways to incorporate wider public opinion into decision-making.

6.2.3.2 Make a better community

Being elected officials from local residents and responsible for the city planning, both politicians and planners expressed their desire to improve the living conditions for the locals and make a better community for them. One politician stated:

> "So our role is to have a tool that the public good, my neighbours, their interests have been protected. And so, if an individual invests money on their property, you can do so, but you don't harm your neighbour. It's a way between the rights of property owner and a commitment of not harming your neighbour."

One city planner reflected:

> "The challenge to zoning was that it was unconstitutional, that the landowners who felt that they can do anything with their land, they were taking their property rights, the basic rule, I mean the policy can't do that. So essentially the comprehensive plan outlines what that purchase is, it describes what goals we are trying to achieve as a community, so that zoning is a tool to achieve the goals. And so when someone comes in with a proposal saying they want their residential property to change zoning to commercial, we look at the comprehensive plan, look at the specifics of that property, and find out what kinds of policies in the comprehensive plan related to the case,

> and whether or not this is good based on the comprehensive plan, then you know, we include that as part of our decision-making process."

In addition, as in the example provided in Chapter 5, the city is now working on the new strategic plan aiming to create a strong neighbourhood and grow a sustainable city. These examples implied that the city has put improving neighbourhood as well as acknowledging individual's property rights on the city's development agenda. Enhancing good neighbourhoods are strategic not only because it will improve the local community by establishing a fair and friendly environment, but also helps to maintain the city's sustainable future in the long-term. The city planner stated that their review regarding the land-development proposal is based on the comprehensive plan, which is setting out the policies and criteria to assess the development proposal. His statement also highlighted the importance of property rights for individuals and the negative tradition in valuing property rights as a freedom to do anything regardless of regulations and policies. Individual property rights always matter in the United States as illustrated in Chapter 2. Nevertheless, abuse of property rights may also result in unregulated and uncontrolled land uses. His statement emphasised that it is essential to have an effective regulation and guideline to manage land use, and such regulations can also help to solve the disputes over the disagreements between local government and land developers. The comprehensive land-use plan as a local land-use regulation is developed within the city. In the plan, the city delineates areas of land into different zones and assigns distinct land uses for each zone (Chapter 2). Zoning ordinances usually divide land use into residential, commercial, industrial, or agricultural purposes. The municipality seeks to distance incompatible uses of land. However, an applicant who wants to build something that does not comply with existing use restrictions may still proceed if the municipality grants the applicant a variance to depart from zoning code (Justia, 2010). Local governments through zoning ordinances also regulate the height of buildings, establish building setback requirement, conserve open spaces and historic structures (Law and legal research, 2006). However, a zoning ordinance may still be illegal if it includes provisions that do not comply with the US Constitution. For instance, if it practises an unconstitutional taking of property in violation of the Fifth Amendment of the United States Constitution (Chapter 2). To some extent Zoning ordinances limit the right of ownership of property, and regulate the land use to

"protect not only health and safety but also the amenities of modern living" (United States Constitution, 1868). However, with rapid urbanisation, zoning seems an important tool in regulating different interests over land uses at present.

Interviews with politicians revealed that they claim to represent the taxpayers and speak for them. One politician commented:

> "We also want to make sure that we protect our citizens they are good when they spend thousands of dollars for a home that they get what they pay for as expected. So in some cases, the developers have to complete, some of the recent developments, developers haven't completed some certain parts of their development. Protect certain lands from development just because we can't develop everywhere, we need to protect some of our unique landscape we have, correct?"

Another one commented:

> "If you went to the downtown, there are a lot of poor neighbourhoods, you get out the county, we have a lot of neighbourhoods that don't have sewers, don't have paved roads, where people live in trailers, so the problem here, and a lot people are working, they are working for very low wages and, so to me, look at, we can grow whatever we want and what's the point of people who live in poverty? Well, we want growth that gives people good jobs, and helps them to live good lives. So to me, it feels smarter to attract good industries that can create good jobs, and I think there is a couple here, make a lot sense, renewable, solar, geothermal energy, just nature for here, and we have actually some good resources here too, and those things create good jobs."

These two politicians are concerned about the taxpayers' living environment, and emphasis was placed on the growth patterns that call for a need for a 'smart growth strategy' (Table 6.4) which means growth needs to create more job opportunities and improve the living environment providing necessary infrastructure and services such as water, sewer and utilities as well as protecting the natural environment. These examples illustrate their sense of community, and both social and environment values have been acknowledged. These quotations also imply that there is a need for local government, land developers and local community work to together to make better land-use decisions. The politician indicated that one difficulty to achieve the coordination is that the local government lacks the power to control growth, and most rules tend to favour the land developers. He considered that it is essential to create mechanisms to allow

more people to get involved in government policies and the decision-making process and limit the power of those who currently have more influence. It was considered a major problem in the State of New Mexico that urban interests do not always coincide with a wider population (Condrey and Guillen, 1997). This challenge stresses the influence of political factors and power relations in making dominant land-use decisions, and will be further illustrated in Chapter 8.

Table 6-4: Smart growth principle

Smart growth principle	• Mix land uses • Take advantage of compact building design • Create a range of housing opportunities and choices • Create walkable neighborhoods • Foster distinctive, attractive communities with a strong sense of place • Preserve open space, farmland, natural beauty, and critical environmental areas • Strengthen and direct development towards existing communities • Provide a variety of transportation choices •Make development decisions predictable, fair, and cost effective • Encourage community and stakeholder collaboration in development decisions

Source: (Smart Growth Network, 2006)

6.2.3.3 Summary

This section has presented the driving factors of politicians and city planners in their macro-scale land-use management decisions. Tax revenue is one of the most important factors concerning both groups as the perceived functional value in Chapter 5. The desert land seems rather profitable. Not only land developers, but also local government can gain benefits from approving the development proposals. However, it is not clear that the cost-benefit analysis is addressed well, although it forms an important part of smart growth. It is not shown that the local government and city planners have a complete cost-benefit analysis. Competition between different levels of government is also observed, it is probably part of the reason that the city government promotes land developments in the study area. Gross et al. (2005) states that local governments are often keen to expand their tax bases and hold limited information about the costs and benefits of their decisions.

They tend to perceive their role as being constrained to promote the visions and plans of developers, rather than promoting a public vision and plan developed with the input of a wider community. The standards and criteria for evaluating the costs and benefits of land development for communities are normally applied on an inconsistent basis. For instance, local government depends on the job opportunities the developers projected, but they have limited information about actual jobs created after construction. Therefore, without a careful and consistent cost-benefit analysis, it is difficult to determine whether the tax benefits are greater or the costs to maintain the infrastructure are more, there is also no guarantee that the development will benefit current residents.

Apart from the cultural and socioeconomic factors, the political aspect was identified to impact considerably on the local land management. From the interview results, a small group of people have more power, and the decisions often cannot reveal the needs of diverse population in the community, which implies that there is a barrier to meeting everyone's need especially for those who have less power and lack a voice in the land-management practices. The interaction between local government and community is not sufficient at the moment in the study area.

6.2.4 NGOs

NGOs involved in this study mainly include two formal groups the New Mexico Wilderness Alliance, and the Asombro Institute for Science Education (formerly the Chihuahuan Desert Nature Park); one informal group Citizen Task Force for open space. Three members from each organisation were interviewed to explore their decision-making process and interactions with others. The mission of the New Mexico Wilderness Alliance is to protect and restore New Mexico's wildlands and Wilderness areas through administrative designations, Federal Wilderness designation and on-going advocacy (NMWA, 2010). The Asombro Institute for Science Education aims to increase scientific literacy by promoting an understanding of the Chihuahuan Desert. This NGO organises various education programmes and tours in the Chihuahuan Desert Park to disseminate knowledge of the desert natural ecosystem. Although this NGO is not an environmental conservation group, its education programmes potentially increase

people's environmental awareness of the desert ecosystem. The Citizen Task Force for open space group, which is not formally registered as an NGO, is principally endeavouring to conserve the open space in Doña Ana County. In this study, it was found that environmental protection is the primary motivation of NGO's activities, and all of the NGOs continually emphasise this importance.

6.2.4.1 Environmental protection

NGOs as environmental conservation activists play an important role in land use and management activities. In this study, their decisions are considered as macro-scale decision-making as opposed to residents' decisions on their individual lots. As their mission, environmental protection is the key driving force for their actions as they are the groups who most appreciate the intrinsic value of the desert. One member from the New Mexico Wilderness Alliance stated:

> "I mean I believe very strongly in the protection of environment, and it is the most important thing we can do for future generations and we can do currently. We are here for short amount of time, we have a real responsibility to make sure that we protect most important places we can, so you know, I am lucky to make a living, get paid to do this, but I am really, I am lucky to do something so powerful and so important to me. So my motivation is to do something I believe, and make a living when I do. All of these areas on this map are part of proposal. It is big, this is total about close to 400,000 acres [161,875 hectares]. It is the biggest proposal probably in three decades, 30 years in New Mexico, in one plan. I have been doing this since March of 2005."

The statement exhibited the NGO member's passion and great motivation for conserving the environment not only for current but also for future generations. His statement revealed a sustainable development perspective that "development meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The concept of sustainable development entails the coordinated development and management of natural resources in order to optimise the social and economic needs of current generations whilst simultaneously ensuring natural ecosystem functionality for future generations. The notion of sustainable development implies that land-use decision-making needs to maintain a balance between economic, social and environmental considerations. The proposal this NGO made is especially meaningful when New Mexico is experiencing rapid growth and more and more

land is being converted to residential developments. Although it has a long fight, it is a large plan over many decades, and the success of it will make a considerable difference as wilderness area is designated by Congress in the United States under the provisions of the Wilderness Act as defined in the Wilderness Act:

> "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." (Wilderness Act, 1964)

Once the area of land is designated by Congress, it will remain in its pristine condition and offer its natural beauty for people and for plants and animals to inhabit. The NGO member provided examples of working together with some community members and fighting while selling off some of the proposed protected areas. From his examples, complexity and difficulty of conservation of land was fully revealed, and the importance of involving local communities was highlighted.

Another organisation is struggling to conserve open space in the county; according to one of the leaders:

> "Because of that [mountain area land] biological and scenic value, we think this is the most important part for BLM to hold and not to dispose. The city council said they will protect these natural places during the last two decades, but they didn't do that. I have argued with the city many years about that. No one wants to protect it, so we want to do it."

This statement revealed the NGO's strong motivation for preserving the land: to protect the natural beauty and cultural and historical heritage, which faces serious threats resulting from rapid land development. The quotation again shows the complex and difficult process of the NGO's continued fight with various actors in their endeavour to protect the natural environment. It also underlines that land conservation to some extent is political driven, and undistributed power relations play a key role in the battle.

Indeed, other than the recreational and cultural values of the open space, economic values cannot be neglected. Open space land has a positive and considerable impact on the per acre price of residential parcels located near the

parks (LTER, 2001). Individuals living near the areas are willing to pay a premium to maintain the service. That means open space protection can increase the value of the houses nearby, and potentially benefits for city. In this study, residents frequently expressed their appreciation for the surrounding mountains and the advantage of the location of City of Las Cruces continuously attracts more people to come.

Unlike other NGOs, the member of Asombro Institute for Science Education considered the eastward growth in the city to be a good thing because it means that the park is even more accessible to people, as stated in Chapter 5. It is positive in the sense that having more people live in that area and more will know the facilities are close to them. But she also felt a little disheartened to see how quickly land is getting developed all the way to the park. It makes sense for the NGO to perceive that the growth pattern is beneficial for their organisation, as partial funding comes from public donations. The more people come and get to know the park, the greater the potential for the park to obtain funding.

All of the NGO members acknowledged that work with other institutions in helping the organisations achieve the targets. Working in partnership with other like-minded bodies means more information flow between these organisations, and more advice from a variety of sources and more support to each other (D. Miller et al., 2009). They also appreciated the support from local communities, as all of these organisations have a number of volunteers to work with them in different ways, and they benefited greatly from the local support.

6.2.4.2 Summary

This section illustrated the NGO's strong motivation to conserve the environment and presented the efforts they have made towards their mission. Most of them perceived the rapid land development caused negative impacts. However, not all the NGOs perceived the rapid land development as negative. One NGO considered that the land development is beneficial for their organisation; as more roads are built, their organisation is more accessible to people and developments can bring more visitors for them. It also highlighted the difficulties that arise in the process and acknowledged the importance of working with other organisations to build up more support, and gain more information and advice. It is also

important to gain support from local communities. However, lack of government support and public input and political factors, these organisations are often struggling to fight in the battle and the process to realise the target is very slow. Although participation at grassroots level is considered to generate important insights contributing to the design of policies better fitted to serving the needs of those concerned (Patel et al., 2007), their efforts are sometimes seen as threats to the powerful groups. Hence, mutual understandings by transparent communications need to be improved in the local land-use decision-making process.

From the above discussion, it can be seen that different actor groups make decisions both at micro-scale and macro-scale to use and manage the landscape. However, these decisions are greatly influenced by the interactions between different actors and between actor groups. The next section illustrates these interactions in detail.

6.3 Interactions between actors in the decision-making process

Land-use decision-making involves multifaceted interactions between different actors and actor groups. It was mentioned frequently that the interactions, between land developers and local government, land developers and local community, between different levels of government, are complex and sometimes conflicting.

As for the profit generated from the land development, it was mentioned that not only developers, but also other actors can be the benefit receivers. As one NGO member stated: "the State of New Mexico makes lots of money by selling the land to developers" (Chapter 5). The relationship between land developers and the State Land Office seem to be quite interactive and mutually beneficial. The evidence was also revealed from a politician's comment:

> "The State Land office allowed [one developer] to get all that land, in a way that seems to us not to be legal, and that has gone before the State Attorney General's office, and he didn't advertise it properly, and up here to be a deal. And so that fights are also going on."

According to the local newspaper, this land deal was in doubt. The Assistant Attorney General said: "it contains provisions not authorized by New Mexico

law". The city manager said: "the Attorney General's opinion does not affect the city's decision to annex the land" (Ramiraz, 2008).

These pieces of evidence demonstrated that the influence of power relations in the land-management practices and the power is distributed unevenly, and some people have more control over this practice. These statements imply that power relations played an important role in the land-use decision-making, and mutual benefits are often the products of this relationship.

One developer emphasises the communication between land developers and local community as well as local governments, and entails that the decision-making process involves complex social interactions among different actor groups due to the different needs. As Developer D commented:

> "It's really, it's pretty common to find opposition in the development process, change is always difficult for them [residents near the new development] to accept unless they recognise why is good for them, and what the benefits would be, and if you are not able to communicate, the benefits, that you will have real difficult time. To overcome that opposition that we found at the beginning, it's really more like an education process being open, people get to know us: who we are, and they can then associate personally with who is doing the work, and we then educate on what we exactly are going to do, and then also it's really a two-way streets of developing that you need to understand what their desires are, of the people who live here, and develop that we are looking at, you need to accommodate on their desires and your desires, so we made changes in our plan."

Another developer reflected:

> "It's not about only the land, it's about how we build the community support and how do we work with city and county to build support. And the reviewing agencies that decide they approve my plan or not, and those are the zoning committees, there are engineering committees, all kinds of government agencies like that."

Similarly, Developer C offered another example:

> "I talked to one that lives here, because we are trying to buy that property, we tell the neighbour what's going on, I think most of that comes into play when it goes to the public hearings. So the city council will have public hearings, when this goes to the city councils, then people are given opportunities to speak for or speak against the property, so the public counts in a certain respect."

These examples represented typical conflict between the developers and residents during the land-development process. People are normally suspicious and panic if they feel their rights or benefits will be neglected in the decisions being made, especially when they are unclear about what benefits and costs the decisions will bring them. Developer A and D's method of open dialogue mitigated people's concerns and created a gateway to the effective communication to solve the problem. These examples also highlighted the importance of local governments in approving the developers' decision-making, and establishing public hearings to listen to opinions from both actor groups.

These examples also implied that through mutual understanding, especially when local community's opinion is counted in the decision-making process, conflicts between different actor groups in terms of land use might be mitigated, and a less negative relationship might be established in the future if land developers invest a great deal of effort into coordinating decisions between communities and local governments (Michigan Land Use Leadership Council, 2002).

However, power in this process may not be equally distributed, as land developers and local government may retain the dominant position, and residents are positioned as the least powerful group. Land developers can also obtain support from other developers although they do not necessarily have the same philosophy, as it was mentioned by Developer E, when asked him whether he got on well with other developers:

> "I am not hurting them, I know all of them, they don't really want to hear, I don't want to get too close to anyone, because we have a different philosophy. It is interesting you talk to me, because the closest are Developer D, Me and Y (Developer A's father-in-law, in the same company with Developer A), we are very similar of what we do, there is no one close to us. And then we have F, X, those guys are different style, very much got money, very different."

This quotation attested that some of the developers are similar to each other and building up network support to each other. Developer E also mentioned that he has coffee with the two developers he mentioned above almost every morning and discusses about what is going on in town and sharing news. In a similar vein, Developer A reflected:

> "In real estate development, knowing landowners is something you should make a point of, and relationships are really key. Try to maintain the relationships that you make, and if you are able to do something well in any profession, people will come back to you, they recognised that you are good at something, and there may be a time that they need your help. It's networking; it's really a lifestyle, and the city and the county [need to maintain network with too]."

These examples highlighted the key role of good communications and networks amongst actors in facilitating the information flow and access to resources and implied that the variety of ways in which different actors can benefit from these communications.

6.4 Chapter summary

This chapter has explored the driving factors of multiple actors' decision-making operating from micro-scale to macro-scale. It was found that actors' motivations of using the land are closely related to their perceived functional and intrinsic values of the landscape. Although residents' decisions about their yard choices are at relatively smaller scale, their impacts on the environment cannot be neglected. The land developer-group is considered as the more powerful group in the local land-use decision-making process, their macro-scale decisions can shape the local growth patterns. Although they claimed that creation of community and caring for the environment are also their driving forces as well as the top one profit generation motive, it was found that economic benefits are always associated with these community and social-based claims. However, it is true that land developers can make a profit when they are responsible for the community. Both politicians and city planners groups considered tax generation to be one of the most important driving forces in making their decisions. However, it was found that competition over tax income also exists between different levels of government, and the costs associated with land development are quite vague in the local government decision-making process, and there was not clear evidence that they have carried out an effective cost-benefit analysis for the macro-scale land-use decisions. NGO-groups have strong motivation to conserve the land from being developed. However, without the support of the local government and local community, it is difficult for them to realise their goal.

The results revealed the complex and sometimes conflicting interactions between different actors groups, and that power is unequally distributed among actors. Land developers and local government were perceived to remain the dominant position, and some residents are positioned as the least powerful group. The results also show that the interactions between actor groups are complex and some actors can gain more resources through their good communications and networks with others in the land-use and management processes.

Chapter 7 Impacts of people's land-use decisions on landscape degradation and environment

7.1 Introduction

The previous chapter demonstrated various driving factors of different actors' land-use decision-making in the study area. Residents, land developers, NGOs, politicians and city planners have different preferences and motivations in using and managing the desert landscape. Functional values of landscape, which are related to the use of land, were greatly appreciated by actors. Intrinsic values of landscape, which are related to personal perceptions and affections, were also acknowledged in a few cases. The focus on the functional values of landscape may result in the neglect of the desert ecosystem and consequently cause negative environmental impacts on the desert. In particular, the desert landscape in New Mexico is rather fragile; any disturbance is likely to cause significant environmental changes (United States National Report, 2006). Such environmental changes may limit the functions of desert ecosystems and their provision of goods and services, such as reducing the recreational value and decreasing the air quality (Vogt and Marans, 2004). In particular, the desert receives less water relative to evaporative demand than other habitats and rainfall is distributed unevenly, so that water supply will become a major challenge in the future (Burmil et al., 1999). This chapter therefore aims to explore the consequences and impacts of actors' decision-making on the desert landscape and environment.

The chapter draws on the findings presented in chapters 5 and 6 and considers the main environmental changes and degradation caused by land-use decisions as perceived and understood by local respondents, particularly those made at the macro-scale such as land annexation[9] and land development as mentioned in Chapter 6. In addition, it investigates how these environmental changes and

[9] The purpose of an annexation is to re-designate property outside the city as being within the city limits (City of Las Cruces, 2008).

degradation in turn impact on actors, in particular the way they use and manage the land and environment. The local knowledge of degradation is of great importance, as management practice that is more appropriate and relevant to local concerns and context could be developed (Niemeijer and Mazzucato, 2003). Local actors could have different understandings of the causes of land degradation. This point leads to an exploration of how these understandings differ among local actors, and how they may relate to the different perceptions local actors held and the uses local actors applied to the landscape. Interrelationships between different actors are also explored as well as investigating interactions between humans and the environment.

7.2 Impacts on the land and environment

In the study area, a small number of major negative impacts on the land and environment were widely perceived and reported including vegetation loss, soil erosion, loss of biodiversity and water shortage. Interviews with various actors revealed that these issues seem to be the largest problems in the City of Las Cruces and Doña Ana County. Table 7.1 summaries the key impacts and illustrates total numbers of respondents who mentioned these impacts in the interviews. I will discuss each of them in detail in the following sections.

Table 7-1: Key impacts and total numbers of respondents reported

Impacts	Supporting interview evidence
Vegetation loss	Six
Soil erosion	Six
Loss of biodiversity	Six
Water shortage	Eleven

7.2.1 Vegetation loss

The desert landscape gives the impression of emptiness, in part due to its open range, in part because there is no dense vegetation to cover the land, and the surface resembles an exposed sterile skeleton (Burmil et al., 1999; Limerick, 1985). Nevertheless, the sparse vegetation in the desert plays a significant role (Omuto et al., 2010). Firstly, it provides natural scenes for people and habitats for a wide range of animals and plants. Secondly, it is an important part of many

environmental processes. It protects soil against climatic drivers of wind and water erosion and also influences the hydrological and carbon cycles (Omuto et al., 2010; Robinson, 2009). Vegetation is crucial in balancing human livelihoods and environmental stability in the dryland ecosystem (Omuto et al., 2010). Despite the importance of vegetation in the desert, this study results showed less care and considerations of this important part were taken into people's land-use and management practices. Loss of vegetation was observed by a few respondents in particular experts.

One NGO member commented that:

> "Vegetation is damaged, absolutely no effort is made to protect the vegetation when development happens."

One politician reflected:

> "If you go out to that side of town, the northeast, you'll see that huge areas that have been scraped, vegetation scraped away, and then made lots for future building."

One senior city planner expressed the same view when he was asked about the impacts of land development:

> "I am sure there are, just because when the subdivisions were built, they usually go in, they clear the property, remove all the vegetation, so I think that impacts on the natural environment, then they have to come back and replace that."

Further, two city planners commented on this impact and its associated problems:

> A: "It destroys the flora and fauna, and that's why a lot of people come in and complain …"
>
> B: "…and also destroys natural flow of water, soils."
>
> A: "It just destroys that. Because the desert is such a fragile ecosystem, if you run over plant, it is not going to grow back. If you have to take trees out, and remove trees, and you plant them, again, they are not going to grow. And they remove the roots, especially along the banks, you really ruin these trees in order to get the equipment down and that root structure dies, and it will no longer hold the banks. When pollution comes in, an if you remove all of plants structure, and remove all the roots, so there is nothing holding the ground, and the water comes along, it washes all of that dirt down."

These examples illustrate the influences of land development without carefully taking the desert vegetation into account. In most cases, in order to prepare the ground for the construction of houses and roads, the plants and trees need to be removed completely, which means that their roots need to be taken out. Figure 7.1 provides examples in the study area where vegetation was cleared to prepare the ground for the construction of homes.

Figure 7.1 (a): Photograph of cleared lot for new developments in the East Mesa

Figure 7.1 (b): Another photograph of cleared lot for new developments in the East Mesa

Figure 7.1 (a) and (b) show that most of vegetation was cleared on the lots to prepare for the new construction of homes, and the remaining vegetation appear

drying out or dying. In addition, without vegetation holding the soil, the soil erosion appears. These development activities contribute greatly to the loss of native vegetation, reduce the vegetation cover and increase the risk of erosion and thus cause surface soil loss. Consequently, the soil-moisture capacity will be reduced, and the likelihood of vegetation regrowth will be decreased. Furthermore, the surface runoff will increase during storms, which further causes more soil loss and land degradation in the desert. Moreover, with more developments completed, more people will move in and subsequent roads and increased vehicular traffic may ultimately cause further habitat fragmentation and loss (NMDGF, 2006).

Due to the extreme temperatures, low and unevenly distributed rainfall and high evaporation rates, plant recovery in arid environments is usually inherently slow (Omar et al., 2005). Conditions suitable for plant establishment appear extremely infrequently and irregularly, and it may take hundreds of years for full recovery to take place without active intervention (Lovich and Bainbridge, 1999). Many of the actions of desert development have profound effects on ecosystem stability, diversity and productivity (Rundel and Gibson, 1996). Hence, once vegetation has been removed, it is difficult to return to the original conditions. Furthermore, degradation of vegetation can lead to substantial reduction in ecosystem functions and services (Ravi et al., 2009). Removal of plants and trees can result in several consequences such as the loss of biodiversity due to the destruction of wildlife habitat, water pollution as runoff washes away the soil, and soil erosion.

7.2.2 Soil erosion

The above evidence also showed that closely related to the impact of vegetation loss is that of soil erosion, which was reported by many respondents and considered as the main environmental concern derived from land-development activities. Although these two impacts were discussed in two sections, the effects and causes of them were often interrelated with each other. Soil erosion can be defined as the detachment and transport of soil particles and subsequent redeposition in near or distant areas mainly by the action of wind and water (Ravi et al., 2009; UNCCD, 1994). Soil erosion as a land-surface process can be accelerated and aggravated by human and biophysical factors with unfavorable outcomes on soil, crop productivity, environmental quality and climate. Although

water is the key driving force to soil erosion worldwide, in the dryland of North America, wind plays a key role in accelerating soil erosion. For instance, the cultivated soils in the Great Plains of North America are exceptionally prone to the winds. Extraordinary soil losses and dust emissions were caused in the 1930s (e.g. Dust Bowl) by poor land management and drought conditions (Ravi et al., 2009; United States National Report, 2006).

Soil erosion is the most widespread type of degradation in the dryland landscapes (Ravi et al., 2009). Soil erosion is typically associated with loss of the top soil, decline in soil fertility and productivity, increase in surface runoff and destruction of the seed bank in the soil (Omar et al., 2005). Erosion is of special concern for desert soils, as the nutrient capital is often concentrated in the surface soil (Lovich and Bainbridge, 1999). Housing construction, roads, powerlines and pipelines can all contribute to the disturbance of soil. The construction of pipelines for utilities infrastructure, including gas, oil and water, involves extensive dipping and channelling, which results in serious soil impacts; for instance, leaving subsoil on the surface, disturbing stabilised crusts, and concentrating runoff and erosion. The influences of these infrastructure constructions can extend far beyond the boundaries of the immediate disturbance (Lovich and Bainbridge, 1999). In the study area, soil erosion is reported by respondents broadly and shown from some field photographs (see Figure 7.2). Currently, this problem is mostly induced by extensive urban developments in the study area reported by respondents, although some of the degradation might be the impacts of land-use in the past such as overgrazing livestock on the land.

Figure 7.2 (a): Photograph of rilling due to water erosion on the lot cleared for housing developments in the East Mesa

Figure 7.2 (b): Photograph of rilling due to water erosion on the lot cleared for housing developments in the East Mesa

Figure 7.2 (c): Photograph of wind erosion on the lot cleared for housing developments in the East Mesa

Figure 7.2 photographs (a) and (b) show that rilling takes place due to water erosion on the land preparing for new housing developments. Once the rills are formed by water, erosion is high and soil particles are moved off the field. Figure 7.2 photograph (c) shows some examples of wind erosion in the study area. Once the land was cleared, there was no vegetation holding the soil and wind erosion occurs. These examples demonstrate that erosion occurs once the lots are cleared for the preparation of construction of new buildings. Respondents from different actor groups reported this problem broadly. One NGO member stated:

> "So far the construction caused tremendous soil erosion in the area, because they just cleared all the desert vegetation."

Other respondents also observed the soil-erosion issue. One city planner reflected:

> "I think that a lot of properties [people] see the degradation on their lots, for example, no ground cover to keep the soil, it's not a big enough area that the desert can function well."

One politician observed:

> "Soil erodes. And on the open lots, they have to do a lot of maintenance to restore the lot, it's expensive to everybody. And you clear [soil] for building, that you have to plan some kinds of vegetation that holds the soil in place."

Another politician commented on this problem:

> "Most of the dust you see is the results, it's not natural sand storms, most of it because, if you go out to that side of town, the northeast side of town, you'll see that huge areas that have been scraped, vegetation has been scraped away, and they made lots for future building when you scrape out the vegetation, and you create that loose soil, that where the dust came down. You will not see a lot of dust coming from desert land that hasn't had that vegetation scrape, so that's really a man-made problem. A lot of dust also comes from the unpaved roads that go through from some of the ranch lands. Lots of unpaved roads there for cattlemen and who are raising cows, that kind of stuff. But the point is that that is not a natural problem, that's a man-made environmental problem."

These statements exhibited that land degradation is at least noticed by the above as a common issue throughout the study area at present.

In addition to the soil-erosion issue, one resident gave examples on its associated consequences:

> "When it rains, if there is no plant to hold the soil, the soil erodes. And it causes other problems, it changes the ecosystem of the river, getting the river dirty and the some fish can't live there in Rio Grande." (Resident, professional)

The statement demonstrated that the respondent acknowledged the impact of soil erosion on the desert. He also acknowledged that soil is washed into the river causing water pollution and loss of biodiversity, which is discussed in Section 7.2.2. These examples suggested that human intervention is a necessary input to restore the vegetation and soil after the lots have been built on. These pieces of evidence highlight the need to mitigate the impact associated with land development.

Research has demonstrated the link between the reduction of vegetation cover and land degradation in the drylands. Wolfe and Nickling (1998) argued that vegetation cover is a significant factor in preventing soil loss due to wind erosion in drylands, and destruction of vegetation by human activities always causes increased wind erosion. They suggested that vegetation protects the surface by direct cover of it, trapping of particles and especially extracting momentum from the airflow in a few sparsely vegetated communities in the Sonoran Desert of Arizona. Lancaster and Baas (1998) carried out a study in California to observe the relationship between grass cover and sand-transport rates. The found that sand

flux reduces exponentially with the increase of vegetation cover. Their study also indicated the strong influence of vegetation cover on sediment-transport rates, so that a decrease in sediment flux was observed with increasing vegetation cover. In addition, clearance of vegetation can also increase water erosion. The impact of rainfall on the barren soil surface can break down soil aggregates, and hence soil is easily removed by the rainslash and runoff water (Wall et al., 1987). Soil movement by rainfall is especially intensive during short-duration, high-intensity storms, as usually happens in the study area. Lack of adequate soil conservation practices leaves soils more vulnerable to the process of soil erosion, which in turn can have extensive impacts on land degradation (Nicholson et al., 1998). Once soil erosion happens, it is difficult for the desert to recover and restore itself, and substantial human intervention and resources may be needed.

The above evidence from respondents demonstrated that macro-scale land-use decision-making can lead to significant environmental impacts without careful planning. However, not every land-use decision-maker would agree with this point of view, as argued by Developer A:

> "At some time, you get a lot of people screaming, they can influence the city and they [the city] will say, well, you may follow the rules but we still don't like this, because you are making all those people mad, so there must something different you can do, come back with different plan, or try to develop somewhere else. You can run a lot of problems. People sometimes blame that developers who, for instance, we talked about drainage before, they say well, you come in and because what you do, a lot of soil was washed away, and storms may come. And my explanation to this is, if I did not come here to do land development, and this will still happen, soil will be washed away too. You go out anywhere, any part of the natural desert is going to be, you will see arroyos, you will see damage after sewer, that's not caused by the developer, now, can a developer make mistakes, make the drainage worse? Absolutely. Can the developer build the roads in certain way that after a big rain, soil might get washing away, utilities line get exposes, or retaining water in my floor? Nobody is perfect. When the problems happen, you just need to think how to solve them."

This land developer maintains that people overestimated the impacts that land developments create. He ascribed most of the causes of environmental consequences to the climate factors rather than human-induced problems and defended the land-development activities. Although there are no scientific measurements of how great an impact should be attributed to climatic factors and

how much belong to human-produced problems, scientific research has already identified people's negative impact on the dryland landscape in the study area (Kerley and Whitford, 2000; Yin et al., 2005). He was also looking at what has been affected by changes of other land use and drainage, although he did not provide a specific example of which kind of land uses other than that land development caused the environmental problem. However, it is clear that he feels less responsibility for the environmental impacts and he did not address these potential impacts before starting the developments, and it is often too late to solve these problems when they take place. In particular, land developers are macro-scale decision-makers, their land-use practices can have extensive consequences on the landscape changes. They need to take responsibility and plan carefully before they start their developments, and proceed with caution, recognise the desert landscape is sensitive and easily disturbed, and mitigate the negative consequences resulting from their land-use activities.

Developer A's comments also highlighted the conflicts between the land-developer group and other actors regarding their land development activities. A group of powerful people tend to influence the decisions of the city council to recommend changes to the plans that the land developers made, which means that they probably suggest the way that best represents their benefits. Many other important individuals and groups, because of their political marginality, may be invisible to planners and local government decision-makers. They often suffer the most when problems are created, because they have limited resources and the power to solve the problems. Like the politicians and city planners mentioned earlier, some residents, who have lived in the study area for a long period of time, may be marginalised politically. They may lack wealth and interests of voting and have little participation in the public meetings.

When asked how to engage a wider public in the decision-making process, two city planners commented:

> A: "We are in the process of writing a public participation plan, and looking at different ways of engaging people, because typically the sector of the community who has time to engage, is a small sector of whole population, and generally retirees who have time. There are many who don't particularly participate, particular ethnic groups."

> B: "We have a very high percentage of Hispanic population in Las Cruces and their percentage of participation is very low."

These statements reflect that there are many people who do not contribute to the public participation process and represent their views. There are a few possible reasons. First, they are not interested in taking part in, and they are less sensitive of what is going on in the surrounding area. Second, they have been constrained by their availability of time to participate. If they work in the day, and the public meetings are normally held in the day according to the City of Las Cruces public meeting records (City of Las Cruces, 2000), and they do not have time to attend. Third, they feel that they cannot change anything through their voice. The responsibility of local government is to maintain the balance between different groups, and find a better way to engage all of the groups in the decision-making process, not only the politically powerful ones. It is illustrated in more detail in Chapter 8.

7.2.3 Loss of biodiversity

The third impact observed by respondents is the loss of biodiversity. Research shows that rapid urbanisation and inappropriate land use and management devastate the habitat for animals and plants (Gordon et al., 2008; Kahn, 2000; Mac et al., 1998; Shen et al., 2008). The drylands of New Mexico are home to a wide range of species and diverse ecosystems. However, extensive land developments result in these animals and plants facing serious threats of losing habitats. Evidence can be found from some respondents' statements, such as from one resident who reflected:

> "When the houses are there, wildlife moved out. Two years ago, when I first moved here, I used to see coyotes, I used to see lots of big animals, but not now."(Resident, professional)

Another resident held a similar opinion and she reflected:

> "Because of development near the mountains, a lot of animals on the other side of mountains can't come to get the water. Development affects a lot of biodiversity, the environment and rancher. They have lots of cattle, cattle need to drink water, but they can't get through because of developments. So some ranchers can't do ranching. Animals ran away and disappeared a few years ago." (Resident, professional)

and:

> "We used to have more coyotes, because we don't have walls separating our house. Because of the developments that going on, and then the area was filled in with more homes, many of these animals would live south of us, in all that area, now become more developed, and men are around more, there are more people, so I think that's actually driven them out. They have run around the mountains more, but they don't come down that much." (Resident, retired)

One NGO expressed a similar point of view and commented that "Urban is like this [rapid development], animals disappeared".

Unlike residents who claimed that they rarely see animals currently around their neighbourhoods, one resident offered a different example of animals losing their habitats:

> "Desert that way, all those homes that way, like, oh my god, it is taking like homes for animals, native plants, like snakes, different things are coming to their homes because you know, we took their home, so they are like, crazy." (Resident, professional)

These examples suggested that loss of biodiversity in the study area has happened quite noticeably. Many respondents observed the indicator that animals do not appear in the surrounding areas as much as they did before, and the diversity is lower as many residents reported that only rabbits as the primary animal are still running around their yards, especially those who lived close to the mountain areas. Extensive residential developments push the urban edge outwards, where there used to be habitats for animals and plants. Moreover, many new proposed development plans are ongoing in the desert land, which may result in further degradation of habitat. Figure 7.3 shows a new master planned 'future site of retail village' in the study area. From the photo, it can be seen that this planned retail village is surrounded by desert vegetation. In order to make the site ready to construct, all of the desert plants will need to be removed and cleared. Consequently, the stability of the habitat will be disturbed. Some habitats will be taken over by people, and species will disappear. Meanwhile, new habitats of different species that tolerate disturbed environments may be created. More importantly, there are important issues of landscape ecology, so that as habitats are removed from part of the area, adjacent areas of the same habitat may become unsustainable as they need a specific size. Infrastructure also interferes with the

movement between different parts of the habitat, and it is often the connectivity of the different parts that is as important as the existence of the habitat patches. In addition, additional residential developments might be planned nearby and more people will move into this area and cause further disturbance for the ecosystem in the area.

Figure 7.3: Photograph of a master planned future site of commercial retail village surrounded by desert vegetation in the East Mesa

Many actors demonstrated an understanding of the importance of biodiversity, and recognised the negative impacts of land developments on the animals. However, loss of native plants was not identified by many respondents in this study probably because they are relatively less noticeable and require greater expert knowledge.

Although my field data did not find much evidence of the loss of native vegetation in the study area, evidence from scientific data reveals their reduction and loss. According to Mac et al. (1998), New Mexico is one of the most floristically rich areas in the United States. The diversity of vascular plant species is high, containing about 3,900 taxa of vascular plants. However, more than half of the species are listed as a special concern in New Mexico, which means that the continuing existence of that plant species on Earth is endangered by human acts and natural events. New Mexico has one of the highest proportions of globally rare native plants in the United States (Dick-Peddie, 1999). Like plants, a broad

spectrum of animals is listed as endangered species including invertebrates, amphibians and reptiles, birds and mammals. Habitat alteration and incompatible land uses are the main threats to the region's rare plants and animals. Early in the late 1800s and early 1900s, the first wave of changes in biodiversity was noted (Mac et al., 1998). The high-intensity grazing of open ranges caused significant reduction in density of native plant species and diversity of native plant communities (Fleischner, 1994). The mammalian diversity also decreased due to the conflicts with human activities such as livestock grazing. Other human activities particularly agricultural conversion of natural habitats led to the decline of species such as prairie dog and black-footed ferret due to the grazing conflict with farmers and ranchers (Mac et al., 1998). Nowadays, rapid urban growth and land developments lead to serious habitat loss, fragmentation of surrounding terrestrial and freshwater habitats. According to the Assessment of Biological Diversity in the northern Chihuahuan Desert ecoregion, road and drill pads works by oil and gas companies has caused habitat loss and fragmentation (Dinerstein et al. 2000). Riparian sites and some lowlands areas have been extensively altered and lost substantial amounts of habitats throughout the region due to damming and water diversion for municipal needs. For instance, native fish populations declined and diverse riparian forests were replaced with monocultures of tamarix (an invasive tree introduced in the 1800s) (Hoyt, 2002). Habitat loss has also caused widespread loss of larger native vertebrates, cacti, reptiles and invertebrates (Dinerstein et al. 2000). It was found that large desert vertebrates such as bison, pronghorn, and large cats are rare to see in the Chihuahuan Desert and brown bears have completely disappeared from the region (CBD, 2011).

In the study area, in addition to the loss of animals, it was also found that vegetation was seriously affected by urban development. The construction of buildings and roads directly caused the loss of plants. As can be seen from Figures 7.1 and 7.2, vegetation is cleared completely on the construction site. Another indirect impact is that the disturbance to the natural vegetation takes place near the periphery of the built area, as the land is tracked and used for transportation and recreation. Hence, ecological implications need to be considered carefully in the land-management and planning practices.

7.2.4 Water shortage

Water shortage was reported as one of the current environmental crises resulting from intensive land use in the desert. Many respondents expressed concerns of water shortage and fears of running out of water one day in the study area as discussed in chapters 5 and 6.

Respondents from different actor groups reported the negative impact of land-use activities for water resources. Residents considered that as grass and plants require more water in their yards, their cultivation will cause water shortages in the future. As one resident reflected:

> "If they use too much water in their yards, there wouldn't be enough for us."

One resident commented on the water issue that:

> "They convert agricultural land to houses, but I think there will be not enough water in next 10 years, that government and developers will figure out to get more water." (Resident, retired)

A city planner drew on current management of land uses, and stated:

> "You cannot make water, and so if growth were to continue unrestricted, then the question would be what impact would there be on the water table."

When asked about the impacts on the desert due to land developments on the desert, one expert from a land-management agency said:

> "I think the impact is certainly water, ground-water, probably not enough water supply for the future."

These statements highlight the concern about water in the study area, in the same way that many respondents expressed their fear of water crisis in the questionnaires. However, the possibility that some respondents probably felt that they needed to give a more socially or environmentally minded view cannot be ignored. Nevertheless, the fact is that the city currently faces the dilemma of rapid urban growth and the increasing demand for water. Urban developments are placing new pressure on the ability of available water supplies to support these new demands.

Furthermore, this dilemma is happening at a time when a coherent Federal water supply and management policy no longer exists, and the State has been slow to fill the gap (Lucero and Tarlock, 2003). The population of New Mexico is rapidly growing, but with few urban water supply options compared to other arid western States where ground water supplies 90 percent of the state's drinking water and irrigated agriculture, it has limited surface-water supplies. The major river in the state, the Rio Grande, must be shared with other states (Colorado and Texas), and northern Mexico. New Mexico does not have a large Federal project to support future growth or a major new source of water that can be tapped. All of these facts mean that the state needs a more aggressive water-conservation plan to accommodate continuing water use (Lucero and Tarlock, 2003). Local and state government need to be better coordinated to promote more sustainable water use and smart urban growth. Furthermore, better planning needs to make sure that water policies and urban growth policies must support each other. To complicate this matter, water in the study area is supplied not only by the City of Las Cruces, but also by a few private water companies. A staff member of one of these water companies was interviewed to talk about the water-supply situation in the study area and pointed out the discrepancy of the water policy between state government and local government. He expressed his concerns about the water supply to new subdivisions and worried that the city will take away their business:

> "My issue of concern now is the City of Las Cruces wants to take away our subdivisions. We are trying to get a boundary, the city, they don't want to generate a boundary. And it's the government entity, they have the power, you know, then they can do what they choose. We are exclusive against the other non-profit water providers, there are state regulates us to serve where, when it comes to city government, they are not regulated by the state."

When asked about how they discussed and negotiated with the city, he said that there had been a:

> Lawsuit, in 2004. There has been no discussion about money, you can't talk to. There is no dialogue between us and the city. I have the city utility tells us they will not serve the piece of property and that's ours to serve and if anything change by the city council, they will let us know and we will discuss it. They never called us and they just lied to us. That's my main issue of concern, what happens is the city drills a well into this basin, and they are mining, they are pumping all the water down there, that's going down to the valley, that's the bottom-

> line here, that's a problem. (My follow-up question: what's the consequence?) The consequence is that they are drilling the water basin, so they are exporting the water. You look at, we get our water from a well, like a big bowl, it's for water, when the city pumps it and exports it beyond the boundary of the bowl, this bowl is gonna decline. If they kept the water being used in the boundary of the bowl, it's like a big recycling machine, and that's the key. If you can keep the water like a big recycling system, and you can keep recharging and let Mother Nature purify and clean. If the exploration is more than the recharging, the decline will happen."

This quotation revealed that rapid development generates competition for both water demand and supply. The private water companies are in conflict with the city to decide who will provide water for the new subdivisions and developments. They have been fighting with the city for a few years, but the problem has not been solved. The city does not admit the boundary set by the state government, and they are planning to provide a water supply for the new subdivisions. Consequently, it leads to the private company not trusting the local government, and conflict between the public entity and private company appears as a result. These quotations also highlighted the tensions within existing power structure and social groups, which will be further discussed in Chapter 8.

There are many types of water providers in Doña Ana County and the City of Las Cruces. Table 7.2 illustrates different types of water providers.

Table 7-2: Different types of water providers and examples

Type of water provider	Examples
Operational Utility	Closely related to a municipality but is funded directly through users fees rather than indirectly with tax money. Examples: City of Las Cruces Utilities Department and the Doña Ana County Utilities Department
Water District	Unincorporated municipal government. The district does tax its residents for services including water. Examples: Anthony Water and Sanitation District
Mutual Domestic Water Association	Federal-funded not-for-profit member-owned organisation formed particularly to provide water services. There are 48 'mutual domestics" in Doña Ana County.
Private Water Supplier	Privately-owned well and large enough to supply surrounding homes.

(City of Las Cruces, 2010c)

Within the City of Las Cruces, most water is provided and distributed by the City Utilities Department. The department can also supply water outside the city with approval of the City Council. There are also other water providers within the city – one mutual domestic water supplier and three private suppliers (City of Las Cruces, 2010c). Therefore, the water supply situation is quite complicated in this city. The problem in terms of water supply in the city is that no written document action exists to specify who is responsible for new city annexations, where the boundary of water supply is for each water provider, and protocols for water provision. Lack of statutory regulations and rules of providing water supplies make the water issue more complicated. All of the private companies want to serve more areas, so does the city. The conflict between private water providers and the city has been highlighted and reported on the local news.

> June 20, 2004: Las Cruces Sun-News - An attorney for Moongate Water Co. has filed a motion for declaratory judgment to prevent the city from providing water service to the recently annexed Dos Suenos subdivision on the East Mesa. The council is expected to vote on providing water service, as well as the preliminary plat approval[10] for Dos Suenos, at its Monday meeting at 1 pm in City Hall. Moongate Water has said the 139-acre Dos Suenos is within their service area and it has therefore the exclusive right to serve it (Schurtz, 2004).

> January 15, 2011: Las Cruces Sun-News – It's been a shade over six months since the Las Cruces City Council adopted a resolution authorizing the condemnation of Moongate Water Co. through eminent domain. Marcia Driggers, senior assistant city attorney, said the city is in the process of completing an appraisal. "We are still waiting for that appraisal," City Manager Robert Garza said. "Clearly, that is the basis for any further discussion and negotiations that could take place. Once we know what that appraisal will be, we can have more serious, more substantive discussions." The appraisal would likely serve as the baseline for possible negotiations between the city and Moongate. But if negotiations break down, or never get started, the city could begin the legal process to try to acquire the water company through eminent domain[11] (Ramiraz, 2011).

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[10] Preliminary plat approval is the 'project permit' that shows the location and extent of proposed development, site conditions, subdivision lines, and proposed improvements, and is the subject of review under the State Environmental Policy Act (SEPA) and local development regulations (MESC, 2009).

[11] Eminent domain is the legal process by which a public body (and certain private bodies, such as utility companies, railroads, redevelopment corporations and some others) are given the legal power to acquire private property for a use that has been declared to be public by constitution,

> August 04, 2010: The New Mexico Independent – Public Regulation Commission (PRC) voted 3-0 to fine the small, 800-customer Picacho Hills Utility Company an unprecedented $1 million to $1.5 million for violations of PRC rules and orders, including alleged co-mingling of utility funds with owner Stephen Blanco‘s other businesses, and failing to build a sewer discharge line the Commission had ordered Blanco to build. But Blanco claimed the Commission wouldn’t let him raise rates enough to get a bank loan to build the sewer discharge line they had ordered. He believes the charges against him and the fines represent an effort to force him to sell or surrender his utility’s water rights, which are worth $18 million, he told *The Independent* (Furlow, 2010).

The examples of these news articles demonstrate the ineffective communications between the private water providers and local government, and indicate a lack of trust in the government. The competition and conflicts over water supply also reflects the gap between water policy and urban growth policy, and poor communication between state and local government.

The interviewed staff member of the private water company also worries that over-extraction of water from underground will lead to water-table decline. His view is corroborated by some scientific studies that suggest increased water demands have significantly lowered water-tables (Fredrickson et al., 1998). He considered that if the city keeps growing, it will encounter serious water problems, just like Phoenix, and they need to look for other sources of water they can bring to the city. He stated:

> “There is a water-conservation issue, how we can do this to get the recycling plant. And there is no cooperation with the city right now.”

When asked about whether they carry out any water-conservation activities, he reflected that:

> “Our qualities, our numbers for water consumption, the city wants good water usage, 125 gallons [1 US gallon = 3.8 litres] per person per day, when you start to look at how much water you use, they can do better, but that’s the number they expect. [water company] per capita usage is 128, the City of Las Cruces is 250. Well, they say, it’s not 250, it’s only 135 or 140, because they take all the customers’ usage. But that’s not how you calculate your usage. What the city wants to do, they want to exclude all the commercial, fire, restaurant… They just

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statute or ordinance (Findlaw, 1999).

> want to calculate the water goes into the residential houses, but the state engineer wants to do both ways so they get the residential usage is 140 gallons per day and the overall picture is 250."

He further explained why there is such a big difference:

> "They waste a lot of water. Drive to the Sonoma Ranch, the golf course, that's city water is being wasted on the golf water. And water runs through the pavement. The city wants to stand up and say 'we have a zero water-tolerance policy'. You need to follow. Residential customers need to follow the odd and even watering days. If you don't follow these days, we are gonna fine you. We will take you to the court, and you know, do all these things. But then they turn around and say: 'hi, you, you got a business. We want green grass, and we want trees'. But they tell you as a residential customer, you have to have that xero-scape [Xeriscaping][12]."

His examples indicate that some of the figures in the city's conservation plan might paint an optimistic picture that water usage per capita is not very high by excluding non-household usages. He believed that it is not appropriate to make such calculations, and he considered that the city has wasted a great amount of water in recreational activities such as golf courses. He claimed that there is no cooperation with the city at present to work together about water conservation and recycling programmes. These quotations again revealed the poor communication between the local government and private sectors, and implied that without a transparent discussion of who to serve the new developments and what the plans are for the water use and conservation, the coordination between private sectors and local government will not be well implemented. The city therefore might need to take private companies into account when they plan water supply for new developments. Well planned and effective regulation and policy might be needed to solve the water-supply dispute, and these regulations need to specify the supply boundaries for different water providers. Transparent communication between state, local government and private companies needs to be improved to reduce the conflicts and improve the co-ordination among all bodies.

[12] Xeriscaping is a water conservation concept that originated in Colorado. Eventually the idea spread throughout the west to utilize water efficient landscape designs to save water (UNLV, 2011).

7.3 Impacts of urban landscape degradation on people

Changes in the natural environment, whether to a greater or lesser extent a consequence of the actions of humans, have impacts on social life (Martell, 1994). Results from the interviews demonstrated that landscape degradation in the desert in turn affects the actors in various ways. In particular, dust was mentioned frequently by respondents as one major impact.

Dust appears to be the key perceived problem of the impacts of land degradation, reported by many respondents in the study area.

One resident commented on this issue:

> "Lots of dust blows, we were hoping that [there would be] no more developments, but they will build. We don't know what will be happening there, we are already on the edge [of the area developed]." (Resident, retired)

When asked about things they do not like in the study area, one resident reflected:

> "I don't like here? In the spring, the wind comes out, and you cannot see the mountains, it's terrible. You have to close the highway west of town because of the accidents. Visibility is very low. That's the only thing I don't like. Dust." (Resident, retired)

One politician provided an example: "Have you seen the big pond they built in the East Mesa? There was huge dust, and people were just screaming, their houses are full of dust."

And another politician stated:

> "We can't just scrape the dirt away and build the road, we buy the homes here, we got a lot of dust, and it gets people mad. It is a dust caused problem ..."

These statements highlight the dust problem in the study area, and many respondents mentioned this problem as a disadvantage of living in the area. A number of respondents commented that the dust results from the new developments.

In just one case was residential development identified as a contributing factor in reducing the dust problem (also mentioned in Chapter 5), as stated by one resident:

> "I suppose dust since it has been more developed in Las Cruces, there is less dust than there used to be, it still can get very dusty, and windy here. I used to remember dust was blowing all over, I never see that much now, so developments in time has changed and it reduced some dust." (Resident, retired)

It is an interesting perspective and different from that of all of the other respondents, this respondent considered that more buildings prevent the dust blowing around in the area, and attributed the dusty problem to windy climate in the desert. However, it needs to be pointed out that the situation of 'dust was blowing all over' in the past she described was probably over-estimated, and it is difficult to assess how precise the information is. Although she considered housings could help to diminish the dust coming into the area, she stated that there is too much development near her neighbourhood and does not like the development now.

Despite different opinions regarding the dust issue, a great number of respondents expressed that they do not like the way the city is growing and consider that there is no regulation to reduce the dust problem. They considered that the city and land developers need to improve the performance to control the dust. These statements represented most respondents' point of view and expectations on the local government to mitigate the dust problem.

In fact, some activities are carried out aiming to mitigate the dust issue. A public meeting was organised in the city hall on the 6th, August, 2009 by the mayor, city councillors and city manager to receive public comments about the new dust-control ordinance. I was invited by one politician and attended this public meeting. A few issues, such as dust-associated health and environmental problems, were raised by academic researchers, and one speaker from Environment Protection Agency in the meeting. A retired resident said that the dust caused by construction brought many problems to their daily life. Some land developers argued that it is not the construction caused dust, it is just dusty in the desert regardless which kinds of human actions take place (Chapter 5). One developer gave a speech and commented that it is not fair to blame only them on the dust issues and claimed to have a joint effort to mitigate the problem. He said "Let's sit and talk about it." Although eventually there was no agreed immediate solution on how to make new dust-control ordinance work, this meeting provided a starting point to open the

discussion with various actors who might be concerned, and delivered a message that the city council is ready to hear different opinions from the local people about the dust problem. This meeting also raised health issues associated with the dust problem. Concern was expressed by one politician that "people can get very sick. For breathing in dust, bacteria or fungus, some people get lung disease from that". It is a striking issue needs to be paid more attention by land-use decision-makers as scientific research has found a strong association between desert dust and health risk (Yin et al., 2005).

These consequences resulting from especially large-scale, land-use activities call for new trends of land management and smart growth, which is illustrated in Chapter 9.

7.4 Chapter summary

This chapter has illustrated the impact of people's land-use decision-making on the land and environment perceived by respondents, including vegetation loss, soil erosion, loss of biodiversity and water shortage. This chapter also demonstrates that land degradation in turn affects actors such as dust, which was reported as one key negative impact on their daily life. The two related impacts including vegetation loss and soil erosion were mostly observed by experts, such as NGOs, planners and politicians. Residents noticed and were concerned more about the loss of biodiversity and dust production, perhaps because these two effects are closely related to their daily life. Experts are more concerned about long-term environmental impacts and consequences, and are willing to look for solutions. Perceptions of environmental changes and degradation from local respondents are important, as these perceptions are "often framed by broader concerns that impact levels of well being and affect how individual actors view their environment" (Maconachie, 2007:74). Furthermore, local understanding and knowledge of land degradation are important to develop more relevant and effective land management strategies. Poor communications between different actor groups, between public entities and private companies and between different levels of government were also observed from the responses. Sustainable land management in the study area and therefore calls for coordination among state and local

government, BLM and private sectors, and more careful considerations of the actors who might be politically and socially marginalised.

Chapter 8 A political ecology perspective on land degradation in the American Southwest

8.1 Introduction

This chapter draws on the findings of previous chapters to place environmental changes in their social and political contexts at the local scale. In so doing, it addresses the influence from the broader regional and national levels. Political ecology was selected as a theoretical basis for this research. This chapter provides research findings related to the core themes of the political ecology: power relations in relation to resource use and environmental changes, which were presented and discussed in Chapter 3. The research findings are discussed and compared against those of the wider literature, which facilitates the attainment of objective 3 of the research, which is to explore the complex interactions of the social and political elements of decision-making process and its implications on land degradation.

This chapter starts at the discussion of history, power and politics of land-use issues and land degradation in the American Southwest. It then moves on to focus on the power relations between different and within actor groups, between different levels of government, in influencing the resource use. It then discusses the socially embedded land degradation problem and places it in the broader political, social and economic context.

8.2 History, power and politics

Land-use issues in Las Cruces can be traced back to a part of an old and complex conflict between property and ecology in the American West (Fiege, 2003). The battle over modern Federal legislation, such as the Clean Water Act (CWA, passed in 1972) and Endangered Species Act (ESA, passed in 1973), and other measures to protect land, water and air, the power that those policies grant public officials to regulate private land, and the frustration and anger of numerous US westerners cannot be easily dismissed (Fiege, 2003; Robbins and Foster, 2000). However, these are the very latest conflicts in a much longer history that goes

back almost to the beginning of the European-American settlement in the West (Fiege, 2003). The battle for control over western land has often been violent, and the biggest violence happened between Euro-Americans and native peoples. The Euro-Americans gradually took control of the region by military campaigns and forced treaties that often confined native peoples to inferior lands. The settling of the West fails to acknowledge the presence of others who already settled in the region. The following text presents a brief background of changes of land ownership and property right in the western US accelerated from the 1860s.

Beginning in 1862, Congress passed a series of Homestead Acts that offered free land to settlers who would develop it (Chapter 2). Although the desire to obtain land may have involved all social classes, in the long term the larger capital enterprises were in a more advantageous position to buy out or push away smallholders when there were crucial needs to promote their interests (Robbins and Foster, 2000). Power over these land-use practices was unequally distributed, as some small groups would have more control.

In 1871 the Federal government passed a pivotal law claiming that the United States would no longer consider Native Americans as independent nations. In accomplishing this legislation, the Federal government forced Native Americans to leave their lands and became farmers on small plots of land, and western developers and settlers could purchase the remaining land. As a result, Native Americans' lands were parcelled out and their previously owned lands were filled with European settlers (Haug, 2003).

During the 1880s, a great number of people came to the West from the eastern United States and from across the ocean appealed by the railroad construction, the introduction of large livestock herds, mining resources and farming enterprises in town sites (Wilshire et al. 2008). With the support from the US Congress, which declared most of the old Hispanic land grants part of the public domain, European homesteaders, railroad companies, and the Federal government transferred the Hispanic villagers' common land into private ownerships (Robbins and Foster, 2000). This act resulted in enormous Hispanic loss of their land and severe constraints on access to previously common land, and continued conflict to the present day (Robbins and Foster, 2000).

In addition, in the 1880s extensive grazing emerged to be a major problem (Fredrickson et al., 1998). Part of the problem was the perception of the West held by policy-makers in the East based on their perception of how big a homestead would be needed to support a family in a temperate environment without considering that it might be very different for people in the desert. As illustrated in Chapter 2, The Homestead Act (THA) of 1862 offered settlers 65ha if they occupied the land for five years, and the Enlarged Homestead Act (EHA) passed in 1909 expanded the allotments to 130ha. As a result, many pieces of land, some in a degraded condition, were sold to large mining and livestock interests. These larger interests used other ways to acquire public land as well. For instance, one way is to claim overgrazing land by newcomers. Consequently, there was a competition between cattlemen and newcomers to the range. Little good grass was left, rangeland were severely overgrazed. Extensive use of land, timber and devastation of habitats for wildlife were noticed along with the rapid growth. Francis A. Walker (1890, cited in McEvoy 1998: 99), noted that nineteenth-century American agriculture had utilised the land "in some degree at the expense of future generations" and that conventionally inefficient land-use practices need to change.

After the 1950s, with the rapid urbanisation, land use shifted toward increased recreation and other urban uses (Wilshire et al. 2008). Ecological concerns have appeared as an important topic in debates over land use in the second half of the twentieth century. Private ownership, unrestricted use of land, and the unregulated market have been devastating for many communities. These issues have also caused serious environmental problems. In the second half of the twentieth century, the Federal government gradually put restrictions on land use and incentives for land conservation (Wiebe et al., 2003). In 1976, the US Congress passed the Federal Land Policy and Management Act (FLPMA) for the management of public lands under the BLM. FLPMA, declared that "the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish

and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use" (US Department of the Interior, 2001).

However, these acts and others, including the ESA mentioned earlier, created many conflicts and oppositions. Many of these regulations have been challenged in the courts by those who desire to maintain or enlarge their private benefit from Federal lands and seek low cost timber or cheap grazing leases. There has also been a broader urge to transfer Federal lands to state or private ownership. The Wise Use Movement (WUM) claimed that resources are better managed and exploited in local or private ownership as the locals have more knowledge in opposition to the Federal agencies and environmental groups (Liverman, 1998; McCarthy, 2002). It argued that Federal agencies were portrayed as "outsiders intruding on local communities and denying them their livelihoods and right to self-determination" (McCarthy, 2002:1283). Instead, the rancher group considered that land should be controlled locally and not from the nation's capital and environmental groups or by those not directly linked to the land. Arguments have been common and involved many groups, between ranchers and land management agencies and between ranchers and environmental groups (Pieper, 1998).

This period of history contains the events and stories that ultimately impacts contemporary landscape, and influences people's attitude and actions. In modern times, urban land uses may represent different patterns and preferences from the historical uses. For instance, urban land uses increased including residential, industrial, commercial and recreational purposes as opposed to grazing uses in the historical times (Chapter 4). However, the private ownership and unrestricted use of land in the West still influence the way people perceive and act on the land. As mentioned above, in western US history, the Federal government granted private land owners liberty to do with their land as they please. They do not need to acknowledge and consider others' benefits and needs, and conflicts were generated as a result of different interests. Private individuals demonstrated the desire to obtain more land, but the control over land was concentrated in small numbers people who were in the more advantageous position. Long-term land users were in conflicting with newcomers over the use of land and resource. Governments can regulate the land uses through a set of policies and acts, but these regulations were challenged by many who want to promote the private

ownership and to use land at their will. This culture and tradition left a significant mark on the contemporary land-use practices.

Interviews in this study revealed that many actors continually desire and seek more control over the land, although some have more power to achieve control than others. Urban environmental groups (i.e. NGOs) are on the front lines attempting to obtain some control over what is taking place with real estate development. They are trying to protect wilderness and wildlife and maintain the environment for more people to enjoy. Land developers pursue their business, generate profits and try to obtain more and more of the land surrounding the city where residents would prefer that it be left as open space (Brogden and Greenberg, 2003). Elected officials need to look at the bigger picture and decide what is the most beneficial for the city, and generating tax revenue is often the primary goal. They also need to favour the local voters, as well as balancing the conflicts generated from the disputes over resources use, However, the decisions they make may involve some bureaucracies, and they cannot ensure that all of the local people's benefits are represented and may marginalise some people such as those less wealthy, living in the poor neighbourhood, and their participation at public meetings is low. Therefore, it can be seen that land-use issues are complex and different actor groups have different interests over how to use and manage the land. Power over the land use is defined and negotiated between actor groups, and different actors have different capabilities in struggles over access to, and use of the land. Power relations between different actor groups during decision-making process are also complex and imbalanced. The next section discusses the imbalance of power relations between and within different actor groups operating at different levels in the decision-making process, and the implications they have for the resource use.

8.3 Power relations and resource use

The findings presented in Chapters 5-7 have highlighted that people's landscape perceptions influence their land-use decisions, and power is distributed unequally in the decision-making process on resource use, and the majority of the power to make land-use decisions is concentrated on a small number of people.

Power relations between different actor groups

In Chapter 5, it was seen that many actors considered that land developers are the most powerful, and they have more access and control over land trade and they can drive the development patterns, while in Chapter 6, in addition to land developers, local government was perceived as having more power to influence land development and was in the dominant position in land-use decision-making process. They are the only ones to have the power to annex the land, and they can regulate the land development through zoning ordinance. The interview results revealed that in most cases, they tend to annex the land to generate more tax revenue. It was also observed that the city government is likely to gain more economic benefits and power than the county government through the approval of annexations, even probably more political power, and the competition between city and county government over sales tax revenue is revealed.

In addition to the perceived powerful actor groups, the role of other groups cannot be neglected as they too play an important role in resource use and management. NGOs represent themselves as resource conservation environmentalists, largely because they feel power over resource use and management is distributed unequally, and those that have power do not take into consideration the environment and their actions are very profit-driven. Moreover, some of NGOs considered that the BLM and State Land Office make money together with land developers out of land development (Chapters 5 and 6). It is difficult to judge whether the statements are true or false without more evidence. But it can be seen that the NGOs do not trust the land management agencies, which indicated a lack of transparency over the land transactions between land management agencies and land developers. Planners are part of the local resource-use decision-makers and have expert knowledge in land-use planning, but some of them felt less powerful in such decision-making process, partly because they considered that resource management is politically driven, and power accumulates in more powerful hands such as elected officials. Most of the time, the planners make recommendations in favour of the developers' proposed plans, instead of denying them, in order to have more control over the growth and generate more tax revenue in the city. The majority of residents are positioned as the least powerful group. However, a small group of residents were perceived as being powerful, which can also be observed

from Chapter 7. This small group of powerful residents who are relatively wealthy and have more resources, such as information, knowledge and time, are politically active and powerful. They attend public meetings regularly, as opposed to many residents who are not interested in or do not have time to attend the public meetings and represent their views, and tend to influence the decisions of the city council to recommend changes to the plans that the land developers made. Nevertheless, less wealthy people have limited access to the infrastructure; some of them live in the trailers and mobile homes as seen in some parts of East Mesa (Figure 6.2). As indicated by two planners, less affluent residents tend to get involved less in the local decision-making process, particularly ethnic groups (i.e. Hispanic) as noted in Chapter 7. "Seems like the more affluent the group, the more participation," commented by the two planners. The greater the degree of participation, the greater the source of power, as politically active residents have more opportunities to represent themselves and they probably suggest the way that best represents their benefits.

The interview results highlights the poor communication and sometimes conflict between different levels of government agencies over land management, between government and private individuals, and government and local communities. In Chapter 5, it was shown that poor communication exists between the city and State government (i.e. State Land Office), and the Federal government agency (i.e. BLM). The State and Federal government does not confer with the city government when they trade land with land developers, whist the city government does not negotiate or discuss with the State or Federal government their decisions or feel there is a need to inform them of their decisions. It also indicates a lack of trust by the local community over the city government and Federal government. For instance, one NGO felt cheated by the promises of some local government officials, and considered the benefit receivers through land trade are both local and State government. Another NGO considered that BLM office in the State did not meet their missions to protect the environmentally sensitive areas and generated profits by selling public lands to land developers and finance the state governments. These examples also highlight a lack of transparent land-transactions procedure between BLM and other parties to the public, which results in local communities being unclear about BLM's agendas and actions. McCarthy

(2002:1288) noted that Federal employees in the West tend to "subject to a variety of pressures and temptations that sometimes lead them to favor local resource users at the expense of their administrative mission". In addition, there are competing agendas within the BLM itself, such as older employees committed to maximising commodity production and younger employees with more ecologically-oriented preferences (McCarthy, 2002). The lack of a unitary Federal agenda generates uncertainty and frustration for local resources users and also creates sometimes tactical opportunities for a small numbers of people. Chapter 7 demonstrates that poor communication exists between city government and private individuals over water supply, and also indicates that city government and State government does not negotiate effectively in terms of setting up a clear boundary to provide water supply for the new developments.

Power relations within actor groups

Power relations over resource use are also complex within actor groups, and land-use conflict also occurs within the same actor group. For instance, older, long-term residents consider that newcomers compete with them over resource use, space and the water. In addition, they feel a threat of losing culture and tradition because newcomers have attempted to change these. As one resident said: "I grow up here as a child. I see lots of changes. We have too many people here that don't respect what we have here, they want to change everything to modern, and they want to change the name of the city. If you come here, you should accept our ways and try to live in our ways, and don't try to change it. Consequently, Las Cruces has very little tradition, we lost our culture. There is no historical building left here". In contrast, some of the newcomers are very active in the local decision-making. In Chapter 6, one politician, who has lived in the study area for several decades, commented that these newcomers retire, moved to this area and tend to be politically active. From the comments of the resident and the politician, it can be seen that local land-use decision-making involves complex political factors, and long-term residents, worried that newcomers have much influence on how the city, leads to their applying their experience from elsewhere to the study area. It also demonstrates the unwillingness of long-term residents to be changed or influenced by newcomers.

Power relations at different levels of government

As mentioned in Chapter 6, land-use decisions are always local issues in the United States (Lucero and Tarlock, 2003; Shlay, 1995). Property owners have significant control over the development of their land. Most of the governmental policies and regulations which influence land use are introduced and implemented by local governments. The Federal government has limited power to regulate private property (Dowall, 1989). However, it cannot neglect the power influence from national and state level on the local land-use practices. The Federal government has a number of agencies that regulate and manage the land use, and most major environmental laws are introduced by Federal government such as those mentioned in this chapter earlier (e.g. ESA, CWA) and also National Environmental Policy Act of 1969 (NEPA). In addition, in the study area, land-use decisions are the result of an interplay between different levels of government, locally, regionally, and nationally, as the State (through the State Land Office) and Federal government (through the Bureau of Land Management) own considerable amounts of land, and they have the power to dispose, exchange and lease the land to private individuals (Chapter 4). Power relations between the different levels of land-management agencies in the broader context of State of New Mexico and United States are also considerable. All of these power relations come into play in the decision-making process.

At present, over 60% of land is privately owned in the US (USDA, 2002). The Federal Government owns about 28 percent, mostly in the West[13]State, and local governments together own about 9 percent, and over 2 percent of land is in trust by the Bureau of Indian Affairs for American Indian and Alaskan Native tribes and individuals (USDA, 2002). New Mexico is a special case in that more land is publically owned in comparison to other western States. In New Mexico, 42 percent of land owned by the Federal Government, and less than half land is owned privately (Lubowski et al., 2006), while in the City of Las Cruces, 65.5 percent of the land is owned privately (Chapter 4). The State and BLM manages over 34 percent of the land. Most of the land managed by the State and BLM are

[13] West includes 13 States: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

located in the newly annexed territories of Las Cruces in the East Mesa (Chapter 4) (City of Las Cruces, 2008). BLM is the main Federal land management agency in the City of Las Cruces. Formed in 1946, the mission of BLM is to "sustain the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations"(BLM, 2010). BLM is required to remain aware of local planning efforts, take local plans into consideration, try to solve inconsistencies between Federal and non-Federal plans, and engage public involvement when preparing management plans for the lands it manages (McCarthy, 2002). The State Land Office is another key entity of land management in the study area, whose mission is mainly to support education. Both entities are expected to monitor land use and enforce its own laws and regulations.

Due to the considerable amount of land owned by these two higher levels of government, the relationship between the local, state and national levels is crucially important. However, interview data revealed that the relationship between different levels of government is unsatisfactory. In terms of the relationship between local government and BLM, one politician commented that BLM is federal government, which has another whole set of ideas and constraints. One of the problems for Las Cruces is that it is surrounded by either State- or BLM-owned land so once, for example, the BLM disposes some lands to private land developers, the city needs to work out how to plan the lands such as by creating zoning codes. In some cases, when disagreements appear between the BLM and local government, the BLM tend to lead the discussion as it is the Federal Government. As one expert from BLM commented during the interview: "if we don't come to some kind of agreement, it's really Federal responsibility to make the decisions" (Chapter 5). With regards to the communications between State Land Office and local government, a few politicians mentioned one example which is that one of the largest land transactions in the study area had been completed by the State Land Office, and the State Land Office generated much profit from the transaction. They probably used the profit for supporting the education system and other beneficiaries such as hospitals as they claimed. However, local government officials felt they lack control over these land transactions, and they were not informed to give a voice before this specific

transaction was completed. One politician commented that one department (the State Land Office) should not be deciding the large land transaction, because there are many interests that are affected. This large annexation caused many subsequent problems. The land developer did not complete the infrastructure as promised. Many local people were against the annexation. As interview data revealed, largely due to this specific land annexation, the local political environment has been changed. According to the example provided by one politician, a group of people were against two councillors as they supported it and these two considered the land transaction could generate much tax revenue, and eventually the two councillors lost their attempt for re-election. This indicates that local people can be politically powerful, especially when they have a concerted group action as the politician commented that the politically active residents sent emails to hundreds residents to attempt to manipulate the communities (Chapter 6). This transaction highlights the poor communication between the State Land Office and local government, as well as the power imbalance amongst different actor groups. Moreover, it creates conflict between these two, and between the land developer and local people. This conflict also reveals the tensions generated by the developer's inconsistent action from his claim.

In addition, two politicians commented that the annexation seems to be based on an illegal transaction between the State Land Office and the land developer in Las Cruces, and the question was raised as to why it was not done through public bidding. The Attorney General Gary King called this land deal 'flawed'; his official opinion states that "the lease agreement's method of compensating Mr X's [the developer] company for developing the land is not comprehended by and in conflict with a statute that allows developers who improve land for the state to be compensated only for the appraised value of the improvements". The *New Mexico Independent* Newspaper commented that the controversy "helped fuel public outcry over the city's growth policies" and resulted in the "overthrowing of the two councillors in two elections held in late 2007 and early 2008" (Haussamen, 2009). In addition, the newspaper indicated that during the same period of this land transaction, this developer donated $30,000 to the State Land Commissioner in his election campaign, and "a political committee and lobbyists tied to the developer". The two politicians commented that the procedure is politically driven

and typical in planning practices. It also seems that the developer obtained the land transaction through other means such as individual communication through donating money to the Land commissioner. It seems that the Commissioner and this developer gained mutual benefits through this land transaction. It also indicates the power relations considerably influence the use and management of resource. The developers benefited from good communications with the State Land Office, and consequently they can gain more economic power. Then the economic power may grant them more social and political power and status (Kivell, 1993). This practice negatively affects the local land-use and management decisions, and creates the conflict between different groups.

Power and water use

In addition to land, power is also related to water uses and management, and conflict also exists between local government and the private sector. As mentioned in Chapter 7, a private water company has fought with the city for a number of years over the unclear boundary of who should provide the water to the new subdivisions. The staff from the private water company claimed that the city competes with them for the water supply for the new subdivisions, where previously permitted by the State government that the private company should supply water to. This revealed the absence of a clear boundary between different water suppliers and a lack of coherent water-management policies in the state and local governments. It also indicated an absence of coherent water policies and urban growth policies working together to promote more sustainable water use and support smarter urban growth. The situation is particularly critical in the rapidly growing New Mexico where fewer urban water supply options are available (Lucero and Tarlock, 2003). The ineffective communications amongst different water-supply bodies, both public and private, also demonstrated the imbalance of power over water management. The private water companies have much weaker influence over the decision-making process over the water supply for new developments, while the city government has more power to exert control over the water-management.

Water problems are often part of political issues, and water will probably dominate the world's natural resource politics by the end of the 21st century and permeate

the large part of political, economic, social and cultural conflicts (Ingram et al., 2008). In the arid Southwest, water is the fundamental element for all subsequent development and all profit depends on water supply (Espeland, 1998). It is related to power and social status. As such, water's link to wealth and power makes it 'emotionally potent' (Espeland, 1998). Ingram (1990) states that "people's attachments to water goes well beyond expectations of financial return …water still symbolises such values as opportunity, security and self-determination". This implies more expression of organisational and political control of water than its economic value. With regard to the local context in the study area, rapid urban growth exacerbates water shortages in the arid landscape, and most of people are aware of the water issue; however, many of them refused to accept that water supply is facing severe challenges in the future. Land developers know that water is a crucial commodity in the real estate development process, but few of them are willing to acknowledge the limit of water supply in the future, instead, they use the information to argue that local residents use it as an excuse to fight with their developments. Local government want to provide water for the new subdivisions, probably partly because they identify that the supply of water to the new subdivisions are good opportunities to gain more economic benefit to finance the city and political power to control the resource. At the same time, local government can gain political power to influence the distribution of water. The developers and local government can jointly gain political control and economic benefit over water and growth processes. Those who lack control and power over the use and distribution of water are often suffering from other people's or other institutions' ineffective water management. According to the Las Cruces local newspaper, there has been a few incidences of no water supply for local residents, albeit temporarily:

> (August 27, 2010) Residents near spaceport site still having water problems. One Cutter resident, whose ground well went dry because of the spaceport-related pumping, felt worried and said: "They [officials from the spaceport and the state engineer's office] told us what's going on, but by their graphs, the water is still going down – not as fast – but it's still going down." A handful of households began seeing a declining groundwater supply or outages in April, after a spaceport contractor began leasing a well to supply builders at the spaceport site." (Alba Dalba, 2010)

> (November 24, 2010) For over 24 hours, Sandy Moulton of the East Mesa has been frustrated with no water (Anaya, 2010).
>
> (February 9, 2011) Neighbors in the Dove Canyon mobile park have been without water for eight days now. It's not yet known how severely water levels in Cutter have been impacted by pumping that's tied to the construction of Spaceport America (Galus, 2011).

These reports suggest that water management is not operated very well in the study area, and local communities are vulnerable if an accidental event took place, hindering the ability of the system to provide a safe water supply (Walski et al., 2011). A safe water supply is not only about sound water management, but also requires effective water conservation. The city's 40-Year Water Conservation Plan is ambitious (Chapter 6), and it is not easy to achieve without a significant change in individual lifestyle and collective behaviour. Conservation of water cannot neglect the intertwined relationship between power relations and natural resources, the one may limit the other, hence the balance between growth and resource-use needs to be taken into account and achieved in the urban planning process.

Power and knowledge

As proposed in Chapter 3, power is also connected with knowledge: "not only assumes the authority of 'the truth' but has the power to make itself true" (Foucault, 1995:27). The powerful groups can influence the discourse of resource use by distributing knowledge to others, which is not necessary real knowledge, but 'misinformation' without scientific proof.

Findings from chapters 5 and 6 indicated that there exists a gap of information and knowledge of water between the groups. Many residents are worried about the water supply in the future, but land developers asserted that there is sufficient water to support the growth in the next decades or so according to the city's water research done by a Water-Resource and Environmental Consultants corporation, which claimed that the water resource of Mesilla Bolson (a deep aquifer that serves household and industrial water to Las Cruces) is enough for the next 40 years (Chapter 5). However, this research is different from the scientific research in that there (Mesilla Bolson) is only enough water resources for the next 20 years in Las Cruces (Li et al., 2001). The Utilities Director for the city Garcia states that the water plan will account only for city utilities customers, and the population

number is not equal to the city's population, and some other private companies and water associations will provide water to Las Cruces residents (Alba, 2007). However, a net decrease of Mesilla Bolson is caused in a short-water year, and continued short years could lead to serious strain on the basin (Alba, 2007). The water situation will face serious constraint along the population growth. This information gap enhances the conflicts between different groups over resource use, because, as land developers claimed, they have enough water supply for the future, and will use their knowledge, which might not be true or probably misinformation, as a powerful tool to defend themselves.

Interviews revealed that many residents were not aware of the city's water plan and research, and some of them feared a water crisis in the future. The example of water conflict also suggested that the gap results from the poor dissemination of knowledge and information from the local government and experts to the general public. The local government is probably not providing enough information about detailed water supply and use to the public, or the access to this information is constrained by some limiting factors. For instance, the 40-Year Water Management Plan is situated on the city website, but not everyone is able to access the internet. Hence, other means to deliver the information are much needed to make sure the majority of people can receive it, not necessarily the details about the plan but at least enough information to inform reasonable water use. It also highlights the complexity of the politics revolving resource use and control among actor groups; conflicts emerge when different actor groups have different abilities or powers to meet their interests.

8.4 Socially embedded environmental degradation

Whilst power relations were observed as influential in shaping the decision-making over land use, findings also revealed that land degradation is socially embedded which means the political, social and economic factors come into play to affect the environmental changes.

Brookefield (1969) observed that decision-makers build their decisions on the environment as they perceive it, not necessarily as it is. This contract between the environment as perceived and as it is implies the significance of the actors'

personal understanding of their surroundings in motivating their actions (GeoDZ, 2010). Perceptions of actors are intimately associated with both the functional values, which are related to the use of land, and intrinsic values, which are associated with personal perceptions and affections, of the landscape (Chapter 5). Although intrinsic values were highly appreciated, most actor groups make their decisions mainly based on their perceptions of functional values of the landscape. Land developers perceive the landscape as having a valuable development function to generate profit. Residents appreciate the recreational values of the landscape, and perceive the desert as a place where they can carry out recreational activities and enjoy themselves. Politicians desire the economic benefits generated from the landscape to finance the city as well as having more power to control over the growth patterns. The function-driven motivations over the land use lead to insufficient or no consideration of the environment in the actors' decision-making, which consequently results in the land degradation.

Actors are also probably not willing to tackle the problem generated from their decisions. Interviews revealed that environmental consideration was still not paid enough attention by many macro-scale decision-makers. Or even some of them expressed the environmental awareness during the interview, but perhaps they say one thing but consciously or subconsciously do another. It might also be because they thought that I wanted to hear them talking about the environment, but it is not necessarily consistent with their actions. In fact, even though some people claimed that they are concerned about the environment, interview results revealed these environmental ideas are often related to the economic benefits and incentives, such as those mentioned in relation to energy-efficient buildings in chapters 5 and 6 and water-saving behaviour in Chapter 6. Some land developers viewed the desert landscape as fragile and easily disturbed, and claimed to have reduced the impacts of their land-development activities. However, some other land developers stated that the problems are not their fault

For instance, dust is merely an inherent character of the desert ecosystem. One developer commented: "If people do not want to accept it, they should not come to the desert." Such opinions neglect the human effects and reject the responsibilities as key land-use actors for the environment, and consequently

result in conflicts with other groups and further deterioration of the land due to careless planning and management of environment in the land-use practices.

The traditional and historical land deals still play an important role in shaping actors' perceptions and behaviour and influence how the current land can be used and traded. Property rights grant power to the landowners to make private land transactions in the study area. The ones who have land ownerships want to do what they like on their lands. These perceptions ultimately result in negative impacts on the land and cause land degradation.

Actors who notice more severely the land degradation are those who lack control and are weak in land-use and management decisions. For instance, some residents have fewer advantages and even suffer from some of these developments in their neighbourhoods, but they have less influence unlike other powerful residents to fight with this, and their interests are less acknowledged in the decision-making over land use. For instance, as commented by one politician, besides the field observation, in some areas neighbourhoods have a lack of public infrastructure, which reveals the existence of poverty and marginalisation of these groups in controlling and using resources. They are easily exposed to the dusty environment as the surrounding unpaved roads generate more dust comparing to the paved roads. Moreover, soil erosion and loss of biodiversity were observed by respondents in the East Mesa area, and these people are more likely to be vulnerable to these problems. Historical reasons, for instance unregulated land uses (Chapter 2), are in part responsible for this situation, but their current socio-economic status and lack of voice in the decision-making also play importance roles in reducing their accessibility to the public infrastructure and suffer more from the land and environmental degradation than those who live in well maintained neighbourhoods.

These findings above support those of Blaikie and Brookfield (1987) in noting that the underlying causes of land-degradation related activities and practices originate from deeper political and socio-economic causes: power relations, conflicts between actor groups, unequally distributed power over resource management. Land degradation in a broad sense is a social problem, as the idea and practice of appropriation and use of land are socially constructed. Hence, considerations about

land-use activities and use of natural resources are the products of the process of human-nature interaction (Iosifides and Politidis, 2005).

8.5 Chapter Summary

This chapter has shown that power relations that govern the use and manage resources. Power relations are imbued within social reality, power imbalance between and within actor groups resulting from different socio-economic status, knowledge and information and institutional affiliation. Power is distributed unequally during decision-making processes, and different actor groups have different capacities to influence the patterns of land use. The decisions at local level are often constrained by the State and Federal levels of power structures. Poor communications between different actor groups and different levels of government can create conflicts over resource use, and a lack of transparent land-transaction procedure results in the distrust of local communities on the government. Land degradation is socially embedded and a result of interplay between political, social, economic, historical and cultural factors. Actors who suffer more from the land degradation are often those who lack control and are powerless in land-use and management decisions.

Chapter 9 Conclusion

This chapter first summarises the key research findings. It then refers back to the political ecology framework and discusses the contributions of political ecology of land degradation achieved by this research. It then moves on to discuss the analytical and theoretical considerations of political ecology as a basis for studying land-degradation issues. Following that, it discusses the implications for policy-making regarding resource use through the evaluation of existing land-management strategies in the study area, as well as considering the power relations during the decision-making process. Finally, this chapter concludes with the implications for future research.

9.1 Summary of findings

This research has explored the interactions between land-use decision-making and land degradation in the arid American Southwest. Land-use decision-making influences land degradation, and *vice versa*. Land-use decisions are influenced by a set of socio-economic and political factors, and are constrained by power relations at different levels. The findings of this research are based on empirical data gathered from one case-study area in southern New Mexico. Overall, land degradation is not a simple human-induced problem, but a multifaceted process that involves interplays between human agents and the environment, at various spatial and temporal scales.

In Chapter 5, it was shown that perceptions of landscape held by different actor groups are complex and conflicting, which are connected to both the functional and intrinsic values of the landscape (Chokor, 1990; Kaltenborn and Bjerke, 2002; Kaur et al., 2004). Functional values received high appreciation from most of the actors, especially for those for whom economic benefits are the primary goals. These fundamental perceptions of landscape relate to the actor's land-use decision-making. However, appreciation for functional value of the landscape results in little considerations of environmental consequences in their decisions. Those whom we usually consider as "careless" decision-makers about the environment such as land developers may have surprising environment-orientated

perspectives. Their attitude may signify a change in attitude away from a profit-driven toward a more sustainable way of land development. This change indicates that traditional and common image toward some certain groups may need to be modified, and new directions of land-use activities can be guided through encouragement and education when necessary. However, it was found that this environmentally orientated attitude is also associated with economic incentives. Developers can gain economic benefits alongside the environmentally friendly image. They are required to demonstrate what benefits, e.g. more pubic open space, they can give to the community in their proposed master plan for the Community Development Department. Therefore, it is found that their environmental attitude is probably not entirely altruistic, and not solely based on their appreciation of the intrinsic values of the landscape, but also associated with the functional values of the landscape. Conflicts between different actor groups were observed, partly because some actors consider others generating benefits from the common goods and services (e.g. public open space), and prohibiting them from benefiting from the common good or decreasing the intrinsic value of the landscape (Kaur et al., 2004). For instance, public open space is found to be a big issue in the conflicts between land developers and residents. People living in the study area appreciate the wide open space, because it generates recreational opportunities for them as well as perhaps psychological benefits (Condrey and Guillen, 1997). They perceive increased land developments may become threats to the protection of open space. Without effective communications between land developers and local communities, tensions and conflicts were created. In addition, results also revealed the power inequality as mentioned by politicians that land developers have more access and power over land trade.

In Chapter 6, it was found that the ability to influence the land-use decision-making process is constrained by power relations and social inequality (Blaikie and Brookfield, 1987). Local land-use decisions sometimes represent the opinions from a small group of people, who have relatively better socio-economic status, time and regularly attend public meetings, and inevitably some people are marginised and neglected in the land-management practice. It was also found that interactions between actor groups in the decision-making process are challenging in the local and regional context. When local government complained about the

lack of communication between them and higher government, they also created a barrier to improve the communication as they claimed that the City of Las Cruces is a home-rule city that means they do not need to do what the State and Federal governments tell them to do. The competition between the city and county government over tax income was observed, and competition between the city and private sector, such as who will supply water to new developments under the rapid urbanisation, also existed. The economic gain is ultimately associated with political power and control, hence the competitions are highly political (Kivell, 1993). However, it was found that in the study area, a cost-benefit analysis had not been carried out to evaluate the effects associated with the rapid growth. The local government considered that growth can help the city to generate economic benefits, however, it might not benefit the city in the long-term, as the consequences that result from growth are often uncertain. Although land-use issues tend to be local, due the fact that in the City of Las Cruces, State and Federal agencies own a great amount of land, which acts as a point of tension with the "home-rule" nature of the city, inasmuch as the capacity of actors to be involved in sustainable land-management practices in the local context might be shaped by decision-making forces which are situated at greater distance away (as suggested in other contexts by Elliot, 2006). Hence policy changes on a broader scale are much needed, for instance, higher levels of government agencies need to take local situations into account and also ensure accountability and transparency during decision-making process, and such changes can have a positive influence on the local level. This suggestion is illustrated further in Section 9.4.

In Chapter 7, it was demonstrated that land-use decisions carried out without careful consideration of environmental impacts tend to contribute to land degradation and environmental consequences. These impacts, including vegetation loss, soil erosion, loss of biodiversity and water shortage, are perceived and reported by a wide range of actors. The environmental changes in turn affect people, dust problem as a key impact was reported by respondents. These impacts and consequences were observed by most respondents as relating to the extensive developments, such as construction of new buildings and roads. These perceptions also caused conflicts between land developers and local communities. Some of the land developers claimed that they have done the job to mitigate the problems, and

some land developers did not admit it is their fault to cause these problems. Part of reason for the conflicts is poor communications between land developers and local communities, because the land developers did not clearly inform the public about their plan and the local public was unclear about their agendas. Another reason is that people considered other people generate benefits at the expense of theirs (Kaur et al., 2004). The conflict also reveals that individuals want the land-use patterns to satisfy their own lifestyles and needs (Kivell, 1993). It was observed again that power is unequally distributed between actors. Some actors have more access and control of the natural resources by influencing the management interventions (Robbins, 2004; Minnegal and Dwyer, 2007), and shape the land-use patterns on their desires (Section 3.2.2), i.e. the eastward development patterns in the study area (Section 6.2.2.1).

A small group of residents politically active and are able to represent their views, hence they are empowered to have influence in the local decisions. While some residents who were marginilised in the process of land-use planning and management were those who have relatively lower socio-economic status, who come from specific ethnic groups and who may not have time or confidence to attend public meetings. It was suggested that local actors have the knowledge to identify the environmental impacts and consequences. However, it needs to point out that local people who have knowledge to make decisions often do not have much influence in the decision-making process due to power inequality. The ability to access to and use of resources and the ways in which local actors assess threats to the environmental impacts are functions of the production and accumulation of wealth, social status and power over time (Warren et al., 2001). It is important to engage and empower a wider range of local actors through acknowledging their understandings and knowledge of the environmental changes to develop more relevant and effective land-management strategies (Stringer, 2007).

9.2 Contribution to the political ecology of land degradation

Findings from Chapters 5-7 and discussions in Chapter 8 revealed that political ecology provides a useful conceptual and analytical framework to understanding the relationships between human actions and land degradation and between

different actors (residents, politicians, land developers, city planners and NGOs) in a wider social, economic and political context. In particular, findings indicated that the urban growth is not a linear distancing of human life from nature, but a process that complex relationships of society and nature are created (Keil, 2003). The urbanised landscape is a material and symbolic good that is imbedded in and creates urban social conflicts and power struggles over its use and control (Swyngedouw and Heynen, 2003). The political ecology framework allows us to explore how the unequally distributed power relations shape urban landscape change (Keil, 2003), and how the distribution and control of natural resources are mediated by differential relations of power within and among actor groups (Sheridan, 1995; Robbins, 2004). Differences in socio-economic and political status and resource availability play important roles in causing the power imbalance between different actors during the decision-making process (Warrant et al. 2001). Findings suggested that advantaged individuals have more power to dominate the pattern of urban growth (Section 5.2.2, 6.3 and 8.3). These people include developers, who are wealthier and able to generate loans because of their position in the financial system; and some residents, who are more politically active and have more resources (i.e. information, knowledge). Consequently, the outcomes of the urban growth are in favour of powerful, and at the expense of marginalised users (i.e. those live in areas with limited infrastructure and less access to the politics of local decision-making) (Section 8.4). Findings suggested that the powerful actors have more influence on the land-use decision-making process, consequently, they play important roles in the degradation of desert lands. Land developers are blamed by local residents for increasing land degradation due to development, and local people notice the impacts of degradation strongly, mainly in terms of the dust problem (Section 5.2.1.1, 5.2.2 and 7.3). This situation is even worse for residents who are less affluent and live in the areas which lack good road networks, because they are easily exposed to the dusty environment as the surrounding unpaved roads generate more dust (Section 8.4). The result, that the powerful actors impact land degradation, is consistent with the findings of Stringer (2004) that it is often the people who have a higher socio-economic status who exacerbate degradation in seek offing to exploit the natural resources. In addition, it should be noted that broader social and political factors influence the

land-use practices due to the overlapping administrative boundaries of City of Las Cruces and Doña Ana County and also a large amount of land is owned by public entities including BLM and State Land Office (Section 4.3.2). Power relations are also the central issue in the negotiation of resource use between different levels of government, whilst higher government has more ability and power to make decisions (Rouhana and Fiske, 1995). Moreover, as discussed in Section 5.2.1.2, some land developers also have benefited from good communications with higher levels of government, such as State government, to get good deals for themselves. This distant control may increase the abilities that land developers already have to influence the land use patterns, hence exacerbate the power imbalance between actor groups.

Power is also associated with knowledge (Foucault, 1977). Knowledge is generated as a product of the interaction and dialogue between specific actors involving social, cultural and institutional elements. It is often multi-layered, which means that there exists a multiplicity of possible frames of meaning. Therefore, different actors do not necessarily share the same priorities and parameters of knowledge. The production and transformation of knowledge resides in the processes by which social actors interact, negotiate and accommodate to each other's life-worlds. These processes are shaped by power, authority and legitimation available to the different actors involved (Long and Long, 1992). Findings found that it is often the powerful dominant the discourse, and distribute the knowledge as they seem to have the power to make it true and serve their interest (Gaski, 1984), especially in terms of resource use. The local government claimed that there is plenty of water resource to support future growth, with limitations that they only considered the residents that the City Utilities Department serves. However, there are many residents who depend on other water-service providers, who are also sharing the same water sources (Section 7.2.4 and 8.3). Land developers use this information to argue that water resources are able to support more developments (Section 6.2.2.3). This manifestation of power relationship between different actors illustrates Foucault's (1977) concept of power-knowledge (as discussed in Chapter 3), and also reveals that knowledge is used to promote particular political positions and serve powerful actors' interests (Nightingale, 2002).

Findings suggested that existing practices of decision-making about land use discouraged the active participation of some actors (e.g. public meeting schedules conflict with working time), in particular with the absence of good information dissemination and access, and effective negotiation between different levels of government (Section 6.2.3.1). In addition, the current practices of decision-making may also reduce the trust and confidence between communities and the government (Rasul, 2007). Thus, from a social equity perspective, more public involvement is thought to be appropriate and much needed during the decision-making process of urban growth to enhance a democratic content of socio-environmental construction (Swyngedouw and Heynen, 2003; Rasul, 2007). Such an attempt requires the identification of strategies through a more equitable distribution of social and political power. However, although a more inclusive and participatory decision-making may be more appropriate, findings indicated that powerful groups' expectations and desires were associated with economic benefits. It also seemed to be the case that those who claimed that environmental protection is their motivation were also significantly interested in increased economic benefits and political power (Section 6.2.2.2). In addition, Swyngedouw and Heynen (2003: 911) suggested that "given the power structure for making allocation decisions, those suffering from unjust distributions of resources are less likely to expect redistribution in their favour". For instance, some people who do not attend public meetings may feel that they are unlikely to influence the decisions because they perceive themselves are less powerful. However, findings suggested that some actors indicated desires to realign the power to manage the natural resources, such as NGOs (Section 5.2). It is therefore considered that a balanced power distribution will not be achieved easily in decision-making process, and such an attempt needs continually be sought and requires a long-term effort.

Overall, these findings supported the idea that power relations are imbued within social reality (Bryant, 1997; Robbins, 2004; Brown, 2009). Power imbalance between and within different actor groups during decision-making processes resulted from differentials in socio-economic status and access to resources. Ultimately, all these factors were impacted greatly by broader regional and national context. The findings suggested the centrality of power relations in the

decision-making process over land use, and power relations influenced individuals' abilities to access to and use resources (Blaikie and Brookfield, 1987).

9.3 Analytical and theoretical considerations

Turning to analytical considerations and the challenges to the study of the land-degradation problem, scale is one of most important issues to discuss. Turner (2003:164) asserted that "given the contingent nature of biophysical and social processes and their interaction, one can only understand socioecological processes leading to land degradation for a clearly identified piece of land". A piece of land is not merely an isolatable physical space but a dimension of historical and contemporary, local and national connections (Chapter 3). The local biophysical process has broader sociopolitical forces, knowledge and historical social values embedded therein (Paulson and Gezon, 2005). The urbanisation process renders the flows of capital and information across space and scales, and the localities are affected by regional and national decision-making. By taking a political ecology approach, one can observe and identify the socio-political forces, beyond the lines of the physical boundary of a piece of land or property, affecting the resource-use patterns at the local scale. In addition, environmental consequences resulting from the decision-making are often not static, such as dust, which can be easily moved around by the forces of wind. It is difficult to identify specifically which piece of land or whose particular decision-making caused the environmental impact. That is not to say that one cannot identify the environmental impacts by assessing and monitoring a single piece of land, but to extend lines of causation to a greater observation of the interactions between biophysical and socio-economic forces.

Despite the advantages in taking a political ecology approach, political ecology has been criticised as lacking a coherent theoretical foundation (Chapter 3) (Peet and Watts, 2004; Stringer, 2004). Peet and Watts (2004:11) asserted that political ecology is "is radically pluralist and largely without politics or an explicit sensitivity to class interest and social struggle". However, Stringer (2004) demonstrated that by using a political ecology framework, power relations and politics are found to be the key to the negotiation of social and ecological relations. From above discussions and analysis on power issues and resources use (Chapters 5-8), this research indicated that employing a political ecology approach together

with a multi-methods approach, politics and power relations play the significant roles in the interactions of society and nature and influencing environmental changes. Different actor groups have unequal abilities to control the land-use patterns and make land-use decisions (Blaikie and Brookfield, 1987), and determine what land looks like and in which kind of functionality. Through the analysis it can be seen that actors (e.g. NGOs) indicated desires to realign the power over resource use (Section 5.2.2), and it is a necessary future agenda that social struggle is promoted to distribute the power more equally during the decision-making process.

9.4 Policy implications

This research has suggested that land-use decision-making does not only need to take environmental considerations into consideration, but also a better coordination and negotiation between actor groups and different levels of land-management agencies. This section discusses how the policies may be improved to use and manage the resource through a brief evaluation of past and current land-use plans in the study area.

In the study area, local (city) government introduced a comprehensive land-use plan in 1999, which is a document that provides the framework and policy direction for community-development decisions. The comprehensive plan identifies where and how growth needs will be met and it thus provides the basis for many of the policies, regulation and budget decisions that cities and counties will make (Department of Commerce, 2009). The plan contains eight secions including land use, community facilities, urban design, utilities, economic development, housing, transportation and environment. However, Comprehensive Plan produced in 1999 only contains strategies for the City of Las Cruces, and it was considered insufficient for the current development patterns, due to a number of reasons. Firstly, extensive annexations have occurred in the past decade, so that more and more subdivisions are annexed to the city. The earlier plan lacks the strategies and guidance to promote smart growth and at the same time protect the natural environment. Secondly, the old plan lacks any involvement of local communities. Thirdly, the plan was designed for the City of Las Cruces, and it does not contain guidance of how the Doña Ana county and City of Las Cruces

might work together for a more effective and better land-use management. The plan was criticised by one planner and one politician who stated that the old comprehensive plan only indicated the eastward growth pattern, but did not address well the specific environmental conditions in certain areas. It did not take climatic factors and environmental risks such as flooding risk into account.

In recognising the various problems resulting from inappropriate land-use and management practices, the City of Las Cruces introduced a land-management strategy in 2010, namely Vision 2040, as a new comprehensive regional plan. It is the first comprehensive regional plan to include both the County and the City (City of Las Cruces, 2010c). Public participants took part in community 'visioning' to discuss potentials and issues in each subject area. Participants completed questionnaires and represented potentials and issues on maps in small groups.

Table 9-1 Overview of Vision 2040 Plan

	Vision 2040
The Purpose of Vision 2040: To Plan for a Common Future	• Vision 2040's Relationship to the Comprehensive Plans of the City of Las Cruces and Doña Ana County
Formulating the Vision	• The Public Input Program • The Community Inventory • The Issues Shaping Our Future
Planning Principles	• Smart Growth • Sustainability • Community Health • Smart Growth and Sustainability Work Hand in Hand
The Vision	• The Vision Statement • Goals and Objectives
The Strategy: "Smart" and Sustainable Regional Planning	• The Options Considered • The Growth Concept: A System-based Approach for the Entire Region • Applying the Growth Concept to Real Life • The Opportunities Plan
Implementation Measures	
Selected Impacts of Implementing Vision 2040	

(Source: Adapted from City of Las Cruces Vision 2040, 2010)

Table 9.1 presents the contents and strategies of the Vision 2040 plan. The Vision 2040 plan gives an overview of how the vision is formed, and its planning principles and how to measure the implementation. In accordance with the plan, there are two updated comprehensive plans for the city and the county. Different from the previous ones, the new one identifies the issues of land uses, and plans

the future land-use patterns for both the city and the county, including central city, highway commercial, urban centre, university, city suburban and suburban, and many other detailed areas. Guiding principles contain smart growth, sustainability, intergovernmental cooperation, sensitive design and green design. Vision 2040 represents a shift in the way urban space is planned, through the participation of local communities and cooperation of city and county governments. It addresses a range of environmental issues, such as water, soil and open space. As the new regional strategy for growing smartly and sustainably, it creates the criteria for planners and governmental officials to evaluate land-development plans and make appropriate recommendations. Especially, it integrates input from the local community, which is often identified as a central concern in implementing sustainable land management (Cadieux, 2008; Marchamalo and Romero, 2007; Patel et al., 2007). Although Vision 2040 provides a very positive sign of better land management in the future, this attempt is new for the region, and how effective it will be in the overall land-use and management practice is uncertain, because the land-use issues also involve State government, Bureau of Land Management (BLM) and private land owners. As illustrated earlier, poor communication between State government, BLM and local governments might became a barrier to implementing the plan effectively. In addition, the issue of power relations over environmental resources use needs to be addressed. Despite a wider range of actors being involved in the planning process than before, the terms of involvement still allow the more powerful to frame the ways in which other groups and individuals are engaged. In this case local people have limited opportunities to influence the land use and land management. More transparent and inclusive policies and decision-making processes need to move away from serving the purposes of the powerfuls to a wider population, especially the people who live in more poverty and have limited access to the resources and infrastructures. Furthermore, the interrelated issues of water and land management have not been addressed sufficiently in the new regional plan.

Nevertheless, the new management plan being introduced in the City of Las Cruces provided a starting point that local governments work together toward a smart growth. It is essential to involve the inputs from regional and national levels of government, as negotiation between different levels of government enables the

awareness of potential issues might be encountered in broader perspective. A better coordination and negotiation of the land management agencies means that both top-down and bottom-up land-use policies are also necessary to facilitate the wider participation in the decision-making processes. Higher level authorities with sufficient financial resources and some expert knowledge can help with the local government to implement the policies, and also perform as negotiators when conflicts emerging from the bottom-up approach. Higher level authorities need to improve the performance of accountability and transparency when they make decisions, in order to build trust and have a better leading role in the resource management practices. Local governments (city and county) need to work together to resolve the problems arising from the decision-making process, competition cannot make better economic gains to each entity, effective collaboration with each other is a better ways to gain mutual benefits. It is also important to transfer the plan into more tangible and measurable actions to address real issues facing the community under rapid urbanisation.

Incorporating environmental consideration into decision-making means that consideration is given prior to the land-use activities taking place, in order to minimise the negative effects. To achieve such tasks, different perceptions of actor groups toward the landscape need to be understood because perceptions guide the way actors use and manage the land, and resources cannot be managed properly without the active participation of the people who depend on the resources (Rasul, 2007). Although perceptions of landscape tend to be complex and conflicting, similarities also exist between different actor groups. A better negotiation and public participation needs to be improved so that different actor groups understand each other's expectations and concerns in terms of land use. However, as indicated earlier (Section 9.1), power relations are imbalanced in the negotiation of resource use, and it is uneasy to promote a democratic socio-environmental construction through a balanced distribution of social and political power. Partly because powerful groups tend to actively influence decision-making, whilst less advantaged groups lack motivation to take part in, hence they have limited chances to be actively empowered. Therefore, power relations within the community need to be considered in the participatory process. Research indicated that in some cases, participatory process does not achieve representation of the

best interests of the entire community, and might be directed by a few representatives even if they were selected by a democratic process and intended to represent interests of all (Stringer, 2007). This situation might be improved by involving a wider public taking part in the consultation and review from the beginning of a proposed land-use plan until the end of the decision-making. It also needs to improve the grassroots education in participatory techniques to "root the structures of normative participation and active citizenship within people's everyday lives and help them to understand the roles they can play and the mechanisms they can use to be empowered" (Stringer, 2007: 392).

The difference of perspectives between experts and the general public also needs to be noted, because experts normally have specific knowledge that the general public may not recognise. As the example demonstrated in Chapter 5 (Section 5.2.1.1), most residents consider that the native plants are the best for the desert, but an expert pointed out the limitation of this perspective and commented that it is important to know the precise environments where particular species can grow and survive. However, local knowledge is also meaningful as illustrated in Chapter 7, as local respondents can relatively easily notice environmental changes, and their knowledge and understanding can help policy makers to develop more relevant and effective land-management strategies. Scientific knowledge is also much needed. However, it is also argued that scientific knowledge is perceived as a source of power, because not everyone has equal access to it or ability to interpret it (Stehr, 1991). Therefore, it also needs to make sure that no single group should dominate the discourse. Local government and experts need to disseminate more information and knowledge to a wider community so that people are aware they actually do what is right beyond their knowledge in their own judgement, but also they understand the issues from a broader perspective. It also helps to distribute power between actors since knowledge is associated with power as discussed above (Section 9.1), and empowers local actors because they may become more confident with more information and knowledge to get involved in the decision-making process.

Motivations for land-use decisions ranging from micro-scale to macro-scale also need to be investigated and considered, as they have important environmental implications and can shape the local land-use patterns. More education and

promotion of environmental considerations are much needed to ensure the equal access to resources.

9.5 Implications for future research

The case study that makes up this thesis focused on the land-degradation problem at the local scale and reflected the influence of power relations from the regional and national level. The case-study approach applied in this study enables an in-depth understanding of the complexity of the decision-making process and its related environmental changes within the political, social, economic and cultural context. The actor-oriented approach to the study on the land-degradation problem also makes the research relevant to the local population. Research needs to produce useful and applicable knowledge, which means that researchers need to take into account both the people for whom the research is carried out and the intended applications of results (Stringer, 2004). An improved understanding of the land-degradation problem is not meaningful if it is not translated into accessible forms for both decision-makers and the local population. This translation can only be achieved through more open communications between and within different actor groups. Hence, there is a need for future research into mechanisms of practical knowledge production and communication (Stringer, 2004). These include promotion of political and structural change towards more democratised participatory process, dissemination of knowledge to a wider public and development of practical tools to be utilised in the decision-making processes. It is also important to note power relations may play a significant role in the participatory process. As discussed above, power is unequally distributed between and within actor groups. Differences of socio-economic status and resource availability might influence on individuals, including their capacities to speak, act, communicate and influence others. Exploration of balanced power relations (Or at least ones that seem to be – allowing the different participants to think they have benefitted from their perspectives) between groups and individuals can promote greater success in the participatory approach. Future research including both theoretical and methodological improvements concerning the power issue, including conceptualising power, measuring power and equally distributing power,

would improve the validity of research and facilitate the research translating into more tangible practices in reality, and is therefore much needed.

Further research may look at a comparison between different case-study areas and may shed further insights into the complexity between land uses and socio-political diversity. For instance, comparing the case-study to other arid cities in the Southwest such as El Paso in Texas, which has similar climate and ecological characteristics (both are located in Chihuahuan Desert eco-region and sharing the Rio Grande basin as water resource), but different social and political contexts. In addition, future research can explore the influence from the international scale that provides insights into how the wider political economy shapes the interrelationship between nature and society on the local and regional level, and how the local land-use practices can link to the broader context of natural resource management.

Integrating other scientific research methods to enable a truly interdisciplinary and holistic research, such as field monitoring, ecological modelling and GIS techniques, over longer temporal scale can add depth to this research. Such attempts can observe how different stages of natural processes interact with the socio-economic process and evaluate how realistic the interpretations of the different actors are, because land degradation is a dynamic process and the socio-political environment is changing and interplaying with environmental changes. In addition to the methodological improvements, a final key area for future research is associated with the theoretical improvement of political ecology. Political ecology approach can integrate with other approaches such as sustainable livelihood approaches, as the latter can "lend political ecology a finer texture and an enhanced socio-cultural dimension, thereby helping to integrate different scales of analysis more efficiently." (Jones, 2008: 686). Such integration of methods and theoretical approaches can also enable theoretical and methodological improvements to benefit future research in different cases and contexts.

Appendix I Interview guide

Resident

1. Briefly explain project

2. Ask interviewee to outline their job and how long they've involved.

3. Experience and perceptions about East and Northeast areas

3.1) Could you please tell me how long you lived in this area and why you moved in?

3.2) Do you do recreational or social activities in the N/NE areas other than living here? Which places you normally go for recreational activities? how often? Distance from your home to recreational areas?

3.3) What sorts of things you like in the E/NE? Things dislike? Why and examples.

4. Drivers of decision-making (if not theirs, then perceptions of others')

4.1) Which kind of plants in your both yards? Are they your own design or coming with house?

4.2) What's the agreements/covenants with that? (how much are you allowed to change the yard?)

4.3) Have you been told or have you thought about why the developers are doing this kind of yard?

4.4) If your own design, why did you put these plants and trees instead of others? Why did you choose this design?

Prompt for: safe money? acquire comfortable living? follow my neighbours/fellows? to do something I enjoy? To maintain my lifestyle? Cultural reasons?

4.5) In addition to your own yard, does your neighbour's yard give you some ideas or in any way? Anyone else inspires you?

4.6) Can you give some particular examples?

4.7) Did you seek advice from someone about the yard design (vegetation type, how to maintain it, etc.)?

4.8) Do you read magazines, newspapers regularly related to the yard/garden things? Can you offer some examples?

4.9) Do you like the current yard? Why and examples?

4.10) What sorts of activities do you do in your yard? (children playground, relax,

socialising with people, family party, others etc.)

5. Residential landscaping impacts on the east/northeast area

5.1) What about the benefits and costs (advantages or disadvantages) of this yard brings for you? i.e. xeriscaping vs. lawn?

5.2) Can you elaborate on it?

5.3) Do you see these benefits and costs are also important for the desert? Why are they important?

5.4) Do you have any restrictions on watering your yard?

5.5) It may not happen in your yard, but have you noticed any accidental things like water leakage, plants leaves are blown away, more dusty happened in your neighbourhood?

5.6) Have you heard about any regulations/suggestions to combat them? What are they? Where did you hear from?

6. Desert impacts on residential landscaping design

6.1) Does the desert environment give you any difficulties or advantages to do your yard compare to where you lived before?

6.2) Can you give some examples?

6.3) How do you overcome these difficulties? Report it to some responsible body?

6.4) Which kind of information or help do you think you may need in respect to these difficulties and challenges?

6.5) Have you considered redoing your yard? How?

7. Questionnaire

8. Background of the interviewee throughout the interview. (ethnicity, political side, occupation, age group, education)

9. Debriefing

Land developer

1. Briefly explain project

2. Ask interviewee to outline their organisation/company's:

responsibility/business activities and their role within that.

3. Experience and perceptions about East and Northeast areas

3.1) Could you please tell me about the different ways in which you spend time in this area? For example, you live here or do recreational or social activities etc? If so, how often do you do recreational or social activities in E and NE?

3.2) Why did you start your land development business in the city? Was it profitable?

How long have you been involved in land development?

4. Drivers of decision-making

4.1) Do you have any land development activities in the E or NE currently? What's the most recent one in the E/NE? Where is it located? (show map)

4.2) Could you please tell me a bit more about it from the very beginning?

For instance, how did you know there is an opportunity for this land disposal/deal? Where did you acquire the land from and how? Which type of development? How long has it been approved?

4.3) What factors motivated you to make such efforts to do that transaction/deal? More specifically, why did that piece of land attract you more than others? What criteria is being used to determine the buy/develop decision of that land?

Or How did you arrive at this decision that buy/subdivide a residential/commercial units there?

4.4) Can we go into this in more detail, why did you want to put this residential/commercial units in this location? What else amenities you constructed to serve the housing units? Were they required by regulations?

4.5) Initially, when your company/organisation made the decision to develop the land, what were the organisation's expectations from it? What outcomes were expected?

Prompt for: make a living? capitalise a market opportunity? Maximum business growth? Extend business? Increase income? Acquire comfortable living? Acquire persona wealth? Secure family future? Gain public recognition? Enjoy? Do something I like? Personal hobby? Maintain my lifestyle? Ensure succession?

4.6) If it is a residential unit, what's the backyard agreements/covenant if there is any? And who decided this? Why? Can you elaborate on this?

4.7) Have you had any disagreements or conflicts with some people/organisations in getting that transaction completed? For examples? (name, organisation, relationship)

4.8) Can you give specific examples of what has been discussed, what's the issues of disagreement?

4.9) If not covered earlier, does your company/organisation have much interaction with local government? In which way? Can you elaborate on it?

Or does your company have much interaction with local communities, which ones?

And in which way? Can you give examples?

4.10) Do you read any newspaper articles or magazines in discussing about the topics of land development and growth in the E and NE areas?

4.11) How do you think about these discussions? Can you please offer particular examples?

5. Land development impacts on the east/northeast area

5.1) In your opinion, are there any issues of concern in respect to land developments' impacts on the land and environment in the E and NE areas?

- over developments
- under developments
- uneven land development
- others

5.2) Can you give specific examples?

5.3) How would you think your land development affects the east/northeast area now and in the near future? Both positive and negative?

Dust blow? Noise? Soil degradation? Water pollution and shortage? Land fragmentation? Make a difference? Any other?

5.4) Did you receive any complaints about your land development activity? What are they?

5.5) What sort of plans can be used or do you use to combat/moderate those impacts such as dust blow?

6. Desert impacts on land development decision-making

6.1) How do you think that the desert offers you unique opportunities and/or constraints on your land development business?

6.2) Where do you see your business 10 years from now? Future approach?

7. Questionnaire

8. Background of the interviewee throughout the interview. (ethnicity group, political side, occupation, age group, education)

9. Debriefing (sum up, questions from interview)

Planner

1. Briefly explain project

2. Ask interviewees to outline their organisation/department/section's:

responsibility and their role within that and how long they've involved.

3. Experience and perceptions about East and Northeast areas

3.1) Could you please tell me about the different ways in which you spend time in this area? For example, you live here or do recreational or social activities etc? If so, how often do you do recreational or social activities in E and NE?

4. Drivers of decision-making

4.1) Do you have any land planning activities in the E or NE currently? What's the most recent one in the E/NE? Where is it located? (show map)

4.2) Could you please tell me a bit more about it from the very beginning?

For instance, who acquired the land? For what purposes? Public bidding or how did they acquire it? Give information of opportunities to the public?

4.3) What factors motivated your department/section to make that plan? Why was it important? What criteria are being used to determine the sell/disposal decision of that piece of land?

Can you elaborate on it? benefits? Costs?

Or How did you arrive at this decision that disposal/exchange that piece of land? What role does the location play in your department's choice of exchange?

4.4) Can you give some examples?

4.5) Initially, when your department/organisation made the decision to disposal/exchange the land, what were the organisation's expectations from it? What outcomes were expected?

Prompt for: to increase tax income? increase income opportunities? improve public welfare? Fully utilise the unutilised resources? improve neighbourhood living quality? gain public support? meet challenge? maintain lifestyle? Etc.

4.6) Have you had any disagreements with some organisations/people in getting that deal/transaction completed? (name, relationship etc.)

4.7) Can you give specific examples of what has happened, what's the issue of concerns?

4.8) Do you tend to keep aware of the media discussions/articles on land deal issues or even any controversial debates? Does the media influence your department's decisions in any way?

4.9) Does your department have much interaction with local government? In which way? Do you consult/discuss any of your land deals/plans with local

government? Examples?

4.10) Does your department have much interaction with local communities? In which way?

4.11) How do you think to balance between growth and resources use especially water in the future?

What sorts of approaches/mechanisms can be used (does your department) to achieve the balance?

- regulatory approaches
- voluntary agreements
- others

Can we discuss their relative strengths and weakness?

5. Land deal impacts on the east/northeast area

5.1) What particular issues of concern in respect to land deal/transaction's impacts on the land and environment?

- over developments?

- lack of connection/liaison between regulatory bodies i.e. local and State

-others

5.2) How would you think your land deal influences the east/northeast area now and in the near future? Both positive and negative?

Soil degradation?

Water pollution and shortage?

Land fragmentation?

Any other?

5.3) What plans/approaches can be used or do you use to combat those impacts?

6. Desert impacts on land deal decision-making

6.1) How does the desert provide unique opportunities and/or constraints on your department's planning practices?

7. Questionnaire

8. Background of the interviewee throughout the interview. (ethnicity, political side, occupation,)

9. Debriefing (sum up, and answer interviewees questions)

NGO

1. Briefly explain project

2. Ask interviewees to outline their organisation/department/section's: responsibility and their role within that and how long they've involved.

3. Experience and perceptions about East and Northeast areas

3.1) Could you please tell me about the different ways in which you spend time in this area? For example, you live here or do recreational or social activities etc? How often do you do these activities?

3.2) Why you started doing land conservation in the East/NE area? How long been involved in?

4. Drivers of decision-making

4.1) What's your most recent land conservation activity in the east? Where is it located? (show map)

4.2) Could you please tell me a bit more about it from the very beginning?

For instance, what factors motivated your organisation to conserve that piece of land? More specifically, why did your organisation want to stop that land from being developed? Why was it important?

4.3) Can you elaborate on it?

4.4) Can we go into this in more detail, for example, what are the advantages of this location?

4.5) Initially, when your organisation made the decision to conserve that land, what were the organisation's expectations from it? What outcomes were expected and were they achieved?

Prompt for: acquire comfortable living? Improve living quality? Increase income? Secure sustainable future? Gain public recognition? Enjoy? Do something I like? Personal hobby? Meet challenge?

4.6) Have you had any disagreements with some organisations/people in getting that land conserved? (name, relationship etc.)

4.7) Can you give specific examples of what has happened, what's the issue of concern?

4.8) Do you tend to keep aware of the media discussions/articles on land conservation issues? Does the media influence your organisation's decisions in any way?

4.9) Does your organisation have much interaction with local government? In which way? Can you give some examples?

4.10) Does your organisation have much interaction with local communities? In which way? Can you offer specific examples?

4.11) Has your organisation organise any events or activities to educate the public about land conservation? What are they? Can you give specific examples?

4.12) What approaches can be used or do you use to balance land conservation and growth in the desert?

- regulatory approaches
- voluntary agreements
- others

Can we discuss their relative strengths and weakness?

5. Land conservation impacts on the east/northeast area

5.1) What are the specific issues of concern in respect to land conservation in the E and NE areas?

- over developments?

- lack of connection/liaison between regulatory bodies i.e. local and State

- lack of public support and involvement

-others

5.2) Can you give particular examples?

5.3) How would you think your land conservation influences the east/northeast area now and in the near future? Both positive and negative?

Reduce Dust blow? Increase biodiversity? Reduce soil degradation? Moderate water pollution and shortage? Land fragmentation? Any other?

5.4) To what extent do you think your organisation's activities can influence future land-use policies and practices?

6. Desert impacts on land conservation decision-making

6.1) Do you think that the desert offers you unique opportunities and/or constraints?

6.2) Can you elaborate on it?

7. Questionnaire

8. Background of the interviewee throughout the interview. (ethnicity, political side, occupation, age group, education)

9. Debriefing

Appendix II Perception of desert landscape

Section 1: Your views of East Mesa

For the following statements, please select your answers of your views of East and Northeast areas according to the scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree); except statement 3, which should use the scale: 0 = no, 1 = once, 2 = A few times (more than three), 3 = Often (weekly).

1. I believe that East and Northeast (NE) areas have plenty of water capacity for development.	Strongly disagree 1 2 3 4 5 Strongly agree
2. I believe that the East and NE areas have plenty of land capacity for development.	Strongly disagree 1 2 3 4 5 Strongly agree
3. I have been to the Chihuahuan Desert Nature Park	Yes No = 0 If yes, please select: 1 = once, 2 = A few times (more than three), 3 = Often (weekly).
4. I think the houses are spaced too closely together in the East and NE areas.	Strongly disagree 1 2 3 4 5 Strongly agree
5. I would like to see more development in the East and NE areas.	Strongly disagree 1 2 3 4 5 Strongly agree
6. I would like to see more public open space (park, children playground etc.) in the East and NE areas.	Strongly disagree 1 2 3 4 5 Strongly agree
7. I fear for a water crisis in the East and NE areas in future.	Strongly disagree 1 2 3 4 5 Strongly agree
8. Native plants and trees are the best for home landscaping in the desert.	Strongly disagree 1 2 3 4 5 Strongly agree
9. I see little value in desert vegetation.	Strongly disagree 1 2 3 4 5 Strongly agree
10. When I look at the desert, I see, for the most part, an empty wasteland.	Strongly disagree 1 2 3 4 5 Strongly agree
11. Homes should be built in a water and energy efficient way in the desert.	Strongly disagree 1 2 3 4 5 Strongly agree
12. I would prefer not to stay in a desert.	Strongly disagree 1 2 3 4 5 Strongly agree
13. I would prefer to move out of the desert in the near future.	Strongly disagree 1 2 3 4 5 Strongly agree

Section 2: Your views of desert ecosystem

For the following statements, please select the ones which best reflect your opinion of desert ecosystem, and rank them according to the scale i.e. 1 = most agree 2=second most agree etc.

I perceive the desert as….”
…An inhabitable landscape
…A profitable landscape to be used or developed
…A pristine landscape to be preserved
…A place good for ranching
…A place of a wide range of plants and animals
…A place devoid of biodiversity
…A place full of barren land
…A place full of immense sand dune
…A place full of woody plants
…A place lack of water
…A dusty place
…A windy

Appendix III Consent form

Land-use decision-making and land degradation

PRINCIPAL INVESTIGATOR:

Yang Yu

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Telephone: +44 (0)1142227914

DESCRIPTION:

I am interested in the motivations and effects of people's land-use decision-making in the desert. You, as the decision-makers, either for city planning or for your own landscaping, can describe your motivations behind the decisions.

This research will involve one interview with you, and it will last approximately 45 minutes to 1 hours. The interviews will be audio recorded using a digital voice recorder. The digital file will be typed out as word-for-word transcripts of the interviews. The file will then be erased.

CONFIDENTIALITY:

Your name will not be attached to your interview transcripts. Your name and any other identifiers will be kept in a password-protected file that is only accessible to me. Any information and results from this study that are published will not identify you by name.

BENEFITS:

There will be no direct benefit to you from participating in this study. This study will contribute to the broader literature on decision makings and environmental changes under the pressures of urban sprawl in dryland regions and enhance sustainable landscape changes in the region of South New Mexico. It will raise the awareness that contemporary activities such as recreation and construction becomes more threat without consideration of environmental consequences in the urban areas.

RISKS:

There are no known risks to you.

CONTACT PEOPLE:

If you have any questions regarding this research, please contact the Principal Investigator either by email or by phone number listed above. If you have any questions about your rights as a research subject, please contact the Institutional Review Board Chair, through the Office of Compliance at New Mexico State University at (575) 646-7177 or at ovpr@nmsu.edu.

VOLUNTARY NATURE OF PARTICIPATION:

Your participation in this study is voluntary. If you don't wish to participate, or would like to end your participation in this research study, there will be no penalty or loss of benefits to you to which you are otherwise entitled. You are free to make your own choice about taking part in this study or not, and may quit at any time without penalty.

SIGNATURE:

Your signature on this consent form indicates that you fully understand the above research study, what is being asked of you in this study, and that you are signing this voluntarily. If you have any questions about this study, please feel free to ask them now or at any time throughout the study.

Signature _____

Date _____

A copy of this consent form is available for you to keep.

Date _____

A copy of this consent form is available for you to keep.

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