‘To be bent without breaking …’:

Resilience to Water Scarcity in an Informal Settlement in Lima, Peru

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Abstract

The study examines the proposition that ways of experiencing an environment are inextricably linked to ways of acting within it. It does this by investigating resilience to urban water scarcity in an environment of rapid change along three proxy indicators; perceptions, control and flexibility. Resilience is holistically defined as pertaining to both individuals and their supporting environments; and with a focus on positive, long-term outcomes. The study provides empirical evidence that understanding the experienced dimensions of urban water scarcity is a vital prerequisite for a holistic conceptualization of this phenomenon and that it can act to bridge the divide between the socio-political construction and the human experience of urban water scarcity.

The methodology is designed to elicit depth, rather than breadth of understanding, whilst addressing the need for conceptual generalization that advances theoretical perspectives that may be instructive in studying other, albeit different cases of urban water scarcity elsewhere. Twenty-three households in two neighbourhoods of one informal settlement in Lima, Peru; and eight institutional stakeholders collaborated in the production of data during five months in the Peruvian autumn of 2012.

The study finds that participants did not have sufficient water to meet their basic needs and that water scarcity existed along its indicators of quantity, quality and security of access. Specifically, the study finds that the onus of addressing the effects of water scarcity lay almost entirely on end users, whilst their ability and means for doing so were heavily constrained by individual capacities for adjustment and by features of a disabling environment.

Participants' constraints on considering the best action available, making informed decisions and deploying appropriate responses to water scarcity arose from a combination of having become normalized to the water scarce environment; the effects of the interaction of multiple forms of scarcity; the overwhelming number of water-related tasks consuming resources including time and mental capacity; and from the effects of inequality operating at different scales. These constraints resulted in processes of short-termism, loss of trust in their ability to effect change and in individualization, which further limited the capacity for resilience.

The study makes a number of contributions to the literatures on (water) scarcity, rapid change and resilience. It finds that water, due to its vital role to daily survival, is a distinct type of resource that is not amenable to generalization to other, non-vital types of scarcity. The interaction of water scarcity with other types of scarcity operating at different scales is found to diminish resilience.

The study provides evidence for the need to define resilience as comprising long-term, positive outcomes as it found short-term responses to water scarcity to attract more severe, longer-term challenges. Further, it provides lessons for our understanding of the constraints of rapid urbanization on residents' ability to construct livelihoods, evidenced by findings which show that residents' livelihoods are suspended in a context of rapid change. The study further documents the interaction of multiple, nested scales of water scarcity and the difficulty of assessing their effects on the ability to develop resilience in the long term.

The study's findings suggest that the concept of resilience, in contexts of vital resource scarcity, cannot reasonably be employed as an aim, but can usefully serve as an indicator for identifying the most appropriate areas of intervention or support. The study concludes that chronological compliance, or prior institutional provision of enabling conditions is required before household resilience can unfold to its full potential.

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Chapter 1:
Resilience in Environments of Rapid Change and Scarce Resources

1.1 Resilience in environments of rapid change and scarce resources

The beginning of the 21st Century is characterized by unprecedented speed of environmental change and increasing resource scarcity, which negatively impact on human wellbeing at the global scale, with those living in conditions of poverty in economically developing regions most at risk of the negative consequences of these forces (Thomas, 1997:220). This dissertation examines the parameters that enable and hinder resilience to resource scarcity at the household level[1] in contexts of rapid change, using water scarcity in an informal settlement in Lima, Peru, as a case study.

Issues of resource scarcity are given particular pertinence in rapidly growing urban environments, where fast expansion of human settlements puts particular strains on natural resources, bringing the interaction of rapid change and scarce resources into sharp focus. Whilst rapid urban growth and associated demands on natural resources tend to affect urban populations as a whole, these effects are most keenly observed in areas where conditions of inequality and poverty perpetuate their occurrence, such as in informal settlements of rapidly growing urban centres. This study therefore employs a case study of urban water scarcity in an urban informal settlement. Lima is chosen as the case study for its long history and extensive literature on informal settlements since their rise in the 1950s, as well as for the particular pressures on water resources bearing on the city.

1.1.1 Adjustment to environments of rapid change and scarce resources

The way human beings interact with their environment is undergoing radical changes. The interaction between people and their environment is a two-way process (Redman *et al*, 2004). Human beings respond to changes in their environment and at the same time attempt to modify the environment to meet their needs (Moran, 2006: 40). Before industrial advances and widespread global development, environmental changes were responded to by reproducing tried and tested means of interacting with the environment and gradually modifying these according to success and failure, taking into account the changing features of the environment (Moran, 2006, 2008). This slow adjustment process of

[1] The household is chosen as the primary unit of study, but as some aspects of responses to water scarcity are best observed at the individual level, and others at the neighbourhood level, the analysis moves between these as appropriate.

considered responses of varying scale and effect is becoming increasingly inadequate in contemporary environments of rapid change and severe constraints. Rapid changes require a larger and faster array of responses, which allows less time for reflection or planning before acting (Thomas, 1997:216). Severe environmental constraints, such as resource shortages, are likely to limit the type and range of responses that are possible (Thomas, 1997:220). Both rapid change and severe constraints can therefore have negative consequences for the outcome of responses to environmental change, as they reduce the ability to employ those response strategies that have traditionally ensured appropriate adjustment to environmental changes and challenges.

1.1.2 Rapid change

Change is inherent in any system, and degrees of human adjustment to the environment vary with changing contexts (Nelson *et al,* 2007). Human beings have been a 'major force in global change' (Folke, 2006) and have been inducing environmental change at larger scales and faster rates than natural environmental variation would cause (Sih, 2013), leading to unprecedented threats to human and eco systems. Rapid change is defined as 'occurring so rapidly that natural systems no longer have time to adapt' (IPEC, 2003:3), and, by extension, at a rate that does not allow sufficient time for the consideration of appropriate human responses to such change (Thomas, 1997). Additionally, some natural systems' very slow reaction to rapid change will see impacts become fully apparent only decades later (IPEC, 2003*)*, leading to a high degree of uncertainty and unpredictability.

As a result, there is growing demand for 'a refined understanding […] of the scale and magnitude of the adaptations different populations must make in order to adapt to or mitigate these changes' (Moran, 2008:3). This study focuses on the lived experiences of scarcity and rapid change that inform such adjustments at the household level. The experienced dimensions have not been as widely examined as, for example, the socio-political forces that shape such environments, resulting in an unbalanced understanding of how adjustment to environmental change happens (cf. chapter 3 for further discussion).

A number of associated phenomena have been shown to threaten human life in the medium and longer terms. Forces of globalization (Mennell, 1990; McMichael, 2013, Rockström *et al,* 2009), climate change, rapid urbanization

(Myers and Patz, 2009); population growth and related concerns about food, water, energy and land security all converge to produce a scenario of unpredictability and threat to human life. It is, however, the overarching and unprecedented speed of change, and its convergence with increasing resource scarcity, that affect all these processes and constitute a common threat to human wellbeing. They therefore form the focus of this study.

1.1.3 Scarce resources

Conceptualizations of scarcity have been undergoing considerable changes over the past decades. Originally arising out of the economic principle that infinite human growth would eventually lead to a lack of finite natural resources (Malthus, 1798), the concept of scarcity was long associated with 'material lacking' (cf. Panayotakis, 2011, for a history of the concept). In recent decades it has become recognized that scarcity, and especially scarcity of natural resources such as water, is predominantly a social construct. In urban contexts, the forces affecting the production of scarcity can be at their most pronounced, evidenced by a growing body of literature on urban water scarcity that highlights the role of political processes in the production, distribution and allocation of natural resources (e.g. Escobar, 2006), water among them (e.g Swyngedouw, 1999, 2009). Notwithstanding this literature, the socio-political dimension alone does not suffice to explain constructions of scarcity.

Departing from the economic, social and political dimensions of scarcity, recent work in the behavioural sciences has considered scarcity as a mental construct, delineated by physical resources, but crucially also by individual perceptions of the experience of scarcity. Mullainathan and Shafir (2013) propose that a key dimension of scarcity is its impact on the human mind, whereby scarcity creates a mind-set that 'can help explain the behaviours and consequences of scarcity' (*ibid:* 13) and results in a mind occupied by scarcity lacking the capacity to deal with other aspects of life. The notion of scarcity aggravating the problem of scarcity has also been documented in studies examining the politics of resource allocation in the fields of water, food and energy. Mehta (2010) and her contributors have shown how vicious cycles are created by 'conventional visions of scarcity' (*ibid*:253) that are prioritized over 'local knowledges and experiences of scarcity' (*ibid*). Additionally, water scarcity can rarely be conceived of as an isolated incident of scarcity, but is usually embedded in a web of multiple scarcities (Ioris, 2012b; Ohlsson & Turton, n.d).

1.1.4 Resilience

The concept of resilience has been experiencing a surge in popularity in a multitude of disciplines concerned with questions of human survival and wellbeing in contexts of stress and change, with a growing body of literature examining resilience at the interface of social and ecological systems (e.g Folke, 2006; Walker *et al,* 2002; Nelson *et al,* 2007). These works attempt to understand the interaction of human and natural systems at a time when the destructive impact of the former on the latter is widely acknowledged (Crutzen and Stoermer, 2000).

Despite a long history of the concept tracing back to Classical times (Alexander, 2013), its application to social-ecological systems arose from the observation of 'a system profoundly affected by changes external to it, and continually confronted by the unexpected' (Holling, 1973:1). This description precisely encapsulates the afore-described features of environments of scarce resources and rapid change, making the concept a suitable 'umbrella' for investigating household resilience to resource scarcity in contexts of rapid change.

The concept is examined in greater detail in chapter 2. Suffice to say at this point that for the purposes of this study, I expand on Vaillant's (1993) definition of social resilience ('The capacity to be bent without breaking; and the capacity, once bent, to spring back' [*ibid*:284]) by including the crucial notion that resilience should encompass not a return to the status quo, but a bettering of circumstances and good long-term prospects (National Academies, 2012; DFID, 2011). To adjust Vaillant's definition for the purpose of this study:

'The capacity to be bent without breaking and
the capacity, once bent, to bounce forward'

1.2 Problem Statement

Life in environments of rapid change and scarce resources is threatened by high levels of uncertainty and unpredictability, and by a lack of material and social resources, including time, to prepare appropriate responses to the challenges arising out of such environments. Methodologically, long-term persistence of a population is difficult to assess as the appropriateness of responses to changing environments can only be demonstrated over long time spans (Ulijaszek, 1997a). Nevertheless, the question of the parameters that affect long-term persistence in environments of rapid change and scarce resources is highly pertinent due to the rising number of people inhabiting such environments (Moran, 2008).

This study is thus concerned with addressing the gap in understanding of the experience of scarcity in environments of rapid change. It attempts to do this by examining the scale and magnitude of the adjustments necessary to adapt to environmental changes (Moran, 2008:3) in such circumstances, and by prioritizing 'local knowledges and experiences of scarcity' (Mehta, 2010:253) with a view to arguing their place in a holistic conceptualization of scarcity. These notions are explored through the lens of resilience, and examine the means and processes by which residents of two neighbourhoods in an informal settlement in Lima adjust to the myriad of challenges arising from lack of water and sanitation. The study employs three proxy indicators – perception, control and flexibility - that aid in estimating likelihood of long-term resilience by uncovering and delineating the enabling and hindering parameters arising out of the physical, social and political environments.

1.3 Research Questions

The aim of this research is to understand how resilient households are in dealing with water scarcity in a context of rapid change. In order to achieve this aim, the following questions were formulated to guide the research process:

1. Does water scarcity exist in the study location? If so, how do its extent and quality manifest? (Chapter 5)
2. How do perceptions of water scarcity relate to responses to the constraint? (Chapter 6)
3. How do perceptions of control relate to attempts to exert control over the water scarce environment? (Chapter 7)
4. How flexible are residents in dealing with water scarcity? (Chapter 8)
5. How do perceptions of, control over and flexibility in relation to water scarcity delineate resilience to the constraint? (Chapter 9)

1.4 Research Design

Contexts of rapid change and scarce resources have been studied from a range of disciplinary backgrounds (cf. Moran, 2008:3ff for a discussion). The aim of understanding the experience of water scarcity required a methodological approach of empirically rich description arising from few cases studied in depth, whilst addressing the need for conceptual generalization that advances theoretical perspectives that may be instructive in studying other, albeit different cases of urban water scarcity elsewhere (Small, 2009).

The research design is, with the exception of the quantitative water measure, qualitative in its approach and methods and aims to generate depth of

understanding by applying a case study approach to the sampling of interview participants, with 'each case provid[ing] an increasingly accurate understanding of the question at hand' (Small, 2009:24) and 'each case's findings inform[ing] the next until a point of saturation is reached' (*ibid*). Secondly, the use of some features (although not the full approach) of the 'extended case method' conceived by Van Velsen (1967), Burawoy (1998) and Mitchell (1983), among others, aims to understand the specifics of each case by investigating the societal forces that shape it (Small, 2009:20), allowing the interpretation of individual experiences within their larger socio-political context.

1.5 Theoretical Framework

This study is based on the theoretical assumption that resilience to environmental challenges affords good chances of long term persistence in difficult environments, as it stresses the capacity for considerable fluctuation of both environmental conditions and human responses; acknowledges both the impact of external forces and the role of individual plasticity in reacting to such changes; and enables understanding the role of individual agency in deploying different responses when contexts and associated challenges change. A holistic theory of socially constructed water scarcity, with particular focus on its experienced dimension, is adopted to examine this assumption. Three proxy indicators are employed to examine the likelihood of long term resilience in the face of water scarcity. The conceptual framework on the next page outlines the relationship between the proxy indicators used to examine each concept, and how they relate to the research aim and methodological design.

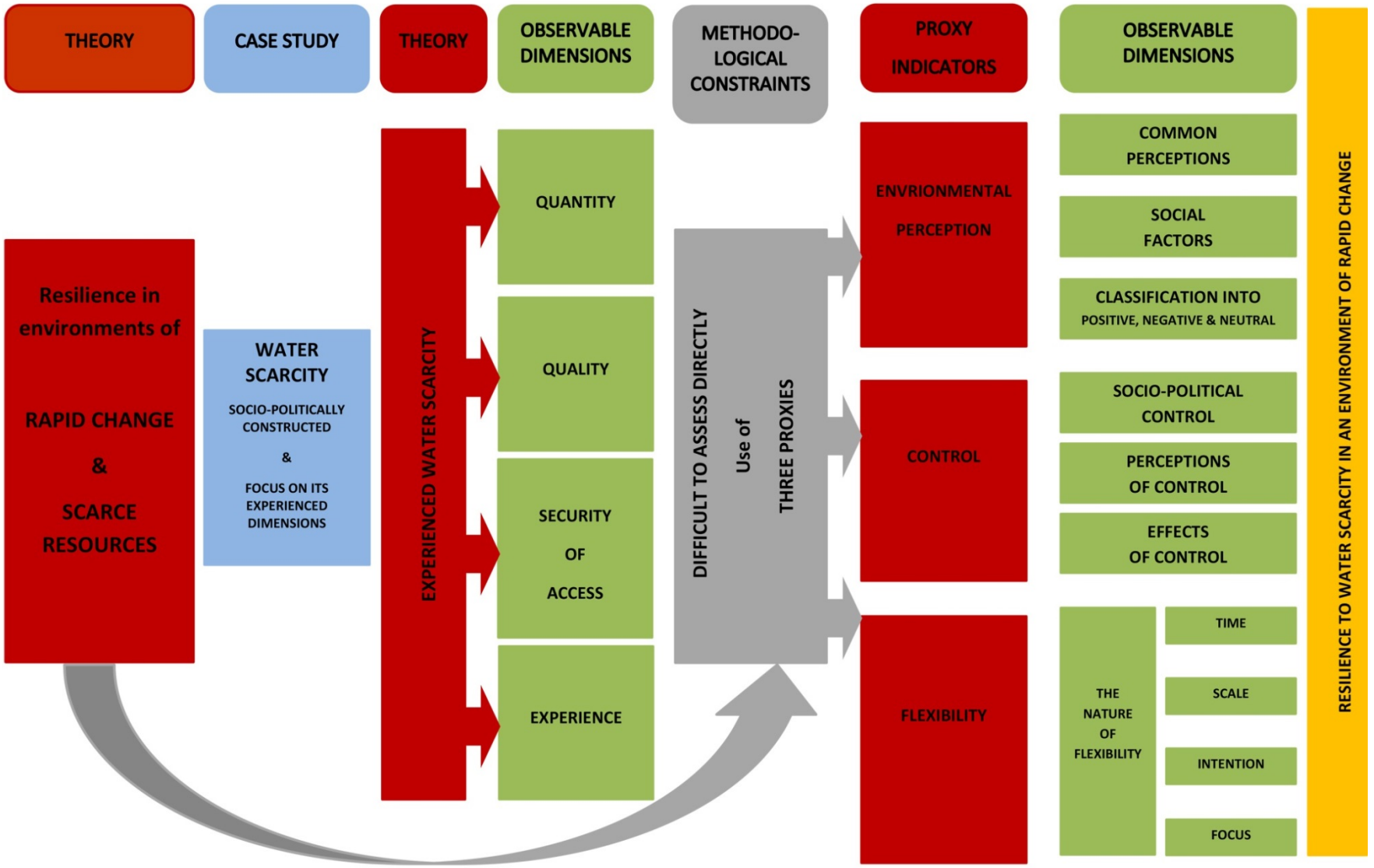


Figure 1.1: Resilience in Environments of Rapid Change and Scarce Resources: Theoretical Framework

1.6 Purpose, Significance and Contributions

This study sets out to determine factors that enable or hinder household resilience to the constraints of water scarcity within a rapidly changing environment. It aims to add to our understanding of the experienced dimensions of water scarcity. In expanding our knowledge of the quality and extent to which this impacts on livelihoods in the study community, it hopes to shed light on the intricately linked forces and multiple scarcities, of which water is one, that affect the realisation of human potential in this environment. The study makes modest contributions to the literatures on (water scarcity), rapid change, perception, control, flexibility and resilience.

1.7 Assumptions, Limitations and Scope

This study is based on a number of assumptions. These include the understanding that participants of the study are highly qualified to contribute their knowledge due to their first-hand experience of living with water scarcity, or of working on issues related to water scarcity in the study location. It is further assumed that participants represent their views of the situation truthfully and accurately based on their personal experience, and to the best of their individual knowledge.

The study is subject to a number of limitations, which arise from the time and budget constraints of a PhD study, as well as from a range of methodological constraints inherent in a study of this kind. These include the risks of researcher bias and perceptual misrepresentation common to qualitative studies. Due to its aim of recording depth, rather than breadth of the experience of water scarcity, the scope of this study was limited to collaboration with 23 households in two neighbourhoods in one informal settlement in Lima, and to in-depth interviewing of 8 key stakeholders. Associated issues of generalizability and validity are discussed in chapter 4.

1.8 Dissertation Structure

The structure of the dissertation reflects the order of the theoretical framework that underlies it.

Chapter 2 provides a literature review of the concepts used to examine responses to environments of rapid change and scarce resource: resilience, perception, control and flexibility.

Chapter 3 introduces the concept of urban water scarcity, and examines its spectrum spanning the combination of global, national and local socio-political processes that shape geological constraints of water availability on the one hand, and the personal experience of lacking water on the other. It discusses the forces that shape the water-scarce context in Lima and its informal settlements; and introduces the characteristics of La Nueva Rinconada, the study location.

Chapter 4 outlines the dissertation's methodology, which is based on the premise that little-understood phenomena, such as the experience of water scarcity, require examination in depth, rather than breadth, so as to maximise understanding of the range of issues that bear on it. It discusses the methodological approach of learning from small samples, the specific research design, data collection and analysis methods employed, as well as the gains and limitations arising from this approach.

Chapter 5 examines the data from La Nueva Rinconada to establish if and how water scarcity manifested in the study location in 2012, and charts its existence and extent along the established parameters of quality, quantity and security of access.

Chapter 6 completes the picture of water scarcity in La Nueva Rinconada by examining local perceptions of water scarcity, and examine the quality of participants' responses by comparing and contrasting perceptions of water scarcity with subsequent responses.

Chapter 7 charts the extent to which participants feel in control of the water scarce environment, and how such perceptions relate to attempts to exert control over the challenges arising from it.

Chapter 8 examines participants' flexibility in dealing with water scarcity to determine the occurrence, extent and quality of flexibility in responding to water scarcity, and relates a range of flexible responses to an array of associated costs.

Chapter 9 discusses the relationship between the findings of chapters five to eight by evaluating how perceptions, control and flexibly impact on resilience to water scarcity in La Nueva Rinconada, and comments on the significance of the findings for our understanding of human resilience in environments of rapid change and scarce resources.

Chapter 10 answers the research question, reflects on methodology, discusses the study's limitations and outlines directions for future research.

Chapter 2:
Estimating Resilience in Environments of Rapid Change and Scarce Resources

2.1 Responding to environmental challenges

Contemporary environments of rapid change and scarce resources require us to adjust the way we interact with them, as our habitual means of doing so are becoming increasingly inadequate in meeting the myriad of challenges arising at ever-faster speeds and with increasingly dwindling resources at our disposal. This chapter examines the processes associated with responding to changes in, and challenges from such environments and proposes resilience as an umbrella concept for examining these processes. The chapter proceeds in four parts to introduce the concept of resilience and three proxy indicators (perception, control and flexibility) for estimating long-term resilience in environments of rapid change and scarce resources.

2.1.1 The adaptive advantage of behavioural and cultural responses

Responses to environmental challenges can take place at the physiological or socio-cultural levels (Ellen, 1982; Kummer, 1971; Harrison, 1997). Socio-cultural responses, which form the focus of this study, can take place in the short-term or long-term, through behavioural or cultural adjustments, respectively; and are interdependent (cf. Ulijaszek, 1997b:10-11 for a discussion). Behavioural and cultural responses have been suggested to be the more efficient means of responding to environmental change (compared to more permanent physical adaptations) due to their inherent flexibility and reversibility (Harrison, 1966:512). Figure 2.1 illustrates.

A response is generically defined as a reaction to a specific stimulus, resulting in an array of activities that take place at different temporal and spatial scales. In the process, we assess the extent and form that these responses should take according to the type of challenge encountered and evaluate this against our internal values (which in turn are shaped by our cultural framework); our previous experience; and our specific needs and personal limitations (Ulijaszek, 1997b). A response involves process and change, which occur with the aim of achieving, or maintaining, a balance between our own being and the environment that allows us to continue to pursue our lives (*ibid*:7).

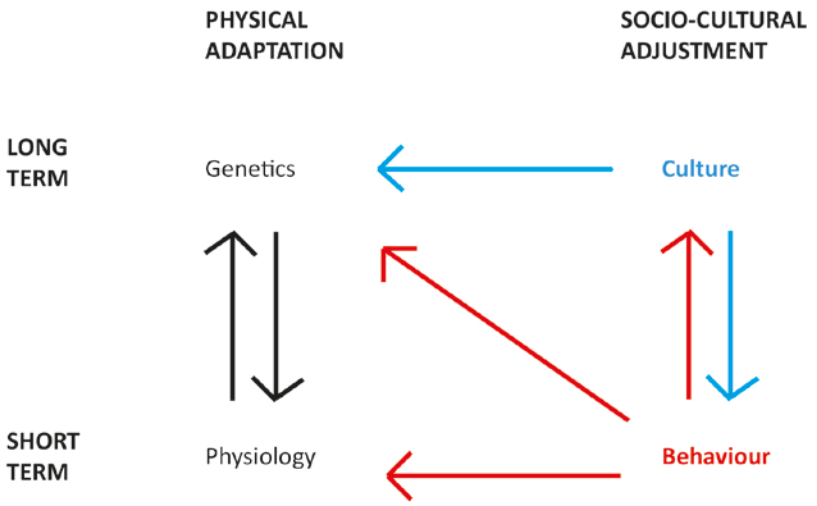


Figure 2.1: Responding to Environmental Change

The interdependent means by which human beings adjust and adapt to environmental change. Adapted from Ulijaszek (1997b:10). Behavioural responses are shown to impact on all other forms of responses (red arrows), with cultural responses having the second-most frequent impact (blue arrows).

The continued pursuit of life implies that responses must be appropriate to the challenge encountered; raising the question as to what constitutes an 'appropriate' response. This is notoriously difficult to assess, as ultimately, only the continued persistence of a group over time can provide proof that the responses they chose towards their changing environment enabled its continued existence (Ulijaszek, 1997a). It is therefore necessary to identify an indicator that allows an estimation of the likelihood of continued, long-term persistence under changing circumstances; and specifically in environments of rapid change and scarce resource, both of provide considerable constraints to the ability to respond well.

2.1.2 Assessing cultural-behavioural adjustment : Resilience as an umbrella concept

The concept of resilience has been experiencing a surge in popularity in a multitude of disciplines concerned with questions of human wellbeing in contexts of stress and change, ranging from social-ecological systems analysis (e.g. Folke, 2006; Eakin and Luers, 2006) via urban studies (Allan and Bryant, 2011, 2014; Godschalk, 2003; Chelleri *et al,* 2015) to psychology (e.g. Fine, 1991; Vaillant, G., 1993), and is undergoing a phase of high popularity in the field of international development and disaster reduction (Lewis, 2013; Kelman, 2008, Alexander, 2013). The concept has a long history tracing back to Classical times (cf. Alexander, 2013; and Sudmeier-Rieux, 2014:69f, for a discussion). Connotations of 'leaping [or] jumping [forward]' (Alexander, 2013*)* have persisted throughout resilience's revival in the systems ecology literature (spearheaded by Holling, 1973) and more recent attempts at disciplinary transfer to examine social resilience (e.g. Adger, 2000). This process has not been straightforward, making resilience simultaneously a promising and contested concept.

Resilience: Definitions and theory

Resilience, defined as

> 'The capacity to be bent without breaking and
> the capacity, once bent, to spring back'
>
> Vaillant
> (1993:284)

encapsulates many of the characteristics common to most conceptualisations of resilience. These concern the capacity for change in response to external impacts without fundamentally changing, but adapting ways of functioning, and to recover from such change and return to the previous status quo. Five aspects of resilience from the social-ecological systems (SES) literature provide further nuance:

1. The amount of disturbance a system can accommodate before crossing a threshold that makes recovery difficult or impossible (Gunderson and Holling, 2002; Walker *et al,* 2002; Carpenter *et al,* 2001). In Vaillant's worlds: 'The capacity to be bent without breaking' (1993:284).
2. The ease or difficulty with which a system undergoes change; also termed 'resistance' to change (Walker *et al,* 2002). In Vaillant's words: 'The capacity, once bent, to spring back' (1993:284).
3. The proximity of the system to thresholds of fundamental change, described in point 1, above, also termed 'precariousness'. The temporal

proximity to such thresholds can be difficult to assess as the impacts of disturbances can be delayed and unpredictable. (Walker *et al,* 2002).

4. The time it takes for a system to return to equilibrium following a disturbance (Pimm, 1984; Tilman and Downing, 1994).
5. Effects at different, nested scales may impact on a system's capacity for resilience, such as for example events at the global scale affecting local behaviour (Walker *et al,* 2002, Gunderson and Holling, 2002; Resilience Alliance, 2010).

Vaillant's definition is compelling, not only for its focus on the individual, but because of its emphasis on resilience as a 'dynamic equilibrium' (Alexander, 2013), highlighting capacity for considerable fluctuation in both the external environment and the individual subjected to environmental changes and challenges. Further relevant to the focus of this study, this definition recognizes not only the impact of external forces, but acknowledges individual plasticity and agency in reacting and responding to such forces. Adger (2000) emphasizes the need to distinguish between 'reacting' and 'responding', which concerns '[…] the difference between resilience and resistance[2], where the latter is the extent to which disturbance is actually translated into impact' (p.349).

Two further dimensions need to be foregrounded in elaborating a holistic definition. Claims of 'leaping [or] jumping [forward]' (Alexander, 2013:2708) persist in many studies, and if the engagement with the resilience concept in this study is to contribute meaningfully to the emerging body of literature critiquing resilience discussed later in this chapter, a comprehensive definition of resilience requires the inclusion of a sense of improvement, as suggested by the National Academies' (2012) and DFID's (2011) notion of positive outcomes and long-term prospects:

6. '[…] resilience is the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses […] without compromising their long-term prospects' (DFID, 2011:6) and 'the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events' (National Academies, 2012:1).

The psychological literature adds a final significant dimension for a study focused on individuals and households, which at the same time has been the subject of considerable criticism:

[2] Adger associates resilience with the process of reacting, and resistance with the process of responding, emphasising that a response involves a consideration of how much a disturbance is allowed to cause impact.

7. 'The capacity for resilience to be learned' (Allan and Bryant, 2014:111; also Luthans *et al*, 2006; Nelson *et al,* 2007)

In conflation of these seven aspects, resilience can then be defined as the learnable[3] ability to accommodate external disturbances arising from different scales (local to global); without fundamentally changing, but adapting ways of functioning; and recover from such disturbances with relative ease[4], in a timely manner, and with good long-term prospects intact; as well as by a considerable distance to critical thresholds of no return.

To adjust Vaillant's (1993) definition for the purpose of this study:

'The learnable capacity to be bent without breaking;
and the capacity, once bent, to bounce forward'

In summary, the notion of resilience provides considerable potential not only for identifying those aspects that enable or prevent a person, household or community to respond well in environments of rapid change and scarce resources; but it also allows the dynamic processes occurring across scales and different systems (social to environmental to political) to be foregrounded in identifying critical areas of weakness or potential. At the same time, the concept is attracting considerable criticism. I discuss three key strands of criticism relevant to the application of resilience in this study, so as to further delineate its scope, applicability and significance.

The value and application of resilience: Key critiques

Prevalent critiques of resilience concern undifferentiated transfer from ecological to social systems (Adger, 2000; Reid, 2012); the mis-use of the resilience concept within the neoliberal doctrine (Reid, 2012); and assertions that resilience reduces, mitigates or even counters vulnerability or risk (Sudmeier-Rieux, 2014).

Prominent in the field of ecology, the concept of resilience was developed to understand the complex interaction of features of ecological systems, which differ considerably from social systems. Whilst it is generally accepted that 'the resilience of social systems is related in some (still undefined) ways to the resilience of the ecological system on which [they] depend' (Adger, 2000:350), a

[3] 'Learnable' here needs to encompass both the ability to be learned, as well as to be a source of learning; meaning that processes of resilience can be acquired through learning, but equally they can be the source of learning.

[4] 'Relative' here refers to the previous point of the ability to accommodate change by adapting, but without fundamentally changing ways of functioning.

large number of unknowns remain in the transfer of the concept to examine social resilience (*ibid*). Adger (2000) suggests that the 'capacity to cope with surprises and large-scale changes' (*ibid*:361) identifies resilience in natural systems, and 'that this is precisely what will allow innovation, coping with change and social learning in social institutions'[5] (*ibid*). Whilst this appears a reasonable assumption to make, Béné *et al* (2012:12) note the limitations arising from a lack of explicitness about agency and power in many resilience studies. Agency and power are distinct features of social systems, with ecological systems lacking both. Therefore, the authors argue, the resilience of a social system may be due to very different factors than the resilience of an ecological system (see also Duit *et al*, 2010:365). Clouding this crucial distinction is unhelpful for both theory development and for the operationalization of the concept when applied to the study of social systems. However, this blurring of differences is not as universal as Béné *et al* (2012) suggest. It is perhaps not surprising that the psychological literature has long assumed that resilience is a feature that can be 'developed' (Luthans et al, 2006:28), 'learned' (Allan and Bryant, 2014:111), 'taken responsibility for' (Vanistendael, 2011) or even 'voluntarily applied' (Vaillant, 1983:305). The suggestion that resilience can be 'imparted' (through urban design) is also arising from the urban and disaster recovery fields (Allan and Bryant, 2014:126; also 2011), suggesting that connotations of - if not explicit engagement with - individual agency and power are starting to be engaged with in the context of resilience studies in disciplines as varied as psychology, urban design and disaster recovery.

From within the social-ecological-systems discipline itself, Nelson *et al* (2007) explicitly acknowledge the differences between the actor-centred approach of adaptation research and the systems-oriented resilience approach, arguing that the two can be usefully combined to interrogate adaptation processes. Attempting to bridge the divide between systems and actors, the authors suggest that 'the sources of resilience for taking adaptive action are common across scales' (*ibid:* 395) and (similarly to Sudmeier-Rieux's [2014] distinction between passive and transformative action) identify differences between incremental adjustments and transformative action (*ibid*) in contributing to resilience of both actors and systems. This suggests that balanced attention to both actors and their supporting systems; careful examination of the nature of responses (passive or

[5] Adger defines social institutions widely, to include informal arrangements including those found in community organisation.

transformative); and appropriate acknowledgement of notions of individual agency and power can all begin to address the valid critiques of undifferentiated transfer of the resilience concept from ecological to social systems.

The second prevalent critique of resilience, the mis-use of the resilience concept within the neoliberal doctrine, revolves around two related points. On the one hand, its proponents shed a political light on the difficulties arising from conceptual transfer to suggest that this has resulted in the commodification of nature; which, secondly, they argue, has given rise to the concept of resilience not only being used as a justification for the withdrawal of the state from its duty of providing for its citizens, but more so has been elemental in producing vulnerable societies and individuals accepting of, rather than challenging the resulting status quo. Reid (2012) suggests that moving the concept of resilience from being a property of the biosphere to being a property of human populations has legitimized the assumption that human resilience should be promoted by 'increasing [human beings'] economic options', resulting in the biosphere being perceived as 'an economy of services which humanity receives' (Reid, 2012:72). Reid argues that coupled with global aims for 'sustainable development', this conceptualization of resilience victimizes '"the poor". For they are the segment of the population of which resilience is now demanded and simultaneously the population said to threaten the degradation of "ecosystem services" ' (*ibid*). He goes on to posit that under the guise of ensuring the resilience of the biosphere, neoliberal systems aim to make 'the poor' more resilient subjects, and do so by emphasizing their 'adaptability' over their security, and by defining the role of the vulnerable as characterized by the need to 'permanently struggle to accommodate [themselves] to the world, [as opposed to being] political subjects who can conceive of changing the world' (*ibid:*74). The shift from the state being responsible for its citizens' security towards an emphasis on self-sufficiency, self-determination and self-empowerment has also been noted by Submeier-Rieux (2014), Cannon and Müller-Mahn (2010) and McKinnnon and Derrickson (2012).

In his critique of resilience, Reid foregrounds the underlying inequality and global political processes that can make the use of the resilience concept highly dangerous in contexts involving vulnerable populations. Three arguments can be taken into account to mitigate Reid's utter rejection of the concept. These arise from the previously discussed importance of conceptualising resilience as occurring across actors and their supporting systems, which here would combine into an ideal of acknowledging individual communities' capacities and their

facilitation by formal and state institutions. The resilience model may serve to bring about change by recognising the assets of vulnerable populations and emphasizing these as the vital foundations to build on instead of replacing them; essentially shifting decision-making from external to internal actors by giving affected populations the right of choice as to which assets to emphasize in efforts to help build resilience. The role of external actors can then be seen not as non-existing, as Reid suggests, but as supporting and strengthening efforts decided upon and directed by affected communities.

Secondly, it is encouraging that political motivations and potential for misuse of the resilience concept are by no means invisible to those affected, as was demonstrated by grass-roots opposition against a resilience-based political discourse in New Orleans after hurricane Katrina (fig 2.2), highlighting that attempts to turn vulnerable populations into subjects deprived of critical capacity (Reid, 2012:73) have, at least in some contexts, not succeeded.

Additionally, the deployment of the resilience concept can be especially useful in contexts characterized by the features of Reid's critique (as is the case for Peru, Lima and the study community, cf. chapter 3). Reid's critique, for all its valid points, stands almost unaccompanied in a comparatively vast number of works highlighting the potential of the resilience concept for understanding adjustment processes in adverse contexts. Providing concrete evidence from empirical applications of the concept in such contexts will help to substantiate or nuance, or indeed refute his positions. The need to engage with resilience in contexts of vulnerability and inequality is further supported by the notion of the inseparable nature of the experienced and political dimensions of scarcity, which is discussed in section 2.2.1 and chapter 3. To inform a substantial critique of the political processes that perpetuate livelihoods endangered by scarcity (or, for that matter, any other environmental 'disturbance'), concrete evidence of the lived experience can contribute to nuancing such critiques, and contribute to developing the concept of resilience towards addressing these very issues.

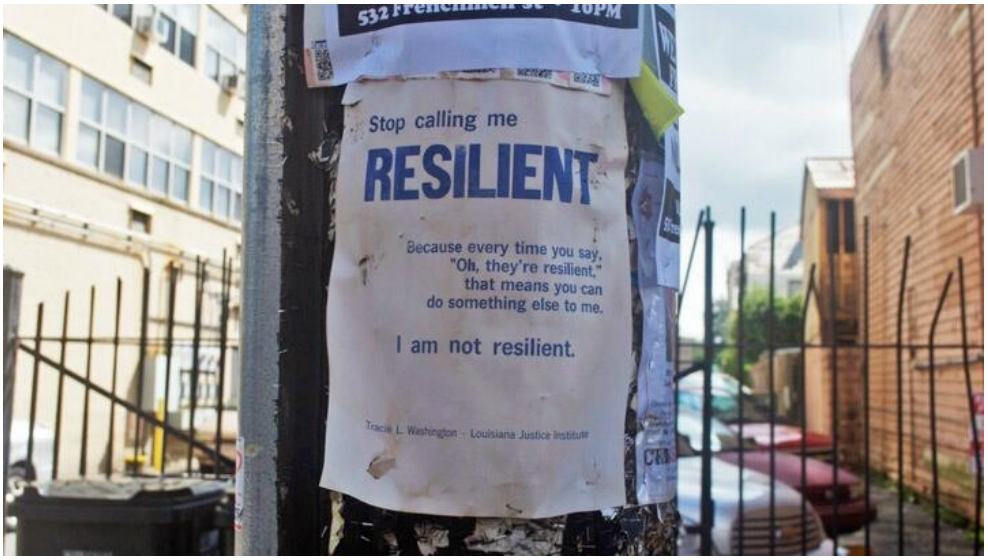


Figure 2.2: 'Stop calling me resilient'

A New Orleans poster by Tracie Washington of the Louisiana Justice Institute neatly summarizes public opposition to the label of 'resilience' and its use as an excuse for neglect by authorities.

The last key strand of criticism of resilience relevant to the focus of this study concerns the conflation of resilience with other attributes of people living in environments of stress and risk. Sudmeier-Rieux (2014) shows that people in marginalised communities are often highly resilient; but that such resilience is all too often erroneously equated with an ability to reduce their own vulnerability or risk[6] (see also Lewis and Kelman, 2010; Levine *et al,* 2012, Reghezza-Zitt *et al,* 2012). Not only should resilience not automatically be equated with a lack of vulnerability or risk, it can also be observed alongside corruption, lack of sustainability and inequality (Levine *et al,* 2012).

These points further emphasize the need to conceptualize resilience as a dual focus on the individual or household and their supporting systems (from environmental to social to policial), as well as with a stated aim of long-term positive outcomes. The imperative focus on positive, long-term outcomes when examining resilience is further substantiated by the fact that a mere return to status quo will fail to address the underlying 'dangerous living conditions and high vulnerability that created risk – as well as resilience – in the first place' (Sudmeier-

[6] Sudmeier-Rieux makes this point in a disaster-recovery context, suggesting that vulnerable populations may be seen to be more resilient due to their existence in precarious environments having provided skills for recovery post-disaster, but that we should not assume that this reduces vulnerability. Indeed, such populations may be seen to be resilient in recovery, but remain vulnerable as they continue to inhabit forbidding environments without choice. The lessons to take from this is two-fold: on the one hand a comparison of vulnerability and resilience depends on the definition of vulnerability; and, perhaps more importantly, this example serves to highlight that resilience, even if observed in highly adverse conditions, does not solve every problem.

Rieux; 2014, Reghezza-Zitt *et al*, 2012). The concept's persisting connotations of ''leaping [or] jumping [forward]' (Alexander, 2013) must therefore be foregrounded to emphasize long-term positive outcomes. Sudmeier-Rieux (2014) offers both helpful terminology ('transformative' as opposed to 'passive' resilience) and important research and policy parameters. She calls for the research community to 'clearly define the scope, context and temporality' (*ibid:* 76) of resilience studies, and for policy actors to ensure that 'robust monitoring and evaluation frameworks […] accompany public funds spent on increasing resilience […]' (*ibid*).

These considerations suggest that rather than the concept of resilience itself being problematic, it is its use or misuse that causes potential problems. These can be addressed by acknowledging the need for careful and context-specific definition, awareness raising, empirical examination of prevailing critiques, and monitoring and evaluation of resilience programmes.

Operationalizing resilience

The concept of resilience, through its dual focus on individuals[7] and their supporting systems, is well suited to exploring the research questions with a view to determining if in responding to water scarcity, residents of the study community are being 'bent without breaking', and, if 'bent', are 'able to bound forward'.

In doing so, resilience should be conceived of as a composite of a systems- and actor-based processes, with a focus on positive, long-term outcomes. A focus on individual experiences in environments of rapid change and scarce resources can highlight forces of individual agency and power, as well as aspects of the wider political, ecological and social systems that support actors towards achieving positive, long-term outcomes.

Different frameworks for evaluating resilience revolve around varying foci, with each attracting different advantages and drawbacks (cf. Jones and Tanner, 2015, for a discussion). Key trends in resilience assessment can be categorized as focusing on either (1) 'objective', and mostly socio-economic indicators, the selection of which can be fraught with difficulties and subject to much criticism (cf. Carpenter et al, 2001 and Bahadur et al, 2015, for a discussion); or, as advocates for 'subjective' resilience measurement do, (2) aim to 'capture the perspectives of those who may know most about their own resilience: the people themselves' (Bahadur et al, 2015:6) and reduce the role of 'experts' in assessing resilience, but can be lacking acknowledgement of the wider, institutional and political forces that shape such resilience. (3) The numerous dimensions documented to affect resilience at the individual level in the psychological literature, with its intense focus on the individual, allude to the wider systems that may play a role in individual resilience (e.g. Vaillant, 1993: 286[8]), but are at best vague in acknowledging political dimensions to resilience, for example in their acknowledgement of negative effects of low socio-economic status, without questioning the structures that may underlie or perpetuate this.

The wide spectrum of resilience assessment frameworks is reflective of the ongoing development of the resilience concept and its application in widely varying contexts. Whilst it is not the aim of this study to develop yet another

[7] I mostly use the term 'individual' in the resilience discussion as much of the psychological literature centres around individuals. There is considerably less literature available on household resilience, so I have loosely equated the plural of 'individuals' to include the notion of households.

[8] Factors range from psychological aspects such as self-esteem via factors pertaining to socio-physical circumstances, such as the amount of living space and age gap to the nearest sibling, to health-related factors such as mental illness or alcoholism in a parent.

framework for assessing resilience, its focus is on testing proxy indicators for resilience for their suitability to examining the lived experience, and ultimately the ability of people to persist with long-term, positive outcomes in environments of rapid change and scarce resources.

2.2 Estimating resilience : Three proxy indicators

Section 2.1 discussed the notorious difficulty of authoritatively assessing the 'appropriateness' of responses to environmental change and challenges, due to the difficulties associated with taking a long-term view. The same applies for the concept of resilience, especially when, as is done here, it is conceptualised as 'transformative' (Sudmeier-Rieux, 2014:75), that is, if processes of resilience are expected to lead to better long-term outcomes than the previous status quo. An individual or group can only confidently be said to have been resilient if its long-term persistence is shown, and it is also recognized that people cannot be resilient all the time and in all aspects of life. The following three proxy indicators (perception, control and flexibility) are chosen as theoretical and analytical tools to enable an estimation of *likelihood* of long-term household resilience, whilst at the same time allowing room for the impact of systems of different types and scales to emerge, thus acknowledging the role and importance of wider 'systems' in achieving resilience, whilst remaining firmly focused on the lived experience of households in responding to water scarcity in an environment of rapid change.

2.2.1 Estimating resilience : Perception as proxy indicator no.1

The question of how we see, or perceive, our environment directly affects our responses to it. In particular, whether we assess a challenge arising from our environment as positive, negative or neutral has been shown to directly impact on the quality of our responses and ultimately on outcomes. If the way we perceive our environment underlies how effectively we respond to it, understanding the factors that affect such perception is an important first step in estimating resilience to water scarcity in environments of rapid change, as such perceptions, together with enabling or disabling features of the context, form the parameters within which responses are framed.

The literature used to frame the notions of perception and stress is rather dated, as theories of environmental perception and stress underwent a period of intense evolution in the 1950s to 1970s, with subsequent studies applying these in highly specific, and often controlled, rather than real-life contexts. The original works

are therefore, despite their age, still most instructive in understanding principles of environmental perception and stress.

People and systems: perceptions as process and product

A holistic definition of resilience requires an examination of both people and the systems that support them. Common definitions of perception refer to both and encompass process or act, as well as effect or product (Tuan, 1974). In psychology, the term can imply recognition as well as interpretation of stimuli and emphasizes the role of memory in perception; we perceive by checking new stimuli against what we have previously known (Epstein, 1967; Cordon, 1997). In the broadest sense, perception can refer to insight, intuition or knowledge gained by perceiving, as well as to the capacity for such insight (Oxford English Dictionary, 1989). The notion therefore implicitly spans perceptions of people and their supporting environments, which can both engender or hinder resilience.

Perception as transient, subjective and active choice

Perceptions rely on two pre-requisites. They are said to occur as a result of awareness (Allport, 1955:14), and as a result of the presence of an environmental stimulus (Epstein, 1967). Countering common impressions of passivity, the act of perception has been shown to involve 'purposeful activity' (Tuan, 1974:4), and can be conceived of as a filtering process in which 'certain phenomena are clearly registered while others recede in the shade or are blocked out' (*ibid*.:4), suggesting that perception involves not only activity, but degrees of choice and influence on the part of the perceiver over how and which things are perceived.

Perception, in all senses of its definition, can also be argued to refer to a subjective processing of the environment. 'In a very basic sense, the environment is what we think it is, and as citizens and decision makers we deal with it as we conceive it to be' (Moore and Golledge, 1976:4). Perception of one's environment is constituted not only of the presence of a stimulus and a person's awareness and filtering of this, but also of 'admittedly subjective beliefs' (*ibid*.:4).

Perceptions persist over short time spans. Whilst they bear considerable overlap with their neighbouring concepts of cognition (which refers to the thought processes that arise from perceptions [Schiff, 1970]), attitudes (which are longer-term, stable systems consisting of feelings and beliefs [*ibid*]), and beliefs (which are less inclusive than attitudes, but more general than perceptions [*ibid*]), perceptions are relatively short-lived, unstable and subject to change with recent past experience and the current state of the perceiver (Schiff, 1970), that, in turn,

is affected by changes in the environment. A focus on short-lived perception, rather than its longer-term focused neighbours, is appropriate for understanding the parameters that affect responses in rapidly changing and resource-scarce environments.

Theory of environmental perception

Theories of environmental perception abound across a spectrum of disciplines. I want to engage here with Ingold's (2000) contention that the way people interact with the (natural) environment is often treated separately to how they 'imaginatively construct' (*ibid:* 9) and perceive that same environment.

Chapter 3 will show how such a divide very much persists in current conceptualisations of water scarcity, and how this division between the experienced and 'constructed' views of lacking water is unhelpful in addressing the spectrum of its effects. I therefore focus here briefly on one of Ingold's suggestions of how this divide may be overcome; his proposition to understand 'ways of seeing the environment [as] ways of acting within it' (*ibid:* 9), to outline its application within this study's context of water scarcity.

Ingold contends that perception of the environment is inextricably linked to ways of acting in it. He suggests that replacing the 'dichotomy of nature and culture' with a 'synergy of organism and environment' by dismantling the distinction between mind and nature is helpful in overcoming this divide. In doing so, and specifically by contending that in perceiving the environment, meaning is constructed through clues[9], rather than a set of well-defined steps or procedures, a subjective 'knowledge grounded in perception […that] may be regarded as sentient ecology' (*ibid:*25) is created. Ingold argues that such intuitive understanding of the environment is based on perceptual skills that emerge from prolonged exposure to an environment, and rather than being contrary to abstracted study and understanding of the same environment, it is a *pre-requisite* (my emphasis) as it provides 'a necessary grounding' (*ibid:* 25) for any more abstract examinations of such an environment. This not only supports my forthcoming argument in chapter 3 that a holistic conceptualization of water scarcity requires an understanding of the lived experience, but takes this further to suggest that an understanding of the lived experience of water scarcity is a pre-requisite for examining other aspects of the concept.

[9] Ingold takes inspiration here from the differences between Lévi-Strauss' (1974) idea of the mind 'decoding the world' and Bateson's (1973) idea of the mind 'opening out to the world in a process of revelations'

Common dimensions of perceptions

If we accept that perceptions of the environment arise from a combination of individual and systemic features, and span the spectrum of individual characteristics to an environment's geographical, social and cultural contexts, it becomes clear that there is great variation in perception. Some perceptions are common to all human beings, others are more specifically culture-, location- or society-bound, and yet others are due to individual differences. Yet there are frameworks that bound perception of the environment at the individual and social levels, which are worth highlighting here for their potential impact on perceptions of water scarcity in the study location.

At the individual level, perception of the environment is affected by the interplay between a person's physical make-up, psychological structures and responses, individual differences and preferences, and by the impact of habit (Tuan, 1974).

Habit is formed by a person's continued exposure to the same environment, and requires particular attention here as it not only affects how a person perceives themselves and their environment; but as it has the potential of highlighting constants and their effects on perception in environments of rapid change. For example, habit affects the extent to which a sense of self is attached to a place; how dangers are assessed and judged; how complexity of the environment is perceived (perception is likely to be less complex the lesser time one spends in a place); and how expression of perceptions are affected (complex perceptions of a place are less easily conveyed than simple ones).

At the social level, a person receives information about their environment through their own experience, or through what he learns from that of others (Tajfel, 1969:333). The effects of ego- and ethnocentrism, the role of the group, and the way an individual sees themselves in relation to that group all affect perceptions at the social level. These include forms of 'perceptive peer pressure' that can cause people to 'mis'-perceive a situation to fall in line with the perception of the group, with less cohesive groups exerting less influence than more cohesive ones (e.g. Pollis, 1964, quoted in Tajfel, 1969:339). The extent to which a group is considered trustworthy plays a role, which in turn is assessed by taking into account the group's cohesion, size and competence, basing the latter on how correctly the group has judged previous situations (Tajfel, 1969:350). Certainty of what is perceived is likely to be enhanced by previous experience of similar situations, as is trust in one's own competence. The impact of a group's

influence is likely to be enhanced in contexts where social relations fill gaps created by a lack of formal social security systems, as is the case in many informal settlements, and in the study location.

Classification of the environment into positive, negative or neutral

Having examined a current theory of environmental perception and briefly sketched some of the processes that can affect perception of the environment at the individual and social levels, it becomes clear that perception depends both on what is perceived and on who perceives it, placing the crucial point of perception at the intersection of the environment and the person perceiving it. To understand how perception affects responses, and ultimately resilience, to environmental challenges, it is necessary to understand how what is perceived is interpreted.

Every perception process, regardless of the level at which it takes place or the type of stimulus that is perceived, displays a universal feature from which subsequent responses are formed. The classification of stimuli into positive, negative or neutral marks the initial assessment of any environmental stimulus by the person perceiving it (Selye, 1982).

When considering this process in the context of water scarcity in the study community, it is important to note that whilst water scarcity is considered an environmental stress, 'stressors' in the psychological literature are defined merely as things that elicit a response (Selye, 1976), and, contrary to their popular use, are considered neutral until they are classified by the person who perceives them. Thus, not all environmental stressors produce stress, and not all events that provoke stress are necessarily noxious, but 'things that produce stress are those that are *perceived* as threatening, unpredictable or anxiety producing' (Huss-Ashmore and Thomas, 1997:304, my emphasis). This emphasises that the outcomes of such classification depend to some degree on both previous experiences and future expectations of the perceiver, which, together with negative or positive appraisal of a situation 'plays a fundamental role in determining, not only the magnitude of the stress response, but also the kind of coping strategies that may employed in efforts to deal with the stress' (Cordon, 1997, n.p.).

The classification of stimuli into positive, negative or neutral has been shown to either enhance response outcomes (in the case of positive classification), or to diminish these (in the case of negative classification) (Lazarus, 1966). It is

important to acknowledge that such a process of appraisal is dynamic, that is, appraisal is repeated and may change as a stressful event unfolds (Folkins, 1970; Lazarus, 1981), resulting in potentially reversing the initial appraisal, not only of the stressor itself, but also of the effectiveness of coping strategies (Cohen *et al,* 1986:6). I have been unable to locate works that address the parameters determining responses to stressors assessed as neutral, and can only assume that these are considered not to entail any responses.

The classification of a stimulus therefore affects the response it elicits, and, by extension, affects the degree to which that response contributes to resilience. Exploring how environmental stressors arising from water scarcity are classified will contribute to understanding which aspects of the water scarce environment positively and negatively affect its inhabitants' ability to respond appropriately to the constraint.

Having argued for a theory of environmental perception that acknowledges lived experiences as one cornerstone of the holistic examination of environments of rapid change and scarce resources, I have discussed the importance of understanding how perceptions of the environment, and particularly classifications of environmental stressors, affect subsequent responses. This enables the operationalization of the concept towards examining how perceptions of the environment might ultimately contribute to resilience to water scarcity. I proposed that Ingold's theory of 'sentient ecology' (after Anderson, 2000) frames the application of environmental perception for a combined analysis of both actors and the various 'systems' on which they rely; and have documented various features that may have a bearing on perceptions in environments of rapid change and scarce resources.

2.2.2 Estimating resilience : Control as proxy indicator no.2

The concept of control is helpful in understanding resilience to water scarcity on two counts. Broadly speaking, 'the political and economic control of resources is an obvious factor affecting [their availability and use]' (Huss-Ashmore and Thomas, 1997:309). Secondly, it has been shown that perception of personal control – the feeling to be able to 'do something about it'– (Mason et al, 1976, quoted in Huss-Ashmore and Thomas, 1997:309) positively affects outcomes of responses[10]. Perceptions of control may consequently affect resilience to water scarcity.

The political and economic control over water in Lima and its informal settlements is examined in the next chapter. This chapter discusses how perceptions of control relate to observable effects of control, and outlines observable dimensions to operationalize the concept with a view to providing a second indicator for estimating likelihood of resilience to water scarcity.

Perceptions and effects of control

The concept of control has been widely explored in a number of disciplines and with varying methodologies, most notably, however, in the field of social psychology, where work on the 'Locus of Control' has enjoyed persistent popularity and evolution since its inception in 1954 (Rotter, also 1990). People who perceive that they are able to control a challenge that presents itself tend to have more positive outcomes than people who feel helpless in the face of problems encountered (Mason et al, 1976), suggesting that perceptions of control impact on the ability to respond well to environmental challenges.

The 'Locus of Control' examines 'individual differences in the extent to which [control] is viewed as a consequence of one's own behaviour or a consequence of such forces as 'chance', 'fate', or powerful others' (Borden and Hendrick, 1973:32). People who feel that they are in control of outcomes are said to have an internal locus of control, whilst those who tend to attribute outcomes to influences other than their own are said to have an external locus of control.

Operationalizing control

The theoretical literature on the concept of power is instructive for its engagement with five dimensions that help to operationalize the concept of

[10] Or, as Mason *et al* phrase it: '….psychological influences are potent…' (1976: 167)

control[11]. These concern the intentions behind the effectiveness, extensiveness, comprehensiveness and intensity of control.

The notion of intentions is used to distinguish social control from overt exercises of control. Social control is generally exercised by groups over individuals in the process of natural socialisation, for example in bringing up children. Overt attempts to control can take the opposite form of an individual controlling another, a group or a situation. Overt control is defined as 'intended and effective influence' (Wrong, 1979:3ff).

The 'effectiveness' of control is somewhat self-explanatory, in that when no effects are noticeable; it is unlikely that control would have been exerted. However, as this study is interested in the quality of effects, and specifically in the appropriateness of responses to water scarcity, it is helpful to compare the intentions which motivated the exercise of control to the effects produced. If, for example, an exercise of control intended to produce effects but only produced a change in attitude in another person, this would not be defined as control, but could rather be termed 'unintended influence' (Wrong, 1979: *ibid*). Whereas if the intention was to produce a change in attitude, then control would have been exerted as the outcome matched the intention. The effectiveness of control can be observed through 'intended outcomes'.

Control is further observed through the ratio between people on either side of the controlling-controlled relationship, termed 'extensiveness' (Wrong, 1979:14).

'Comprehensiveness' (*ibid*) refers to the number of areas or situations that those exercising control have influence in, highlighting that control can be exerted not only over others, but also independently of other people in situations, or in relation to the self.

Lastly, the 'intensity' (*ibid*) of control identifies the limits within which control can be exercised in different areas or over different people without the context it relies on breaking down. This can elicit both quality and extent of actions of control.

[11] This does not assume that power and control are the same. Instead, this discussion is based on the use of transferable aspects of power that appear valid in examining the concept of control. For the purpose of investigating control through the observable dimensions of power, both concepts are considered to overlap in several ways. Rather than being "'zero-sum' concepts" (powercube.net, 2016), both can be held by actors to differing extents, and can also 'be embodied in a web of relationships, behaviour, social norms and discourses which affect everyone' (*ibid*). The concepts also overlap in their definition as 'fluid and accumulative' (*ibid*) sources that 'can be used, shared or created by actors and their networks in many multiple ways'(*ibid*), as well as involving 'capacity and agency to be wielded for positive action'(*ibid*).

Therefore, examining the underlying intentions, effectiveness, extensiveness, comprehensiveness and intensity of responses to water scarcity will help to foreground and qualify observable effects produced by attempts to control the water scarce environment and aid in understanding how perceptions of control over and actions to control the water scarce environment contribute to resilience to water scarcity.

In summary, control can be understood as a composite of perceptions of being in control and the ability to exert control for positive outcomes. The former can be observed through and internal or external locus of control, while the latter can be observed by considering (1) how intentions to control relate to outcomes achieved by actions of control; (2) how the quality of outcomes relates to the aims that first motivated these; (3) the number of people exerting control or being controlled; (4) the number of areas or situations in which control is exerted; and (5) the limits within which control is exercised, as well as the boundaries at which a controlling-controlled relationship breaks down.

2.2.3 Estimating resilience: Flexibility as proxy indicator no.3

In order to maintain the ability to respond well when circumstances change in future, responses to environmental changes and challenges ought to be flexible (Malik, 2002; Lindberg and Kaiser, 2004; Davis *et al,* 1996; Sloan, 1994). Section 2.1 has outlined the difficulties in assessing the long-term appropriateness of responses to environmental challenges. The concept of flexibility provides a further proxy indicator for assessing how responses can contribute to resilience in environments of rapid change and scarce resources.

Flexibility: polymorphous, multi-dimensional and elusive

A review of the concept of flexibility in different disciplines shows that no consensual definition exists. Flexibility has long been identified as one of the 'defining characteristics of the human species' (Malik, 2002:n.p.), as it allows human beings to inhabit a more extensive range of environments and display a larger range of behaviours than any other living being. The concept is polymorphous, somewhat elusive and multi-dimensional, so that in any given situation, flexibility can occur in some ways, whilst at the same time lack in others (Suarez *et al*, 1995), requiring its occurrence and quality to be precisely qualified according to context.

Theoretical underpinnings

The broadest conceptualisation of flexibility arises from the anthropological literature as a 'conflation of two meanings; flexibility as plasticity - a sensitivity to external conditions; and flexibility as agency – the ability to tailor the particular path to a set goal to the state of environmental conditions' (Malik, 2002, n.p.). More behaviourally specific in its definitions of flexibility, the literature of applied psychology is dominated by two approaches (Lindberg and Kaiser, 2004). The first sees flexibility as 'a capability to adapt to new, different or changing requirements' (*ibid*.:2) and stresses the ability to vary behaviour, rather than 'the range of specific behaviours one is capable of'(*ibid*). This definition refers to the ability 'to move quickly, deal with ambiguity, and accept change' (Davis *et al,* 1996:648). It is considered the more 'straightforward and intuitive' definition of the concept and is often used in applied circumstances. It has been studied by 'operationalizing it as a monolithic tendency to vary behaviour across contexts' (Lindberg and Kaiser, 2004:3).

The other prevalent conceptualisation of behavioural flexibility 'is more behaviourally specific and complex, finding its roots in […] paradoxes, tensions and trade-offs […]' (Lindberg and Kaiser, 2004:3), or in several balances to be struck (Sloan, 1994) between seemingly competing interests. The key difference between the two approaches lies in that '[…] the [latter] specifies particular behaviours whereas the [former] does not and instead refers to general, cross-situational tendencies summarized across behaviours.' (Lindberg and Kaiser, 2004:3). Both theorizations are instructive towards a definition of flexibility and towards operationalizing the concept. The latter, however, appears to be more specifically suited to the focus of this study as it pays closer attention to seemingly irreconcilable tensions and opposing forces, which are likely to be defining features of environments of scarce resources and rapid change.

Response flexibility

As this study is concerned with understanding if and how responses to environmental changes contribute to resilience, it is useful to examine at which stage of a response flexibility becomes important. Behaviour is constituted of three consecutive mechanisms (Cosmides and Tooby, 1995): (i) the identification of a goal, (ii) the recognition of the action most likely to achieve that goal and (iii) the ability to implement the appropriate response. The authors suggest that lack of flexibility becomes problematic only at the final implementation stage, but I

would imagine that flexibility can impact on earlier stages of a particular behaviour.

Some qualifications of the nature of flexibility

Before examining those aspects of flexibility that are amenable to operationalization, it has to be noted that flexibility, despite its many advantages, is not an exclusively desirable and positive state. A number of potential disadvantages have been discussed, two of which are particularly relevant to the context of this study.

First, it has been suggested that negative long-term consequences of increased flexibility may include the 'sacrificing [of] social support' (Huss-Ashmore and Thomas, 1997:308), as flexibility is more easily achieved by individuals than groups, and may therefore result in 'individualization and atomisation' (*ibid*). This may attract considerable disadvantages, especially in vulnerable environments where social support mechanisms fulfil a myriad of roles in the absence of formal insurance networks (Dercon, 2005; Bloch *et al,* 2008).

Secondly, the consequences of inequalities within or between groups may reduce the ability to respond flexibly (Thomas, 1997), for example through the over-use of a resource by one group at the cost of the other. If deprived of basic resources, those affected may be unable to respond through behavioural adjustments, and forced to resort to physical adjustments, which, due to slow or no reversibility, afford lesser long-term chances of survival as they reduce the ability to act flexibly under changing circumstances (*ibid*:225). Inequalities within Peruvian society are well documented (Cotler and Cuenca, 2011), and particularly pronounced in the contexts of multi-dimensional poverty found in Lima's informal settlements.

It has further been noted that flexibility is not a free good, but comes at a cost (Carlsson, 1988). The same literature provides empiric evidence of the importance of flexibility to long-term survival[12]. In this context, various studies have shown flexibility to be associated with effectiveness (Steers, 1975); have labelled it 'an important determinant of competitiveness' (Carlsson, 1988) and have identified flexibility as 'a critical success factor in its own right' (Ward *et al,* 1997). Effectiveness, competitiveness and flexibility are such universal concepts that a cautious adaptation to the household scale does not appear unreasonable.

[12] Although this point is discussed in terms of survival of companies, the principles are transferable to more generic application.

Operationalizing flexibility

Flexibility can take several forms and manifest in different dimensions, requiring identification of the realms in which flexibility can occur. Thomas (1997) and Golden and Powell (2000) discuss four observable dimensions of flexibility: (1) The time it takes to respond to a challenge; (2) the extent to which a person responds; (3) the options available in responding and if a reactive or proactive stance is taken; and (4) the area in which flexibility is created.

The temporal dimension of flexibility considers the amount of time it takes to respond, and whether this occurs within a 'critical' time span to meet the challenge encountered (Gustavsson, 1984; Thomas, 1997). Different studies have conceived of the time perspective of flexibility in two complementary ways. The first suggests that all environmental change affects either or all of three levels; the operational level (day-to-day activities), the competitive level (thinking ahead to improvements), and the strategic level (long-term plans) (Eppnik, 1978). The second proposes a more straightforward break down of the temporal dimension of flexibility into short, medium or long-term challenges (Gustavson, 1984). A slight variation of this is provided by Upton (1994), who labels the three categories, respectively: the ability to respond day-to-day or within a day; occasionally and with some effort or commitment; or infrequently, which involves irreversible, long-term changes that require considerable commitment. Appendix E, table E.1, illustrates.

The second dimension is termed 'scale, or range' (Golden and Powell, 2000), and refers to (1) the extent to which a person or group can respond to foreseeable and unforeseeable challenges and (2) the range of options that are available in responding to these challenges (*ibid*:377). Foreseeable challenges are related 'to the concept of risk and involve planning for foreseeable events' (Carlsson, 1988), whilst unforeseeable challenges relate to 'uncertainty and how to make good use of new […] opportunities and to rapidly respond to […] unforeseen changes […]' (Golden and Powell, 2000:377), which are said to provide potential opportunities, as well as challenges. The range of options available in response to a challenge are, according to that first classification, again broken down into a range of options that have been planned for, and a range of options for events that were not planned for. Golden and Powell conclude that foreseen and unforeseen 'represent the two ends of the continuum for this dimension of flexibility' (*ibid*:377). Appendix E, table E.2, illustrates.

The aspect of intention bears considerable overlaps with the previously discussed concept of control. It is based on the premise that whilst environmental change is ubiquitous, those responding to that change have a range of options of dealing with it. 'Intention' refers to the degree with which individuals or groups take an 'offensive or defensive stance towards flexibility' (Golden and Powell, 2000:377). Impact is assessed through temporal means by noting if action is considered or taken before or after a challenge has occurred. Appendix E, table E.3, illustrates.

The last observable dimension of flexibility, termed 'focus' (Golden and Powell, 2000), refers to the 'area in which […] flexibility is created' (*ibid*:377) and manifests in changes made to the internal system (e.g. attitude or the way a household is internally organized) or relationships with external agents or the environment (e.g. different means of acquiring resources or households forming support networks). Appendix E, table E.4, illustrates.

A combination of any or all of these dimensions may be observed when examining response flexibility to water scarcity, enabling a composite picture of flexibility to emerge which conveys the nature, extent and quality of flexibility in dealing with water scarcity, as well as any associated costs or disadvantages. Such context-specific understanding of how flexible people are in responding to water scarcity will provide a further indicator for estimating the likelihood of long-term resilience to water scarcity.

A review of the concept of flexibility across different literatures shows that it plays an important role in understanding persistence under changing circumstances, but can attract a number of potential disadvantages, which emphasises the need to assess the occurrence, extent and quality of flexibility in the context of associated costs. Flexibility can be understood as the ability to balance a number of seemingly irreconcilable tensions and opposing forces by responding to challenges from the environment within an adequate time span, to sufficient extent, with suitable intention and appropriate focus to achieve a positive outcome.

2.3 Conclusion: Resilience in environments of rapid change and scarce resources

This chapter has discussed the difficulty of assessing the long-term 'appropriateness' of responses to environmental constraints, changes and challenges, and has put forward the concept of resilience as a means of estimating the *likelihood* of long-term, positive outcomes in environments of rapid change and scarce resources. I have argued that despite the concept being highly contested and broadly defined, an inclusive definition which pays attention to both individuals and the systems that support them, and which emphasises positive, long-term outcomes, can be usefully employed in environments of rapid change and scarce resources and may contribute to addressing some of the prevalent critiques of the concept.

I proposed the concepts of perception, control and flexibility as proxy indicators for resilience, and explained how each can contribute to estimating long-term resilience in environments of rapid change and scarce resources.

The next chapter introduces the concept of urban water scarcity and discusses the specific water situation in Peru, Lima and its informal settlements, as well as in the study community of La Nueva Rinconada. In doing so, it presents the geographic, ecological, political and social systems of the study location and introduces the community and individuals they support.

Chapter 3:
Urban water scarcity in Lima and its informal settlements

3.1 Understanding urban water scarcity

The global water crisis arises from a complex web of issues as varied as water management, effects of climate change and urbanization processes, among many others; and manifest in severe health, morbidity and mortality implications, adverse effects on ecosystems, and increasingly conflict over water (Gleick, 2009, 2014). Their common denominators have been argued to be forces pertaining to poverty, power and inequality (Watkins, 2006), with effects manifesting as two tightly interwoven and tangible problems affecting human wellbeing for millions of people worldwide. In 2015, the global community failed to provide adequate drinking water to more than 663 million people; and adequate sanitation to 32% of the world's population, 2.4 billion people (Unicef/WHO, 2015).

The global water crisis reaches particular bottlenecks in the many rapidly growing urban centres of the developing world (Vairavamoorthy *et al*, 2008). Urban water scarcity's prominence in the research literature has been exponentially increasing with the mounting demand on water resources from growing numbers of people concentrated in urban centres, and increased water use for associated rises in food production, life style and industrial production; and, crucially, underlying unsustainable and inequitable political structures (Scott *et al,* 2015). 'Climate induced reductions' (Jenerette and Larsen, 2006:202) in water availability compound these pressures, as does the considerable speed of these trajectories in rapidly urbanizing areas of many developing countries (Vairavamoorthy *et al,* 2008).

This chapter proceeds in three parts to introduce and examine the geographic, ecological, political and social systems of the study location and the community and individuals they support on the one hand, and the factors that are understood to shape contemporary urban water scarcity on the other. As such, this chapter serves to introduce both 'actors' and their supporting 'systems' as per the adopted definition of resilience.

The first section examines the spectrum of conceptualizations of urban water scarcity and foregrounds the importance of the experienced dimensions of the phenomenon. The second section discusses the historical and political trajectories and geographical features that contribute to the prevalence of urban water scarcity in Lima's informal settlements. The third section introduces the study community of La Nueva Rinconada and the complex web of issues understood to produce the lack of water and sanitation in this particular

settlement. The chapter concludes by summarizing the theoretical strands understood to affect the production of urban water scarcity in La Nueva Rinconada, and makes the case for a study focused on the experienced dimensions of water scarcity.

3.2 Current conceptualizations of urban water scarcity

Urban water scarcity arises at the intersection of geographical contexts, socio-political processes and individual experiences. Since its recent rise in the environmental and urban literatures, it has been characterized by conflicts of definition and measurement resulting from water's multiple roles as the resource most fundamental to all aspects of life (Strang, 2004; Falkenmark, 2009); its use as a commodity and economic resource (Postel, 2000; Griffin, 2006); and the multitude of abstract values it has been assigned throughout history (Linton, 2010; Peppard, 2011; Orlove and Caton, 2010). A number of partial narratives (Ohlsson and Turton, n.d.) have been told around the challenge of water scarcity, focusing variously on the concept's physical properties (e.g. absolute global availability, per capita measures); problems of social mis-use and resulting effects on social orders (e.g. 'water wars'); or highlighting the importance of political management of the resource (e.g. the water-power nexus).

3.2.1 Geo-physical aspects of urban water scarcity

There is little doubt that global water resources are under considerable pressure (Vörösmarty *et al,* 2015), and that this provides a substantial constraint to human development (Mehta, 2014). 'First-order analyses' (Turton and Ohlsson, n.d.:1) of urban water resources focus on per-capita availability and stress finite supply, especially in relation to increased withdrawal for human uses over the last 50 years (Jenerette and Larsen, 2006) and ever-growing demands from further projected increases in population numbers and lifestyle changes (Clarke and King, 2004). An overriding problem in examining the physical aspects of water scarcity is the large scale at which figures are usually developed. Contexts where national averages of, for example, minimum supply are being met, whilst large proportions of the population fall beneath specified thresholds (Conway, 2011) indicate that the use of averages does not accurately reflect reality. This problem has variously been addressed at different points in time by attempts to define minimum standards to meet basic human water requirements (e.g. White, Bradley and White, 1972; ICRP, 1975; National Research Council, 1989; Engelman and LeRoy,

1993; WHO/ Unicef, 2000). The acknowledgement that such definitions should take into account climatic, cultural and technological variations between societies has given rise to the currently employed average of 50 litres per person per day (50l/p/d) (Gleick, 1996). This takes into account the quality and quantity to meet four basic human needs ('drinking water for survival, water for human hygiene, water for sanitation services and modest household needs for preparing food' [ibid.:83]), but excludes any water for 'growing food and protecting natural eco systems' (ibid: 83).

Questions of supply and access, and the quality-source-cost nexus usefully highlight the interaction of physical constraints of water availability with socio-political processes. Insecurity of supply and access can be caused by seasonal variability in rainfall and river flows, forcing a switch to more distant or polluted resources. Annual droughts may reinforce this, as may poorly funded or maintained sources that can make supply precarious in urban areas of developing countries (Sullivan *et al*, 2003:190). The importance of guaranteeing security of supply 'independently of an individual's economic, social, or political status' (Gleick, 1996: 83) is stressed in the basic needs literature.

The quality-source-cost nexus is helpful in understanding the interdependence of factors affecting water consumption. The WHO/Unicef (2000) distinguish poor quality from 'improved' sources of water, and note that 'improved' does not include water provided by vendors, tanker-trucks, or bottled water. This type of water, whilst being of varying quality and reliability (OPS/OMS, 2001; UNDP, 2006), is provided at disproportionate costs compared to municipal supplies. This forces the inhabitants of many urban informal settlements in the developing world to spend a forbidding percentage of their overall income on water (Bakker, 2003). The distance of the water source from the dwelling place further constrains availability, access and use, as it affects the amount of time spent fetching water, as well as the activities for which water is used, with longer distances associated with lesser water use for cleaning and washing (Sullivan *et al*, 2003:190). The combination of these issues highlights the role of social and political processes in the production of urban water scarcity.

3.2.2 The socio-political construction of urban water scarcity

The inseparable nature of social and environmental processes of change has been well documented (e.g. Norgaard, 1994; Adger, 2000; Nelson *et al,* 2007). In the case of water, it is now widely accepted that global water scarcity is caused by

inequitable use, distribution and access, rather than from a physical lack of available water (Savenije, 2000; Mehta, 2010; Swyngedouw, 1999, 2009; Turton, 1999).

The need to provide water to rapidly growing urban populations attracts a range of additional, specific challenges. Swyngedouw *et al* (2002) highlight that rapid urban development often occurs at the cost of the water cycle as urban expansion requires increasing water extraction beyond sustainable levels, which attracts not only environmental costs but also frequently results in social conflict. Rapid urban development is often characterized by a failure of service provision to keep pace with the speedy expansion of urban areas (Gilbert, 1992; Serageldin, 1994), resulting in a widespread inequity of water supply between upper and middle income groups compared to the urban poor (Banes *et al,* 1996, Black, 1996; World Bank, 1994), as well as further discrimination among the urban poor with those in longer-established areas enjoying comparatively better service access than those in newer areas (Graham and Marvin, 2001:131).

Water cycles are complex webs of interdependent elements (Savenije, 2002:742). Where local, regional and global aspects of the hydrological cycle, through their close correlation to processes of social, political, economic and cultural power (Swyngedouw, 2004) might improve social and physical contexts of water for one group, this will often cause the deterioration of the same for another group, leading to unequal access to water for different groups depending on the same source (Peet and Watts, 1996, Keil, 2000)

The shortcomings of socio-political processes for the equitable management of limited water resources are illustrated by examples where the principle of 'Integrated Water Resources Management' (IWRM) is implemented. This often falls short of addressing the needs of all water users as it operates at the policy discourse level, which, by virtue of its partial nature, reflects the interests of those able to construct arguments while excluding those who do not have access to the discourse (Allan, 2003), thus perpetuating engrained structures of unequal access to a vital resource.

In the absence of fair water allocation systems, certain groups are subject to unpredictable and fluctuating levels of water scarcity that require considerable efforts to address. The role of informal insurance networks in mitigating the effects of poverty are well-documented in the development studies literature (Morduch, 1999; Dercon, 2005) in general, and one study provides evidence that non-market based social support networks can mitigate the distressing effects of

water scarcity, if not scarcity itself. Wutich and Ragsdale (2008) show that transparency, clear rules and lack of need for daily negotiations of informal social support systems make them effective in mitigating the effects of water scarcity in a Bolivian context.

For all its contributions towards understanding the effects of the complex socio-political processes that produce urban water scarcity, some of the political ecology literature makes claims of 'teasing out […] who suffers (and in what way)[..]' (Swyngedouw *et al,* 2002:4, see also Cutter, 1995), yet its analysis tends to remain at the macro scale, thus not fully disentangling the personal experience of suffering from water scarcity at the individual or household levels. If 'the power relations […] through which socio-environmental processes take place […] ultimately decide who will have access to or control over […] resources'; […] and if 'these power geometries, in turn, shape the particular social and political configurations and the environments in which we live' (Swyngedouw *et al,* 2002:4), then an exploration of the *experience* of living in such environments is vital to creating a holistic understanding of water scarcity in any given locality. Accordingly, if, as Ingold (2000) proposes, ways of acting within an environment are inextricably linked to ways of perceiving it (*ibid:* p.9), then an understanding of how water scarcity is experienced is a necessary prerequisite to influencing how socio-political power can be usefully exercised in addressing and mitigating its causes and effects.

3.2.3 Experienced dimensions of urban water scarcity

A small, yet varied body of research expands the conceptualization of water into the realm of the personal. Analyses of its integral and 'essential' (Strang, 2004:5) role to most areas of life, or conceptualizing water as a 'total social fact' (Orlove and Caton, 2010; after Mauss, 1990:3) that gives 'expression to all kinds of institutions at one and the same time', and 'connect[s] different domains of social life' (Orlove and Caton, 2010:402) enable a holistic appreciation of the experienced dimensions of water (and its lack), and allow to conceive of it beyond merely a physical phenomenon, or as purely the physical expression of the distribution of social power in a given society (Swyngedouw, 1999).

Water displays a range of 'special' characteristics, each of which individually do not make it exceptional, but in combination make it a resource unlike any other.

Particularly, the combination of its 'non-substitutable', 'fugitive' and 'indivisible'[13] natures, in combination with its 'high mobilisation costs' (Savenije, 2002:742), have been argued to elevate it to a good that requires an inter-disciplinary approach to fully valuing it (Peppard, 2011:308).

An even smaller number of studies have expanded their focus on the experience of water scarcity. These works address a range of issues, including how secure supply of, and access to, water are a component part of the experience of water scarcity (Wutich, 2006); how social and physical suffering arises from unequal access to water (Ennis-McMillan, 2001; also Wutich and Ragsdale, 2008); the detrimental effects of water scarcity on sociability and reciprocity (Wutich, 2006); the co-existence of positive feelings related to having safe potable water with the negative emotions arising from simultaneously 'suffering for and from water' (Sultana, 2011:171); water-related emotional distress arising from negotiations of access to water (Wutich and Ragsdale, 2008); and the challenges faced by communities that are lacking in both natural resources and adaptive capacity (Turton, 1999). These studies highlight not only a substantial spectrum of experienced dimensions of water scarcity by documenting the considerable impact on human wellbeing, but document links between emotional, physical, social and political dimensions of lacking water, suggesting that the prevailing separation between distinct aspects of the phenomenon can, and ought to be bridged.

The pressures bearing on the social, cultural and political processes that determine availability of water to different interest groups are likely to increase in contexts where the physical availability of water is limited, as is the case in the coastal desert that is home to Lima; and the experience of lacking water and sanitation is likely to be intensified in such environments. The next sections examine the geographic context, and historical and political trajectories that shape urban water scarcity in Lima's informal settlements.

3.3 Resource issues in Lima's informal settlements

The pressures on water and sanitation at the heart of this study are inextricably linked to Peru's history, and have reached a particular bottle neck in its capital's informal settlements since their formation began to accelerate in the 1950s. This section examines Peru's geography and sketches its environmental and political

[13] By this the interdependence of the different stages of a water cycle is meant, whereby the interference with one aspect of the cycle inevitably causes effects in another stage.

history to understand contemporary resource issues in Lima's informal settlements. The literature pertaining to each of these topics is vast; and as the focus of this study is on examining the experience of water scarcity, only those issues crucial to understanding the background of the people at the centre of this study, and the various systems that support them, are examined here. These primarily concern the contention that whilst water is physically scarce in Lima, the persistent lack of its provision in informal settlements derives from historically engrained socio-political inequality.

3.3.1 Peru: a brief political ecology

The persistent and comprehensive failure to provide water and sanitation to Lima's informal settlements (Ioris, 2012a, 2012b; Fernández-Maldonado, 2008) derives from a unique combination of circumstances that are no doubt characterized by physical water shortages, but are chiefly determined by political factors - which in turn are deeply historically engrained – and that govern the production, distribution and management of the vital resource that is water in Peru's capital.

Peru's geography is characterized by a strong division between the coastal desert that is home to Lima, its capital, and the fertile *selva* of the Amazon Jungle. They are separated by the Andes mountains, making communication and trade between the two zones difficult (Riofrío, 2003). Only 4% of the coastal desert region is arable, and all of its populations depend to a large degree on waters descending from the Andes. This water is highly contested, being in demand for increased water needs for domestic and agricultural use following rapid urbanization in Lima and other coastal centres (Hudson, 1992), and mining activities nearer the source of the water (Budds and Hinojosa-Valencia, 2012; Bebbington and Williams, 2008).

It has been suggested that forming the city in the place it occupies was a grave error of the Spanish, who founded it in its coastal desert location in 1535, and who prioritized a sea location at the cost of sufficient space for urban expansion and sufficient water resources (Riofrío, n.d.). The lack of both play a crucial role in explaining current pressures on the city as a whole, and on the study community in particular. The city of Lima has an extremely low average of annual rainfall of 15mm (Alcázar et al, 1999) and its three main rivers Rímac, Chillón and Lurín are subject to seasonally variable flows resulting in a shortage of water reaching the capital, especially in winter (Fernández-Maldonado, 2008). The city is located on

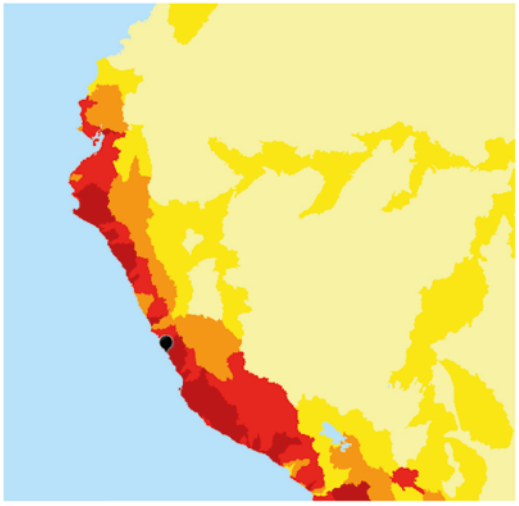
a large aquifer that extends over roughly 390km², its depth ranging from 0m at sea level to an estimated 500m further inland. Over-pumping had led to severe drops of between 10 and 40m in levels of available water between 1969 and 1985 (Anton, 1993), and although depletion has since slowed, largely due to the aquifer's levels dropping so low (to -55m in 2010; Montoya and Mamani, 2014) that most wells no longer reach the water, the historical over-extraction has led to problems of seasonal salination making the water unfit for human consumption. Due to very little rainfall, the aquifer is never recharged directly and relies on indirect replenishment from the city's river beds, swamps to the north of the city, agricultural and domestic garden irrigation, and losses from the water distribution and sewage systems (Anton, 1993:101). Many of these sources of replenishment have been compromised as permeable surfaces such as parks, farmland and rivers were replaced by impermeable ones in the process of urbanization, causing negative rates of recharge to slow further. As a result, the aquifer is replenished more slowly than water is being extracted from it, making it a dwindling source of water.

A number of other factors combine to expose Lima to extremely high levels of water-related risks. The aggregated measure of a range of indicators pertaining to 'physical quantity, quality and regulatory & reputational risk' (World Resources Institute, 2014) are presented on the following pages. Whilst these measures are approximate and display averages at the city level, they nevertheless draw a comprehensive picture of Lima's precarious water situation.

Figure 3.1: High Water Risk in Lima: Quantitative Factors

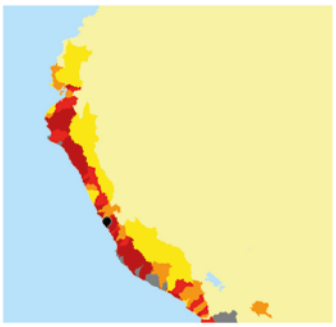
Composite Physical Risk arising from quantitative factors: Extremely High

Physical risks related to quantity arise from a range of factors impacting on short or long term water availability, listed below.



Physical Risk Quantity
- Low risk (0-1)
- Low to medium risk (1-2)
- Medium to high risk (2-3)
- High risk (3-4)
- Extremely high risk (4-5)
- No Data

The following indicators are used to determine the overal physical risk arising from quantitative factors:

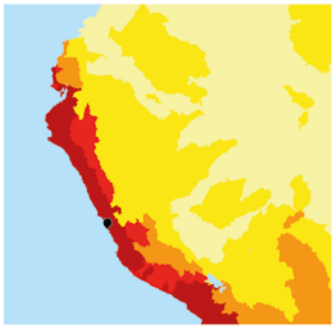


Baseline Water Stress:
EXTREMELY HIGH

Baseline Water Stress
- Low (<10%)
- Low to medium (10-20%)
- Medium to high (20-40%)
- High (40-80%)
- Extremely high (>80%)
- Arid & low water use
- No data

Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. Higher values indicate more competition among users.

Sources:
WRI Aqueduct, 2014
FAO AQUASTAT, 2008-2012
NASA GLDAS-2, 2012
Shiklomanov and Rodda, 2004
Floerke et al, 2012
Matsutomi et al, 2009

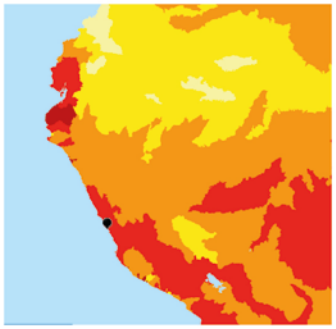


Inter-annual variability:
EXTREMELY HIGH

Inter-annual Variability
- Arid & low water use
- Low (<0.25)
- Low to medium (0.25-0.5)
- Medium to high (0.5-0.75)
- High (0.75-1.0)
- Extremely high (>1.0)
- No data

Inter-annual variability measures the variation in water supply from year to year.

Source:
WRI Aqueduct, 2014
NASA GLDAS-2, 2012



Seasonal Variability:
HIGH

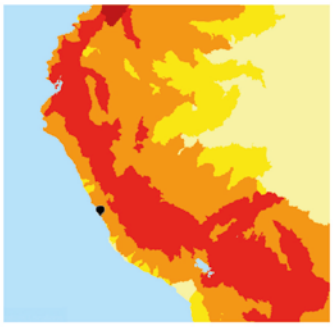
Seasonal Variability
- Arid & low water use
- Low (<0.33)
- Low to medium (0.33-0.66)
- Medium to high (0.66-1.0)
- High (1.0-1.33)
- Extremely high (>1.33)
- No data

Seasonal variability measures variation in water supply between months of the year.

Source:
WRI Aqueduct, 2014
NASA GLDAS-2, 2012

Map, key and text source: World Resources Institute, 2014

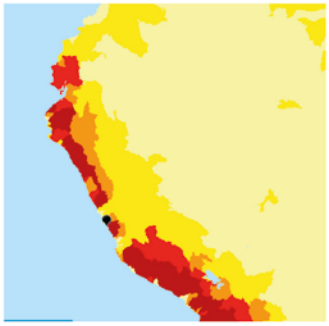
The following indicators are used to determine the overal physical risk arising from quantitative factors:



Flood Occurence: MEDIUM TO HIGH

Flood Occurence
- Low (0-1)
- Low to medium (2-3)
- Medium to high (4-9)
- High (10-27)
- Extremely high (>27)
- No data

Flood occurence is a count of the number of floods recorded from 1985-2011.
Source:
Brakenridge, Dartmoor Flood Observatory, 2011



Drought Severity: EXTREMELY HIGH

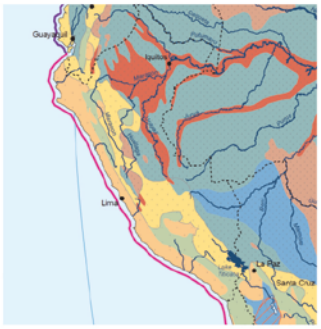
Drought Severity
- Low (<20)
- Low to medium (20-30)
- Medium to high (30-40)
- High (40-50)
- Extremely high (>50)
- Arid & low water use
- No data

Drought severity estimates the average of the length times the dryness of droughts from 1901 to 2008. Drought is defined as a continuous period where soil moisture remains below the 20th percentile, length is measured in months, and dryness is the number of percentage points below the 20th percentile.
Source:
Sheffield and Wood, 2007

Upstream Storage: NO MAJOR RESERVOIRS

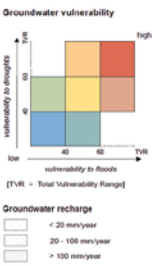
Upstream Storage
- High (>1)
- High to medium (1-0.5)
- Medium to low (0.5-0.25)
- Low (0.25-0.12)
- Extremely low (<0.12)
- No major reservoirs

Upstream storage measures the water storage capacity available upstream of a location relative to the total water supply at that location; higher values indicate areas more capable of buffering variations in water supply (e.g. droughts and floods).
Sources:
WRI Aqueduct, 2014
NASA GLDAS-02, 2012
Lehner et al, 2011



Groundwater Stress: HIGH

Groundwater stress measures the relative ration of groundwater withdrawal to recharge rate. Values above one indicate where unsustainable groundwater consumption could affect groundwater availability and groundwater-dependent ecosystems.
Sources:
Gleeson, Wada, Bierkens and van Beek, 2012

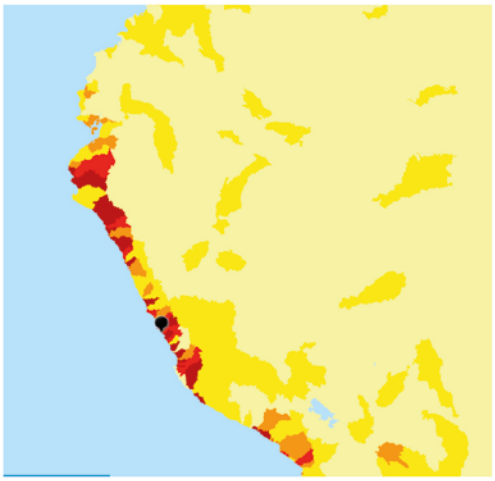


Map, key and text source: World Resources Institute, 2014

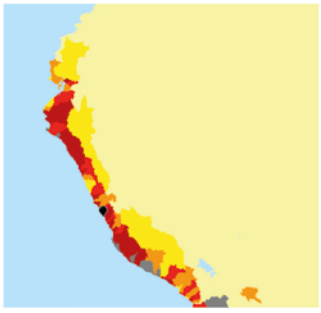
Figure 3.2: High Water Risk in Lima: Qualitative Factors

Composite Physical Risk arising from qualitative factors: Extremely High

Physical risks related to quality identify areas of concern that may impact on short term or long term water quality.



The following indicators are used to determine the overal physical risk arising from qualitative factors:

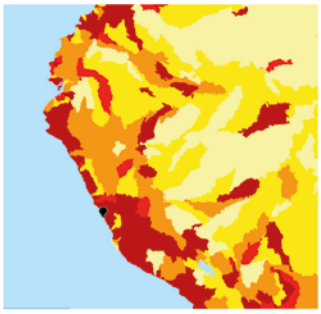


Return Flow Ratio: HIGH

Return Flow Ratio
- Low (<10%)
- Low to medium (10-20%)
- Medium to high (20-40%)
- High (40-80%)
- Extremely high (>80%)
- Arid & low water use
- No data

Return flow ration measures the percentage of available water that has been previously used and discharged upstream as wastewater. Higher values indicate higher dependency on treatment plants and potentially poor water quality in areas that lack sufficient treatment infrastructure.

Sources:
WRI Aqueduct, 2014
FAO AQUASTAT, 2008-2012
NASA GLDAS-2, 2012
Shiklomanov and Rodda, 2004
Floerke et al, 2012
Matsutomi et al, 2009



Upstream Protected Land: EXTREMELY LOW

Upstream Protected Land
- High (>40%)
- High to medium (20-40%)
- Medium to low (20-10%)
- Low (10-5%)
- Extremely low (<5%)
- No data

Upstream protected land measures the percentage of total water supply that originates from protected ecosystems.
Lower values indicate areas located downstream from less-protected watersheds. Water quality could, therefore, be compromised in that area.

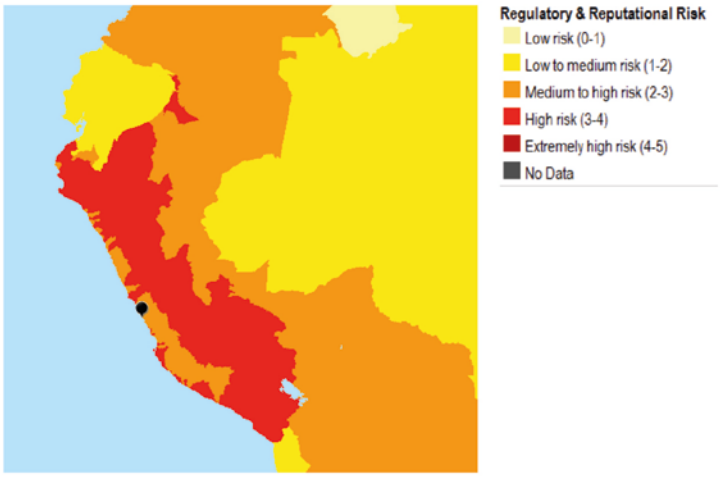
Source:
WRI Aqueduct, 2014
NASA GLDAS-2, 2012
IUCN, UNEP 2012

Map, key and text source: World Resources Institute, 2014

Figure 3.3: High Water Risk in Lima: Regulatory and Reputational Factors

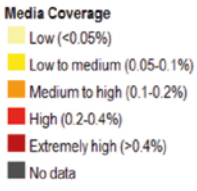
Composite Physical Risk arising from regulatory and reputational factors: Medium High to High

Regulatory and reputational risks identify uncertainties in regulatory change, as well as conflicts with the public regarding water issues.

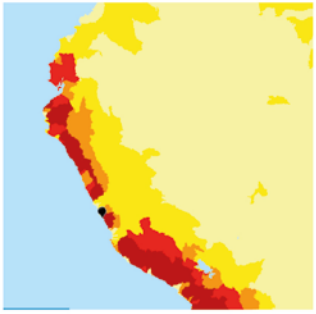


The following indicators are used to determine the overal physical risk arising from regulatory and reputational factors:

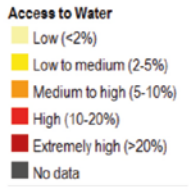
Media coverage: MEDIUM TO HIGH



Media coverage measures the percentage of all media articles in an area that cover water-related issues.
Higher values indicate areas with higher public awareness around water issues, and consequently higher reputational risks to those not sustainably managing water.
Source:
Google



Lack of access to water: HIGH



Access to water measures the percentage of population without access to improved drinking water sources.
Higher values indicate areas where people have less access to safe drinking water supplies, and indicating high reputational risks to those using water in an inequitable way.
Source:
WHO Unicef JMP 2010

Map, key and text source: World Resources Institute, 2014

In many large cities of Latin America, water scarcity is experienced due to uneven distribution and lack of access or economic means to acquire water, rather than as a result of actual lack of water available (Anton, 1993:163). Lima's situation differs as it 'uses most of the water available in [its] rivers' (*ibid*:102), which means that social, political and economic inequities resulting in inequitable water provision are exacerbated by severe physical shortages. The contamination of surface and ground water from domestic wastewater and industrial waste entering the water supply upstream of Lima results in the pollution of water reaching Lima (*ibid*), resulting in problems of not only physical shortages but compromised quality.

This suggests that the pressures on scarce water in the coastal desert are not primarily geographic. The water crisis in wider Latin America has been argued to principally derive from a historically engrained unequal access to resources, beginning with the arrival of European colonialists and the ensuing integration of the continent into the global economic system (Anton, 1993:27). Latin America's peoples and environments have been subjected to centuries of exploitation from external powers (Faber, 1992), with 'ecological destruction and human poverty and misery […] becom[ing] more profound' (*ibid*:3) and further exacerbated by the effects of globalisation (Kendall, 2005). Durham (1995) suggests that this has caused two interlinked pathways of destruction through capital accumulation for the wealthy on the one hand, and impoverishment for the poor on the other. The pressures on scarce water in Peru are consequently emphasized by severe and deeply engrained inequality that has been perpetuated by a succession of economic models of neoliberal capitalism under subsequent governments since the early 2000s (Burron, 2012; Ioris, 2012a). These have been prioritizing the interests of Peru's industrial elites over the needs of the country's poor, leaving the power of the former unchallenged (*ibid*).

Despite promising rhetoric and partial improvements of conditions for the poor under several governments, and most notably so under the most recent one of Ollanta Humala (Burron, 2012), the prioritization of minority interests over the majority's rights and needs continues to prevent the improvement of conditions for the country's poor in general, and the provision of water and sanitation infrastructure to large proportions of the urban poor in particular. Dietz (1989) argues that this is in part perpetuated by recurring external debt cycles, which, rather than disadvantaging monetary elites, have served to 'augment[…] their relative positions within their own economies' (*ibid:*13), thus further removing

incentives for the ruling elites to address social inequalities. In 2013, only 93% of the capital's population of 9,750,000 had access to 'improved' sanitation (INEI, 2013) and 6.4%, approximately 625,000 people, continued to live without access to safe drinking water (*ibid*).

3.3.2 Urban informal growth and resource pressures in Lima's informal settlements

Decades of under-investment in, and mismanagement of, urban water infrastructure, as well as the costs associated with bringing water and sanitation infrastructure to Lima's hilly geography in a country with a large proportion of poor end users have protracted the process. This section explores the phenomenon of a persistent lack of water and sanitation provision as 'a result of the intersection between poverty and inequality' (Ioris, 2012b:613), and as perpetuated by rapid urbanization.

Lima's informal settlements, which have been variously termed *barriadas* (marginal neighbourhoods), *pueblos jóvenes* (young towns) and *asentamientos humanos* (human settlements) (Olórtegui, 2001) grew rapidly as a result of rural-urban migration in the 1950s[14]. Rural conflict and poverty (Drake and Hershberg, 2006), combined with Lima's increasing national economic domination (Riofrío, n.d.) drove large portions of people to Lima in search of employment opportunities, resulting in extreme demographic growth from 650,000 in the 1950s to nearly 10m in 2012. Figure 3.4 illustrates the impact of this growth on the city's geographical spread.

Whilst the very early settlers occupied *tugurios* (tenements) close to employment opportunities in Lima's historic centre (Olórtegui, 2001), these were soon filled, and in a context of severe under-provision of affordable public housing (Riofrío, n.d.) by successive governments, subsequent generations of arrivals were forced to settle in ever-more distant and geographically hazardous areas on Lima's periphery. After initially positive reception of government schemes for providing 'sites and services' (Riofrío, n.d.) for poor immigrants, it was soon realized that this led to an unequal provision of housing, with the poor being provided with land and having their formal community leadership structures officially recognised, but the onus of building both individual homes and public

[14] The different terms have been variously grounded in a number of legal articles, and vary in definition with their geographic location, land ownership, tenure situation, physical regularization of plots, formal recognition, amongst others (Dupont *et al,* 2015). As such, the different terms do not represent the same social realities, but are related to progressive stages of formalization, although in popular use they are often used interchangeably.

infrastructure falling on those least able to afford the process. This led to a highly inefficient self-help process that saw those caught in its midst living in inadequate accommodation for extended periods of time and in crowded, unsafe conditions, without access to credit to improve their facilities, nor to technical expertise to ensure the safety of the buildings and infrastructure constructed in precarious, remote and earthquake-prone areas of the city (Riofrío, n.d.). These constraints still characterize life in many of Lima's informal settlements in the early 2000s. At the same time, 'the state and private sector sought to provide housing for the middle class' (Riofrío, 1978).

The combination of rapid urbanization in increasingly remote and geographically perilous locations on Lima's periphery and political lack of prioritization of service provision have resulted in a direct correlation between socio-economic status, housing quality and water provision. This means that informal settlements tend to exist for a minimum of 2 decades before protracted processes of formalization and legalization are sufficiently advanced to enable the provision of basic services.

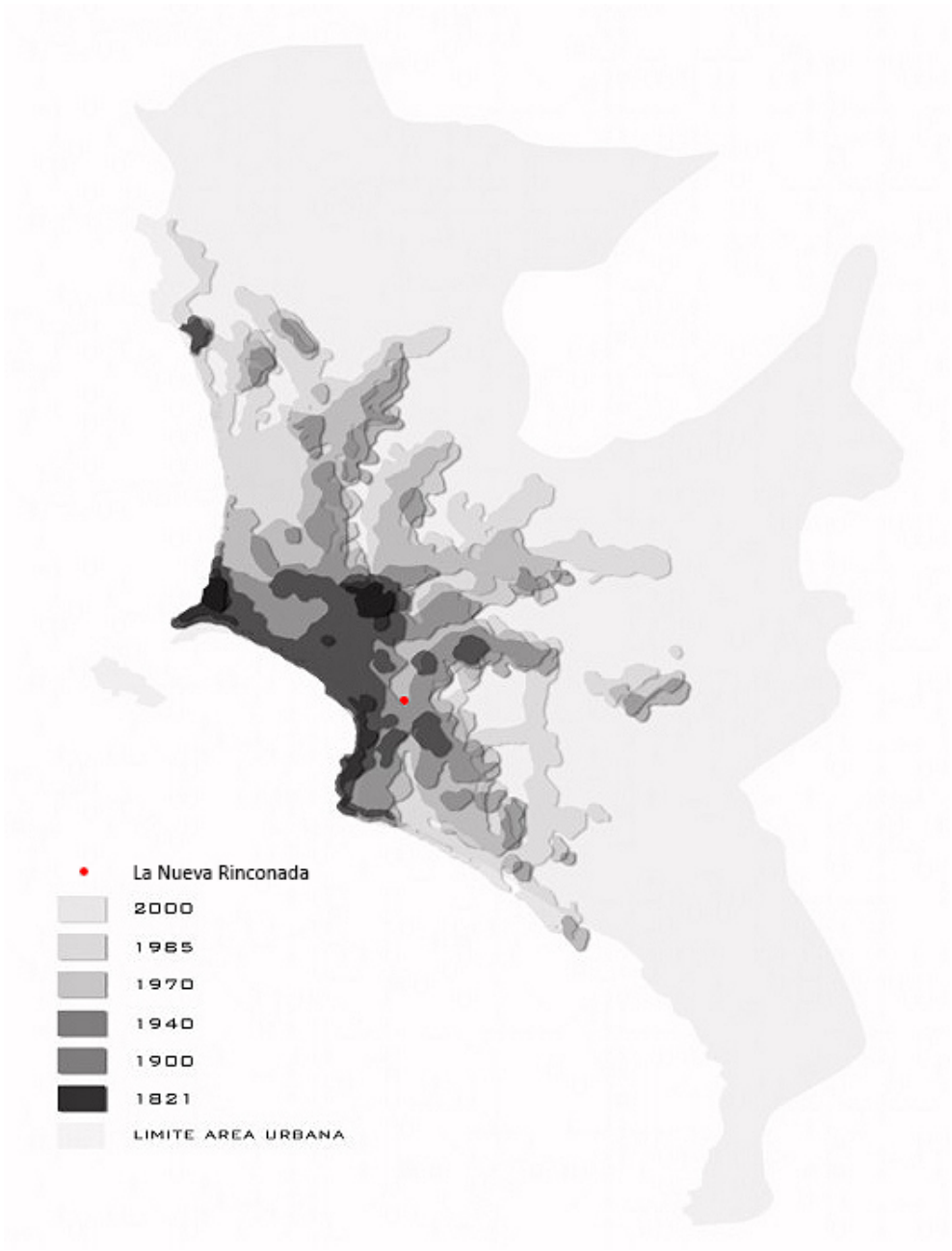


Figure 3.4: Lima's urban growth.

Source: Adapted from contemporarycity.org

3.3.3 Illegal tenure

A particular constraint on the expansion and development of informal settlements revolves around the legal constraints governing titling provision. A policy to legalise property in informal settlements was first introduced by the Fujimori government in 1996, 'with the support of the World Bank, through the Urban Property Rights Programme', and via the creation of a commission to legalise informal property (COFOPRI), which saw the distribution of over 1m title deeds by 2000 (Calderón, 2004:289). The policy was largely used by Fujimori to ensure his re-election in the year 2000, but as he fled the country to avoid persecution for serious corruption charges six months later, the subsequent transition government made significant changes to the policy, effectively decentralising responsibilities for legalising informal properties. Toledo's government (2001-2006) strengthened the policy, most notably through legalising those who had illegally invaded between 1996 and 2001. This was in part driven by the work of Peruvian economist Hernando de Soto, whose work on the importance of property rights in promoting prosperity in general, and access to credit in particular, was highly influential. The causality between title deeds and access to credit has since been questioned (McKechnie, 2005), and to this day, whilst some 3000 informal settlements are expected to benefit from a supreme decree ensuring the legalization of their inhabitants and the formalization of land tenure (Calderón, 2004), the intended speedy provision of title deeds is slowed by local complexity arising from a large range of tenure categories (cf. Calderón, 2004, for a discussion) and complicated land ownership contexts comprising multiple owners.

Calderón (2004) posits two positive effects of illegal land invasions in relation to titling issues which will be interesting to observe in the study location. The first concerns a claim of a 'strong sense of security' (*ibid:* 296) among poor urban squatters arising from having settled on publicly owned land and recurring policies of amnesties for illegal squatters. The second concerns the assertion that full property and tenure rights are not required for settlers to start investing in their property, nor for obtaining basic services, including water and sanitation (*ibid:* 298).

12 years after the invasion of La Nueva Rinconada, its residents were yet to obtain title deeds for the land they occupy, and in 2012 only one of the settlement's 143

neighbourhoods had been provided with electricity from the grid, with none enjoying municipal water or sanitation provision.

3.3.4 Lima's informal settlements today

Whilst Lima's older areas of informal settlements continued to spread for many years, resulting in rapid urban sprawl, space eventually became scarce, leading to over-crowding and a change in tenure arrangements, with families forced to rent when unable to obtain a plot. The newer settlements faced additional complications from being in increasingly remote locations and housing a changing demographic of mostly natives from Lima, the children of rural-urban migrants who arrived from the 1950s onwards. This demographic group, although educated and literate, suffers from lack of access to secure employment, resulting in a 'lack of resources to consolidate and improve shelter' (Riofrío, n.d.). A growing, and to date unresolved problem affecting quality of life in Lima's informal settlements concerns the authorities' lack of prioritisation to provide basic services to the capital's low-income populations. In the 1960s and 70s, both electricity and water provision were extended by lengthening power lines without increasing overall capacity; or, in the case of water, increasing the flow in existing pipes without increasing or even maintaining their capacity, leading to a rapid deterioration of services in the 1980s (Riofrío, n.d.).

3.3.5 Water and sanitation provision in Lima

Water had been scarce in Lima since the mid-1960s, which saw the first instances of rationing supply to informal areas (Riofrío, n.d.). In the 1970s and 1980s, a shift in national economic policy towards 'greater reliance on market practices and a withdrawal of the state' (Fernández-Maldonado, 2008:1884) followed a 'profound restructuring of the state' (*ibid)* forced by global financial institutions including the World Bank, International Monetary Fund and Inter-American Development Bank, and resulted in the widespread liberalization and privatization of public sector services, including those in charge of water and sanitation. A Latin American-wide context of 'low or negative economic growth, chronic inflation, soaring external debts, high macroeconomic instability and fiscal crises' (*ibid)* allowed the global financial institutions to force national governments to adopt Structural Adjustment Policies (SAPs) that were characterized by 'radical public-spending cutbacks, reduction of the public sector, privatization, deregulation and

liberalization of trade and finance', producing a 'visible increase in income inequality, […] and a stagnation or increase of the informal proletariat' (Portes and Hoffman, 2003:14).

Graham and Marvin (2001) suggest that such 'unbundling' of networks and services produces effects of urban segregation and is conducive to the creation of inequality in service provision. Due to water infrastructure being very costly to provide and maintain, it is cost ineffective to open its provision to market competition, instead requiring 'regulation […] to promote efficiency, correct distortions, and protect users' (Fernández-Maldonado, 2008:1887). In Lima, a lack or weaknesses in regulation and water's vital role in sustaining life have led to political and at times violent conflicts (*ibid).*

The severe economic crisis of the 1980s and longstanding under-financing, under-maintenance and under-expansion (Watkins, 2006) saw Lima's water and sanitation service SEDAPAL (*Servicio de Agua Potable y Alcantarillado de Lima*) increasingly unable to meet growing water demand, with the system nearing collapse in 1990. This was characterized by frequent service interruptions, significant wastage from leaky infrastructure and deterioration in quality, making water unsafe to drink (Fernández-Maldonado, 2008)[15].

In an apparent response to this crisis, but largely as a result of externally enforced neoliberal reforms, Fujimori in 1994 launched a General Law of Sanitation Services, opened the sector to private capital and created a regulatory body, SUNASS (*Superintendencia Nacional De Servicios de Saneamiento)* (Fernández-Maldonado, 2008). This privatization attempt was unsuccessful due to high production costs associated with bringing water to Lima's mountainous geography, and the longstanding neglect of the water infrastructure, both of which required high upfront costs, which would have resulted in high charges for water provision, and which investors knew Lima's poor populations would not be able to afford, resulting in a collapse of various privatization attempts. Public uprising provided further incentives towards an agreement for reform and regulation, which in the early 2000s was supported across the political spectrum, evidenced by all 2006 presidential candidates rejecting the privatization of SEDAPAL (Fernández-Maldonado, 2008).

[15] This culminated in a Cholera epidemic in 1991, which infected some 390,000 people on the Latin American continent. Peru was the worst affected country with some 320,000 cases reported, 800 of whom died (University of Texas, 1996). The costs of the epidemic were estimated to have reached a total of $200m arising from direct costs of managing the epidemic, and associated costs of increased morbidity and impacts on tourism and the national economy (Suarez and Bradford, 1993:34). Not only could those costs have covered the provision of safe water and sanitation to many affected communities, but they would have entailed associated intangible positive effects that are difficult to put into economic terms (*ibid:* 35).

Ioris (2012a, 2012b) describes Lima's current pressures relating to water and sanitation provision as arising from the 'material and discursive' (p.93) elements of water scarcity having been 'exacerbated by political and ideological affirmation of market-based institutions and private property relations' (*ibid*), and by scarcity having been used to maintain social and spatial inequalities. The swift resolution of the problems of water and sanitation provision therefore seems unlikely, as it pertains not only to physical lack of water and issues of management and regulation, but is more deeply engrained in the city's socio-economic and political structures that are unlikely to radically change any time soon.

3.3 The study setting: La Nueva Rinconada

The study community of La Nueva Rinconada occupies a valley and its surrounding hills in Lima's South-Eastern Pamplona Alta district. It is inhabited by approximately 66 000 people, who occupy some 11000 plots of land organized in 143 neighbourhoods (Pebal La Inmaculada, n.d.). The government designated the area for food production by Lima's pig breeders in the 1950s to satisfy a growing demand for pork in the capital. On the 8th January 2000, several hundreds of families of *invadores* (illegal settlers) invaded the territory known as *Las Chancherias* (the pig sties). Reports of the circumstances surrounding this event vary widely, with the big breeders proclaiming the right to defend their land, whilst the invaders reported having been informed by the municipality that it had revoked settlement rights due to the pig breeders not having met conditions for physical improvement of the area (Ortiz Sánchez and Donayre Muñoz, 2011). A series of violent clashes and evictions ensued, but with ever-greater numbers of families returning at each 're-invasion', the *invadores* soon settled permanently, first occupying privately owned land at the bottom of the valley and later increasingly settling on the steeply rising hills of government-owned land (Pebal La Inmaculada, 2010). Figure 3.5 illustrates the settlement's growth since being recorded via satellite image in 2003. The settlement today stretches across 2 municipalities (Figure 3.6 illustrates). Figure 3.7 presents some images of the settlement's evolution between the years 2003 and 2015.

Figure 3.5: Urban Growth of La Rinconada, 2003-2015

KEY: Mountain ridge (white). Main road at bottom of valley (green). Physical edges of the settlement/ recent expansions (red).

2003

La Nueva Rinconada three years after the beginning of invasions. The settlement stretches out from the gently sloping road at the bottom of the valley into its steeper Northern areas.

2007

By 2007, the Northernmost neighbourhoods are expanding into the steepest slopes, and minor growth continues to the East.

2011

By 2011, neighbourhoods start to stretch across the ridge of the mountainin the North-West, and growth continues to the East.

2012

In 2012, the year of data collection, the settlement continues to expand along the boundaries of existing neighbourhoods despite the settlement having been declared 'consolidated' during 2012. New areas occupy ever-steeper slopes.

2015

By 2015, two new neighbourhoods are established on the settlement's most precarious Northern slopes.

Maps: adapted from Google Earth.

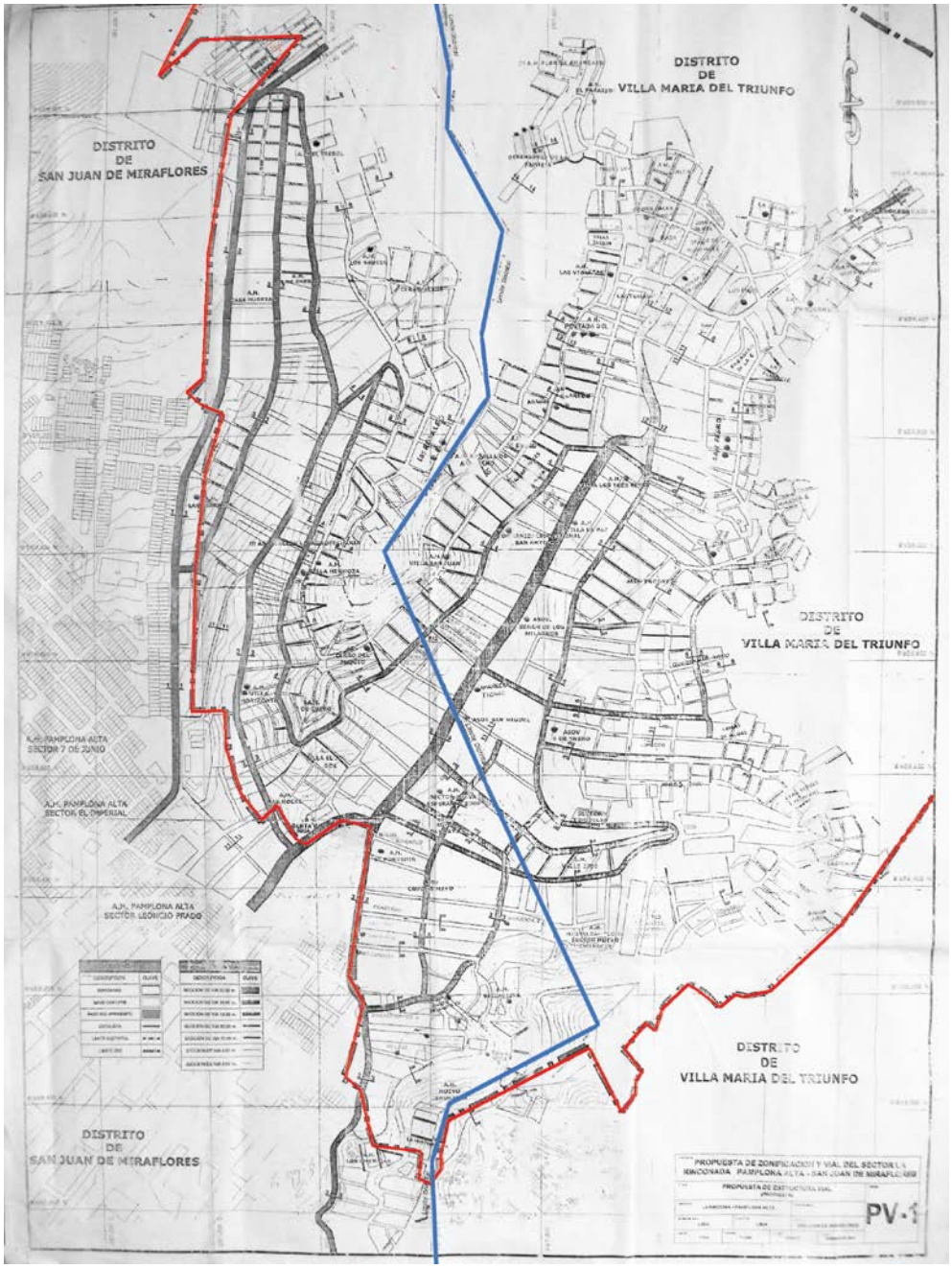


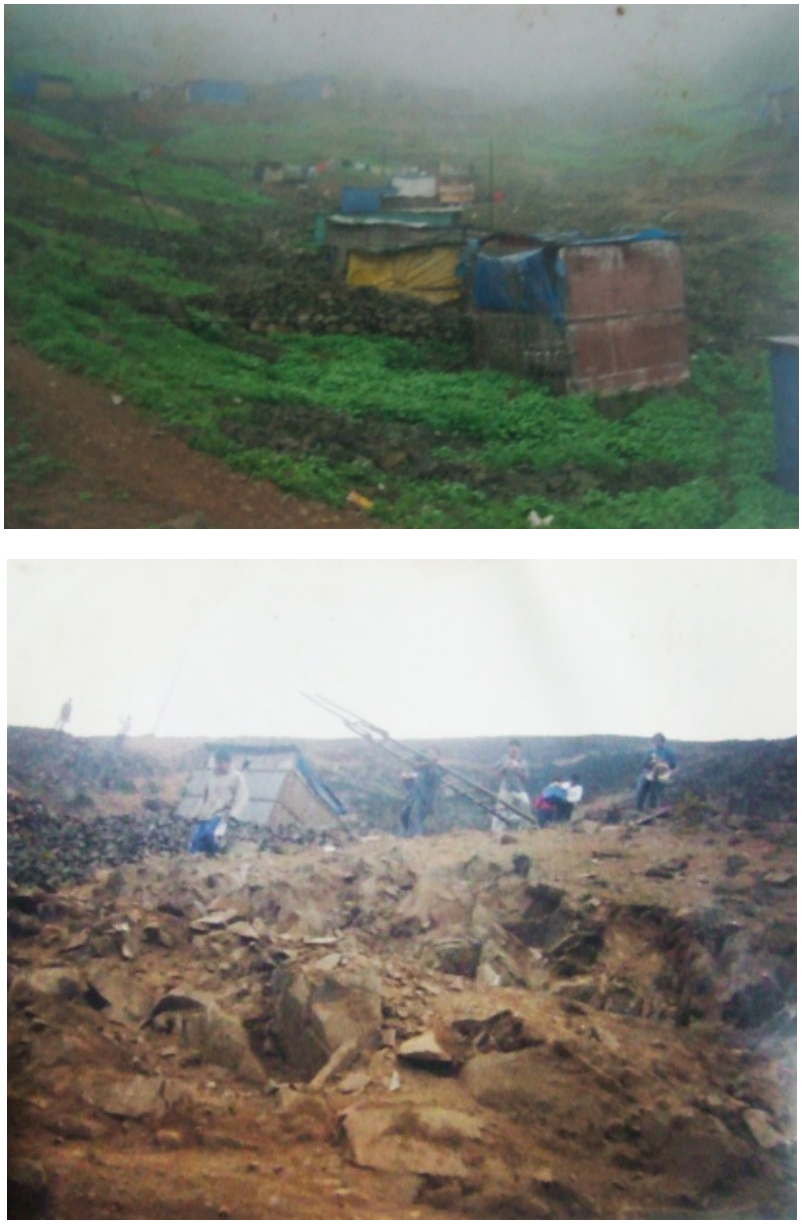
Figure 3.6: La Nueva Rinconada and its administrative boundaries

One of the few existing maps of the settlement in 2012 shows its location across the two municipalities of San Juan de Miraflores in the West, and Villa Maria del Triunfo in the East (municipal boundary indicated by the blue line; note this differs from the boundary understood to affect one of the study neighbourhoods by its representative).

The map also highlights some first areas of the settlement's continued growth beyond its 'consolidated' boundaries (red line) in the North-West and along its Western edge.

Source: La Nueva Rinconada Health Centre map. Photograph by researcher.

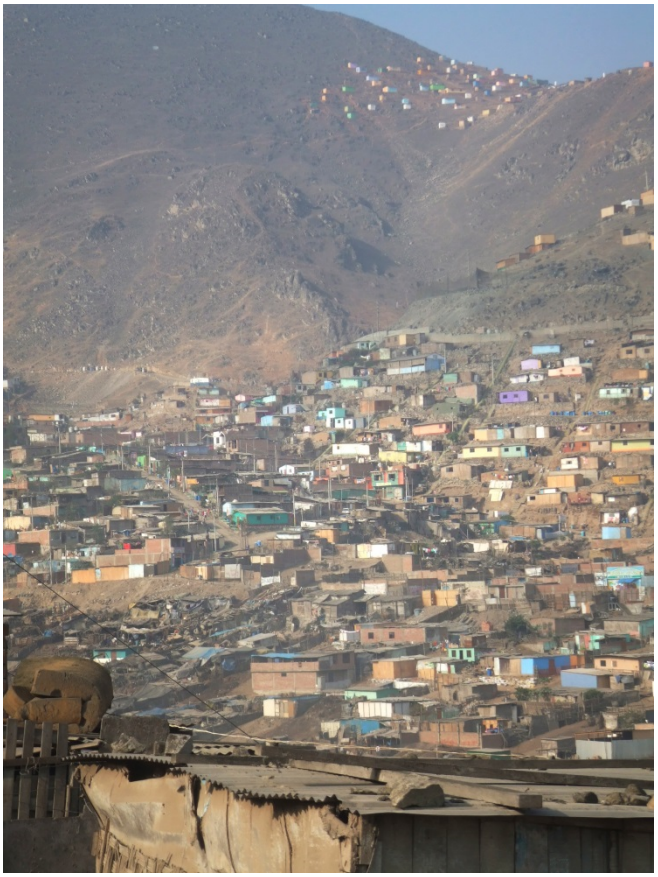
Figure 3.7: La Nueva Rinconada: Then and Now (2000 & 2012)



Residents' photographs show snapshots of the settlement's evolution from initial occupation of the bare landscape in temporary shelters (top), via the levelling of plots (middle) to the setting out of roads (bottom).

Residents' photographs show snapshots of the settlement's evolution. Once roads were set out and plots allocated,
the area saw the arrival of the first businesses along its main thoroughfare (top).
Unlike most homes, these are constructed in more permanent materials, such as brick (bottom).

Photographs: Participants



La Nueva Rinconada in 2012:
Neighbourhoods stretch high up the valley's steepest slopes, and cross the peaks of its mountains (top).
Dynamic change is evidenced by the prominent patches of swine herder enclaves (dark area in centre of bottom image),
occasional empty plots where residents have left, and a newly constructed school (top of bottom image).

Neighbourhoods progress is evidenced by the provision of services, such as the opportunity to house a health centre (top). The different levels of development across the settlement are highlighted in the bottom image, which shows the courtyard of one of the few serviced public buildings, solidly constructed and providing childcare facilities, with the single neighbourhood in receipt of municipal electricity supply and the settlement's school visible behind.

An area of recent invasion is visible at the very top of the mountain in the distance.

Photographs: Researcher

The geography of the area is at high risk from earthquakes and natural disasters (Predes/ OXFAM, 2010), and is hostile to settlement due to its ground of solid rock that makes plant retention and the construction of level plots, roads and other infrastructure highly difficult. The climate is humid and in the mountain's highest parts the temperatures drop to 9°C in winter, and rise to over 30°C in summer.

The population is comprised of mostly urban-urban migrants who arrive from other areas of Lima to occupy a plot of land to secure livelihoods in old age, when, in the absence of national security systems, they will be unable to afford rent when they are too old to work. These are complemented by a minority of rural-urban migrants who continue the steady, but nowadays much-decreased flow of rural migrants seeking work in the capital. The population is comprised of roughly 50% men and 50% women, ranging across all age groups (Pebal La Inmaculada, 2009:16).

Employment is found usually at long distance from the settlement and in unskilled or low-skilled occupations, such as construction workers, street vendors, manual labourers, household employees, child and elderly carers and cleaners, as well as taxi drivers, chauffeurs and bus drivers. The majority of households contain between 3-5 people, and in a 2009 survey of employment in the area, a staggering 58% chose not to respond to the question whether any household member had gainful employment (Pebal La Inmaculada, 2009:69), confirming La Nueva Rinconada as one of Lima's 180 'pockets of poverty' (Pebal, n.d.), and placing its population in the first quintiles of both poverty and extreme poverty[16] measures.

The problems affecting the community are made all the more striking by a large wall that runs the length of some 10km along north-western ridge of mountains that are home to the community. The wall was constructed in 1985, prior to the settlement's expansion, by the community who occupies the other side of the mountain, and whose enclave of Las Casuarinas is synonymous with wealth and privilege, as the area is widely considered to be Lima's most exclusive gated community (Huayta and Romero, 2014; La República, 2014). Figure 3.8 illustrates.

[16] Both are measures of monetary poverty, rather than multi-dimensional poverty.

Figure 3.8: La Nueva Rinconada and Las Casuarinas.
The wall separating La Nueva Rinconda (on the left) from the gated community of Las Casuarinas was constructed prior to the invasion.
In this location was an image of the separating wall by David Huamaní for La Republica, which can be found at the following location:
http://cdn7.larepublica.pe/impresa/sociedad/709468-habla-el-muro

Community representatives, supported by local and international organisations, are engaged in a number of committees with different tasks (from water via legal issues to citizen security and civil defence) to address the different problems the settlement. In addition, numerous neighbourhood councils are in charge of public kitchens, milk subsidiary programmes for children, health promotion and youth groups. Whilst all these are fully-fledged interlocutors with local, metropolitan and national governments, the range, extent and diversity of the committees' responsibilities highlights the widespread absence of formal institutions in providing these services and public goods, as does the observation that the community is largely 'missing' from official maps of the municipal districts it belongs to. For example, the development plan for 2012-2021 for the district of San Juan de Miraflores (which is home to half of La Nueva Rinconada's residents), acknowledges issues of informality and poverty in its text, but fails to consistently include the settlement in the maps of its jurisdiction (Municipalidad de San Juan de Miraflores, 2012: 10, 27, 40).

Progress in addressing the multiple factors that perpetuate poverty in the settlement has been slow. In 2014, a working group consisting of members of national and local governments and civil society, had reignited efforts to define strategies of intervention to solve the physio-legal problems of the titling situation; and the water commission of La Nueva Rinconada had been granted a budget to finalise the pre-investment report, and had submitted a request for a

budget to construct retaining walls that allow the passing of water mains (Pebal La Inmaculada, n.d.).

Due to a lack of water and sanitation networks, the community of La Nueva Rinconada, like many other informal settlements in Lima, is not connected to the municipal water system and as a result does not benefit from processed water derived from the city's rivers and aquifer available to those connected to the municipal grid. Its raised position and resulting distance from the underlying aquifer makes the drilling of local wells cost prohibitive. As a result, the community relies entirely on having their water delivered by private water vendors in trucks that is blighted by 'questionable quality' (PAHO, 2001, cited in Oswald *et al,* 2008) and by being charged at a disproportionately higher price for water compared to those connected to the grid (reportealdia.com, 2015).

At the time of my stay in 2012, La Nueva Rinconada displayed all the documented features of unchecked urban growth, informality, environmental pollution and lack of public services (Pebal La Inmaculada, 2014) and was in need of coordinated planning efforts, physio-legal restructuring, installation of water and sanitation, as well as communication and electricity infrastructure (*ibid*). Underlying this comprehensive lack of service provision are protracted title deed negotiations, the resolution of which appears lengthy at best, and unlikely at worst.

3.4 Conclusions: Foregrounding the experience of urban water scarcity

In reviewing the history and contemporary context of informal settlements and resource pressures in Lima, and specifically those pertaining to water and sanitation, I have sought to sketch the context in which water scarcity is experienced on a daily basis by the inhabitants of La Nueva Rinconada.

Drawing together the strands from the chapter's three sections shows that whilst a range of geographical and socio-political issues pertaining to water scarcity are well-documented and problematized, the experience of water scarcity remains little explored, not only in the study community, but in the literature on urban water scarcity in general.

I suggest that the experience of water scarcity is invaluable to fully understanding the phenomenon as it provides a vital perspective to complement the more widely examined socio-political and physical constraints that contribute to the production of urban water scarcity. Acknowledging Ingold's assertion that 'ways of acting within an environment are inextricably linked to ways of perceiving it' (Ingold, 2000:9, cf. chapter 2) make understanding how water scarcity is experienced an imperative prerequisite to determining how socio-political power can be usefully exercised to address and mitigate its causes and effects.

The following chapter describes the research methodology designed to examine the experience of, and resilience to water scarcity in depth, and understand both in the context of wider physical and socio-political systems.

Chapter 4:
Research Methodology

4.1 Theorizing the setting

On one of my first visits to La Nueva Rinconada, accompanying sister Marcia of the *hermanas combonianas de Pamplona Alta* on her usual Sunday walk through the settlement, we climbed high up its northernmost ascents to reach the assemblage of tents that had sprung up on a forbiddingly steep incline just a week before. As Marcia chatted to the group of people who had gathered to discuss how to lay out the plots, roads and access stairs to this newest of neighbourhoods, I glanced down over the rest of the settlement, taking in the different stages of progress made in the more established neighbourhoods in the distance, wondering what work and hardship lay ahead for those who had resolved to set up home here. The ground was excessively steep and slippery with sand on pure rock face. Access from the road was through barely-trodden precipitous footpaths. Makeshift structures supporting blue plastic sheets were pitched in a seemingly haphazard way and a heated discussion as to who should move their tents to align with the planned neighbourhood layout was underway. There was no sign of anything that might contribute to comfort; no means of preparing food, no means of acquiring water, no means of waste removal, no natural or manmade structures to protect from the beating sun, other than the makeshift tents. Familiar with the theory of why migration and land invasions continue in Lima and other Peruvian cities, I could nevertheless not help wonder what promise this most forbidding environment held for those arriving and what strengths they must believe to find in themselves to make it habitable.

*

This small vignette describes a typical starting point for residents of informal settlements in Lima, who set up home in hostile and remote geographical locations with little economic means to build a livelihood, exposing themselves to decades of hardship for the possibility of owning a plot of land in old age. It illustrates the underlying interplay between people and their supporting environments that first triggered my interest to study human-environment interactions, but also hints at the socio-political structures that frame this particular interaction in Lima. Throughout this chapter, I will introduce the key analytical strands that shape the thesis. They converge around the aim to examine the complexity of the lived experience in environments of rapid change and scarce resources, and to inform this through an understanding of the wider systems that shape it.

4.2 Introduction: Learning from small samples

> 'Consider a contrast: When Geertz (1973) wrote on the cockfights in a small Balinese village, many expected his *theoretical model* (of how games can embody societal power relations) to be applicable to other sites, but few expected the *empirical findings* to be so applicable – that is, for cockfights to look similar or to follow the same rules in other villages throughout or outside of Indonesia. The latter would be wholly beside the point. […]
>
> Today, ethnographers and qualitative researchers in fields such as urban poverty […] face a demand for case studies of poor, minority […] groups and neighbourhoods that not only generate theory but also somehow speak to *empirical* conditions in *other cases* (not observed). […] in fields such as urban poverty […] ethnographic case studies are often explicitly expected to represent larger entities.'
>
> Small, 2009

The field of urban poverty spans a large spectrum, as do the disciplines that study it. The risks of assuming that characteristics of deprivation in one community in conditions of urban poverty are empirically representatives of those in other, similar communities have only recently been touched on (Small, 2007). Researching a global phenomenon such as water scarcity by means of a small number of respondents, or cases, carries with it well-documented challenges of validity, generalizability and reliability (Small, 2007, 2009; Merriam, 1995; Shadish, 1995; Maxwell, 1992; LeCompte and Goetz, 1982; Kirk and Miller, 1986; March *et al,* 1991). Apart from the assumption that empirical conditions in one community of urban poverty can speak of those in another, the widespread, and often implicit, manner in which qualitative research is sometimes judged in comparison to quantitative research presents further methodological challenges. Qualitative research is at times presented as 'what it is not and less than [quantitative research]' (Sandelowski, 2008), with a frequent tendency to address such perceived 'lack' by integrating quantitative methods into qualitative studies, albeit without always fully acknowledging the limits of such strategies (Small, 2009:12).

The key methodological challenges facing a study of this kind are thus the requirement for empirically rich description arising from few cases studied in depth, whilst addressing the need for conceptual generalization that advances theoretical perspectives that may be instructive in studying other, albeit different cases of urban water scarcity elsewhere.

A number of strategies have been implemented to pursue these two methodological aims. They include the use of some features (although not the full approach) of the 'extended case method' conceived by Van Velsen (1976), Burawoy (1998) and Mitchell (1983), whereby the specifics of a case are understood by investigating the societal forces that shape it (Small, 2009:20). This

approach is essential in a study with few cases, as it allows 'exceptional or deviant' cases' contributions to be equally valued (Burawoy *et al*, 1991:278). Secondly, applying a case study logic (Yin, 2012) to the sampling of interview participants allows conceiving of these not so much as 'small-sample studies, but as multiple-case studies'(Small, 2009:24). That way, 'each case provides an increasingly accurate understanding of the question at hand' (*ibid*) and 'each case's findings inform the next until a point of saturation is reached' (*ibid*).

These two methodological approaches aim to produce tight associations between empirical data and the wider conclusions drawn from these; resulting in a study of high internal validity. The study employs data collection and analysis techniques commonly used in ethnography, including the interaction with participants over a long period of time that allows iterative data analysis and comparison to refine constructs and match these to reality; the ability to phrase interview questions closely to the empirical understanding of participants; the observation of life in natural settings; and processes of self-monitoring during analysis (Le Compte and Goetz, 1982:43).

The study makes no claims of representativeness, and only limited claims of generalizability. As Small (2009:28) notes, 'the representative single neighbourhood' (or household, for that matter) does not exist, and it would be foolish to pretend otherwise. Notwithstanding its stated aim of conceptual generalization to give the findings meaning beyond the setting of the study location, this study aims for saturation, rather than representativeness in its approach to participant sampling and data collection. Whilst a qualitative study of this kind can of course not be statistically representative, some degree of theoretical generalization can arise from rigorous inductive and interpretative strategies (Mason, 2002), and those are adapted here. They include means of relating the social processes observed to their setting and defining how similar processes may arise in different settings, basing claims of generalizability on 'key explanatory factors' (*ibid:* 196); the selection of unusual or deviant cases as described in the extended case method, with the aim of extending or developing theory for testing elsewhere; and by showing 'how and why particular issues or processes work in particular contexts […], [which] allows for potential cross-contextual generalizations […]' (Emmel, 2013:61).

In summary, this chapter proposes that in complex and high impact fields such as urban poverty, a deep, rather than broad understanding of issues is appropriate

as it allows the construction of a nuanced image of a multi-faceted phenomenon. Examining a small number of cases in depth enables a detailed understanding of what affects residents' long term resilience to water scarcity in an environment of rapid change through 'capturing complexity, nuance, and the dynamics of a lived experience […]' (Emmel, 2013:138). Its emphasis lies on demonstrating 'how each of the participants contributed to the rich narrative […]' (*ibid*) of the experience of water scarcity in the study location.

This chapter describes the challenges I encountered and adjustments I made in the planning, gathering, documentation, analysis and interpretation of a large body of different types of data collected during 5 months in two neighbourhoods and in collaboration with 23 households and 8 institutional stakeholders in La Nueva Rinconada, Lima.

4.3 Research Stages

Pilot

Sampson (2004) discusses the lack of attention given to pilot studies in qualitative research, highlighting their contribution to informing methodological approaches, such as the initial framing of research questions, collection of background information and adaptation of research approaches (*ibid:* 385-6), all of which resulted from a pilot visit in the case of this study.

Having previously worked on international development projects as an architect, my initial proposal focused on environmental outcomes in building upgrading programmes in informal settlements. The Peruvian context offers a well-documented history of the rise and development of informal settlements in its capital, Lima, and as such served as a rich theoretical field to start work from. Whilst I spoke Spanish, I had never been to Peru and knew of the issues facing its informal settlements only from literature.

In the autumn of 2010, 6 months into the PhD, I visited Lima for 1 month to explore the feasibility of investigating environmental outcomes of housing upgrading programmes in informal settlements. Whilst my research question was loosely formed, it was not resolved to an extent that this visit would have allowed me to test specific data collection methods, but I was able to radically adapt my research focus to local realities, collect background information and tentatively frame a research question.

Informal visits to various informal settlements and conversations with DESCO, Lima's main urban development organization, quickly showed that housing upgrading, whilst still widespread in both formal and informal forms, was neither at the forefront of residents' priorities, nor at the centre of academic and policy debates in the city. In 2010, the pressures on Lima's still expanding informal settlements revolved around three key themes: the ongoing struggle of illegal settlers to obtain titles for the land they occupied; the drive to empower women to effect change; and the growing pressures arising from ever more precarious water and sanitation situations. As my interest lay firmly in human-environment relationships, I used the visit to gather information about the nature of water scarcity in Lima's informal settlements through consulting local literature and visiting a number of informal settlements. I was struck by how residents recounted widely differing experiences of living without water and sanitation, and very variable effects of water scarcity on their livelihoods, whilst actively choosing to relocate to areas without water and sanitation provision. My research question was loosely outlined:

'What impacts on the ability
to respond well to water scarcity over time?'

Having spent just four weeks visiting a small number of informal settlements and discussing the issues affecting these with just a few local stakeholders, I was relatively objective, and certainly very distant, which may have allowed me to see the paradoxes surrounding the experience of water scarcity with relative clarity, whilst at the same time having only a very limited insight into what the people-water interaction entailed (Siskind, 1973).

Narrowing the field: Literature review

Back in the UK, I started to design my research approach. With over 18% (INEI, 2013) of Lima's population living in informal settlements, and with a third of these without access to good quality water (*ibid*), and 1/6 without access to sanitation (*ibid*), the problems around water in this desert city are well documented (cf. chapter 3). Less documented, however, is the daily experience of living without water and sanitation and its effects on livelihoods.

In trying to frame the question of how people respond to water scarcity in rapidly changing environments and the effects this has on their livelihoods, I first overviewed the range of theories that fall under the umbrella of human adaptability, and was struck by the prevalence of both longitudinal and

physiological measures (cf. Moran, 2008, for an overview), neither of which were feasible within the confines of a PhD dissertation.

I then narrowed the field to examine the various strands of recent literature that deal with human-environment relations, and was encouraged to detect a consensus regarding the need to combine the previously separate foci on people and their environments in these studies (e.g Redman, 1999). From within this literature, commentary on the potential for the resilience concept to combine the study of people and their environments alike, and especially notions of longer-term, positive outcomes (e.g. Folke, 2006) awoke my interest in the resilience literature. Finding a wealth of resilience studies addressing resilience through personal experiences, as well as resilience of environmental systems, and the theoretical emphasis on positive outcomes all confirmed resilience as a suitable umbrella concept for framing my research questions. The considerable critiques levelled at the concept during its recent rise in popularity, as well as the large spectrum of existing assessment frameworks (cf. chapter 2) soon clarified that within the space of a PhD dissertation, I would not be able to authoritatively assess resilience to water scarcity, but that I might be able to estimate *likelihood* of resilience and explore the suitability of a range of *indicators* for estimating resilience in environments of rapid change and scarce resources.

Not knowing what indicators of resilience I would find in the study community, I concentrated the literature review prior to fieldwork on understanding methodological challenges of examining water scarcity, whilst keeping an open mind about the range of issues I understood from literature to be conducive to resilience. The emergence of indicators of resilience during field work is discussed in section 4.5, Data Analysis - Emerging themes: Indicators for resilience, below.

In chapter 3 I outlined my reasons for focusing on the experience of water scarcity. Before this could be evaluated, it was important to understand how much water people have at their disposal for daily needs to establish if water scarcity manifested in La Nueva Rinconda at the time of data collection.

Measuring water use

Wutich (2006) has developed a range of 'locally appropriate approaches to estimating water provision' in areas where 'water distribution is highly complex' (*ibid:71*). I drew heavily on Wutich's three complementary means of measuring water use and adapted these to the conditions of La Nueva Rinconada: (1) a visual water measure, (2) a task-based estimate of water use; and (3) an overall estimate of water use. I adopted Wutich's visual water measure tool to allow

participants to capture the source, amount and end use of their water, but, unlike Wutich, I asked participants to record water use for one continuous week only, allowing me to capture perceptions about water around the same time as the measure was taken. I asked participants about their task-based estimate of weekly water use when I collected the weekly water measure, using prompts to compare this information with that of the overall daily amounts bought and used, as logged on the water measure sheets. This served as a means to verify overall water use, as well as water use for each task in detail. As a last way of triangulation, I followed Wutich's overall measure, intended to capture the overall amount of water a household bought in one week, by asking how much water a household head had bought in that week. I used no further prompts and compared this measure with the amount logged on the water measure sheets. Figure 4.1 shows the daily water measure charts used.

Lima's engrained water and sanitation challenges are as much due to geographical constraints and socio-political inequalities as they are perpetuated by the rapid formation of new settlements, with a typical time span of 20 years until land titles are awarded, which paves the way for the provision of basic services (cf. chapter 3). For the purposes of understanding the effects of water scarcity on residents' livelihoods during those difficult 2 decades, I hoped to work with a relatively recent settlement that had not yet reached the point of titling provision.

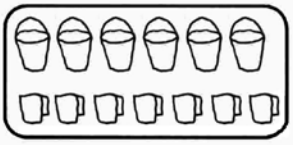
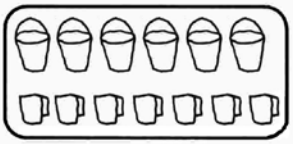
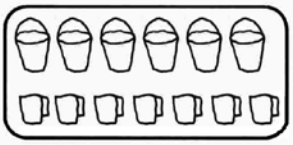
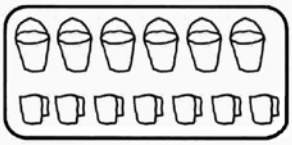
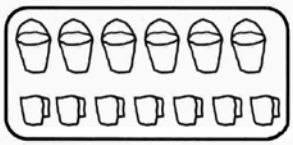
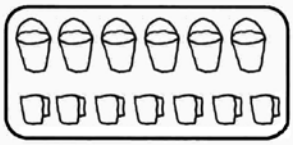
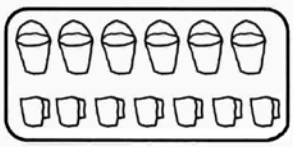
USO DIARIO DEL AGUA

DIA/ FECHA _____ NOMBRE _____ A.H. _____ MZ __ LT __

¿HA COMPRADO USTED AGUA HOY? SI ☐ NO ☐ ¿CUANTA? _____

¿CUANTO HA PAGADO POR EL AGUA HOY? PEN _____

POR FAVOR, INDIQUE LA CANTIDAD DE AGUA USADA PARA CADA ACTIVIDAD MARCANDO EL NUMERO ADECUADO DE BALDES Y/O JARRAS.
TAMBIEN, POR FAVOR, INDIQUE DE DONDE VENIA EL AGUA USADA PONIENDO UNA CRUZ DONDE APLIQUE. MUCHAS GRACIAS.

¿HA UTILIZADO AGUA HOY PARA…	¿CUANTOS BALDES Y/O JARRAS HA UTILIZADO HOY PARA ESTA ACTIVIDAD?	¿ERA ESA AGUA LIMPIA O REUSADA?	¿DE DONDE VENIA EL AGUA?
			
			
			
			
			
			
			

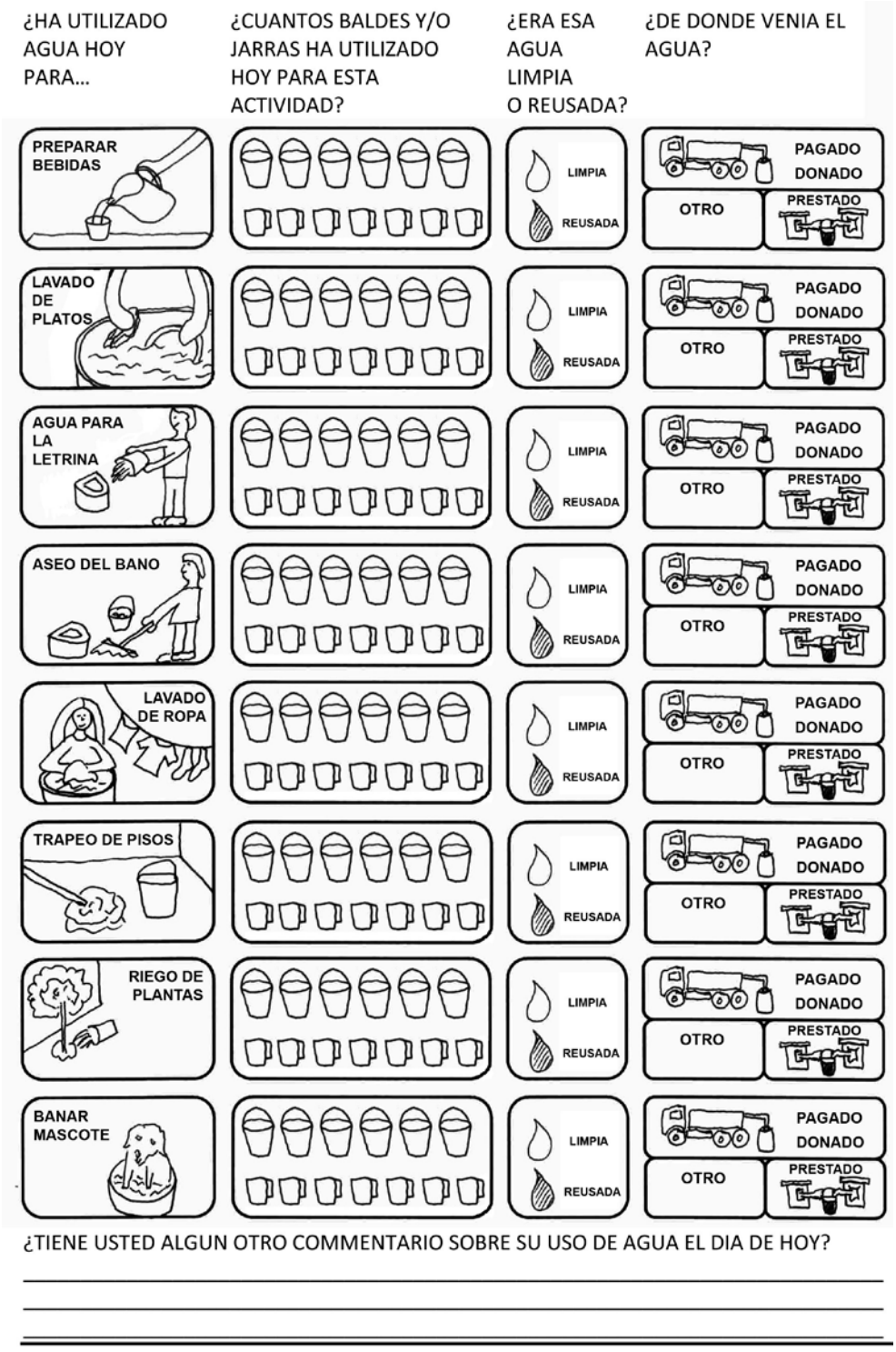


Figure 4.1: The self-administered water measure tool (adopted from Wutich, 2006)
The water measure chart contains images for different water use activities derived from the 'basic needs' literature (Gleick, 1996), as well as additional water uses that became apparent during participant observation.
The chart asks participants to measure water use according to two sizes of containers provided (buckets and jugs); indicate if water is used for the first time or reused; indicate the water source for each use; log if water was bought water on that day, how much, and at what price.
A third water use sheet (not shown) originally developed for swine breeding-related water use was discarded once the deep hostility between the majority of illegal settlers and minority of land-owning swine herders became apparent and ruled out the participation of swine herders in the study

Finding the study community

Returning to Lima in January 2012, I visited DESCO's offices in Villa el Salvador, one of Lima's oldest settlements, to better understand where the city's more recent settlements lay, as official maps tend to document periods and areas of urban growth, rather than individual areas. I was invited to visit a longstanding resident of El Augustino, another long-established settlement, who generously showed me around her neighbourhood and explained its progress over the 2 decades she had lived there. In the same week, my friend invited me to accompany her to La Nueva Rinconada, a 12-year-old settlement located in the district of Pamplona Alta. The contrast between Villa El Salvador and El Augustino compared to La Nueva Rinconada could not have been starker. Whilst the former two neighbourhoods had paved roads, shops, street lights, and buildings of more than one storey mostly constructed of *material noble* (strong building materials such as brick or concrete, in contrast to the weaker materials such as straw mats or corrugated iron commonly found in more recent informal settlements in Lima), all this was absent in La Nueva Rinconada. The other stark difference was the widespread presence of water barrels in the streets in La Nueva Rinconada, the first visible sign of a precarious water network.

La Nueva Rinconada appeared to possess the required characteristics of a recently established settlement, without basic service provision, with the additional advantage that I had contacts who could make valuable introductions. I tried to learn more about its history, but was soon at a dead end with the only publicly available document, a 2009 report on the complex land ownership and titling situation in La Nueva Rinconada, published by PEBAL La Inmaculada, a community organization with over 30 years' experience in Pamplona Alta.

Acquiring community support

My friend facilitated a welcoming encounter with a group of religious sisters, the Brazilian order of the *Hermanas Combonianas,* who had been working in the area since its first illegal settlers' arrival. The sisters invited me to visit them at the daily community drop in centre they ran, and to accompany them on their Sunday walks throughout the settlement. This allowed me to see life in a range of very different neighbourhoods, from relatively well-established, older neighbourhoods at the bottom of the valley, to more recent neighbourhoods high up on the hills on both sides of the valley (Figure 4.2). The sisters helpfully introduced me to a number of *dirigentes,* neighbourhood representatives, on our walks, and I was able to speak to many residents about their water issues, with each conversation

providing additional information that allowed me to gradually refine interview protocols and observation schedules.

Figure 4.2: Different stages of development in La Nueva Rinconada in 2012

Top left: Recently sprung up tents on bare rock face, the neighbourhood of this chapter's introductory vignette.
Top right: A longer established neighbourhood with levelled plots and wooden houses, but lacking vital infrastructure.
Bottom left: The most commonly found type of neighbourhood has rudimentary roads, trucked water supply and electricity tapped from afar, with some dwellings incorporating more robust construction materials such as brick and concrete.
Bottom right: Only one neighbourhood enjoys metered electricity provision from the municipal grid to each home.
Photographs: Researcher

Field study

The field research was designed to yield data on water scarcity and participants' responses to this. It was carried out in three overlapping phases, which took place after the initial pilot visit. During the first phase, I carried out participant-observation of the settlement as a whole; sampled participating neighbourhoods; and developed and adapted interview protocols and water measure charts. During the second phase, I carried out in-depth participant-observation in 2 neighbourhoods and worked with 23 households, conducting in-depth open-ended and semi-structured household interviews, collected and verified quantitative water measures, produced water acquisition maps for each household and neighbourhood, and spent varying periods of time with each household[17] to carry out direct observation of a range of water use practices and produced supporting visual data. In the third phase, I carried out interviews with 8 institutional stakeholders.

This approach has several advantages. Participant observation allowed data collection tools to be adapted to the local cultural context, yielding data with high internal validity. Quantitative water measures established a locally specific base line of the nature and extent of water scarcity in La Nueva Rinconada during the Peruvian autumn of 2012. Household interviews, water acquisition maps and direct observations allowed me to gain externally valid data on responses to water scarcity. Stakeholder interviews provided additional insights into the socio-political and institutional contexts, as well as additional information on the 'key explanatory factors' (Mason, 2002:196) of the experience of water scarcity recounted by residents. Using the three main data collection tools of participant observation, household interviews and direct observation in conjunction allowed for triangulation of emerging issues.

Settlement-wide participant observation

Settlement-wide participant observation, in the form of accompanying the religious sisters on their outings, attending drop-in sessions in the local community centre, and following the Easter procession through the settlement, allowed me to speak to a large number of residents, who, if they had time, willingly shared their views on the water and sanitation situation. Residents' perceptions and experience of water scarcity were to some extent contingent upon the level of progress within their neighbourhood. This in turn appeared to

[17] The time spent with each household varied depending on participants' availability, and ranged from a minimum of 3 days to up to 16 days.

be dependent on a number of parameters; most importantly (a) the neighbourhood's geographical location within the settlement, and the position of a home within the neighbourhood; (b) the land ownership situation; (c) the efficiency and dedication of its representative; and (d) the level of community cohesion within the neighbourhood. Once I reached a level of saturation with regards to these factors, I felt reasonably confident that a sampling framework for neighbourhoods could be defined. I now faced the challenge of identifying 2-3 neighbourhoods that displayed different attributes of each of these features and convincing their representatives to allow me to approach their residents for my study.

The sisters had introduced me to a number of *dirigentes* whom I'd asked if they would consider their neighbourhood to take part in the study, and who, despite initially positive replies, were then evasive when I tried to advance negotiations, mostly because they were already over-stretched in their tasks of advancing the works in their neighbourhood in their spare time. As I was unable to offer financial rewards for participation, it became increasingly clear that I needed to find representatives who saw me, and the research, as useful in some way. Discussing this with the sisters, Socorro immediately said she knew who I should talk to, and the next day, introduced me to Maria, the representative of a neighbourhood called Absalón Alarcón [18]. Maria welcomed me to her neighbourhood and allowed me to meet her almost daily at one of the settlement's four health centres located in the neighbourhood's main road. There, many residents passed on their way to see the doctor and dentist, and visitors were received. The neighbourhood's nursery was located opposite, as was the community hall. Maria explained the variable nature of her work, and explained that officials from the National Passport Office, RENIEC, would be present for some weeks to carry out a campaign to get national identity cards issued to all residents of the settlement. It quickly became clear that Maria's work extended beyond the boundaries of her neighbourhood. I had been hoping to make myself useful to Maria, but she seemed content to let me accompany her and tell me her view of life in the settlement and speak of the issues faced by her neighbourhood. It soon became clear, however, that my having a camera would be useful to Maria, and I spent some weeks accompanying her and the RENIEC

[18] Only much later did I find out that Maria's efforts for her neighbourhood had been so extensive that the neighbourhood previously named 'Absalón Bravo de Rueda', had decided to incorporate Maria's second surname, Alarcón, in honour of the progress she had achieved for its residents.

officials across the settlement to advertise their campaign, recording images and films for Maria in the process (Figure 4.6).

Figure 4.3: Settlement wide participant observation with the neighbourhood representative and RENIEC official.

I learned a lot more about the settlement now that I was accompanying a local and another Peruvian. Hoping to make systematic notes about the different neighbourhoods we visited, I asked Maria for a copy of a map of the settlement. She laughed and said that there was no such thing, the next best alternative was the rather aged copy of an outdated map of some of the settlement that was displayed in the health centre. I asked Maria if a map showing an aerial view of the settlement would be useful to her, which she enthusiastically confirmed. I was finally able to help a little by producing a map of the zone composed of google earth images, with Maria adding names to neighbourhoods. I was content to usefully contribute to Maria's work, and a noticeable change in our relationship took place, evidenced by invitations to Maria's home to see its advanced construction and her personal altar and self-built sanitation provision, as well as an invitation to attend a dental appointment with her. This appeared to have the additional function of showing me the facilities of one of the settlement's four medical centres, which she had been instrumental in winning for her neighbourhood.

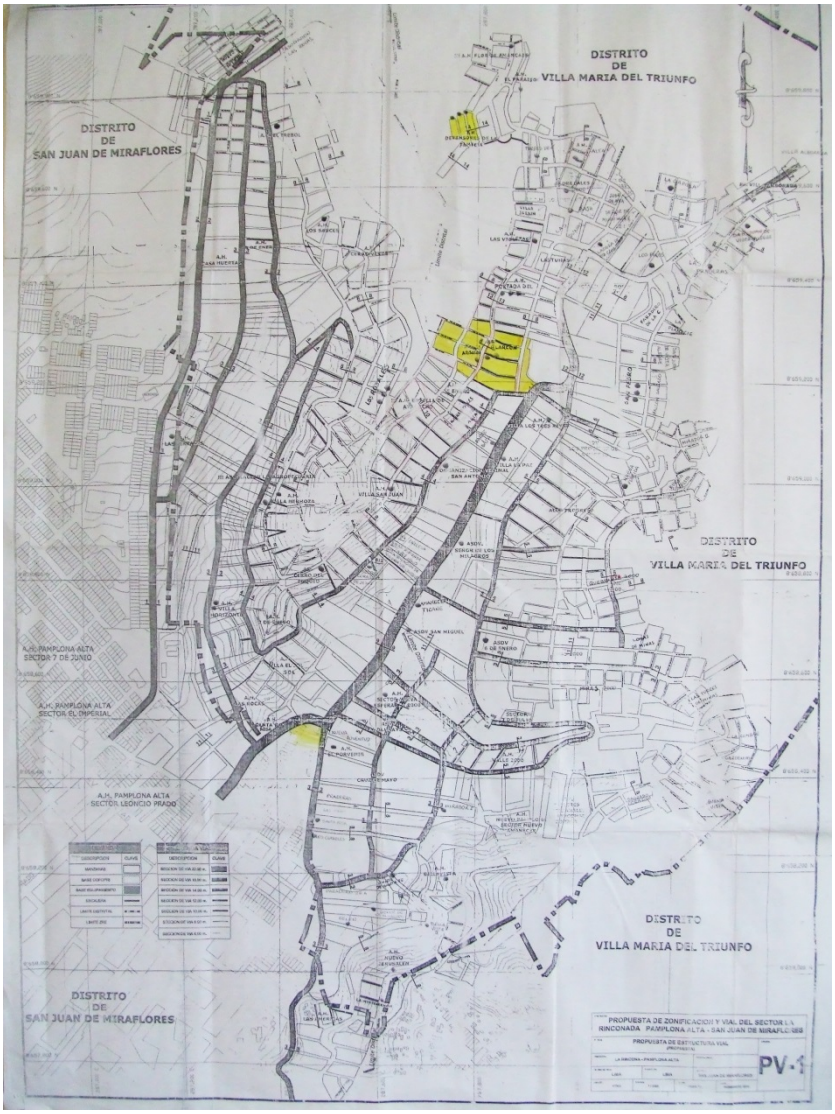


Figure 4.4:

The neighbourhood representative works on annotating the google earth map of the settlement with the names of the different neighbourhoods. Photograph: Researcher

Figure 4.5:

One of the few existing maps of the settlement of La Nueva Rinconada, showing a combination of existing and planned infrastructure, but missing records of the more recent neighbourhoods.

Source: Absalon Alarcon Health Centre.

Figure 4.6: Collaboratively produced map of the settlement of La Nueva Rinconada.

Immersion and distance: Limitations to participation

Notwithstanding this progress, there were frequent reminders of the limits to my participation in life in La Nueva Rinconada. When a bout of illness prevented me from visiting the settlement for 5 days, this coincided with a complete breakdown in water deliveries. For reasons I was never able to fully retrace in hindsight, the number of trucks providing water to the settlement drastically reduced during this week, and people struggled much more than usual with acute water shortages. I learned of the severity and impact of this from several participants after the episode, but when I asked Maria about it, she acted as if nothing had happened, and that this event was certainly not worth me having attended. Insisting that I would have liked to have known about the crisis when it happened, she brushed this away saying that it hadn't occurred to her to call me, as she frequently did to let me know about other 'events' happening in the neighbourhood. This served as a useful reminder that while much information and access were volunteered and I was seemingly included in many aspects of life in the neighbourhood, I was subject to a considerable degree of exclusion that prevented me from observing a complete picture of water scarcity in La Nueva Rinconada. Not having access to the data that could have been gleaned from this period, which could have acted as a natural field experiment to observe what happens when households' usual water management practices were disrupted by the complete lack of water, presents a considerable limitation to this study, and I deeply regret to have missed this opportunity for insight.

The delicate boundary between immersion and distance was also highlighted once I had recruited individual households and spent extended periods of time with each family. I was often exposed to information I found distressing. Some of this related to issues of water scarcity, such as accounts of which family members were 'least deserving' of water, or practices that aimed to address water-related problems, but put health at risk in the process. Being immersed in participants' lives for extended periods, I also heard many accounts unrelated to water, involving the causes, details and consequences of domestic violence, child and substance abuse. I struggled to find a balance between the rational need to make sense of this information in my understanding of the overall picture of life in La Nueva Rinconada, and the at times overwhelming desire to reduce the frequency of my visits to the settlement as I struggled to process such information. I addressed this dilemma by reducing my days in the settlement to 3-4 per week once participating households were recruited and the period of neighbourhood-

wide participant observation gave way to more time spent with individual households. Having a day in between visits to reflect aided not only the processing of distressing information, but also the in-the-field analysis of increasingly large amounts of data.

4.4 Research Ethics

Processing the realities of life in the settlement put these at a stark contrast with the issues I had grappled with in the process of obtaining ethics approval for my study. Ethicists' treatment of ethnographic work appears to revolve around 'the dual concerns with outcomes and rights' (Murphy and Dingwall, 2001:339), as well as the researcher's 'responsibility not only to protect research participants from harm, but also to have regard to their rights' (*ibid*). Whilst these two concerns appear to be covered in the ethics approval process the university requires its PhD studies to go through, I perceived an unsatisfactory chasm between the process of ethical approval and its real life ethical implications. I will briefly discuss this after outlining the measures I took to ensure ethical interaction with the study's participants. This study was reviewed and approved by Oxford Brookes University's Ethics committee in July 2011 (UREC ref: 110574).

Informed consent, compensation and participant protection

Participants' privacy could only be protected to a very limited degree due to the nature of localised research, participants knowing each other, and the small number of neighbourhoods and participants in the study. Whilst almost all indicated on the consent form that they were happy to have information attributed to their person and quoted in the study output, I heeded, in relation to resident (but not stakeholder) participants, LeCompte and Schensul's (1999a) warning never to reveal participants' identity 'because it is never possible to assess adequately in advance which data, if revealed, might become harmful to an informant' (p.191). I therefore refer to residency in a particular neighbourhood as the most identifying feature when using quotes. Where I planned to use visual data, I explained that, for example, showing an image of the front of the house and its water storage barrels, would easily identify a participant, and asked for permission of this to happen. Institutional stakeholders and neighbourhood representatives, on the other hand, were easily identified through their professional positions. All gave permission to be fully identified and quoted.

The principle of informed consent provided some difficulty in a context of partial literacy, as residents had in the past been tricked into signing documents they could not fully comprehend. The neighbourhood representative advised me to broach the subject of consent only once trust was established. Practically, informed consent was obtained in very different ways in the two neighbourhoods. In Absalón Alarcón, where a group introduction to the study was facilitated by

Maria, she condensed the key issues of the study for potential participants, and presented the signing of the consent form in conjunction with a commitment to participate, as well as an assurance to be issued with the buckets and jugs for measuring water use. Sensing the desirability of residents receiving buckets and jugs, I was uncomfortable with this association being created, but was told in no uncertain terms by Maria that if I wanted participants to take part, I would have to trust her way of facilitating this. I clarified at the outset of the first visit to each participant's house that participation was voluntary, could be abandoned at any time without giving reason and without suffering any disadvantages, and that information already offered would not in that case be used. I also clarified that participants could keep buckets and jugs regardless of whether they continued to participate.

I was unable to offer participants monetary compensation for their participation, wishing to avoid a distortion of information offered in reaction to the perceived value of any compensation. I did, however, compensate participants in small ways commensurate with customs of being a guest in their house, and acknowledging the sacrifice of time they made to participate in my study. Both types of compensation offered valuable insights. In issuing the buckets and jugs for participants to measure water use, I had to make some unethical and difficult choices. The literature on poor water quality is clear that to reduce pollution of water by end users, water storage containers should contain a spigot to enable hygienic water retrieval without the danger of contamination by hand (WHO, 2011). Such buckets were available in Lima, but residents told me that they did not use them as they were on the one hand more expensive than buckets without taps, and on the other hand they dispensed water too slowly, as well as requiring a stool or similar for the bucket to stand on. Residents preferred to scoop larger volumes of water from ground-based buckets with jugs. This contributes to further pollution by allowing the water to come in contact with hands and ground-based contaminants, but I did choose to issue spigot-less buckets as I feared that providing tapped buckets would alter participants' water use practices to such a degree that quantities used would be incorrectly logged. Instead, I provided the commonly used jugs.

I also brought participants a box of home-made chocolate cake when I first visited them. Most asked where I had bought this, and seemed disappointed when I told them that I had made it myself. They were, however, happy to receive the box the cake came in. After several such disappointed reactions, one participant

explained. When told the cakes were home-made, she asked if my maid had made them. When I told her I had no household help, but had made the cakes myself, the woman asked why I would slave in the kitchen when I had the money to buy much nicer cake in a bakery? It dawned on me that my own assumptions of home-made cake being a nicer gesture than a shop-bought one were entirely inappropriate in a setting where almost all food was home-made and shop-bought represented a certain level of luxury. Despite having been enlightened, I continued my disappointing gifts of home-made cakes so as not to create differences between participants.

Lastly, despite having been warned by everyone working in, but not residing in, the settlement, to avoid material gifts as these created dependencies; I saw real material need and its effect on children, as well as families' inability to address this despite best efforts. It felt wrong to cite moral principles after having spent 5 months during which one of the most striking patterns emerging was one of multiple scarcities preventing residents of the zone from fulfilling their potential. I discussed the concerns raised by outsiders and my perceptions of material need with Maria. We agreed to organise a collection of children's clothes and toys among the parents of the nursery my daughter attended during our stay in Lima. Once data collection was complete, two car loads of clothes and toys were distributed by representatives of the participating neighbourhoods. This did not prevent comments of unfair distribution from residents of both neighbourhoods, but I felt it to be preferable to not donating these items.

In October 2012, upon return from my fieldwork, I asked to present my fieldwork experiences to the university's ethics committee to discuss the chasms between theoretical and practical ethical implications. I felt that the ethics approval process, whilst superficially touching on issues of positive consequences, impact and benefits, inadequately addressed real life issues arising from studies in disadvantaged communities. I wondered if the priority is to assure that we are not leaving our host institution open to legal action, or if in considering the ethics of such projects, more could be done to engage with real life impacts. [19]

[19] Specifically, I asked the UREC:
Ethically, where does the university, and its ethics committee, stand on the issue of 'meaningful consequence'? Should we be required, perhaps not in advance, but then at least once local conditions are known, to investigate more fully true paths of impact, rather than ideally desirable ones?

Should the contribution to knowledge include a more explicit acknowledgement that knowledge will be just that, with no obligation by anyone to use that knowledge for positive change? And what does this mean for the formulation of 'valid' future research questions?

The university research ethics committee kindly invited me to discuss my experience, but felt that the regulations need to serve the range of studies undertaken in a university, which would make their adaptation to vulnerable contexts inappropriate. I respectfully maintain that issues of meaningful consequence, impact, dissemination, and value of our work to our participants and wider society are generically applicable issues that do not appear to be sufficiently prioritized in the ethics approval process.

4.5 Research Design

Defining the sampling frame and sampling participating neighbourhoods

The neighbourhood as a unit of study can be fraught with problems of definition and delineation (cf. Dempsey, 2006:77ff, for a discussion), but this was not an issue in La Nueva Rinconada. Land in Lima's informal settlements is highly contested and plot, neighbourhood and settlement boundaries, whilst the subject of much negotiation and violent conflict at the time of the first invasions, are nowadays clearly and strictly defined, which brought considerable advantages in the definition of the sampling frame. I knew that if I a representative agreed for their residents to take part in my study, the boundaries of that neighbourhood would be clearly defined.

Having reached a point of saturation in my understanding of the parameters that appeared to affect experiences of water scarcity at the neighbourhood level, my next task was to identify up to three neighbourhoods with different expressions of the identified characteristics, and convince their representative to allow me to approach their residents to take part in my study. Maria invited me to an evening meeting where a large number of neighbourhood representatives discussed issues affecting the settlement as a whole: the suspected outbreak of pig cholera, the ongoing pollution from residents burning rubbish, the municipality's failure to collect rubbish on a regular basis, ongoing titling problems, among others. These type of meetings were helpful in observing how issues are discussed, how difficult topics are approached and how contentious matters are negotiated. At the end

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When justifying our research, should we be required to be more explicit about the exact pathways by which findings will be disseminated, and, once local conditions are known, should we be required to update our dissemination plan to take into account political and other obstacles? Should each researcher be required to report back on the specific hurdles to benefits, dissemination, etc., so that the committee can request more specific engagement with issues in different research environments?

How immediate or long term, and how idealistic should benefits to participants be? Interesting questions are raised when considering whose advice to follow when deciding on benefits – e.g. do the local development workers know 'better' than those living the reality what they need?

of the meeting, I got to speak informally to the representative of a neighbourhood located at the entrance of the settlement, who gave me a first impression of the challenges facing his zone.

It seemed to me that this neighbourhood would provide a good balance to Maria's. Whilst Absalón Alarcón was located deep into the settlement across land characterized by a large range of titling statuses, Villa Sol lay at the very entrance of the settlement and comprised only private and state owned land. Where Absalón Alarcón appeared to have a cohesive community of neighbours and had one single strong representative who had achieved excellent progress, Villa Sol consisted of many opposing factions, each adhering to a dispersed group of representatives who were accused of varying degrees of self-servingness, corruption and inefficiency. Perhaps as a result of this, Villa Sol suffered from palpable social stratification and a general lack of progress (table 4.1 summarizes). I arranged to meet the representative in the coming days.

NEIGHBOURHOOD NAME	**Absalón Alarcón**	**Villa Sol**
SAMPLING CHARACTERISTICS		
Geographical Location & characteristics	Deep into settlement, Stretching from bottom of valley to peak of hills	At entrance of settlement, On steep incline
Land ownership	Private, state, and 'contested'	Private
Neighbourhood representation	Single, highly motivated and effective neighbourhood representative	Dispersed group of 9 representatives adhering to competing factions, said to be motivated by self-servingness and corruption
Community cohesion	Apparently coherent	Apparently fragmented

Table 4.1 : Sampling characteristics for participating neighbourhoods

Neighbourhood-wide participant observation: finding my role

My first meeting with Villa Sol's representative took part in the main market over a soft drink, where he told me of the many problems befalling his zone; lack of representative agreement and lack of community support and flawed characters among the residents were among the recurring themes that he cited as reasons for a general lack of progress in his zone. Soon after my meeting with the representative, I received a text message from his wife asking who I was and warning me to stay away from him. When I explained my motives, she apologised for the misunderstanding, but this highlighted the need to be more cautious when meeting male participants. Where economic hardship is a defining feature of life, the threat of another woman approaching one's husband far exceeds romantic concerns; it threatens the precarious economic basis of many women's livelihoods. I resolved to make my own status of being a mother and in a relationship much more explicit in future. I briefly considered whether I should portray myself as married as most people were outwardly religious and in favour of marriage, but then decided that the truth should be preferable. I could not have imagined just how much bonding with my female participants my unmarried status would engender. Many women I spoke to were also unmarried mothers, which made for an immediate topic of conversation.

I also learned that similarity is not the only way to bond with participants, but that difference can equally foster familiarity. As I made my status of being a mother more public, I was often asked how old my child was. When told that she was under 2, people asked where on earth I had left her, as children of that age belong to their mother. When told that her father was looking after her when I visited the settlement, reactions ranged from deeply concerned to downright outraged. The women I worked with could not conceive of a man safely looking after a child so small on his own. My participants' were incredulous when they learned that we, despite being *gringos*, had no household help and no nanny. I described that where I came from, it was common for fathers to be equally responsible for all aspects of child rearing. I used the expression that he was a *hombre moderno,* a 'modern man', to help explain this. This became a recurrent topic of much conversation and laughter, as every time my partner telephoned, my participants would pretend-whisper to each other, making sure I (and probably he, too), heard: *El hombre moderno está luchando con la bébé.* (The modern man is struggling with the baby). Over time, one or two participants mentioned their own aims of bringing up their sons to be 'modern men'.

Having established contact with two representatives who were willing to facilitate the residents of their zones to take part in my study, I started to carry out targeted participant observation in both neighbourhoods. The aim of this was three-fold. I wanted to get to know the daily rhythms of people in each neighbourhood, observe the publicly visible parts of the water-use cycle, and wanted to allow residents to get to know me so as to engender trust in my person and research project.

Direct observation of public water use

Before I could ask household heads about their water use practices and experience of water scarcity, I needed to understand both in more detail. By that point, I was friendly with a number of residents and was often invited to sit with them outside their homes or accompany them as they went about their tasks in the local area, but I was not usually invited inside homes.

The aim of direct observation of water use in public was two-fold. First, I needed to understand how water use happened in La Nueva Rinconada to elaborate and adapt my interview protocol and water measure chart to the practices observed. Secondly, I used direct observation to triangulate water use accounts given by participants. To this end, I defined a series of 'water interaction events' of the publicly visible aspects of water use (and experience) that took place, and made an observation schedule for each type of event. These were:

- Residents waiting for water delivery
- Residents buying water from the truck
- Residents treating bought water
- Residents storing water outside the home
- Residents fetching water from outside their house for use inside the house
- Residents discarding used water into the streets

I did not develop these schedules to log quantitative data in relation to these events; rather, I set out to observe these events whenever possible to add nuance to my understanding of the parameters that define these. Gillham (2008:11) discusses the difficult balance to strike between elaborating categories of interaction in sufficient detail whilst ensuring that too much elusive and fragmented detail does not make the categories unmanageable. For those reasons, I concentrated on listing relevant aspects in table form, revising the tables to reflect my understanding of the interaction of categories and associated detail as and when they evolved. Table 4.2 provides an example of such a direct observation table.

	CATEGORY		
	Waiting for water	**Ensuring water trucks passes house**	**Reaction upon seeing truck approach**
LOCATION / ACTION	Inside home	Quickly leaving home	Waiting for own household's turn
	Outside home away from road/ water barrel	Calling out '*agua, agua!'* (water, water!)	Running or walking to road/ barrel
	Outside home near water barrel	Nodding or eye contact signalling driver to stop	Removing lid from barrel
			Rinsing barrel with remaining water
			Tipping out used water
			Moving barrels to allow truck to manoeuvre into position

Table 4.2: A direct observation table records the categories and associated actions of residents waiting for water

These schedules served to add nuance to my understanding of these different interactions, and were used to develop and adapt questions for the interview protocols about water use in the private areas of the home. Lastly, they provided a first suggestion of the interaction between the different 'water use events' of the cycle of water acquisition, storage, use, reuse and discarding.

Neighbourhood-wide participant observation

Participant observation took very different forms in the two participating neighbourhoods. In Absalón Alarcón , I was initially shown around by Maria, who gave me a good overview of the different areas, as well as plenty of information on the general social and cultural practices of the neighbourhood and background information on many of its individuals. I learnt about feuds old and new, and the ongoing challenges of her work. She introduced me to many residents on our walks, who I would then visit by myself and become friendly with as time passed. Many women were happy to have someone to chat to as they went about their daily chores outside the home. That way, I got to observe not only how water trucks entered and made their way through the neighbourhood and how

residents ensured a truck passed their house, but also how residents purchased, stored, used and discarded water outside their homes.

After the first extensive meeting with one of Villa Sol's representatives in the market, he introduced me to one of the zone's residents, who was also in charge of dispensing the government's *vaso de leche,* the provision of a daily portion of cereal-enriched milk for the children of households living in poverty. As the representative himself was out of the settlement most days for work, this resident became the person who introduced me to her neighbourhood's residents and told me of its challenges.

After these initial introductions and several weeks spent visiting both neighbourhoods and speaking to residents informally, I felt that my presence started to be more accepted in both neighbourhoods, as people would greet me and invite me to sit with them for a while, or to accompany them to the local market to do their shopping. But I still struggled to get participants to commit to formally taking part in the study. I sensed that Maria's authority in Absalón Alarcón would probably ensure a good group of participants if I asked for this, so I concentrated my efforts in Villa Sol for some time, where the lack of a singular representative was becoming problematic.

When I told the resident I was mostly in contact with of my problems of recruiting participants for my study, she explained that the neighbourhood was severely stratified, and effectively consisted of several factions, each of which adhered to one of 9 neighbourhood representatives. Each of those, in turn, I was told, was entirely self-serving, corrupt, and only interested in advancing the interests of their small group of supporters. I learned many details of the neighbourhood's troubled past and present problems, and understood why those I had approached had not been keen to become more involved as I had mentioned the name of the representative I had first made contact with: they belonged to other factions of the zone. My contact offered to help me out by introducing me to some of her friends. I told her that I was keen to speak to residents of different factions, and she told me she would make sure of this: she would introduce me to one person, then ask that person to introduce me to another. Neighbours were friendly enough amongst each other across factions, it was just necessary to avoid reference to one or another of the representatives. And so it happened that one of my participants became the initiator of network sampling in Villa Sol.

Network, theoretical and purposeful sampling

Emmel (2013:131) discusses the connotations of the different terms describing similar sampling methods; snowball sampling, network sampling and chain sampling. In this study, characteristics of chain sampling ('clear and distinct links between participants as they are referred to researchers by previous participants', *ibid:* 131) were evident in the sampling of households of Villa Sol, but the defining characteristic was that of network sampling, whereby 'the relationships between participants [were being] made explicit in the recruitment process, so we can gain insight into who is being recruited to the research and why they have been found' (*ibid: 131).* In Villa Sol, it was important to sample households from different factions of the neighbourhood, as factions roughly related to blocks of the neighbourhood, and had arisen out of different priorities arising from block location and geography, which settlement-wide participant observation had found to be impacting on perceptions of and responses to water scarcity. As I was introduced to one participant by the previous one, I managed to obtain a small sample of residents from different factions of the neighbourhood. However, due to high levels of disillusionment and mistrust within the neighbourhood, the overall number of participating households remained low; 7 in total.

In Absalón Alarcón, obtaining the participation of a good number of residents was considerably facilitated by Maria. After I had spent nearly 2 months in Villa Sol, but had only managed to recruit a small handful of participants, on a particularly disheartening day where interviews had fallen through and people had avoided me, I allowed myself to complain about my problems to Maria. As I described how people would be friendly and appear keen up to the point of making fixed appointments for interviews, but would then not be at home or avoid me, Maria nodded and nodded and then summed up my problems in one sentence: *Falta compromiso.* '[People are] lacking commitment'. She acknowledged this with a sigh as the underlying problem to all her own efforts, and I sensed a certain ambition to show me that she could overcome this stumbling block on my behalf, and perhaps demonstrate her authority in facilitating my study to take place in her neighbourhood.

With this, a combined approach of purposeful and theoretical sampling was devised for recruiting participants from within Absalón Alarcón. From my experience in Villa Sol and Maria's acknowledgement of the 'lack of commitment', I concluded that I needed to be pragmatic in my sampling approach. I needed to

recruit participants who would be likely to commit to the length and breadth of the study. At the same time, I required the sampling to be purposeful, in that it needed to include cases that would provide as deep and rich data as possible, especially considering the overall small number of cases. Patton (1990) outlines the common constraints that lead to purposeful sampling:

> 'The [purposeful] sampling strategy must be selected to fit the purpose of the study, the resources available, the questions being asked, and constraints being faced' (*ibid*:181-2).

Two further requirements of sampling needed to be fulfilled. A number of themes had emerged during the pilot study and neighbourhood-wide participant observation. Having sampled neighbourhoods according to the features that appeared to be related to how well participants coped with water scarcity, I needed the sampling of individual households to also reflect these emerging issues and theoretical concerns, which arose from initial analysis of the household interviews in Villa Sol. Emmel (2013) discusses how in theoretical sampling, 'the researcher is continuously guided by emerging theory as to where to go next in search of their sample' (*ibid:* 13), stressing that 'in using theoretical sampling, researchers are not seeking a perfect representation of a concrete situation under study. They are aiming to generate categories and their properties for general and specific situations and problems […]' (*ibid:* 13), making theoretical sampling a good fit for the small sample, non-representative, in-depth methodology of this study.

To address the problems of generalizability discussed in section 4.2., I aimed to include 'deviant or unique cases' (Small, 2009:21) in the selection for their potential to 'develop and extend theory' (*ibid),* with the aim of understanding the 'societal significance' of each single case. As Burawoy et al (1991:281) argue, 'the importance of the single case lies in what it tells us about society as a whole rather than about the population of similar cases'. I therefore asked Maria to invite a range of residents to participate in the study to cover the following criteria: residents of different lengths of stay in the settlement; residents residing in different geographical and legal plot situations; residents across the spectrum of socio-economic means. Maria and I discussed the relationship between these criteria, and I asked Maria to also invite residents whose circumstances defied the assumption that participants of longer residency in more conveniently located and legally less complicated plots were of better socio-economic standing and therefore better able to cope with the constraints of water scarcity.

Household participant-observation

The degree to which I 'participated' in everyday life in La Nueva Rinconada was very limited. I was a daily visitor to the area and to my participants' households. As my presence did, however, impact on my participants' behaviour and on their representation of their lives to me, I have adopted the term of participant observer, to do justice to the fact that while I was primarily an observer of life in La Nueva Rinconada, I did participate in very limited ways through my presence in both neighbourhoods and in participants' households.

Household participant observation had three aims. First, it served to obtain external data on participants' water use activities. Second, in conjunction with interview data, it allowed me to form an understanding of the range of issues that affect participants' dealing with water, especially those that participants did not mention in their accounts. Lastly, participant observation, in conjunction with direct observation, served to obtain data to triangulate participants' accounts and water use measures. Household participant observation was recorded in maps, photographs and films, which all complemented field notes that recorded homes and the activities taking place in these.

Indicators of Resilience: Perceptions, control and flexibility

The composite definition of resilience as pertaining to both individual and systemic features (cf. chapter 2) requires a methodological approach of examining individual experiences in light of the larger socio-political processes that shape them. I do this by paying attention to both individual experiences and the impacts of wider influences arising from the diverse 'systems' that individuals depend on. The three proxy indicators are borrowed from fields as diverse as psychology and management studies, and are associated with specific, often quantitative measures or with the use of scales that are often applied in controlled settings in their respective fields. As the present study aims for a nuanced understanding of the parameters that impact on dealing with water scarcity, I neglected the use of these quantitative methods and instead analysed the different types of ethnographic data by looking for observable parameters of each concept; allowing residents' accounts to highlight the extent to which they perceived issues to be related to individuals and households, or to be pertaining to the wider systems that support them.

For example, one of the objectives was to gauge perceptions of personal control, and to observe any effects of attempts to exert control over the water scarce

environment. The literature on control suggests that this could happen through changes to the internal system, or through external relationships (cf. chapters 2 and 7). I therefore examined participants' accounts of how they managed their water problems by looking for expressions relating to 'internal' and 'external' locus of control, with a number of sub-categories arising for each. Tangible effects of attempts to exert control can be understood, for example, by examining what intention underlay an attempt to control the water scarce environment, and whether this intention had the desirable effects (cf. chapter 2). To analyse such effects, I compared participants' accounts of how they addressed a particular problem arising from water scarcity, and if they thought their actions successfully solved the problem, with visual data and field notes of each household, to determine if attempts to exercise control had resulted in the intended effects. A further comparison was then made to a baseline of an aspect of water scarcity derived from literature. Similar approaches were followed for examining the indicators of perception and flexibility.

In doing so, I have sought to create a detailed understanding of responses to water scarcity, moving between the scales of the household, individual or community, as appropriate, and to analyse those through the wider socio-political forces that shape them, thus foregrounding features of the wider systems that enable or hinder capacity for resilience.

Household and stakeholder Interviews

The type and quality of interviews differed for resident-participants and stakeholder-participants. Whilst some resident participants afforded me the time to develop a close relationship with them that allowed the building of enough trust to engage in an open and a thorough exploration of their views (Heyl, 2001:379), others' time constraints allowed for just a few days of unstructured and semi-structured interviewing to take place. Stakeholder interviews took the form of semi-structured interviews to probe into the underlying social, political and cultural systems' effects on the particular themes that had arisen from residents' accounts.

A recurring hurdle at the outset of interviews was participants trying to gauge what I wanted to hear, unsure of what might be noteworthy in their dealings with water. I employed versions of Spradley's (1979:34) 'I want to know what you know in the way you know it' to put participants at ease and minimize any influence a more specific answer on my part might have had. In this context, I

noticed early on that attempting to work through a pre-determined interview protocol was unproductive in that it led to monosyllabic answers or vagueness as participants tried to gauge what answer I would 'prefer'. I had drawn heavily on both Ennis-McMillan's (2001) and Wutich's (2006) work to develop a protocol for semi-structured interviews to gauge the breadth and depth of participants' experiences of water scarcity, but soon realized that if I were to use this to best effect, it needed to be preceded by a less formal way of conversation.

Schensul *et al*'s (1999) accessible account of using in-depth, open-ended interviews was helpful, and led to developing a much looser set of questions for use in open-ended interviews that aimed to fulfil three criteria:

1. They would put people at ease by asking about their lives and what was important to them.
2. They covered issues I had understood to be related to the context of water scarcity, such as length of stay in the settlement, social relationships, or neighbourhood representation.
3. They would allow me to incorporate the more structured questions on water scarcity at different stages throughout the interview.

In some instances I had the opportunity to analyse open-ended interviews before returning for more structured explorations with the same participant. Where time was more restricted, I switched between open-ended questions and the water-specific protocol during the same interview.

The extended case method requires the particulars of a case to be understood by the socio-political forces that shape it. To this end, when a good point of saturation had been reached and had given rise to three distinct and recurrent themes that appeared to impact on the experience of water scarcity in the two participating neighbourhoods, I made the decision not to extend my research to a third neighbourhood, but instead to interview stakeholders who were able to provide information on some of the underlying social, political and cultural processes bearing on the issues that had begun to emerge. This data collection took place largely among stakeholders that were closely connected to the settlement, 2 of whom were resident-neighbourhood representatives, with the remaining 6 closely involved in the settlement through their work. Further stakeholder information was gleaned from a public meeting held by local politicians in the settlement, and from regular meetings with the local mayor with a representative working group of the settlement. Lastly, a series of special

events, such as for example the inauguration of the health centre, provided further opportunity to gather data on the wider aspects that impact on the issues under study.

Recording and producing visual data

Whilst water scarcity is a social construct, and many responses to this are intangible, both scarcity and responses also manifest in a variety of visually tangible data. The aim of producing, recording and analysing visual data of water scarcity and residents' responses to this was three-fold. Primarily, in a study focused on a physical environment, visual data had to play a key role in documenting the physical processes through which water scarcity manifests. Secondly, I recorded visual data of 'naturally occurring social interaction' (Emmison and Smith, 2000:22) to triangulate the findings that emerged from interviews. Lastly, the production of visual data in conjunction with participants (see c., below) proved to be a useful tool for eliciting information that other data collection methods failed to capture.

Visual data used in this study falls into four distinct categories: (a) I captured images of the built environment and its water-related uses; (b) I recorded naturally occurring water-related social interaction in still and moving images; (c) I visualized water acquisition practices in collaboration with participants' accounts; and (d) I analysed historic and current images of the settlement provided by participants and found in public locations.

The most voluminous data I gathered, apart from interview data, are recordings of the built environment and its uses and naturally occurring social interaction. This data served a multitude of purposes. Capturing film and photographic images allowed me to record large amounts of raw data of the built environment and of natural interactions throughout my stay. Although this is of course subject to the selection I made in choosing to record some things and not others, it has the distinct advantage that it captured a large array of settings and interactions that I could not possibly have held in my memory due to their sheer amount and the length of time I spent in La Nueva Rinconada. It further has the advantage that it charts, to some degree, the extent to which I became familiar with certain activities and started to notice others that may have escaped my attention at the outset. Visual data of the built environment and human interactions served to triangulate, emphasise and provide nuance to the key findings emerging from the research.

I produced water acquisition maps during interviews to elicit information about water use that was not otherwise volunteered by participants, usually because it seemed too commonplace to mention. These maps were drawn by me as I sensed a strong reluctance by participants to draw themselves. Drawing the maps while participants told me what to draw had several advantages. First, I used very simple and standardised graphics to represent common features, such as stairs, roads, houses, water barrels and water trucks. These could be drawn rapidly so as not to interrupt participants' accounts. Secondly, by using standard A4 pages and setting up the 'context' of a household's water acquisition process on one page, this allowed participants to point and explain various features that impacted on the process, such as the slight incline in a road, or the adjacent neighbourhood's standpipe. The maps served 'as sources of concrete visual information about the abstract concepts and processes which are central to understanding everyday life' (Emmison and Smith, 2000:58). Figure 4.7 illustrates.

Lastly, I analysed two categories of existing images of the settlement provided by participants and found in public locations. Some participants provided photographs of the early days of the settlement that they used as prompts to describe the changes that had taken place since the time of the photograph, the struggles they had faced, and the hopes they had had. These images allowed me to take equivalent views of the same places and use these to corroborate accounts and ask about other features they contained. In that way, they served to both uncover processes of social change and elicit information that other data did not uncover. Secondly, I analysed signs displayed in public places as a means of triangulating interview and observation data.

[~~AA~~ - 01] 120528
Mapping water acquisition. Read in conjunction w.r. participant's account - ll. 1125-1213.

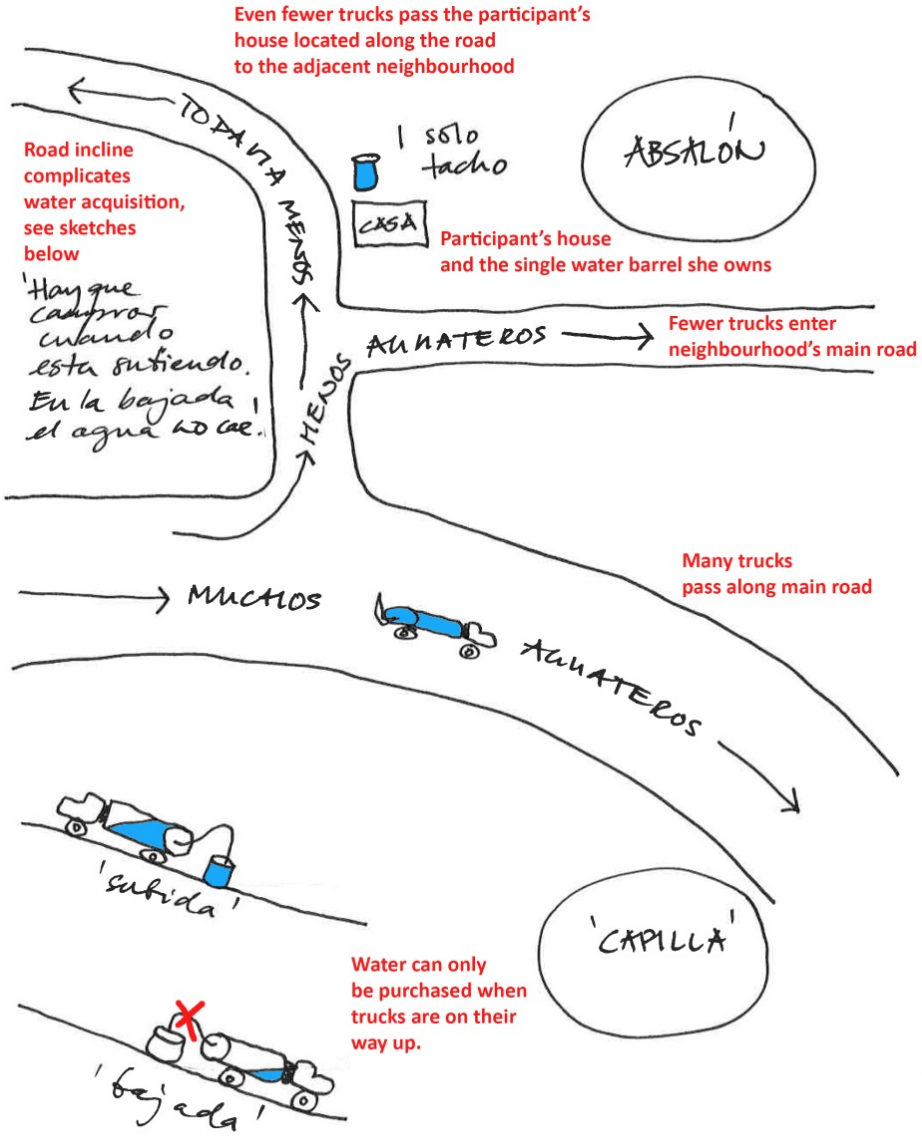


Figure 4.7: Collaboratively produced water acquisition map. Please read in conjunction with interview transcript on next page.

This visual data collection tool, produced by the researcher alongside participants' account of their water acquisition practices, consistently elicited information about the water use cycle that was not unearthed by other methods.

'Me gustaría hacer una mapa de cómo usted compra su agua. Me había comentado que el aguatero viene acá, del camino real.
Sí, ya.

Y acá entra… Y dice que va por la carretera principal, que es… esa.
¿Cuál es la carretera? Esta es la carretera principal, esto es para la entrada y esto es para este lado de acá y aquí estoy yo.

Sí.
Ajá. Ya. Ese… el aguatero viene, esta es la carretera principal, a veces se va así, doblando por otro lado, a veces por acá también hay un camino, se va por este camino, por donde está el mercado, a veces viene, en vez de pasarse por acá, vamo' se va por este lado, por arriba, y a veces a veces dificulta venir por acá, no quiere venir.

Y sigue por la carretera.
…hasta el fondo. Ujum.

¿Cuantos aguateros vienen por su lado?
No muchos. Y cuando regresan ya no te quieren vender, porque como está en bajada el agua no cae pues.

¡Ah! Entonces hay que cogerles cuando suben.
Cuando están subiendo. Ajá. Yo he querido comprar en la mañana, yo estaba… ¡ay!, tengo agua o no tengo agua, dije, como estoy yendo a dejar a mi hija en el jardín, justo viene cuando estoy yendo a dejarle allá en la esquina, en el jardín. ¡Ay!, cuando regrese ya compraré. Estoy regresando, de allá le veo, "¡agua, agua!, le digo, "¡no va a caer señora -me dice- porque está en bajada". ¡Ay! No, ahora, le digo, ahora no [vino?] el agua pue'. No quería darse la vuelta. No puede pues darse la vuelta, ¿no ves que está en bajada ya?

Claro.
Está medio vacío el agua ya se llena pa'dentro y ya no cae pa'fuera ya.

Entonces, ¿pasa una vez al día o un poquito más?
Dos veces a veces pasa, dos, a veces tres veces pero no por acá, una vez pasará por acá, donde pasa a cada rato es por allá, por la carretera se va de frente. Por acá a veces una vez a las quinientas pasa, una vez la semana pues, una a veces por día, a veces una vez pasa, otra vez sale, a veces… a veces que vienen a cada rato, que ya cansa verlos ya, y hay veces viene hasta las tres, cuatro de la tarde, difícil a veces, ah. Pero así, por acá dificultad por la misma subida también.'

'I would like to draw a map of how you buy your water. You had told me that the water truck comes along here, from the main road?
Yes, that's right.

So he comes in here….and you say he goes along the main road, which is….this one.
Which is the road? This is the main road, this is the entrance [to this neighbourhood] and this is [the road] which passes [the neighbourhood] and here is my house.

Yes.
That's right. The truck comes, this is the main road, sometimes he goes along here, turning along the other route, sometimes also along here, there's a path, he comes along this road, from where the market is, and sometimes he comes, and instead of passing by here, he goes along here, upwards, and sometimes it's difficult to come along here, they don't want to come.

So he continues along the road.
….until the end. Yes.

How many water trucks pass by your road?
Not many. And on the way back they don't want to sell you [water], as they're facing down hill, the water won't come out.

Ah! So you have to catch them on their way up.
When they are going up, yes. I had wanted to buy this morning, I was wondering – do I have water or not?, I said, as I was walking to drop my daughter off at the nursery; [the truck] came just as I was going to drop her off at the corner, at nursery.
'Oh dear! When I come back I'll buy [water]' And on my way back, from over there I see him – 'water, water!' I told him – 'It won't come out, señora' – he tells me – 'because the truck is facing downhill.'
'Oh dear!' I said. 'And now I have no water.' He didn't want to turn around. Well, he couldn't turn around [and said] 'don't you see that I am facing downhill?'

I see.
The water is half empty and it falls to one side [inside the truck] and won't come out.

So [the truck] passes once per day or a little more often?
Sometimes they passes twice, and sometimes three times, but not here; they'll pass here once, where they pass all the time is over there, from the main road they go straight ahead. Sometimes one in every five hundred trucks passes here, once a week, sometimes daily, sometimes they pass here, then they don't…..sometimes they come so much I get tired of seeing them, and sometimes they don't come until 3 or 4 in the afternoon, it's difficult sometimes. But here it's difficult because of the road facing uphill.'

Interview transcript of water acquisition process. Please read in conjunction with water acquisition map on previous page.

4.6 Data analysis

In analysing the different types of data for this study, I faced a range of challenges. Due to my background in architecture, I was not trained in ethnographic methods, but have aimed to collect data to contribute to an ethnographic account of water scarcity in La Nueva Rinconada. I found LeCompte and Schensul's (1999a, 1999b) 'Ethnographer's Toolkit' an invaluable resource, and heavily drew on their recommendations for analysing and interpreting data.

The second challenge concerned the weighting of the different data sources in their analysis. For some households, the interview data was richest, whilst for others the visual data spoke strongest. Yet others had gone to particular lengths to record their water use in minute detail and highlight particular challenges or idiosyncrasies in relation to this. My approach to addressing this is discussed below (cf. 'From the bottom up and from the top down').

In the field analysis

In the field analysis took place in four stages during my fieldwork. I would make notes during, or straight after, data collection in the settlement. I would then mull these over, and try to extract some meaning from these notes on my long bus journey home in the evenings. Once at home, I would type up and further order my notes. At sporadic intervals, I would further summarize and interpret initial impressions to report back to my supervisors in the UK.

In the early days of participant observation, I was, like any novice ethnographer, overwhelmed by the sheer volume of things to notice, see, and make sense of. LeCompte and Schensul (1999a) and Clifford (1990) describe the human tendency to prioritize things one is familiar with, and the need for ethnographers to 'learn to notice what is important to other people and what one has not been trained to see' (Le Compte and Schensul, 1999a:14), as well as the filtering that inevitably arises from the ethnographer's writing down of notes through their own perspective.

I had devised a standard record sheet for recording life in the settlement and another for recording first impressions after interviews. As there were few places to sit in public in the settlement, I would often return to the health centre in Absalón Alarcón and sit on its terrace, making my notes. The neighbourhood's representative, who spoke some English, was always intrigued by what I was recording, so in the early days, when I made my notes in English, I would run my

first impressions past her, and she would point out things I was missing, or correct my interpretations. When I later switched to making my notes in Spanish, she would correct terms, and in doing so, provide further detail and insight. Keen to practice her English, she would also ask me how I intended to write about one issue or another, which often gave me a chance to consider how I would translate ideas back into English. The evolution of record sheets over the 5 months of fieldwork track my changing understanding of what I was seeing and being told.

Emerging themes: Indicators for resilience

As the data collection progressed, I was increasingly struck by three recurring issues of apparent inconsistency. The first concerned notable differences between what people said and what they did. This is perhaps a common feature of the human condition, but it particularly struck me that some water and sanitation-related issues were frequently and fervently discussed, but not at all addressed through actions; whilst extensive resources were mobilised in response to others aspects of water scarcity that were barely mentioned. This led me towards investigating theories of environmental perception, with the particular aim of understanding how perceptions relate to subsequent action.

Secondly, I perceived a curious co-existence of helplessness and ingenuity. I was frequently struck by how helpless many residents considered themselves in relation to the water and sanitation situation, whilst at the same time seeing evidence of extensive ingenuity in dealing with the daily challenges arising from it. For some time, I examined theories of power in the hope of shedding light onto this contradiction, but as I learned more about the socio-political forces that shape water provision in La Nueva Rinconada, I eventually concluded that theories of control, and specifically the locus of control, would be more instructive in understanding the co-existence of helplessness and ingenuity at the household level and within a context of severe social inequality.

Delving deeper into the responses observed and recounted in relation to the challenges arising from water and sanitation, it struck me that where residents were able to respond flexibility to a challenge of water scarcity, this appeared to be navigated more successfully than where responses were tightly constrained. This led me to theories of flexibility in search of a framework for understanding the appropriateness of responses to water scarcity in more detail.

Initial analysis

Having gathered a large amount of interview data, I started to use qualitative data-analysis software to interrogate the data. This was useful at the early stages to add nuance and emphases to emerging themes, for example by identifying which words were used most frequently by participants, and in which context. Through this computerized analysis process, I was able to confirm, or refute, a number of hunches that arose from field work, whilst others emerged.

For example, as I described above, I came away from the settlement most days feeling that I had seen people manage the constraints of water scarcity in an impressive number of ways, whilst their rhetoric surrounding their dealings with water seemed characterized by a sense of 'not being able to', or 'not managing'. A *keyword in context* search confirmed that *no se puede* (one cannot) or *no podemos* (we cannot) or *no puedo* (I cannot), were frequently used in participants descriptions of their handling of the water-related environment, whilst my observations, photographs, films and water use maps depicted an array of strategies for managing the water scarce environment. Whilst it was useful to have these early impressions confirmed, refuted and nuanced in this way, I abandoned the software after the initial data analysis stages, as I felt too removed from the data when handling it via this software. Perhaps due to my previous training as an architect I had internalised the need to 'feel' my work through pen and paper that urged me to have all data printed out, ready to be seen, felt, handled, sorted, ordered and reordered. That way, I felt much more confident that I was paying sufficient attention to not only words, but sketches, images, notes on margins, quotes and all the undertones, hidden meanings, suggestions and possibilities arising somewhat elusively between all the 'hard' data. Having the words so very close to me also contributed to assuring myself that I was staying true to my participants' accounts; that in finding meaning and explanation beyond their words, I was still doing justice, as best I could, to the lived experience of water scarcity.

Transcription and translation

Carrying out research in a setting that neither shares one's native language, nor that of the language that the research is designed and written in, presents a number of challenges. Several aspects integral to the research design are influenced by issues of language, such as epistemology (how things are known in context), methodology (how things are asked about) and transfer (the shared context between cultures). Temple and Young's (2004) discussion of these issues

has framed my approach to translation and transcription. Additionally, dimensions of language, such as dialect and slang; cognitive structures (ways of framing and processing reality) and behaviour (ways of acting out responses) bear a considerable impact on the outcomes of any study (Harrison, 2011).

For each data collection tool, a process of double translation was implemented before data collection began with participants. I translated all interview protocols, water measure charts, etc. from English to Spanish with the help of a native Spanish speaker. I then checked each tool in detail with a key informant from the settlement. The additional time spent explaining the various data collection tools to this informant, getting her feedback and amending the wording, sequence or delivery was vital to ensure that what I asked, and what was being reported, was understood as well as possible by both sides, thus minimizing culturally and linguistically based misinterpretation. I then undertook a process of reverse translation from Peruvian Spanish to English to record the changes in my own understanding of the context I intended to ask about.

Having gathered many hours of interview data from each household, I needed to transcribe the words so as to be able to analyse them in detail. Whilst I was fluent in Spanish, I was unfamiliar with the various dialects of Peruvian Spanish spoken in La Nueva Rinconada. A Peruvian anthropologist transcribed the interview data, ensuring that local expressions were picked up correctly, and nuances not lost in transcription. As I had carried out all interviews in Spanish, and as the volume of interview data was very large, I decided to carry out data analysis in Spanish and translate findings. Findings are reported in English throughout, and quotes are presented in their original form alongside an English translation. I have simplified quotes in translation, omitting, for example, repetition. The strategy for establishing clear lines of translation in the work is summarized in table 4.3:

Literature review Conceptual framework Methodology	Translation of data collection tools into Peruvian Spanish	Data collection Transcription Analysis	Translation of findings into English	Interpretation and reporting of findings	Translation of summary of findings into Spanish for dissemi-nation in Lima
ENGLISH		**SPANISH**		**ENGLISH**	

Table 4.3 : Distinction of languages in different research stages.
The challenges of carrying out research in two different languages are addressed by designing, carrying out, analysing, interpreting and reporting the research in clearly delineated phases. The conceptual framework, research question and methodology and data collection tools have been developed in English. A clear transition was then made by translating the data collection tools into Peruvian Spanish. Data were collected, transcribed and analysed in Spanish, at which point another clear transition occurs by translating the findings back into English. Data were interpreted and findings reported in English, with key quotes presented in both languages. A summary of the findings will be translated into Spanish for dissemination within the community and local institutions.

'From the bottom up and from the top down'

Upon my return to the UK, I spent considerable time tidying up and arranging my field notes. The in the field analysis yielded a small number of emerging themes, or rather paradoxes, that served as a first guide for the further analysis process. Of the various ways of putting field notes into order suggested by Schensul and LeCompte (1990b:38), I concentrated on three complementary means that allowed me to work between units of analysis, emerging themes and different data types. Accordingly, I duplicated and ordered data according to (a) types of data (e.g. all interviews, films, water measure records, water acquisition maps, etc.); (b) 'cast-of-character' (*ibid: 38)* files (e.g. all data belonging to one household); and (c) 'event' (*ibid: 38)* files (e.g. all data pertaining to one type of event, such as 'water delivery' or 'discarding of water'). This allowed searching for further insight, nuance, and negative examples disconfirming my initial hunches in three complementary ways, focusing alternately on different units of analysis (e.g. different households), different types of data, or different water-related events.

I had come to the field with the intuition of a real world paradox existing around the experience of water scarcity, as well as with a broad theoretical concept suggesting ways of investigating this. Doing justice to both required me to analyse my data both inductively and deductively. Having read a number of

ethnographic accounts, I strongly identified with, and agonized over, Schensul and LeCompte's (1999b) observation that in the methodological sections of such accounts, the means and processes by which patterns and structures emerge from raw data are often merely hinted at, suggesting that they occur somehow as if by magic. I was therefore most grateful for the authors' dissection of the analysis process, and adapted some of their suggested steps, making my best effort to put the broad framework of resilience to one side so as not to be overly constrained by it as I followed Schensul and LeCompte's (1999b) steps for analysing the data at the item, pattern and structural levels (*ibid:*68f).

Patterns and structure, components and constituents: Emerging meaning

In doing so, my initial hunches of paradoxes and apparent consistencies were elaborated, some discarded, others combined, and yet others emerged for the first time, into a first array of potential findings hinting at the underlying reasons for the observed discrepancies.

I then started to assemble this collection of 'meanings' into patterns that established connections between these. Schensul and LeCompte's (1999b) guidance of how patterns emerge (*ibid:* 98), as well as their illustration of how operational level data are linked to theoretical levels (*ibid:* 115) was most helpful in this process, as was the extended case method of emphasizing unusual or divergent cases and paying attention to socio-political context to expand understanding of any of the emerging themes.

The iterative process of inductive and deductive ways of working naturally continued in the writing of the findings. Whilst the description of how residents dealt with water scarcity was deductively organized along the analytical themes of 'perception', 'control' and 'flexibility', the themes that started to emerge from this description were analysed inductively. As such, each theme was elaborated on and composed of the data arising from the deductive analysis. Again, Schensul and LeCompte's (1999b:186ff) strategies for turning the collection of vignettes, summaries, and themes into a cohesive account that links in both directions to the empirical data that supports it and to the theoretical model that arises from it, was most helpful in this process.

Interpretation

In interpreting the findings of this study, I faced a number of considerable challenges. The first among them was to find the confidence, from my data, that engaging in interpretation, which by definition goes beyond the data (Schensul and LeCompte, 1999b:2015ff), I was doing justice to the empirical reality of the situation and to the lived experiences of the residents of La Nueva Rinconada. The question of the potential audience of this study was problematic in that I struggled with the realization that any interpretations I arrived at could be interpreted very differently, depending on whether the study was read by its academic examiners, the participants, or people engaged in policy making in Lima.

These conundrums led to the structure of the thesis as it is presented here, whereby the data analysis is presented in 4 empirical chapters that depict the empirical reality of living with water scarcity in La Nueva Rinconada. Each chapter analyses this reality's contribution to the relevant body of literature (e.g. the chapter on water scarcity describes how water scarcity manifests in La Nueva Rinconada and analyses the meanings of this for the literature on water scarcity). I would hope that in reading these chapters, my participants would recognize their reality. Chapters 1-3 and 9-10 provide the interpretive 'bookends' to these empirical chapters, in that they clearly depart from the data and set it in the context of the wider literature, aiming to give it meaning beyond its immediate context.

In interpreting the results, I engaged in several of the strategies suggested by Schensul and LeCompte (1999b:216). Each of these led to a partial account that covered one or more of the emerging themes. I then assembled these accounts and looked for overlaps and contradictions. From these accounts, the discussion of the findings was assembled, allowing the data to be considered in light of the overarching literatures on resilience in environments of rapid change and scarce resources.

4.7 Conclusions : Learning from small samples

In this chapter I have sought to link the importance of examining the experience of water scarcity with an in-depth, small-sample, non-representative methodological approach. Applying a case-study approach to the sampling of participants in conjunction with the use of features of the extended case method has allowed the production of an account of the experience of water scarcity which not only generates rich empirical descriptions for a nuanced understanding of a little-understood phenomenon, but has also enabled limited generalization of the findings beyond the locality of the study community, and in doing so, allowed a more balanced picture of urban water scarcity to emerge.

I have never felt less than deeply affected by what I saw, learned and was told in La Nueva Rinconada. This chapter describes my attempts at managing the extensive personal involvement so as to generate an as unbiased account of the lived experience of water scarcity in La Nueva Rinconada as is possible within the ethnographic approach.

In describing the research process, I have aimed to portray a truthful image of the less-than-perfect data collection and analysis processes that led to this account, in the belief that such transparency will aid its credibility.

Chapter 5:
Water Scarcity in La Nueva Rinconada

5.1 Assessing urban water scarcity

Of the different ways in which water scarcity can be conceived, the experience of water scarcity is the least explored, yet vital to a holistic picture of the phenomenon (cf. Chapter 3). Before the experience of water scarcity can be examined, a context and time-specific understanding of how it manifests is required. This chapter aims to understand if, and how, water scarcity presents in La Nueva Rinconada.

Water supply in areas which are not connected to municipal water distribution and sanitation grids is precarious for a number of reasons. The 'basic needs' principle (Gleick, 1996) sets out minimum water quantities per person per day; guidelines pertaining to adequate quality to maintain human health and personal hygiene; and, because inequitable water distribution often arises from wider political discrimination of the poor, considers if security of supply is given 'independently of an individual's economic, social, or political status' (*ibid:* 83).
This chapter examines whether participants have enough water to meet basic needs; whether this water is of adequate quality for human consumption; and whether water is available when it is needed. As water scarcity is culturally and socially constructed, its definition needs to take into account the perceptions of people experiencing the phenomenon[20]. The definition of adequate water provision for meeting the basic daily needs of an individual adopted for the purpose of this study therefore reads (after Gleick, 1996):

> 'The provision of a minimum of 49 litres per person per day;
> of adequate quality to maintain health and personal hygiene;
> guaranteed independent of an individual's economic, social or political status;
> and taking into account the perceptions of those who experience the water situation.'

The term 'water use' refers to the amount of water 'required to meet a specific need or to accomplish a particular task' (Gleick, 1996:2). It is defined here as 'the use of water including that which has been reused' (*ibid*) and 'the consumption of water which prevents further use' (*ibid*)[21].

[20] Perceptions of water scarcity are explored in detail in chapter 6.
[21] This is distinct from 'water withdrawal' (*ibid*), which refers to water drawn from a source, all of which is not necessarily consumed.

5.2 Measuring quantity of water use

The first dimension of water scarcity relates to the daily amount of water a person has available to cover a range of 'basic needs' (Gleick, 1996). The recommended daily minimum amount per person (litres per person per day; or l/p/d) lies between 28 and 60 litres and is composed of four separate categories, which in combination are vital to meet the basic daily water needs of an individual. Each category comprises a range intended to meet basic needs across a variety of different climatic, geographic and cultural contexts (*ibid*). The categories are: drinking water (3-5 l/p/d), water for sanitation (0-20l/p/d), water for personal hygiene (15-25 l/p/d) and water for food preparation (10-20 l/p/d) (Gleick, 1996).

5.2.1 Water use categories, ranges and levels adapted for definition

The drinking water range of between 3 and 5 l/p/d is based on the notion that a 'minimum [drinking] water requirement […] can be defined only for maintaining human survival' (Gleick, 1996:84), which is guaranteed by replacing any fluid lost by the body through drinking. 3 litres are considered the daily minimum for a person of average build in temperate climates, whilst this is raised to 5l/p/d in tropical and subtropical climates. As the study took place in the Peruvian autumn (February to July), which in 2012 saw temperatures at unusually high levels of between 30°C in April, and still at 25°C in June 2012[22], the median value of 4l/p/d was adopted for this study as temperatures were unseasonably high, but not at maximum levels.

The range of 0-20l/p/d for sanitation is based on the premise that waterless sanitation is theoretically possible, but extends to 20l as waterless systems are neither very widespread, nor affordable, nor always culturally acceptable (Gleick, 1996). As both waterless sanitation and water-intensive sanitation systems were observed among the study sample, I have adopted the median value of 10l/p/d for the purpose of definition.

Water supply for personal hygiene has rarely been measured in contexts where households are not connected to the municipal water supply. Gleick (1996) recommends 15l/p/d as an absolute minimum for bathing needs, but that showering requires between 15-25l/p/d. As none of the participants took baths, but all used shower-like facilities, the median value of 20l/p/d for personal hygiene was adopted.

[22] Putting temperatures at 5°C higher than average temperatures of 25°C and 20°C, respectively.

The last factor concerns the minimum water requirements for food preparation. A range of studies in both developed and developing countries (cf. Gleick, 1996:85, for a discussion) suggest that between 10-20l/p/d 'satisfy most regional standards' (*ibid*). A median value of 15l/p/d has therefore been adopted for definition here; resulting in a total daily minimum of 49l per person to meet daily needs.

In order to understand if scarcity exists in the study location, I used 4 complementary means of measuring household water use.

I asked participants to measure their household's daily water over 7 consecutive days (1). I recorded the size and holding capacity of each household's water storage barrels and verified the daily water use measure with the task-based (2) and overall water measures (3) (cf. section 4.3: Measuring water use). I divided the composite measure by the number of people in the household, applying a weighting (the OECD equivalence scale) for different household members (OECD, n.d). This allowed me to gain a first understanding about how much water people have available to carry out the daily tasks required to maintain health and personal hygiene. In addition to the basic needs categories, other measures were taken to capture other uses of water as reported by participants. These uses included washing clothes, cleaning floors, watering plants and feeding and bathing pets.

Figure 5.1 plots the minimum ranges stipulated in the literature to meet basic needs as described above (light blue), the levels adopted for the study location (yellow), and shows the maximum (red), minimum (dark blue) and median (green) water use observed among all participants for each of the categories of water use. The graph shows that individuals do not use enough water to meet basic needs in any of the four categories. The category marked 'other' in the graph shows that additional water of between 2-10l/p/d is consumed for uses outside the basic needs categories. In order to understand how water scarcity manifests despite additional (although minimal) amounts of water being available to participants, I examine each category in detail.

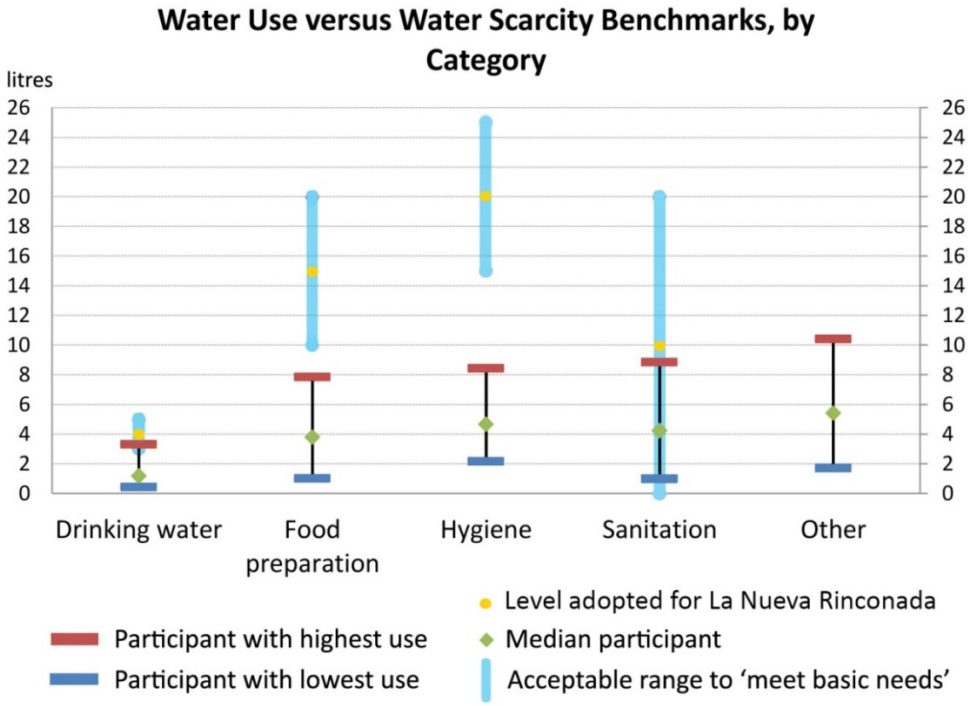


Figure 5.1: Household water use plotted against 'basic needs' categories

The graph plots the minimum ranges stipulated in the 'basic needs' literature as described above (light blue), and shows the maximum (red), minimum (dark blue) and median (green) water use observed among all participants for each of the categories of water use, as well as the water use recorded for non-'basic needs' uses. The graph highlights that basic needs are not met in any of the categories in comparison to the levels adopted for use in La Nueva Rinconada (yellow).

Appendix A contains a typical daily water record.

Lacking sufficient drinking water

Figure 5.1 shows that the large majority of participants do not drink enough water to 'meet basic needs'. Participants' accounts reveal that rather than reflecting an absolute lack of water available for consumption, insufficient consumption of drinking water is imposed by issues of poor water quality and lack of sanitation infrastructure. Participants under-consume drinking water because processing water to drinking standards is time, cost and labour intensive; and because the lack of municipal sanitation provision forces them to reduce the load on their on-plot sanitation system by drinking less.

As the water available in La Nueva Rinconada (cf. section 5.4.1, below, for a description of the different means of acquiring water) is inadequate for human consumption (Pebal La Inmaculada, 2010a), all water needs to be treated to make it drinkable. Participants reported that they boil water for varying lengths of time and treat water chemically before it becomes consumable.

This process is made time, cost and labour intensive due to a lack of refrigeration, inadequately covered storage containers and environmental pollutants such as insects and rodents, all of which allow treated water to be stored for short periods only, and require new water to be treated daily among a number of competing chores. Participants reported encouraging family members to drink less to make daily supplies last, or that, when treated water ran out, none was made available until the next day. Others reported that the pressures on their on-site sanitation system forced them to reduce water consumption unless it was exceptionally hot, so as not to increase the speed at which pit latrines were filled and became permanently unusable, as this would entail labour and cost extensive construction of a new latrine plot.

This category highlights what I will term 'forced scarcity', which, rather than being characterized by an absolute lack of water, arises from a combination of poor water quality, lack of sanitation systems, economic constraints and lack of time to attend to water quality among a range of competing chores. This combination of multiple scarcities forces participants to consume less water than is considered adequate for maintaining health.

Figure 5.2: Physical indicators of poor water quality and water quality safeguarding solutions

Participant demonstrates physical indicators of poor quality water even after chemical and heat treatment (top left). Participants display a range of water storage solutions aimed at protecting water treated for consumption from pollution from hot temperatures, insects, rodents and hand contamination (top right, bottom left, bottom right).

Water use for food preparation

Figure 5.1 indicates that all participants used less than the minimum amount of water considered adequate for daily food preparation needs. As in the previous category, this does not indicate an absolute lack of water available for this purpose, but can be attributed to a combination of external factors which lower levels of water consumption in this category. These include the availability of government food aid, which replaces breakfast for many families, and the remoteness of the settlement from places of employment, which forces those working outside the home to consume one or more of their daily meals away from home.

In areas of high levels of poverty where many children suffer from malnutrition, the government's *vaso de leche* ('Glass of Milk') programme supplies a large jug of milk enriched with cereals and sugar to every family which has a child under the age of seven, substituting home-cooked breakfasts for many families. All but one of the participants had children qualifying for this benefit. Whilst the programme is targeted to improve low nutritional status of poor households, a 2003 study has failed to find evidence of this (Stifel and Alderman, 2003). A lack of water used to prepare food is thus here not indicative of an absolute lack of water, but of a series of mutually perpetuating ill-effects of poverty, exemplified here by the availability of food subsidies. As the desired effect of improving nutritional status is not achieved, the fact that its availability reduces water use for many households may contribute to the subsidy continuing despite being counter-productive.

The one participant who did not have children ate all her meals at the restaurant where she worked, which eliminated water use for food preparation almost completely. Equating three meals a day and the water used for their preparation with the majority of a person's earning is again symptomatic of a context of multiple scarcities: for this participant, the three meals per day consumed at her place of work represented the major part of her earnings; she referred to the money she took home as 'tips only'.

The second factor which reduces water used for food preparation relates to the settlement's remote location and lack of refrigeration and facilities to reheat food, which force husbands and older sons to leave home very early and consume breakfast and dinner on the way to and from work, as food cannot be stored in high temperatures and unhygienic conditions. As a result, the only family meal

participants prepared for themselves and their children was lunch, with some delivering this meal also for their husbands if they worked within reasonable distance.

Despite low levels of water use being recorded for food preparation, scarcity in this category is not characterized by absolute lack of water, but rather by what I will term 'secondary scarcity'. Such scarcity arises from the secondary effects of circumstances of low socio-economic status and remoteness of the place of work from home, as well as from government food subsidies that may have the appearance of conveniently saving time and water, but may fail to achieve their desired effects (Stifel and Alderman, 2003). The combination of the above factors also meant that families rarely took meals together.

Lacking sufficient water for personal hygiene

Figure 5.1 shows that participants used between 2-8 litres of water per person per day for personal hygiene, less than half of the median value of 20 litres considered adequate in this study area. The scarcity observed in this category arises from an array of factors pertaining to absolute availability, priorities of allocation, and water discarding problems. Participants addressed the combination of these factors through differential intra-household allocation of water for personal hygiene.

The overriding constraint recounted by participants related to the high cost of water and the large quantities required for personal hygiene of a large family. Absolute lack of water arose from lack of funds to purchase water and the challenges of storing large quantities of water. The aforementioned pressures arising from the lack of formal waste water systems in the area force households to discard considerable quantities of water used for personal hygiene in their own pit latrines or the settlement's roads, which double as open sewers, and are often far from plots, requiring long journeys to discard wastewater. The following quote illustrates a residents' relief over a vacant plot which enables the household to discard water locally.

'… hemos hecho un tubito así para afuera para que salga y ahí seca ya. Lo que lavamos también todo lo echamos pa'fuera, pero no vive el vecino, estamos aprovechando, el día que vive tenemos que echarle para la parte de abajo. [se ríe]'

'…we've constructed a little pipeline to the outside so that [the latrine] dries out. We also throw all our washing water outside; but now that the neighbour has left, we make good use of this [situation], the day he returns we'll need to throw it all down [to the main road] again [laughs].'

Villa Sol resident

To address the combined problems arising from high water costs, storage constraints and discarding problems, households allowed only children and adolescents to use the latrine for showering to afford this group privacy in their personal hygiene. Adults used public showering facilities in the main market. High costs[23] and relatively large distances to these facilities meant they were only used sparingly, resulting in household members being afforded different priorities in using water for personal hygiene.

One participant explained that as her husband needed to be clean and presentable to instil confidence in potential buyers of his wares, which he sold on the street, he was the first to use water for washing himself every night. School-age children were washed after their father, as they would otherwise be bullied at school for 'coming from the settlement'. Several days would pass between showers and washing hair for the participant herself, even in very hot weather. She explained that as she 'only worked around the house', she did not need to be as clean as those engaging with the outside world. The family's small baby was frequently bathed, but it was explained that this required very little water, which could be easily found and heated.

Conditions of 'absolute scarcity' were observed in this category, with household members using on average less than half the acceptable minimum amount of water for personal hygiene. Absolute scarcity was seen to arise from the high cost of water and storage and discarding problems preventing sufficient amounts being available for all household members' personal hygiene. Some household members suffered further reductions in water allowance due to differential intra-household allocation.

[23] A shower was charged at a price equivalent to 1/3 of a barrel of water.

'A veces no hay. Se acaba, y ya lavas ropa así, ya no hay ya para que se bañe el bebe o… más ellos pues que salen al colegio, tienen que cambiarse todos los días. Y a veces, este… bueno, uno sí ya dejando un día yo sí me baño, como no salgo a trabajar, en cambio mi enana todos los días se baña, mi esposo también todos los días se baña, entonces se gasta rapidito el agua pues.'

'Sometimes we don't have [any water]. It finishes, and once you've washed the clothes like this, there's none left to bathe the baby or…rather the kids who go to school, they have to change [into new clothes] every day. So sometimes, I skip a day and then bathe the next, as I don't go out to work; on the other hand my little one bathes every day, my husband too, so the water gets used up quickly.'

Villa Sol resident

Lacking sufficient water for sanitation

Figure 5. 1 shows that water use within the 'sanitation' category falls within acceptable levels suggested by the literature. However, participants used between 1-9l of water per day for sanitation, which falls short of the median value of 10l/p/d adopted for this study.

The factors affecting water use for sanitation are similar to those for personal hygiene, described above. An additional factor concerns the high cost of water-reducing sanitation solutions. Lime stone powder is used in La Nueva Rinconada to replace water-based sanitation as it dries out and captures odours within pit latrines, but was reported to be cost prohibitive by participants. Unable to use this technology, participants were forced to adopt different use allowance for adults, children and adolescents to minimise the strain on pit latrines. Adults would bag faeces to be added to the household waste, and use public toilet facilities in the market whenever possible, whilst younger household members were allowed to use the on-plot sanitation systems. These accounts were confirmed by settlement-wide statistics, which show that 'open-air disposal' and use of public facilities account for 5% of human excrement elimination settlement-wide. Figure 5.3 illustrates.

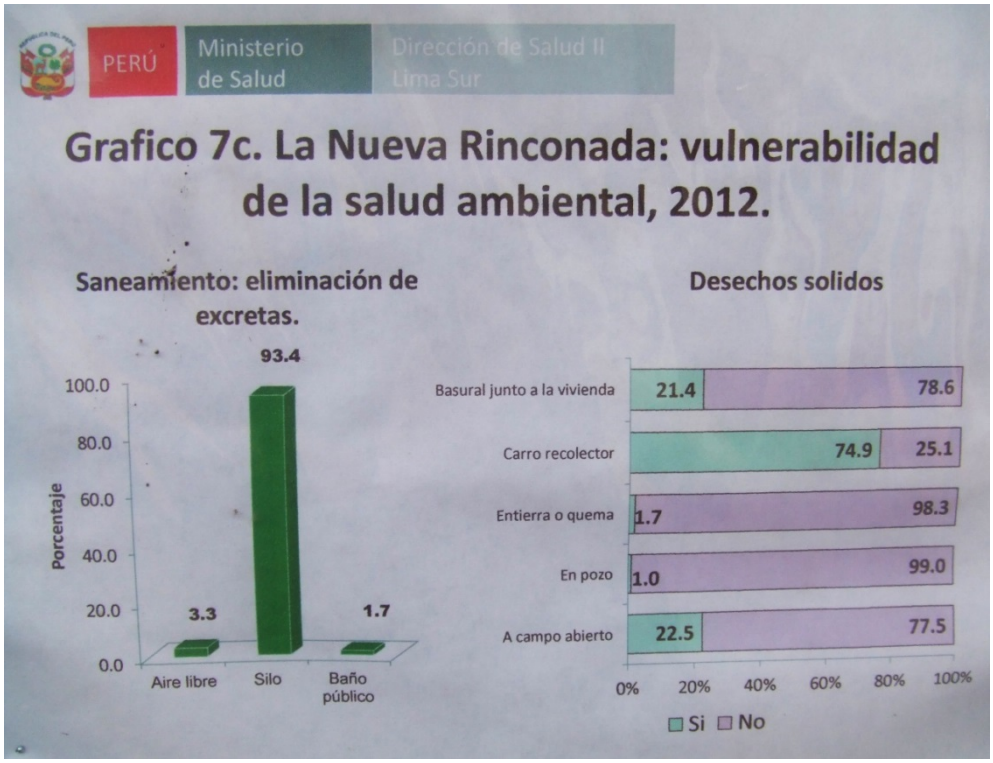


Figure 5.3: Environmental Health Statistics for La Nueva Rinconada, 2012.
Source: Ministry of Health, Lima South Health District.

The green graph on the left shows settlement-wide statistics for the elimination of human excretions:
3.3% of households bag faeces to be added to household waste, or dispose of them 'open air', as the graph euphemistically names this practice (leftmost green column).
1.7% use public facilities rather than on-plot pit latrines (rightmost green column).
The largest green column (middle) refers to those who dispose of excretions in on-plot latrines.

This category presents another instance of 'forced water scarcity', whereby the lack of municipal sanitation provision and prohibitive costs of water-reducing sanitation technologies force households to impose intra-household differences in sanitation use, which are not only inconvenient but carry considerable health risks (Montgomery *et al,* 2003).

Additional water use in non- 'basic need' categories

Figure 5.1 shows that apart from the water used to meet four 'basic needs' (Gleick, 1996) categories, participants used between 2-10l of water per day for activities outside those categories. Almost all of this was grey water, with the largest amount used for washing clothes. The cycle for washing clothes included the use of small amounts of fresh water, which was used to rinse washed clothes, this same water was then used to soak dirty clothes and used a third time for washing them. Additional uses of grey water included the bathing of pets. Plants were watered with both fresh and grey water. Participants' accounts confirmed that, apart from fresh water used in the final washing cycle, and in some households for watering plants, all water in this category had been previously used in one of the four 'basic needs' categories.

Figure 5.4

Figure 5.5

Figures 5.4 – 5.7: Water for non-'basic needs' uses

Figure 5.4: A typical clothes washing cycle shows that small amounts of fresh water used outside the 'basic needs' categories; here in the final stage of the wash cycle to rinse clean clothes. The same water is then re-used twice to soak and wash clothes.

Figure 5.5 to 5.7: Non-'basic needs' water use for the care of plants. A participant inspects a bucket of grey water collected to water plants outside her house.

Figure 5.6

Figure 5.7

Figure 5.6 to 5.7: Non-'basic needs' water use for the care of plants. The participant has a dream of the trees on both sides of the road growing tall enough to create a green roof for people to sit under (top) and enjoy the food and drink she sells from her shop (bottom).

Photographs: Researcher

5.3 Assessing water quality

The second component of the water scarcity measure considers whether available water is of adequate quality to maintain personal hygiene and health. It is well documented that those areas not connected to the municipal supply grid in Lima are supplied with water of inferior quality (PAHO, 2001; WHO/Unicef, 2000), which adversely affects people's health (Pebal La Inmaculada, 2010a ; López, 2012) and requires considerable time and cost expenditure to treat to consumable standards.

5.3.1 Safe drinking water guidelines

This section examines international guidelines for safe drinking water and compares those to national guidelines before describing the factors that affect water quality in La Nueva Rinconada. I use the World Health Organisation's Guidelines for Drinking-water Quality (2011), the Peruvian national standards for water quality (MINAM, 2008) and a local study on drinking water quality in La Nueva Rinconada (Pebal La Inmaculada, 2010a) to inform this section.

The World Health Organisation's recommendations for safe drinking water for human consumption stipulate that this should 'not represent any significant risk to health over a lifetime of consumption' (WHO, 2011:1)[24].

Poor water quality can be caused by a combination of physical, microbial and chemical indicators. Physical contamination is indicated by changes in the appearance, taste and/ or odour of water. The WHO cautions that although water that appears, tastes or smells unacceptable may not in fact be detrimental to health, such contamination should be avoided at all costs, as this may in extreme cases and in absence of comprehensive education campaigns, lead to the consumption of water that appears, tastes or smells more appealing, but is in fact more detrimental to health (*ibid*: 8).

Microbial contamination occurs through human or animal faeces entering the water (WHO, 2011: 4). This can lead to the existence of pathogenic bacteria, viruses and parasites, all of which are characterised by their ability to 'cause acute and chronic health effects', 'grow in the environment', 'multiply[…] in their host, in food, beverages and warm water systems once ingested', 'have an immediate [rather than cumulative] effect' (*ibid:*118). Any disease outcomes may be more severe in vulnerable populations (*ibid:*117*)*.

[24] This includes water used for 'drinking, food preparation and personal hygiene' (*ibid*).

Chemical contamination, unlike microbial and physical contamination, is considered harmful only after prolonged exposure over several years. As residents of La Nueva Rinconada have been receiving contaminated water since the inception of the settlement in 2000, and as a number of water treatment procedures practices, such as chlorination, have been shown to have adverse health effects in the long term (WHO ref), this type of contamination must be considered equally dangerous as physical and microbial indicators.

5.3.2 Barriers to water contamination: Institutional and constitutional contexts

The WHO recommends that the most effective way of preventing water contamination is to ensure that 'multiple barriers, […]including protection of water resources, proper selection and operation of a series of treatment steps and management of distribution systems' (WHO, 2011:4) are in place. These are currently lacking in the sourcing and distribution of water sold by trucks in Lima's informal settlements.

Whilst the right to adequate drinking water is embedded in the Peruvian constitution (MINAM, 2008, n.p.), its implementation in legislative measures was only initiated as recently as 2009. 'Profound inequalities' (Cárdenas *et al,* 2005:29) have to date hindered the full implementation of the human right to water for those sections of Peruvian society subject to disproportionate discrimination and vulnerability. Despite considerable advances in some areas, most notably following high-profile disastrous disease outbreaks, such as for example the Cholera epidemic in 1991, the specific barriers to safe drinking water have not been addressed in sufficient detail or breadth to effect comprehensive improvement of water quality for Lima's most vulnerable populations. Whilst a number of institutional actors at all levels from the President of the Republic to the municipality and end users have been assigned theoretical responsibilities in the safeguarding of water quality in Peru (Pebal La Inmaculada, 2010a), the barriers to water pollution stipulated by the WHO are at present at best only partially in place, and in Lima's informal settlements, the water sold by private water vendors is of very poor quality.

5.3.3 Factors affecting water quality in La Nueva Rinconada

A 2010 study of water quality and related educational campaigns in the zone of La Nueva Rinconada found water quality to be compromised according to physical, chemical and microbial indicators (Pebal La Inmaculada, 2010a).

This is caused by three factors, which exemplify the lack of the 'barriers' to water pollution stipulated by the WHO (2011). Institutional 'barriers' relating to the protection of water sources and adequate distribution systems are not in place in La Nueva Rinconada. Water sold in the settlement is drawn from questionable sources (Programa de Agua y Saneamiento, 2002) and is further contaminated by inadequate transportation and lengthy storage in rusty trucks and in hot temperatures (Pebal La Inmaculada, 2010a; Peruanos Sin Agua, 2012).

The failure of water providers to implement the institutional barriers to water contamination puts the onus of treating variously contaminated water entirely onto end users. Inadequate storage and end user practices showed the final barrier to poor water quality to be missing, and to further exacerbate poor water quality in La Nueva Rinconada.

The WHO's (2011) recommendations of how individual consumers should best ensure adequate drinking water quality prove themselves to be severely out of touch with the realities of life in informal settlements. They recommend that 'consumers [….] ensure that their actions do not have adverse impacts on water quality' (*ibid:*15) and that 'appropriate efforts [be made] to ensure safe collection, storage and […]treatment of their drinking water' (*ibid*). It further advocates that water be treated in the home to ensure its safety, and that such measures are only likely to be successful in the context of community education and training, as the efficiency of any treatment largely depends on the correct assessment of the type of pollution (*ibid:*138).

Awareness and understanding of poor water quality

Interviews and observation revealed widely varying degrees of awareness and knowledge of the factors that affect water quality and of appropriate measures to address these. This was particularly evident in the wide spectrum of perceptions surrounding the physical, chemical and microbial contaminants of water, how these manifested and could be mitigated. Participants' perceptions of poor water quality revolved largely around visible factors of water pollution and were characterized by widely varying understanding of how best to address this.

Haphazard education campaigns sporadically bring the subject to the forefront of some (although by no means all) residents' awareness, but owing to their uncoordinated nature, awareness and knowledge of water quality varied widely (even among residents of the same neighbourhood) and was not consistently at the forefront of residents' priorities. This was perpetuated by minimum medical capacity in the settlement's four health centres, which allowed the symptomatic treatment of health problems, but did not extend to prevention and education campaigns (López, 2012).

Among those who bought water from private trucks, knowledge about the provenance of the water they consumed varied widely, and perceptions of contaminants were largely confined to visible aspects pertaining to physical contamination. Those who illegally drew water from neighbours connected to the grid were aware that the water was provided by SEDAPAL, and convinced that the water was of 'better' quality ('*más limpio*': cleaner) than that from the truck. A high degree of variation in people's perception of how to best remedy issues of poor water quality was observed in participants' understanding of appropriate storage containers, materials and locations and in relation to appropriate maximum storage lengths for water

Despite poor water quality being listed as the second most frequent cause for health complications in the settlement by its chief doctor (López, 2012), problems arising from poor water quality were not at the forefront of residents' priorities, and were not perceived to be as important as other issues.

Measures used to address poor quality water

Participants' scope for addressing poor water quality is highly constrained. Not only do extensive institutional and political failings place the onus to improve water quality entirely on residents, but within this constraint, residents' remedial opportunities are severely limited. Of the WHO's (2011) recommendations relating to 'safe collection, storage and treatment [in the home] of drinking water' (*ibid*) and to 'a context of community education and training [to correctly assess type of pollution and identify appropriate treatment]' (*ibid:*138), residents' opportunities for effective action were reduced to the type and location of water storage, and to a lesser extent, to water treatment options.

The type of water storage varied from very common blue plastic barrels to self-built concrete or brick enclosures. Plastic barrels have the advantage that they are mobile, and thus more easily cleaned, which, if practiced, aids hygienic water

storage. They have the disadvantage that they are poorly insulated and expose water to high external temperatures, aiding bacterial and viral growth. Concrete or brick enclosures have the disadvantage of being more difficult to clean, but due to their greater wall thickness they provide better insulation from external temperatures and other external pollutants.

Positively impacting on water quality was the widespread deployment of different barrels for water for consumption and water for other uses. The WHO (2011) recommends secure and tight covers and the use of spigots for retrieving water from storage barrels to minimise contamination from the immediate environment. Secure covers were observed in newly bought barrels, but as many, if not more, incidences of inadequate covers in the form of thin plastic sheeting, which becomes instable in hot temperatures, or wooden planks, which only partially cover barrels and make water vulnerable to environmental contamination, were observed. The use of spigots to retrieve water is intended to minimise contamination from hand contact but was not observed, instead smaller jugs (left floating in the barrel when not in use), buckets or hosepipes were used to retrieve water from storage barrels. Contact of these containers with hands, floors, roads (which doubled as open sewers) and other storage containers risked extraneous contamination at every instance of water retrieval.

The location of water storage containers varied widely across participating households, depending on the location of individual plots as well as on the type of storage container used. Those who lived on a main road located their storage containers outside their front doors, often in close proximity to open sewers, thus risking contamination of water with human and animal faeces[25]. Those living away from main roads located their barrels either in communal locations on water delivery routes, or outside their front doors. Whilst the latter avoids contact with open sewers, the need to transfer water from main storage containers to the house exposes water to contamination in transfer.

Treatment to make water consumable includes the boiling of water intended for consumption, and chemical treatment. In both types of treatment, a wide variety of awareness and resulting practices was observed. This variety can be attributed to haphazard and inconsistent educational campaigns, which on the one hand spread knowledge about water safety in an uneven manner across the settlement,

[25] As figure 5.11 shows, barrels are located in the unstructured part of the road that doubles as an open sewer, rather than on cemented pavements. This arises from a regulation forbidding residents to use communally constructed infrastructure for private use.

and on the other hand sent contradictory messages regarding the best means of treating water for consumption. Underlying economic considerations relating to the cost of gas and chemicals prevented best practice from taking place. Both excessive boiling of water and unnecessary wastage of costly gas and under-treatment were observed, with the latter resulting in the dangerous combination of residents perceiving that they had addressed poor water quality when this was not the case.

Figure 5.8

Figure 5.9

Figure 5.10

Figure 5.8: The range of covers used once water barrels' original hard plastic covers (in foreground) become damaged or lost is seen at a communal water storage point.

Figure 5.9: A rare example of a water storage solution contributing to safeguarding water quality as barrels are raised to avoid ground contact.

Figure 5.10: A brick enclosure protects water from high temperatures, but is difficult to clean and prone to contamination from the low-level hosepipe connecting it to the plastic barrel used to remove water for daily use.

Photographs: Researcher

Figure 5.11

Figure 5.12

Figure 5.13

Figure 5.11: Water quality is safeguarded by the use of different barrels for water for consumption and for other uses, and by the use of tight-fitting lids. Positive effects of this are diminished by barrels being located in roads that double as open sewers.

Figure 5.12: The use of spigots to draw water from barrels was not practised in La Nueva Rinconada; instead, water was typically transferred by jug, heightening risk of contamination through hand contact.

Figure 5.13: Partial safeguarding of water quality in use.

Photographs: Researcher

5.4 Examining security of water supply

In contexts where households are not connected to the municipal water grid, obtaining water when it is needed can present considerable challenges, as distance from and type of water source greatly influence a household's water use (Gleick, 1996). Residents of informal settlements, which are by definition (UN Habitat, 2015) not connected to municipal water infrastructures, have insecure access to water supply with the burden to ensure that water is available when needed falling almost entirely onto individual households. Security of access to water is thus considered the third component of water scarcity (Wutich, 2006:125).

In La Nueva Rinconada, despite the zone not being connected to the municipal water grid, security of water supply appears to be a given, as a stream of water trucks are highly visible throughout the settlement on a daily basis. Looking beneath the surface, however, security of supply is precarious and varies widely across the settlement. To examine what impacts on security of water supply for the residents of La Nueva Rinconada, I follow Wutich's (2006) indicators, each of which is designed to estimate the likelihood of a household being able to obtain water when needed (Wutich, 2006:131). As rainfall cannot be taken into account to contribute to a household's water security in heavily polluted Lima, security of supply depends largely on the location of a neighbourhood within the settlement, and on the location of a household within its neighbourhood. These two factors in turn affect a household's requirement for water storage capacity. Lastly, social relations play a part in ensuring water supply. Within each of these categories, a number of factors were seen to affect how likely households are to obtain water when needed.

5.4.1 Water supply in La Nueva Rinconada

To give a first impression of the wide variety of water acquisition processes employed to mitigate insecure water supply among just 23 participating households within the seemingly homogenous setting of trucked supply, I outline the 6 distinct ways of acquiring water which I observed in the two participating neighbourhoods. I have no doubt that there are other means of obtaining water in other neighbourhoods of the settlement.

1. Water is delivered by truck to a plastic holding barrel or brick/ cement structure located outside the house, usually several times daily. Water is carried inside the house and back courtyard by bucket as and when needed.
2. Water is delivered by truck to a holding barrel located inside the house, usually various times daily. The barrel is carried outside to receive water deliveries and carried inside once full. Water is then retrieved by bucket as and when needed.
3. Water is delivered by water truck to a holding barrel located in a communal location away from the house at highly varying intervals. A number of mechanisms to secure water and barrels are in operation, ranging from no security measures taken; to removing the hosepipe used to pipe water to the house; to moving the entire barrel only when needed and relocating water by bucket and/or hosepipe to a second set of barrels near the house.
4. Water is delivered by water truck to a holding barrel located away from the house, 2-3 times per week, and brought to the house by a permanent self-built infrastructure of hose pipe and/ or intermediate holding barrel.
5. Water is delivered to a neighbour's temporary holding tank, 2-3 times per week, and transferred to the house by private hosepipe.
6. Water is illegally drawn by hosepipe from a neighbouring house connected to the municipal grid at infrequent intervals, and stored in numerous containers inside and outside the house.

The following section examines each of the indicators of security of water supply to present the range of factors that bear on it.

5.4.2 The impact of monthly precipitation on security of water supply

Lima has notoriously low rainfall levels. In 2012, they totalled 48mm per year (Tu Tiempo, 2012) (compared to an average of 915mm in the UK; Defra, 2012). However, there have been occasional heavy rainfalls over the past decade. The data from the study period highlights that precipitation cannot be taken into account in Lima as the combination of very low quantities and high pollution levels make rainwater harvesting ineffective. In a context of wide-ranging initiatives in the acquisition, storage, use and reuse of water participants unanimously reported that no provisions for harvesting rainwater were made.

On the contrary, periods of intense rainfall caused considerable complications to the informal waste water 'system' of ground penetration and evaporation as the ground was saturated from rainwater. This intensifies insect breeding and heightens accumulation of animal and human faeces, making streets not only more difficult to navigate but the source of heightened health risks. The rainy season also causes additional problems for water access and quality, as roads become inaccessible to water trucks (Fig. 5.16) and water in inadequately covered storage containers is further contaminated by polluted rainwater.

Rainfall can therefore not be taken into account towards secure water supply to households in the area and negatively affects security of supply across the settlement.

5.4.3 The impact of neighbourhood location on security of water supply

The settlement's 143 neighbourhoods stretch from relatively flat ground along the bottom of the gently rising valley high into the peaks of the steep hills. As road construction is time consuming and resource intensive, the road network that allows water trucks to access neighbourhoods decreases in reach, width and structural quality the further and higher up into the settlement a neighbourhood is located, and the more recently it has been established (Figures 5.14-5.18). A neighbourhood's location within the settlement therefore affects security of water supply to its residents. Figure 5.19 illustrates the location of the two study neighbourhoods within the settlement and lists a range of factors pertaining to their respective locations which affect access to water.

To assess the impact of the two participating neighbourhoods' locations on security of water supply, a range of mapping techniques was employed in conjunction with participant and stakeholder accounts. Four factors were found to impact on security of water supply:

1. The existence, width and structural quality of roads
2. The proximity to water delivery routes and the number of neighbourhoods served along the same route before and after a neighbourhood
3. Land tenure and municipal responsibilities within the neighbourhood
4. The effectiveness of neighbourhood representation

In conjunction with a neighbourhood's geography; customer demand for water; presence or lack of stairs and land tenure situations in a neighbourhood, the above-listed factors result in a large range and variety of water provision scenarios. For the purpose of analysis, I have grouped these into distinct water access zones for each neighbourhood. Figures 5.23 to 5.29 illustrate the factors that impact on each water zone's characteristics for the neighbourhood of Villa Sol (zones A-C). Figures 5.30 to 5.36 illustrate the same for the neighbourhood of Absalón Alarcón (zones D-G). Before examining each of the above factors in detail, I now briefly describe the resulting water access zones for each neighbourhood.

Villa Sol

Villa Sol is located near the entrance of the settlement, in close proximity to the central market, several bus stops serving buses both to the higher parts of the settlement, various local commercial and residential destinations, and destinations further into central Lima. The geography of this neighbourhood is very steep. Its seven blocks are all located on steeply rising hills (Fig. 5.23). The land is privately owned, and lies adjacent to a formalized neighbourhood with municipal access to water, sanitation and electricity provision (Fig. 5.29).

The residents of this neighbourhood acquire their water in three distinct manners, which I have termed water delivery zones A, B and C (Figure 5.29). Residents in zone A buy water from neighbours whose houses lie in the formalised area. They do this by illegally connecting a hosepipe and drawing water down the hill and up into the settlement, directly into each recipient's house and barrels, by pressure. Payment is estimated depending on buyer's water storage capacity, frequency

and length of withdrawal. 2 residents of this water delivery zone participated in this study.

Residents in zone B are located too far from their neighbours' tap, but are in relative proximity to a dead-end road which the water truck can access. Their barrels are located in communal barrel locations. 1 resident of this water delivery zone participated in this study.

Residents in zone C receive water from the trucks travelling along the neighbourhood's northern edge. Households located adjacent to the road fill their barrels or temporary holding tanks directly. Others are located at the bottom end of the block, some 95m away from the road down a steep flight of stairs. These households use private infrastructure to pipe water from roadside holding tanks to their homes; or make use of a neighbours' holding tank to transfer water to barrels near their house; or carry their barrels up to the road when the water truck arrives, then transfer water back down the stairs. 4 residents of this water delivery zone participated in this study, each experiencing one of the 4 situations described.

Absalón Alarcón

Absalón Alarcón is located some way into the settlement, in close proximity to its central bus station which served buses into Lima and local residential and commercial destinations, as well as buses higher up into the settlement. Its geography stretches from its near-flat main road all the way up the peaks of one of the valley's mountains (fig. 5.30). The neighbourhood stretches across 2 municipalities and comprises three different land tenure situations (fig. 5.35).

The residents of this neighbourhood acquire their water in four distinct manners, which I have termed water delivery zones D, E, F and G (Figure 5.36). Residents in zone D receive water from the truck travelling along the neighbourhood's main road, either directly to their door, or to barrels located in communal locations along this road. 11 residents of this zone took part in the study. Residents in zone E receive their water in barrels located in a communal location at the last accessible point of the road, and carry water across unmade rock to their house. 1 resident of zone E took part in the study. Residents in zone F receive their water at a communal location in an adjacent neighbourhood and have to carry it with buckets to barrels located near their house. 1 resident of zone F took part in the study. Residents of zone G receive their water at a communal location located in an adjacent neighbourhood at the top of the mountains, and transfer water with

buckets or via hosepipe to barrels located near their house. 3 residents of zone G took part in the study.

Existence, width and structural quality of roads

As most households rely on trucked water supply, the extent, width and structural quality of roads impacts on whether water trucks can access individual households and communal barrel locations. Many neighbourhoods' roads are too narrow, insufficiently secured, partially completed, or at worst entirely inexistent, to allow water trucks to enter. Participants reported good will by truck drivers to access difficult areas; with many performing complicated and time consuming manoeuvres to bring water to customers on request and as part of their usual delivery routine.

The ease with which roads are built depends on the one hand on the geographical features of a neighbourhood, and on the level of commitment to the works by the population on the other hand. Both, however, need to be understood in a context of absence of formal infrastructure provision, which puts the onus of road construction entirely onto a neighbourhood's community, and also in the context of severe resource constraints arising from very limited economic means, lack of technical expertise and access to machinery, and lack of time to dedicate to communal works. As a result of these constraints, all roads in the settlement have been constructed through time-consuming manual labour by its residents, with participation provided both voluntarily and strongly enforced under threat of fines by neighbourhood representatives (Figures 5.20 to 5.22 illustrate).

Figures 5.24 and 5.31 illustrate that neither of the study neighbourhoods enjoys access to a main road[26]. Neighbourhood no.1 is served by a secondary road along its norther edge, and a tertiary road along a fraction of its southern edge; while neighbourhood no.2 is served by secondary roads on its eastern and western edges, and by two tertiary roads which just reach its northern and southern edges.

[26] Road types have been derived from the map of the settlement displayed in its health centre and from observations. I have termed 'main road' the primary road of 22m width running along the bottom of the valley, which is accessible to water trucks all year around. I have termed 'secondary roads' the narrower roads of approximately 10m width, which are accessible in the dry season but prone to difficulties in the wet season. 'Tertiary roads' are narrower, incomplete and not fully secured roads that suffer frequent periods of inaccessibility.

Figure 5.14: An aerial view of the settlement shows the decrease in reach, width and structural quality of the road network the higher up into the settlement a neighbourhood is located.
Source: Google Earth, 2016

Figure 5.15: The entrance of the settlement is marked by a change in road surfaces. Source: Google Earth, 2016

Figure 5.16: Road in neighbourhoods at the bottom of the valley are only slightly inclined, but deteriorate in the wet season. Photograph: Researcher

Figure 5.17: Roads higher up in the settlements are still under construction,
with tasks aimed at widening and securing road to improve access for water trucks.
Photograph: Researcher

Figure 5.18: Geography and date of arrival impact on the provision of services.
The newest neighbourhood high up in the settlement has no road network (nearest road indicated by blue arrows),
but the image shows that the age of the neighbourhood also influences infrastructure provision,
as the adjacent neighbourhood's electricity poles are visible just to the right (circled red).
Photograph: Researcher

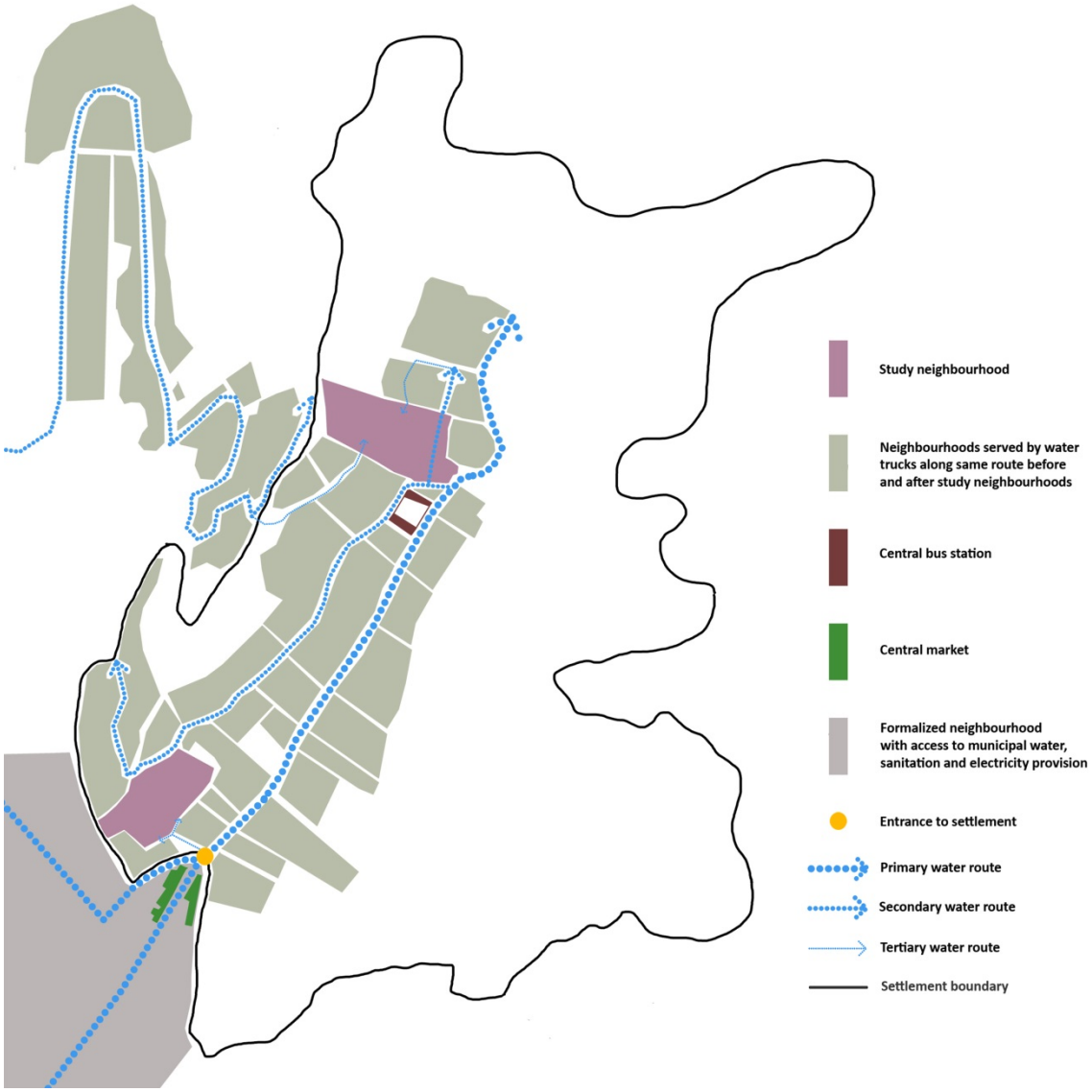


Figure 5.19:
The location of a neighbourhood within the settlement and in relation to public facilities with water provision both affect security of access to water, as do a neighbourhood's location in relation to water delivery routes and the number of neighbourhoods served along the same water delivery route before and after a neighbourhood.

Figures 5.20 to 5.22:
Part-voluntary and part-enforced communal labour is employed to construct vital infrastructure, including roads.

Figure 5.20, top: A public sign reminds residents whose turn it is to participate in early morning communal works on the coming Sunday
Figure 5.21, middle: A logbook details weekly participation and fines for non-participants.
Figure 5.22, bottom: Road construction is characterized by lack of economic means, technical expertise, lack of time and access to machinery. Here, a road is widened using burning tyres to explode the rock to improve water truck access to a neighbourhood's communal water barrel location.
Photographs: Researcher

Proximity to water routes and number of neighbourhoods served

Living in close proximity to a route along which the *aguateros* (water trucks) travel greatly increases the likelihood of being able to buy water when needed. Residents can go about their work in the house whilst waiting for the water truck, run less risk of missing the truck, and do not have to spend a long time walking to the water delivery point or waiting for the water truck. Living in close proximity to a busy water delivery route also reduces the need to store water inside or outside the house for long periods of time as water trucks pass frequently.

Proximity to a water delivery route alone, however, does not equal secure access to water. This additionally depends on the relative position of a neighbourhood along the water truck's route. Whether a neighbourhood is among the first served by a full truck, or if a large number of other neighbourhoods are served along the same route before a truck reaches a neighbourhood both affect water availability. The number of neighbourhoods served *after* the truck passes also has an impact on a participants' ability to secure water when needed. The more neighbourhoods are located further along a route, the more likely it is that larger numbers of water vendors will choose to travel along that route in search of customers.

Figure 5.19 shows the water routes which serve both study neighbourhoods and highlights the number of neighbourhoods served along the same routes before and after the study neighbourhoods. Figures 5.25 and 5.32 show that neither of the study neighbourhoods is located along a main water route, but both are serviced by secondary and tertiary routes[27].

A number of scenarios were reported to impact the ability to get water when needed. In Villa Sol, residents reported that the trucks travelling along its northern edge had often run out of water due to the large number of neighbourhoods having been served before. The recent installation of a standpipe in the neighbourhood further along the same route had further decreased the numbers of trucks passing as demand had dwindled. Figure 5.29 and the following quote illustrate:

[27] Routes were assessed through observation of numbers of water trucks passing and residents' accounts. Main routes are characterized by frequent passing of trucks in both directions during daylight hours, and residents reporting that they could buy water whenever they needed. Secondary routes are characterized by fewer numbers of trucks passing during daylight hours, and residents reporting that they could usually, although not always, buy water when needed. Tertiary routes are characterized by intermittent access by water trucks and residents reporting specific, short windows of opportunity for buying water.

'De repente viene el aguatero lleno, va… va llenando, llenando pues, viene acá. Ni bien entra…van vendiendo ya, entrando-vendiendo, entrando-vendiendo.

De repente se acaba acá nomás. De repente en mi poza nomás compro yo mis cinco soles o un tachito compro, y se acaba, ya no hay agua ya…Se regresa y de ahí en un rato de repente vuelve o sino ya no vuelve.

Y los de allá se quedan sin agua. En tiempo de calor ahí si sufren un poco los de allá, porque se acaba el agua y…A veces también se termina el ague antes de ahí nomás ya se…

Más atrás (…) han colocado una pileta para que jalen cada morador…ya no necesitan aguatero, pero en cambio si nosotros sí, no tenemos pues ni pileta, nada. Endenantes se fue de ahí y de ahí 'dentró' otro.

No, pero yo soy bien precavida, yo no hago que el agua se me acabe para… ya le tengo que comprar, porque si no me quedo sin agua, cuando lavo ropa a veces si me quedo… … el agua es necesaria, sino no tengo agua ni para tomar, quién va a estar pidiendo a la vecina. [se ríe]'

'So the water truck comes [along the road] full….and he's filling up [barrel after barrel], and he gets to us, he can hardly fit in here…..passing houses, selling, and so on.

And suddenly, here he runs out, that's it. And so I get to buy 5 soles worth [of water] or I buy a small barrel's worth, and he's run out, that's it, no more water….So he goes back and then a bit later he may or may not come back [full again].

And those over there are left without water. In the hot season they do suffer a bit over there because the water runs out…and sometimes it runs out before [the truck] gets to us….

Further along [the road] they've installed a standpipe, so that people can draw water from there….they no longer need the truck, but we on the other hand do, as we have no standpipe, nothing. Before [the arrival of the standpipe] the trucks went this way, and others went in there….

No, but I'm very careful, I make sure I don't run out of water so that….I'll buy [on time] because otherwise I'm left without water, when I wash clothes sometimes that happens….water is a necessity, otherwise I might not even have water to drink, and who wants to be borrowing from the neighbours. [laughs]'

Villa Sol resident

Residents along Villa Sol's southern edge reported that despite being in close proximity to the main water route, access was made difficult by the narrow and unstructured road, which required water trucks to reverse in and out. Residents recounted needing to wait by the main road and convince truck drivers to access the narrow tertiary road to get water.

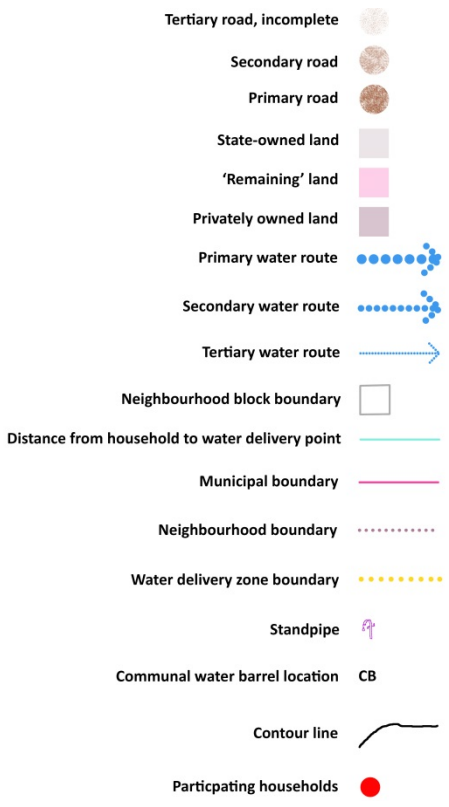
In Absalón Alarcón, water access was made difficult due to the secondary water route originating in the neighbouring settlement, causing trucks to either run out by the time they reached the peaks of the mountain, or not feeling responsible for providing water for the residents of the study neighbourhood. Figure 5.19 illustrates the secondary and tertiary water routes originating outside the settlement.

Land ownership scenarios and municipal responsibilities affect security of access to water in the longer term. Those settled on state-owned land stand better chances of resolving their titling disputes and being granted land titles, which pave the way for the provision of water and sanitation services. Those on private or 'contested'[28] land face bigger complications due to unknown land ownership or hostile owners unwilling to settle disputes, and are therefore less likely to gain land titles. The situation is further complicated by private land being located at the bottom of the valley, and state-owned land towards the higher reaches of the mountains. Practically, it would be very difficult to provide water and sanitation infrastructure to the higher parts of the settlement without accessing its lower parts. Neighbourhood representatives therefore reported that the government was willing to enter titling negotiations only once the land ownership situation of an entire neighbourhood was resolved.

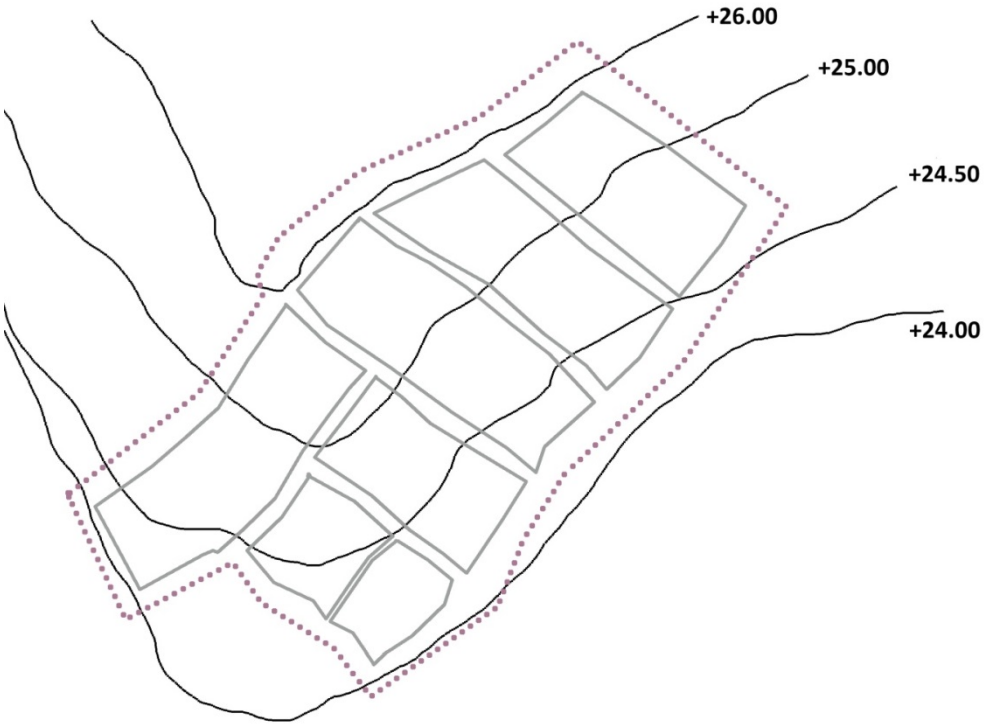
Figure 5.29 shows that Villa Sol is located entirely on privately owned land. Its residents reported a range of complicating factors preventing the resolution of titling provision. Many plots had multiple landlords and it was unknown who was legally entitled to sell the land. Many landowners were unwilling to sell, or were asking unaffordable prices. The problems of neighbourhood representation in this neighbourhood prevented the resolution of titling issues, as discussed in more detail below. Figure 5.35 shows that Absalón Alarcón is located across 2 municipalities and comprises 3 land ownership scenarios. In addition to the complications described above, being under the governance of two municipalities provides additional hurdles as permissions need to sought twice and agreed

[28] This term has been loosely translated from the Peruvian *remanente*. It refers to areas of disputed land ownership. Such land was gifted to swine herders when they first settled in the area, but due to their failure to improve its sanitary provision, is said to have reversed to the state; which is in turn contested by swine herders.

between municipalities. Figures 5.23 to 5.29 highlight the factors which affect security of access to water in Villa Sol. Figures 5.30 to 5.36 highlight the factors which affect security of access to water in Absalón Alarcón.



Key to maps 5.23 to 5.36



Figures 5.23-5.29: Factors affecting security of water supply in Villa Sol.

Figure 5.23: Neighbourhood blocks stretch across a range of geographic heights, making access to individual households difficult.

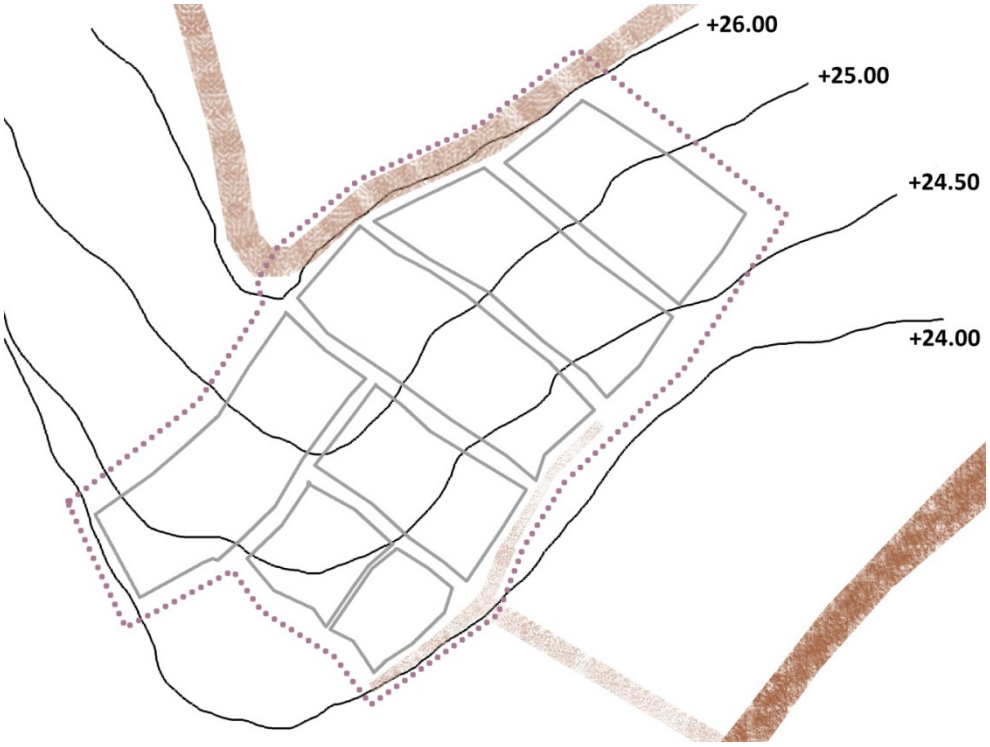


Figure 5.24: The existence, proximity, width, structural quality and completeness of roads affect water truck access.

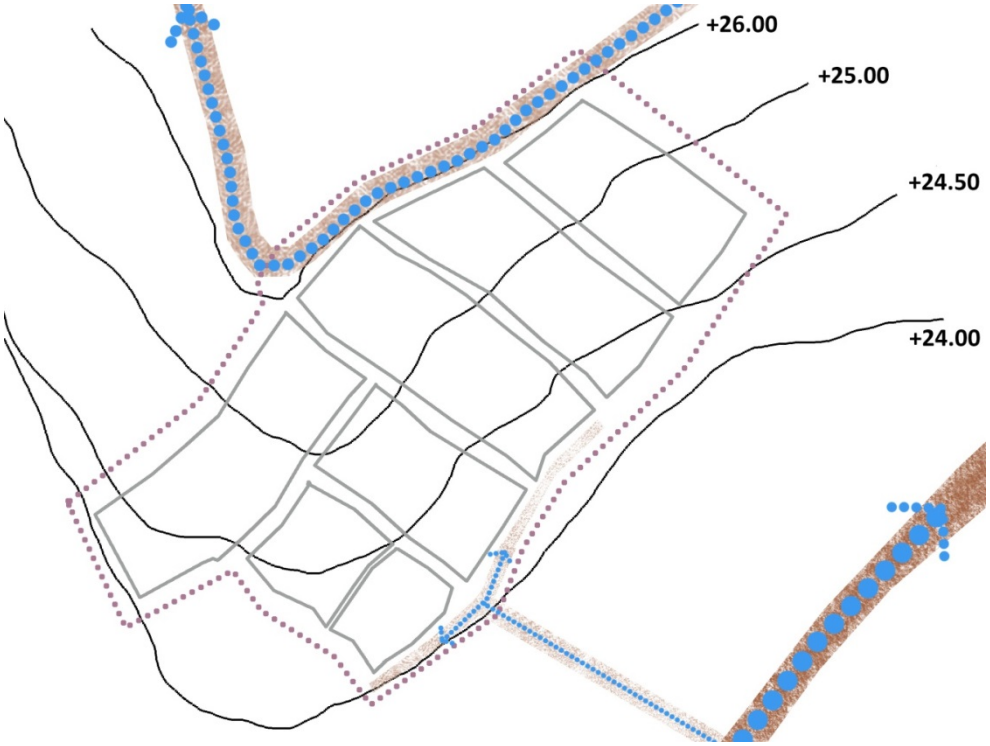


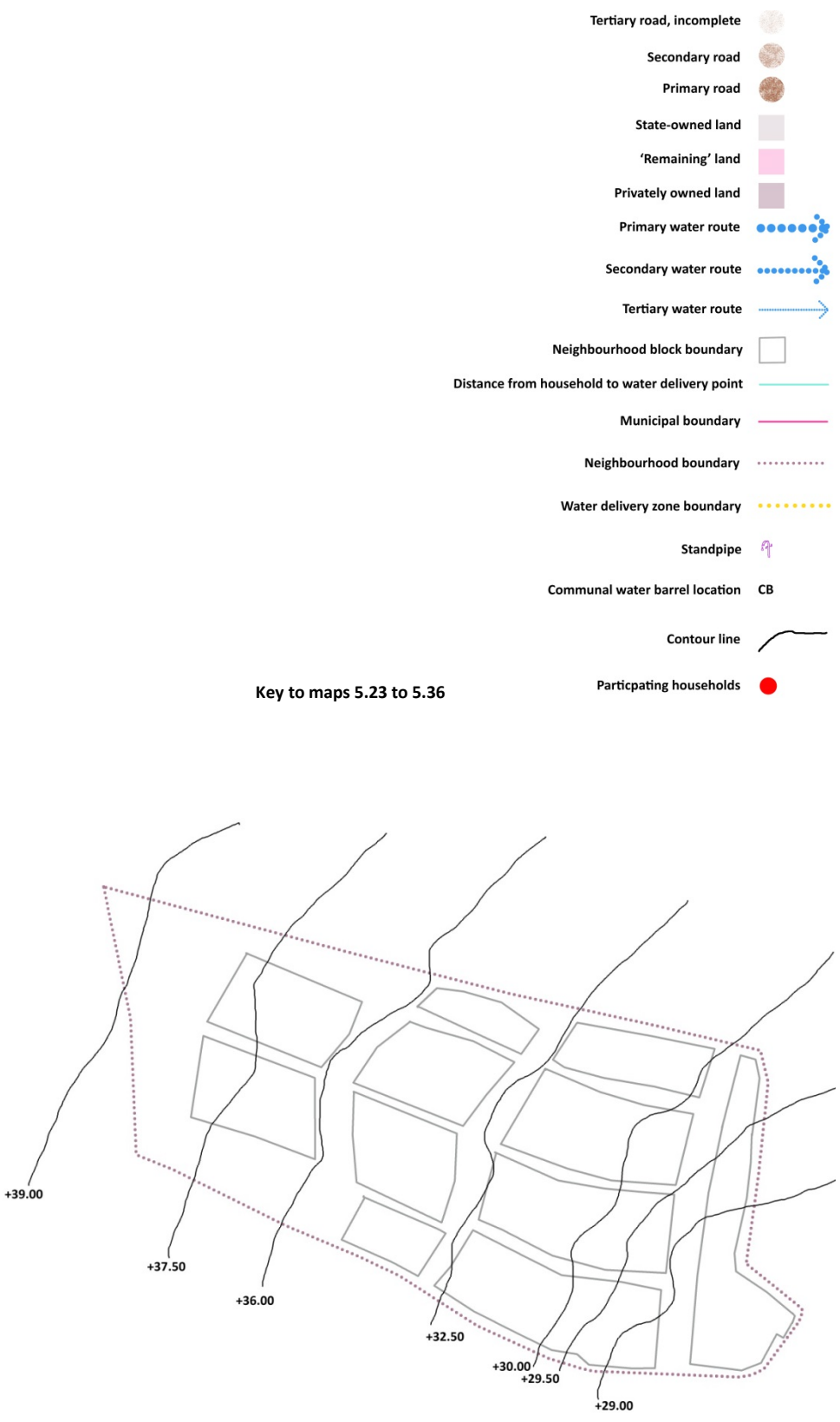
Figure 5.25: Security of access to water is further impacted by the proximity to water delivery routes. This map shows the water delivery routes serving Villa Sol.

Figure 5.26: For households not located directly along a water delivery route, access to water depends on the distance and relative location (uphill or downhill) from communal barrel locations (CB).

Figure 5.27: The presence or absence of stairs further impacts on how easily water is transported to households. The turquoise lines indicate relative distances from water delivery points to households.

Figure 5.28: Land ownership situation affects security of water supply in the long term as state-owned plots are more likely to have titling deeds awarded. This map shows that access to improved quality and better value water is available for few households in close proximity to a formalized neighbourhood (grey).

Figure 5.29: The combination of the above factors, in conjunction with the recent arrival of a standpipe in the neighbouring area (top left) result in three distinct water delivery zones (A, B, C) , each with highly variable factors affecting security of access to water.



Figures 5.30-5.36: Factors affecting security of water supply in Absalón Alarcón.

Figure 5.30: The blocks of neighbourhood no.2 stretch across an even steeper geography, with only those at the very bottom of the neighbourhood located on near-flat plots

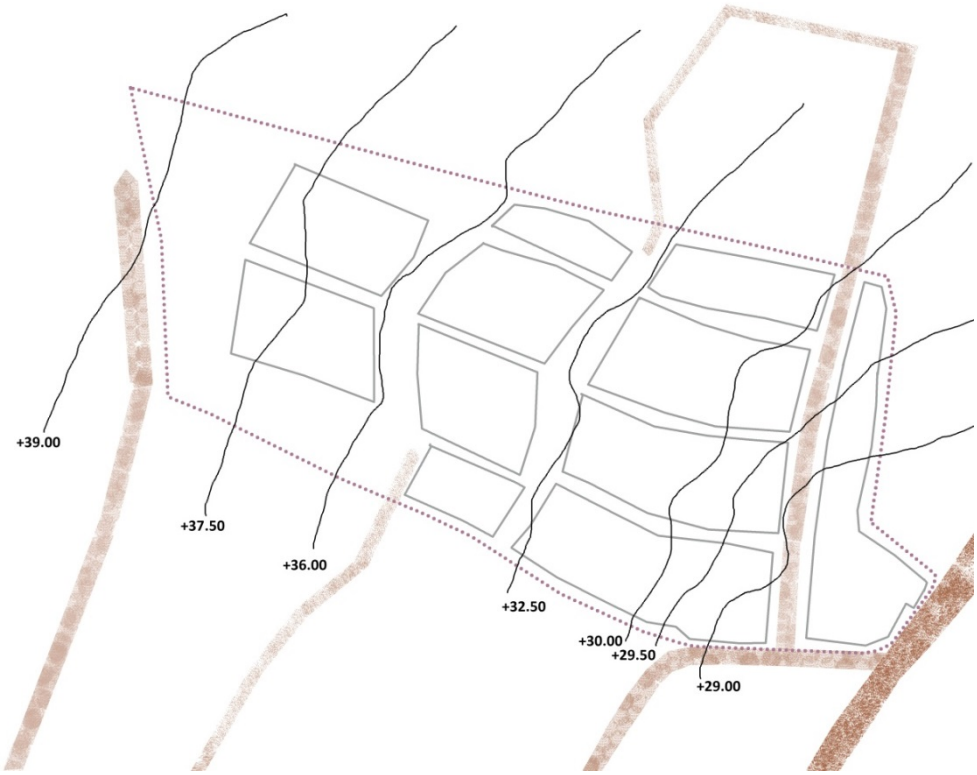


Figure 5.31: The existence, proximity, width, structural quality and completeness of roads affect water truck access.

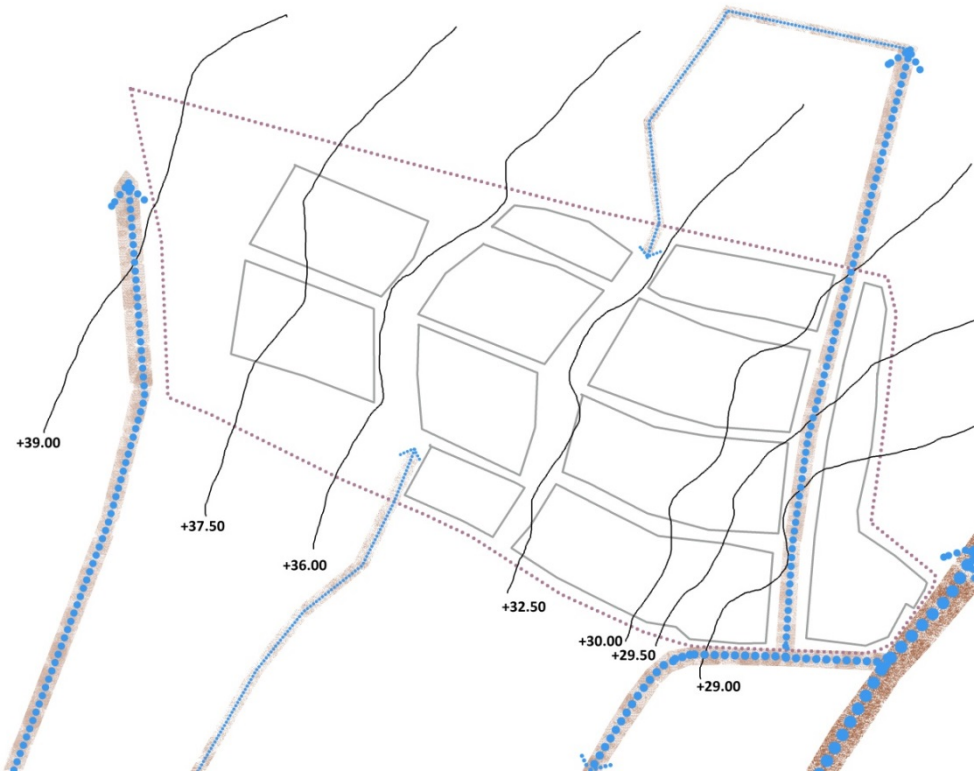


Figure 5.32: Security of access to water is further impacted by the proximity to water delivery routes. This map shows the water delivery routes serving Absalón Alarcón.

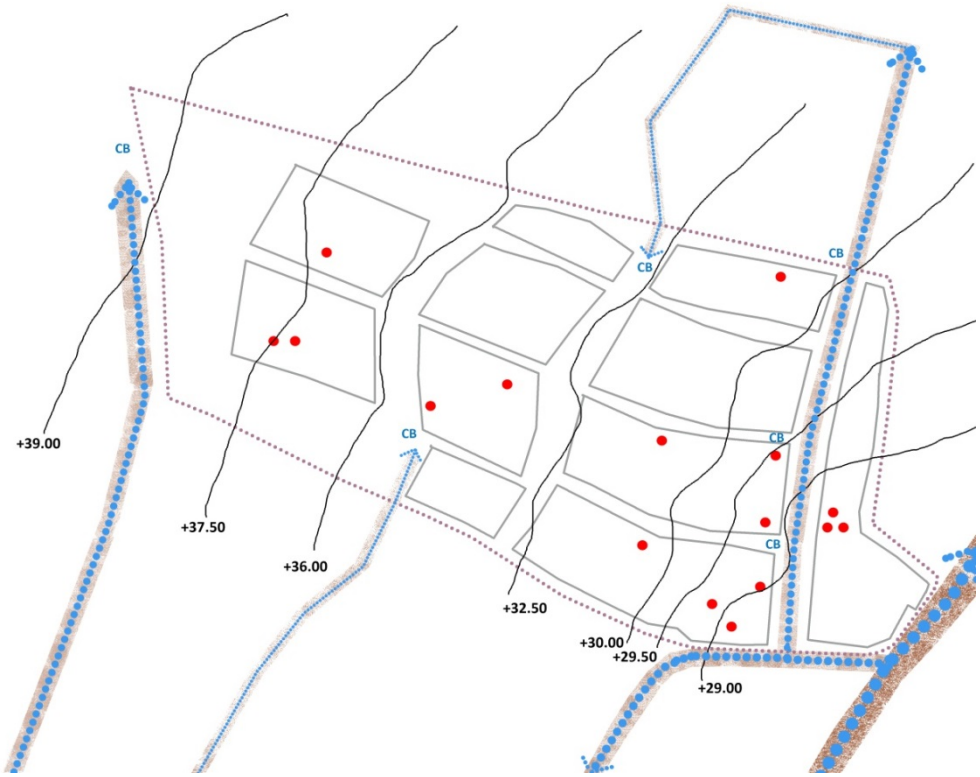


Figure 5.33: For households not located directly along a water delivery route, access to water depends on the distance and relative location (uphill or downhill) from communal barrel locations (CB).

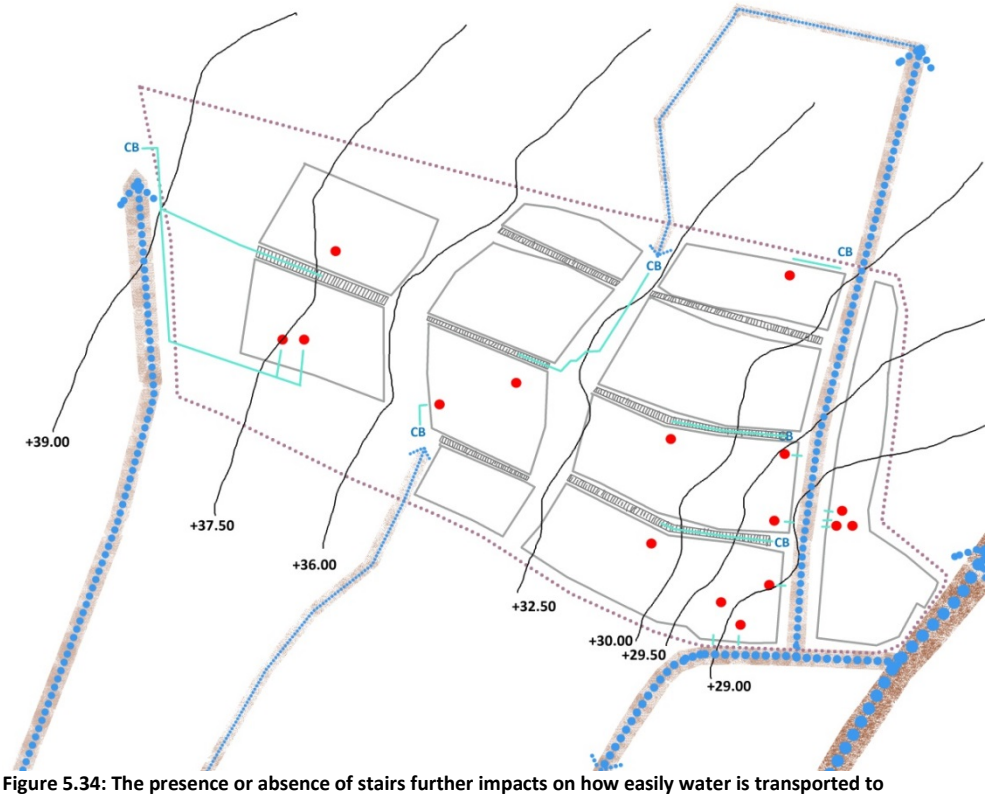


Figure 5.34: The presence or absence of stairs further impacts on how easily water is transported to households. The turquoise lines indicate relative distances from water delivery points to households.

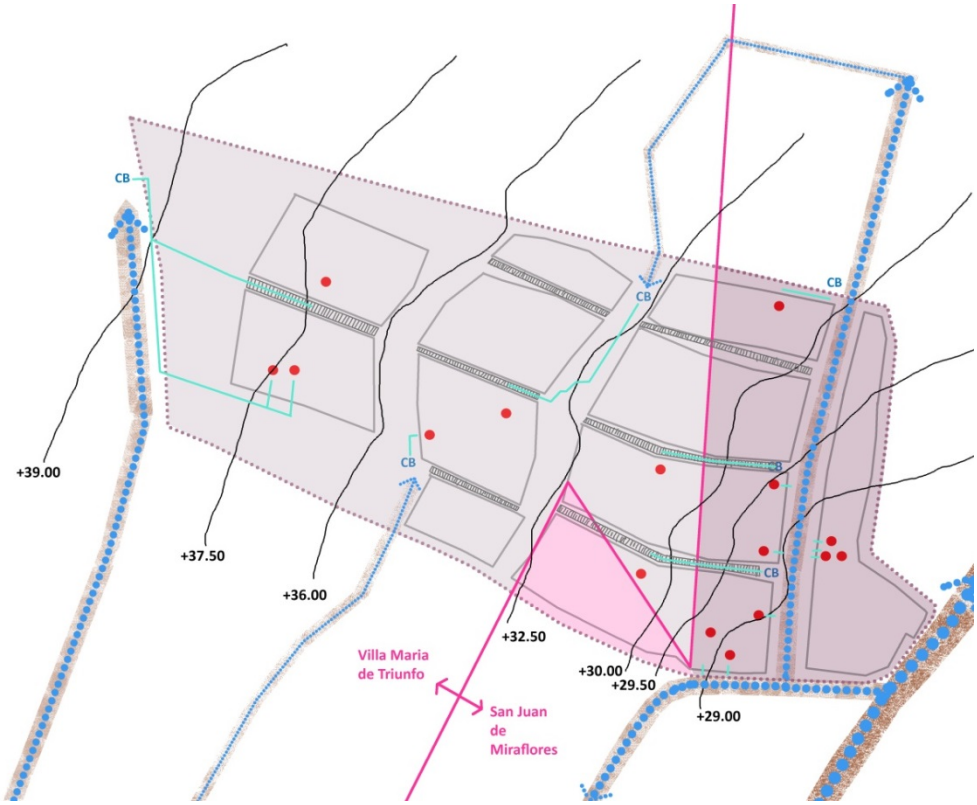


Figure 5.35: Land ownership situation affects security of water supply in the long term as state-owned plots are more likely to have titling deeds awarded. This map shows that titling negotiations are further complicated by the neighbourhood comprising three different land ownership scenarios and being located across two municipalities.

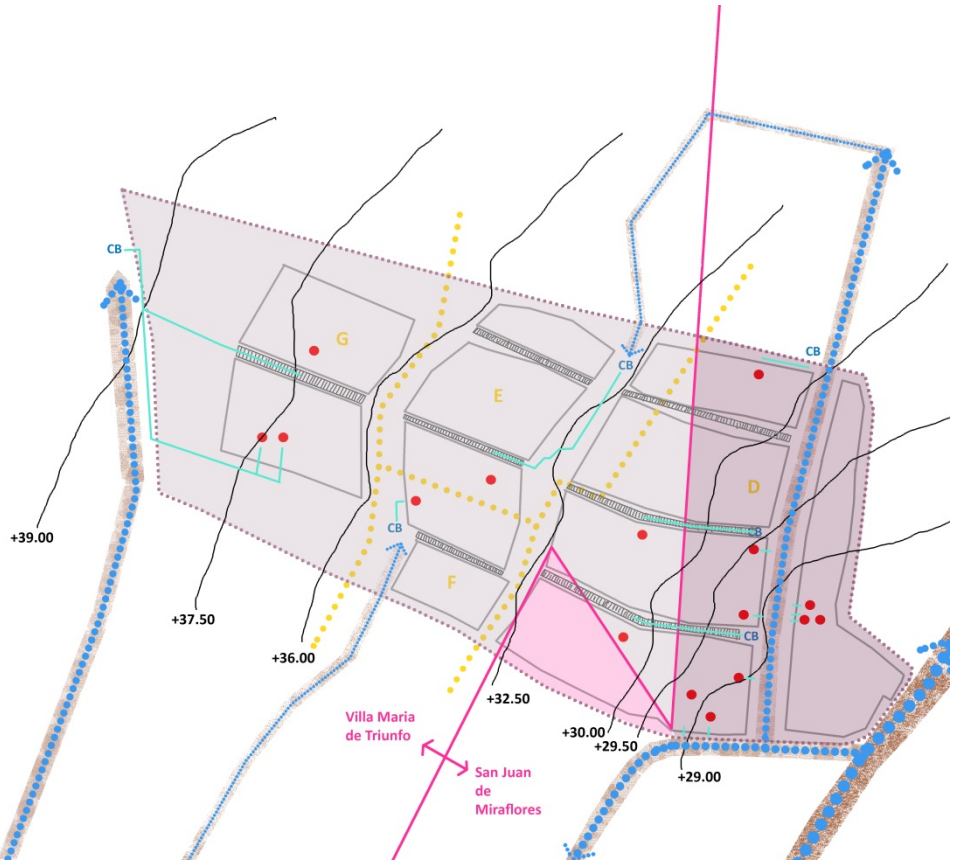


Figure 5.36: The combination of the above factors result in four distinct water delivery zones (D, E, F, G) , each with highly variable factors affecting security of access to water.

Effectiveness of neighbourhood representation

The issues described in relation to road construction illustrate that effective neighbourhood representation positively affects security of water supply. The better organised a neighbourhood is, the more likely it is to be able to address the obstacles associated with security of access to water through a range of practical and political pathways.

Villa Sol suffers from a large representative body of 9 members, which was widely reported to be ineffective, self-serving and corrupt. This had resulted in several attempts of land consolidation and infrastructure provision being blighted by theft and embezzlement of communal funds. The cumulative effect of this was reflected in the little-developed state of neighbourhood infrastructure, including inadequate access roads and communal facilities, and the lack of an established neighbourhood plan for the provision of basic services. Figures 5.37 to 5.39 illustrate.

Absalón Alarcón enjoys a highly effective and largely transparent single representative. Whilst not all infrastructure is fully established yet, the neighbourhood was very much on its way to establishing roads to reach as many households as the steep geography permits, and to achieving the legal status required for basic service provision. An endorsed neighbourhood plan for obtaining basic services, as well as other communal infrastructure and a range of public services evidence that effective neighbourhood representation can indirectly positively affect security of water supply. It was further seen that positives beget positives in relation to the challenge of securing water provision. The neighbourhood's exemplary progress had won it the right to house one of just 4 health centres in the settlement, which benefitted from relatively secure water supply through a large underground holding tank and municipal deliveries, which in times of crisis served as an emergency source of water for individual and community needs. Figures 5.40 to 5.45 illustrate.

Figure 5.37 to 5.39: A lack of infrastructure provision highlights ineffective neighbourhood representation.

Figure 5.37, top: Villa Sol's lack of plan for the provision of basic services (illustrated by the aerial photograph in absence of a drawn neighbourhood plan) highlights the ineffective service provided by the diverse body of neighbourhood representatives.
Figure 5.38, middle: A widespread lack of infrastructure provision is reflective of poorly organised neighbourhood representation, and indirectly impacts on security of water supply. The image shows a poorly constructed retaining walls that does not meet government requirements.
Figure 5.39, bottom: A community centre building site lies abandoned after accusations of corruption and self-serving by the neighbourhood's representatives.
Photographs: Researcher

Figures 5.40 and 5.41: In Absalón Alarcón, despite forbidding geography, good, albeit very slow, progress towards the provision of land titles and basic services was being made due to a very effective neighbourhood representative. This indirectly positively affects security of water supply.

Figure 5.40, above: The neighbourhood's steep geography stretches all the way to the top of the mountain. Photograph: Researcher

Figure 5.41, below: A plan for the provision of basic services has been established and submitted for approval.

Source: Neighbourhood representative

Figures 5.42 to 5.44: An effective neighbourhood representative ensures participation in communal works towards the construction of basic infrastructure to meet the government's requirements for the provision of land titles. These in turn pave the way for the provision of water and sanitation provision.

Figure 5.42(top) : Roads are chiselled out of solid rock in painstaking manual labour.

Figure 5.43 (bottom left): Retaining walls conforming to government construction standards are constructed from residents' funds

Figure 5.44, (bottom right): Concrete stairs and handrails mark most thoroughfares.

Photographs: Researcher

Figure 5.45: Public buildings bridge gaps in water supply in times of crisis.

The health centre's large underground water holding tank is filled by a municipal water truck. In times of crisis this serves as an emergency source of water for individual and community needs.

Photograph: Researcher

5.4.4 The impact of household location on security of water supply

As some neighbourhoods stretch from the flat central plains of the valley all the way to its hills' ridges, the location of an individual dwelling within its neighbourhood impacts on a household's security of water supply in a similar manner to that of the location of a neighbourhood within the settlement, with a range of additional factors impacting. At a physical level, the distance and relative location (uphill or downhill) from water delivery points impact (Figures 5.27 and 5.34 illustrate), resulting in the wide variety of water acquisition practices described above. In addition, date of arrival and length of residency affect security of water supply, as do a household's storage capacity.

Date of arrival and length of residency

The date of arrival within a neighbourhood affects how desirable and convenient a plot a household occupies. Earlier settlers have occupied more easily accessible plots at the bottom of the valley, and those arriving in more recent years have settled in less accessible plots further away from water delivery routes. Length of stay within a neighbourhood affects a household's chances of relocating to more conveniently located plots, as vacant plots are entered into draws for those who have paid their dues to the neighbourhood through a certain length of residency. The following quote illustrates:

'Yo estaba arriba, más arriba y ahí ya nos bajamos, nos bajaron acá abajo. Y así… Y ya, nos vinimos acá, ya todo. Y… ya pues, ya me… como yo hacía vivencia, vivencia arriba, entonces ya… acá abajo me bajaron, por lo que hacía vivencia, y aparte que mi… aparte que mi hijo el mayorcito se paraba cayendo… Jalábamos de arriba, bajábamos hasta acá abajo el agua. Mi esposo subía el agua…. acá abajo …. a cada rato el aguatero.'

'I was further up, and from there we came down, they took us down here. And so…..so we came here. […] As I had paid the (residency) dues further up….they took me down here […], and apart from that my…..my oldest son kept falling…..
We had to draw water from [where the truck arrives] up there, to here we had to bring the water down. My husband had to carry water up….[whereas] down here…..every few moments a water truck [passes].'

Absalón Alarcón resident

However, as more conveniently located plots at the bottom of the valley are privately owned, relocating to these plots improves water security in the short term, but makes resolution of titling provision much less likely, and therefore adversely affects security of water supply in the long term.

Additionally, a number of accidental circumstances of geographical, political and legal natures were observed to affect the security of access to water afforded by particular plots. Figures 5.46 to 5.48 illustrate how combinations of

neighbourhood conflict and remote dwelling location; geographical context and basic water delivery technology; and fragmented neighbourhood representation and lack of settlement-wide enforcement mechanisms can all adversely affect security of water supply.

Figures 5.46-5.48: Accidental circumstances impact negatively on security of water supply.

Figure 5.46: A resident's remote dwelling location high up in the neighbourhood locates her nearest water collection point in the adjacent neighbourhood. Inter-neighbourhood conflict requires her to move barrels and water in time-consuming hard labour along a rocky path to obtain daily water supplies.

Top: the route taken from her house to the water delivery point, seen in the distance.

Bottom: On the way back to her house (located beyond the road bend in the distance), she needs to carry barrels and water in buckets uphill along the rocky path.

Photographs: Researcher

Figure 5.47, top: A combination of geographical context and basic water delivery technology constrains a residents' ability to acquire water when needed. This participant can only buy water when the truck passes her house on the way up the hill, as on the way down, basic water delivery technology reliant on gravity means water can only be delivered on the way uphill (cf. section 4.4:'Recording and producing visual data' for further details).

Figure 5.48, bottom: Fragmented neighbourhood representation and lack of settlement-wide enforcement mechanisms adversely affect security of water supply. Efforts to clear this road and maintain access for water trucks by one neighbourhood were undermined overnight by an adjacent neighbourhood's resident, who constructed their pit latrine in the recently cleared road, making it difficult for the water truck to turn. The affected neighbourhood had no formal means of recourse to enforce their rights to the road.

Photographs: Researcher

Storage Capacity

In the absence of secure water supply from the municipal grid, households with more storage capacity are generally better able to ensure a secure supply as they can make plans for replenishing stocks while their barrels are still reasonably full, whilst lesser storage capacity makes households more reliant on the water truck arriving to fill their barrels as soon as they become empty. Households' storage capacity reflected frequency and reliability of water deliveries, making it a reliable third indicator for security of water supply.

People store water mainly in *tachos* (plastic barrels) of varying sizes and quality, as well as in a range of smaller containers holding water that is currently in use or waiting to be reused. Some have constructed brick or concrete holding tanks to store larger amounts, usually the equivalent of 5 large blue plastic barrels.

Whilst household storage capacity was seen to relate to frequency and reliability of water supply, and does affect security of water supply, storing large quantities of water can, dependent on the type and location of storage, negatively impact on other aspects of life, requiring a nuanced, case-by-case assessment of the impact of household storage capacity. A range of adverse effects arising from storing large quantities of water were observed among participating households. These include (1) water storage taking up valuable living space; (2) the negative impacts on water quality arising from storing water for long periods of time in sub-optimal conditions; (3) individual constraints arising out of the specific combination of a plot's location, geography, access point and relation to access road, which all dictate where and how much water can be stored.

The analysis of the impact of storage capacity on security of water supply shows that whilst there is a uniform need for storage capacity in order to minimize the risk of running out of water, a number of factors, many of which are largely outside a household's control, affect the individual storage capacity of different households and may have negative impacts on other aspects of life.

Figure 5.49: Common types of water storage containers

Clockwise from top left:
Typical blue plastic barrels in a communal location and smaller containers used to transport water.
Smaller plastic barrels outside a participants' house indicate frequent passing of water trucks.
A wide variety of smaller receptacles are used to hold water whilst in use.
Large brick and cement water storage tanks hold the equivalent of 5 blue plastic barrels

Photographs: Researcher

5.4.5 The impact of social relations on security of water supply

In the absence of formal social security networks, social relations constitute informal insurance networks and play a considerable role in bridging gaps in the supply of water, but having to engage in social negotiations for water may entail distress (Wutich and Ragsdale, 2008). Participants unanimously reported that social relations play an important role in securing water supply, as much in day-to-day interactions as in moments of crisis, and reported a range of adverse effects.

All residents relied upon different types of social relations in times of water crisis, which could be triggered either by money to buy water running out, or by frequent and unpredictable gaps in water delivery. Participants recounted how friends and neighbours 'can always be counted on to lend me a little bucket or two'; and told of their own efforts to help those who ran out, be that through giving away or selling small amounts of water.

'A veces me… a mí me deja cinco soles nomás para la comida, entonces yo tengo que ver agua, tengo que ver, cómo se llama, comida, a veces no tengo. Entonces, a mí me da la María, la vecina María, abajo, en la tienda, y me da fiado. Ella me fía, entonces yo mañana trabajo y le doy…'

'Some days…[my sister-in-law] only leaves me five soles for food, so I have to see where I get water from, I have to see about [getting] food, sometimes I don't have any. So Maria gives me, the neighbour from down there, who owns the shop, she lends me. She trusts me, tomorrow I'll work and repay her…'

Absalón Alarcón resident

Similarly, water crises were triggered by problematic social relations and negatively affected security of water supply. In one example, social conflict among neighbours led to reduced frequenting of water delivery points by those involved, severely constraining that household's ability to acquire water when needed.

Two reasons for the strong impact of social relations on security of water supply were identified. The length and intensity of long-established social relations on the one hand, and social relations with persons in power on the other hand were seen to particularly impact on security of water supply.

The majority of residents of La Nueva Rinconada had pre-existing social relations before moving to the zone. The first settlers tended to settle in groups with members of family, neighbours, and acquaintances. Those early settlers reported that social relations were crucial to survival, as a comprehensive lack of infrastructure and services, in combination with hostile geography, lack of law enforcement and frequent acts of violence from land owners made for fragile

existences. The strength derived from large numbers and strong social bonds allowed to defend this existence and eventually enabled permanent settlement. These type of social relations pre-dated settlers' arrival and were strengthened in the settlements' early times of intense crisis and hardship, highlighting why these relations are called upon in times of water-related or other crises.

Pre-existing social relations were also crucial in ensuring security of water supply to those who moved to the zone in the intervening years, once neighbourhoods were established. An informal system of existing residents vouching for newcomers establishes a mutual dependence between those already resident and those newly settling in a neighbourhood. When a new resident is accepted through this 'referee' system, they are under pressure to conform to the neighbourhood rules, whilst those who recommended their acceptance are under pressure to ensure that newcomers observe neighbourhood rules, creating a mutual dependency, which was seen to be played out along many lines, water exchanges among these.

Good relations with the neighbourhood representative were reported to affect security of water supply for some residents. The above-described draws for conveniently located plots were reported not to be solely accessible according to length of residency and luck in the draw. Implicit good relations with the neighbourhood representative were cited as favourable factors to steer outcomes in a plot draw, and can therefore implicitly affect security of water supply. Being in a comparatively more difficult situation than other residents was also stated to favour 'luck' in lottery draws, such as was the case for a single parent household with many children and especially precarious economic situation, whose daily routines were helped by 'winning' the right to move to a prime plot along the main water delivery route.

Figure 5.50: The role of social relations to security of water supply. Pre-existing social relations ensured survival and persistence at the time of invasion and in the face of severe constraints and attack, and continue to be drawn on in times of lacking security of water supply.

Life during the first year of the invasion was characterized by fragile shelter; hostile geography and lack of services and infrastructure, as well as violent clashes with land owners.

Photographs: Participants

Comparing the view from a participants' plot in 2001 (top); and the same view in 2012 (bottom) document the neighbourhood's and individual household's progress, partly made possible by pre-existing social relations.

Photographs: Participants

5.5 Conclusions: Water Scarcity in La Nueva Rinconada

This chapter has examined if water scarcity existed in La Nueva Rinconada in the Peruvian autumn of 2012, and found it to manifest along all three of its indicators of quantity, quality and security of access. Two broad but related themes emerged from the analysis of these indicators. They concern the observations (1) that a holistic conceptualisation of water scarcity requires nuanced definition beyond the notion of 'basic needs', and specifically, that a consideration of extending the notion of basic needs to include water for human wellbeing may be warranted; and (2) that the onus of addressing the effects of water scarcity appears to be almost exclusively on end users, whilst their means for doing so appear heavily constrained.

The need for nuanced definitions: Water for human wellbeing

Analysis of water scarcity along its indicators of quantity, quality and security of access suggests that the concept might benefit from more nuanced definition. The 'basic needs' literature (Gleick, 1996) advocates time- and context-specific definitions of water scarcity, although primarily through its fourth dimensions pertaining to perceptions. Here, the need for nuanced definition was observed in relation to other indicators of water scarcity, including its arguably most quantitative measure of water quantity, which gave rise to observations of different types of scarcity (ranging from 'absolute' to 'forced' and 'secondary') within the homogenous category of quantitative water availability. The need for a more nuanced definition of each of the concept's indicators seems particularly essential in a study focused on the experience of water scarcity, as the data from La Nueva Rinconada highlights that quantitative measures and experienced dimensions are inseparable. Paying closer attention to the underlying causes for quantitative water scarcity has here contributed some insight into the experience of water scarcity, such as the observation that a lack of water for food preparation, although quantitatively evident, did not result in insufficient amounts of food being consumed, but was attributed to a range of mutually perpetuating secondary effects of poverty.

More support for refining the 'basic needs' categories emerges in relation to the analysis of water quality, the provision of which is contingent on the observation of a series of chronological steps. The failure to implement the earlier, institutional steps observed in La Nueva Rinconada highlights that

recommendations for the safeguarding of water quality might need to emphasize the interdependence, and need for chronological compliance, of all stakeholders' responsibilities in achieving adequate water quality. Failure to do so was here shown to severely limit end users' ability to comply with their responsibilities for maintaining water quality.

The analysis of security of water supply indicators showed that this was very much subject to unpredictability, unreliability and sudden change, highlighting the need to conceive of this measure as subject to dynamic change, which at present is not explicit in its definition. The data from La Nueva Rinconada suggests that the indicator may be improved by recording changes over time as well as dynamic interaction with other forms of scarcity in areas of high poverty.

The data from La Nueva Rinconada therefore gives rise to the question whether the 'basic needs' literature is sufficiently inclusive in scope, and whether it ought to include water use for human well-being. The question is most strongly supported by the observation that despite quantitative water scarcity presenting in the three 'basic needs' categories, additional, albeit minimal, use of water for activities outside these categories was observed, with additional uses all pertaining to issues of human wellbeing. As participants went to considerable lengths to tolerate various disadvantages from storing water for such uses, it does not appear unreasonable to suggest that inclusion of the notion of water for human well-being may be warranted in the 'basic needs' concept.

Constrained action spaces

Residents of La Nueva Rinconada were seen to be almost exclusively responsible for the resolution of water and sanitation provision. Unpredictability, sudden change and high variability in the provision of water were seen to constrain residents' ability to meet the challenges arising from water scarcity. Constraints on the ability to respond appropriately were also evidenced by households' inconsistent addressing of poor water quality. The data suggests that this could on the one hand be due to the failure of institutional compliance described above, not only to provide good quality water, but also to comprehensively educate end users as to the best means of addressing poor water quality. Secondly, residents' accounts suggested that a lack of prioritization of water quality may be due to an overwhelmingly large array of daily and non-negotiable chores surrounding water.

In attempting to understand whether residents of La Nueva Rinconada had sufficient water of adequate quality when it was needed and regardless of their

status, the themes emerging from this chapter's analysis highlight two areas which require further attention.

On the one hand, the need for more nuanced definitions of the basic needs concept suggests that determining the relative importance of existing categories, and the potential need for an additional category pertaining to wellbeing, would aid a comprehensive understanding of the experience of urban water scarcity, and ultimately contribute to better assessment of the factors that enable or hinder resilience to the constraint.

The observation that the onus of addressing the effects of water scarcity lay largely on end users, in combination with the fact that the causes of water scarcity lay largely outside the control of residents, requires a more in-depth examination of what factors affect residents' ability to respond well, and ultimately to be resilient, to water scarcity. The following chapter aims to address these two areas by exploring perceptions of water scarcity and associated responses in greater detail.

Chapter 6:
Perceptions of water scarcity: A necessary evil?

6.1 Perceptions of water scarcity

This chapter's aim is to expand the understanding of urban water scarcity in La Nueva Rinconada, and to cast better light on residents' perceptions of the constraint, specifically in relation to subsequent responses.

The experience of urban water scarcity is gradually unravelled in this chapter by foregrounding perceptions of water scarcity by those who experience it; by examining how perceptions relate to responses to water scarcity; how social factors affect perceptions of and responses to water scarcity; and how the assessment of aspects of water scarcity as positive, negative or neutral relates to subsequent responses.

As perceptions are said to rely on the presence and awareness of an environmental stimulus, they occur at the intersection of people and their supporting environments (cf. section 2.2.1[29]), I now examine the range of environmental stimuli arising from water scarcity in relation to participants' perception of these. I first outline common perceptions of the water-scarce environment and then examine perceptions specifically related to the three water scarcity dimensions of quantity, quality and security of access. In doing so, I uncover correspondences as well as discrepancies and inconsistencies between perception and subsequent action.

6.1.1 Common perceptions of water scarcity

'Suffering from water'

The expression *sufriendo del agua* ('suffering from water') was identified as a key emotion which linked participants' experience of water scarcity to wider socio-political processes by Ennis-McMillan (2001) and Wutich (2006) in their respective Latin American study contexts, and by Sultana (2011) in a Bangladeshi context. Despite not having been explicitly asked about 'suffering', the expression was used frequently in La Nueva Rinconada as an umbrella term by which participants described the extent of their water-related distress on the one hand, and as a way of alluding to the key factors causing such suffering. In setting out the extent of their water-related suffering, participants would describe their water acquisition, storage, use, reuse and discarding strategies, and conclude by summarizing:

'You see, this is how we suffer from water.'

[29] I had in this context discussed the role of both perceptions and features of the environment, which can be enabling or disabling, in influencing responses.

More specifically, participants would describe problems relating to lack of space for storing water; various issues related to lack of sanitation; time, distance and physical effort involved in obtaining water; issues arising from insecure supply; water scarcity evoking past trauma; seasonal deterioration; and geographical differences causing different levels of suffering (Appendix B contains a selection of statements of suffering from water). At the opposite end of the scale, one participant expressed their perception of rights to water having arisen from prolonged suffering from water. Perceptions relating to 'suffering from water' were, with one notable exception, characterized by hardship, inequality and lack of security.

Feeling helpless in the face of water scarcity

Helplessness was the most frequently expressed sentiment when probed on specific aspects of the water situation. After having described a particular water-related problem, and asked about their thoughts on possible remedies, participants would express feelings of helplessness with the words of 'well, what can we do?'. Such helplessness was perceived as resulting from participants' lack of education, and in relation to the perceived higher levels of education of neighbourhood representatives. In particular the longer term and structural aspects of water scarcity were considered 'not for us to worry about, but for those in the know to resolve'. This was often prefaced with expressions suggesting a lack of qualifications to consider such problems, such as 'well, what do I know?', suggesting that some responsibility for addressing water scarcity had been relinquished.

Feeling resigned to the fate of water scarcity

Feelings of resignation spanned the spectrum of time from the arrival at the zone to an unspecified point in the future. Participants illustrated this with examples concerning the shock of drastic lifestyle changes after moving to the zone, followed by resignation as they gradually became accustomed to the water situation; or with expressions of hopelessness when contemplating the future of the water situation. Expressions such as 'you just have to adapt to whatever the situation is (was/ will be)' were used frequently, highlighting that resignation pervaded water-related experiences of the past, present and future.

More nuanced levels of resignation were expressed when considering the role of politics in creating or alleviating water scarcity, with politicians and stakeholders at the settlement level considered largely trustworthy in their efforts to address

the problem, albeit slow in advancing local interests. Municipal and national politicians, however, were unanimously reviled, and feelings of resignation, sometimes expressed as anger, were directed at governments of different eras. Few believed that the proclamations for improvement of the water situation, such as were made at regular public appearances of government representatives in the settlement, would ever come to fruition.

'Así va a pasar otro gobierno, otro gobierno y no hace nada. Pero así por campaña nomás vienen a ofrecer, "les vamos a ayudar…", pero después ya se olvidan. Hacen sus promesas, pero de ahí vamos a ver cuántos años va a pasar también. Todos los años pasa así. Casi nada va cambiar. No sé, bueno, yo pienso que casi nada. Estamos doce años ya. No tenemos luz, no tenemos agua. Ocampo te pone mil pretextos, "no, falta esto", "que no podemos", … ni qué la basura vienen a recoger, nada. Entonces…'

'And we'll have another government, and they'll do nothing. During the campaign they offer help, and after [they are elected] they forget all about it. They make their promises, and then we'll see how many years will pass. It's the same every year. Almost nothing will change. Well, at least I think so. It's been twelve years already. We don't have electricity, no water. [The mayor] Ocampo gives you a million excuses, "you are missing this", "well, we can't"….they don't even come to collect the rubbish, nothing. So…'

Villa Sol resident

Experiencing water scarcity is not 'normal'

Despite high levels of helplessness and resignation, the water scarce environment had not become completely commonplace to participants. Most perceived the water situation as 'not normal' and qualified this by comparing the water situation in their place of origin or previous residence favourably with the current situation. 'Normal' was the term used to describe situations where enough water of good quality water was available free of charge or at reasonable prices, implying that the current situation was not only 'not normal', but gave rise to much worry, whilst before people 'never had to worry about water'. Even those who grew up in similar circumstances as children would say that the situation now was 'more difficult', because they did not see a speedy resolution to it on the horizon. Aspects of time thus play a role in perceptions, as hopes had been higher in the past and were now starting to be disappointed. Similarly, when living in rented accommodation hopes were attached to things being better when a plot of land was occupied, and experiencing the protracted nature of obtaining services had resulted in hopes being disappointed.

Awareness of the lack of 'normality' in the water situation was displayed chiefly in relation to the dimensions of quality and security of access, but somewhat less so in relation to the dimension of quantity. All participants commented on the sub-standard quality of water available to them in the zone and extensively remarked on the lengths they needed to go to to ensure that they had water available when needed; neither of which was considered 'normal' or 'acceptable'. Despite consumed water quantities falling below the recommended minimum levels to meet 'basic needs' (cf. section 5.2), participants expressed few perceptions that this was not 'normal'. Instead they recounted a wide range of strategies employed to reduce water use as part of their daily routines.

Habit and familiarity affecting perceptions of the water situation

Habit and familiarity had changed perceptions of the water situation over time. Despite knowing of the lack of water infrastructure prior to their arrival in the zone, most recounted enormous shock and dismay at experiencing the difficulties arising from it on a daily basis and over time. Most used expressions such as 'it really hit us' or 'we were so shocked' to describe early impressions of dealing with water and sanitation related issues in the settlement. However, all expressed they had over time got used to this to some extent, evidenced by previously discussed expressions of resignation and helplessness, whilst emphasising their suffering. This change in perception over time can therefore not be interpreted as a general acceptance of the water situation, but more likely as a realization of the inevitable evils that come with the situation, while continuing to suffer from it.

Ultimately, all participants clearly expressed that they continued to endure the effects of the water scarce environment in the hope of being awarded land titles in future, which, in turn, would pave the way for the provision of basic services including water and sanitation. This resulted in participants moderating the effects of the water scarce situation when discussing them in relation to titling provision.

Awareness of the need to address water scarcity

Notwithstanding the moderating effects of resignation and familiarization, participants were highly aware of the need to address the problem of water scarcity. This perception related most acutely to the challenges that water scarcity presented on a daily basis, but manifested considerably less so in relation to structural and longer term dimensions of water scarcity. Interestingly, this awareness extended across all three dimensions of water scarcity – quantity, quality and security of access. Despite not recounting high perceptions of 'abnormality' in relation to the quantities of water consumed, participants nevertheless adjusted their behaviour to address this dimension of scarcity and recounted a range of strategies to reduce the quantity of water their household consumed. Less surprisingly, as aspects of poor water quality were more actively perceived; a range of actions available to improve the poor quality of water were also perceived. Equally, all participants perceived a need to address the lack of secure water supply, for example by buying more water than needed on a daily basis to bridge potential gaps in water delivery.

This overview of common perceptions of water scarcity highlights possible chasms between the presence of an aspect of water scarcity, and participants' perceptions of it, highlighting that the linear relationship suggested by perception theory (Allport, 1955; Epstein, 1967):

Stimulus + awareness = perception

may not manifest as such in La Nueva Rinconada. Feelings of resignation and helplessness, as well as processes of normalization to the water scarce environment appear to affect perceptions, and possibly consequent action. For example, the observed discrepancy between the considerable lack of sufficient water for 'basic needs', and relative lack of participants' perceptions of this constraint warrants further probing, especially in light of the observation that households employed a large range of strategies to address this. It appears that the above-described relation, in La Nueva Rinconada, may instead take the following form in relation to some aspects of water scarcity:

Stimulus + awareness ≠ perception

The following section therefore examines perceptions of each dimension of water scarcity in more detail to form a better understanding how participants perceive different aspects of scarcity and how such perceptions relate to subsequent responses.

6.1.2 Perceptions and observed presence of scarcity

The relationship between perceptions of and responses to an environmental stimulus is said to be linear and to some degree purposeful. A stimulus is said to have to be present, and perceived, for a response to follow (Allport, 1955; Epstein, 1967; Tuan, 1974), and responses are said to involve 'purposeful activity' (Tuan, 1974:4) and degrees of choice and influence:

Stimulus + Perception = Response

The foregone documentation of common perceptions of water scarcity has cast some doubt on such linearity, suggesting that perceptions may occur even where participants are not knowingly aware of an aspect of water scarcity; and that responses may be deployed, even when an aspect of water scarcity is not consciously perceived.

This suggests that the relationship between an aspect of water scarcity, participants' awareness of it, associated perceptions and subsequent responses may be subject to nuance and varying quality, or may not manifest at all in La Nueva Rinconada. Unravelling such variability and nuance will be helpful towards understanding why some aspects of water scarcity are managed relatively well, whilst others are not addressed by participants, and ultimately, how perceptions contribute to resilience to water scarcity.

Balanced pairings

Balanced pairings of perceptions and responses were observed across all three dimensions of water scarcity, in 10 out of the 17 sub-categories examined (cf. Appendix C), revealing instances combining low levels of perception with low levels of responses, as well as high levels of perceptions with high levels of responses, showing that in just over half of the dimension that constitute water scarcity according to the 'basic needs' literature, responses are in line with perceptions.

<u>Balanced pairings: Low levels of perception coupled with low levels of responses</u>

In 6 of the 17 indicators of water scarcity, low levels of perception were followed by low levels of responses. These are instances where an aspect of water scarcity is not sufficiently perceived to trigger a response. This was observed across all three aspects of water scarcity (cf. Appendix C), but cannot be interpreted as adequate dealing with water scarcity. For example, incomplete perceptions of the full range of issues affecting poor water quality led to very limited responses to address water quality. A number of reasons contribute to such widespread low

awareness of a broad range of aspects of water scarcity. On the one hand, some issues, such as lacking water for food preparation, occur frequently, but are relatively easily remedied, and as a result do not register as particular bottlenecks in people's dealings with water. Others, such as the lack of perceptions of non-visible aspects of water quality, are indicative of a range of institutional failings, not only in the ultimate failure to provide safe drinking water, but also of the lack of comprehensive and coordinated education about the dangers of poor quality water. Lastly, as obtaining a plot anywhere in the settlement and working towards titling provision constitutes the ultimate aim of residency in the settlement, it is perhaps no surprise that the location of a dwelling or neighbourhood are not strongly perceived as impacting on water security. As a result, low perceptions of varied aspects of water scarcity coupled with low levels of responses are indicative of a range of constraints that affect decision-making and action in relation to water. It further shows the mediating effect that titling provision has on perceptions of water scarcity.

Balanced pairings: High levels of perceptions coupled with high levels of responses

In 4 of 17 indicators of water scarcity, high levels of perception were followed by high levels of responses, suggesting that some aspects of water scarcity are comprehensively perceived and appropriate responses deployed. However, this is confined to aspects of water quantity and security of access, with problems related to water quality not entailing high levels of perceptions or responses (cf. Appendix C).

I provide several readings of this. First and foremost, as poor water quality is not always visible to the naked eye, and its effects are slow to materialise, these issues are rarely brought into acute focus; both of which may explain the lack of perceptions of this particular constraint. Secondly, three dimensions related to the security of access to water are strongly perceived, and engender a large range of responses. This indicates the precarious nature of water provision and the vital role of water to daily survival, which keeps the challenge of obtaining water when needed, and the potentially disastrous consequences of failing to do so very much at the forefront of people's mind.

Lastly, high levels of perceptions of lacking sufficient water for 'other' purposes highlight not only, as suggested in chapter 5, the importance of water for human wellbeing. As is more practically evidenced here, such high perceptions are also a function of the precariousness of water supply, the severe difficulties of

discarding water, and the high cost of purchasing water, making multiple reuse of water a necessity. These are further indices of the severely constrained decision-making and action spaces participants occupy in their dealings with water. In summary, high levels of perceptions coupled with a large array of responses, rather than signifying successful responding to water scarcity, highlight water's vital role to daily survival and provide further evidence of severely constrained deliberation, decision-making and action spaces.

Discrepancies

Discrepancies between the range and extent of participants' perceptions and associated responses were observed only in relation to the amount of water available to meet basic needs (cf. Appendix C). Of the three instances observed, two showed very low levels of perceptions of the constraint, coupled with high levels of responses (drinking water and water for personal hygiene); and one showed the opposite: high levels of perceptions coupled with low levels of responses (water cost).

Discrepancies: Low levels of perceptions coupled with high levels of responses

Notable discrepancies between low levels of perceptions and high levels of responses were observed in relation to lacking drinking water and water for personal hygiene. In the case of drinking water, I had in chapter 5 shown that water scarcity in this category is not so much caused by absolute lack of water (or lack of funds to purchase water) itself, but that it arises as the result of external pressures relating to poor water quality and inadequate sanitation systems, both of which were seen to reduce consumption (cf. section 5.2.1: 'Lacking sufficient drinking water').

Participants recounted the constraints of lacking and strategies for saving drinking water in a matter-of-fact manner and among the normal daily chores of a household. None of the participants offered a negative account of their drinking water habits, no one referred to these causing particular problems in the household or negatively impacting on livelihoods. Equally, none of the participants mentioned long- or short term health risks or problems arising from under-consumption of drinking water. Being without water between meals was very much the status quo, and seeing participants drink, either in public or in the home, between meals, was very uncommon.

Non-existent perceptions of drinking water scarcity are here in stark contrast to the considerable scarcity observed in the quantitative measure, and, coupled with high levels of responses, are indicative of processes of normalization having taken place, whereby lacking sufficient drinking water had ceased to be perceived as extraordinary and had been amalgamated into the practices of daily life.

Similar effects of normalization were observed in relation to the lack of water for personal hygiene, although the underlying causes and processes differ slightly. I had discussed in chapter 5 (section 5.2.1: 'Lacking Water for Personal Hygiene')

how differential intra-household allocation of water was employed to reduce water use for personal hygiene, with women consistently the victims of this practice. Although women participants recounted their own choice of showering and washing less frequently in a non-complaining and matter-of-fact manner, this is indicative of similar processes of normalisation having taken place whereby the persistent lack of water for personal hygiene had resulted in the needs of the earning male of the household and the wellbeing of children at school being prioritized in the allocation of water. One could relate this to the traditional role assignment in families, but this would be simplistic. Women in La Nueva Rinconada do work outside the home if this can be combined with meeting the needs of the family. The settlement's remote location and the need for a family member to attend to children means, however, that many women are unable to travel to work. Local employment opportunities are increasingly offered and indeed very much part of the positive political rhetoric surrounding the settlement, but because of a failure to coordinate employment offers with the need of obtaining other services, such as water, women continue to be denied the opportunity to take up employment as unpredictable water delivery schedules force them to wait at home. Through not having any outside engagements, they remain the 'least deserving' family member as far as water consumption for personal hygiene is concerned. Here, processes of normalization interact with the effects of multiple scarcities (lack of water and lack of suitable local employment) in perpetuating chasms between perceptions of and responses to water scarcity.

Discrepancies: High levels of perceptions and low levels of responses

In a reverse situation, a discrepancy between high levels of perceptions and an almost complete lack of responses was observed in relation to the cost of water. Some, although not all, participants were aware of the relatively higher costs of water delivered by truck, compared to that available from the grid. Those who had previously bought from the truck and were now able to buy from the grid were most acutely aware of cost differences. All reported that the cost of water was very high, and a considerable weekly outgoing, especially when compared to the cost of electricity. No one reported any awareness of the underlying structural causes of the high cost of truck water compared to grid water, which is a well-documented phenomenon in informal settlements anywhere (WHO/ Unicef, 2000; OPS/OMS, 2001). The complete lack of response to this perception of cost issues can only be read as one of the most extreme examples of the highly constrained action space that participants occupy: residents of La Nueva

Rinconada have no choice whatsoever to influence water prices and are entirely at the mercy of trucked water supply. This was further evidenced by participants' willingness to 'pay' for 'free' water of superior quality, which was delivered once a week by the municipality. Participants readily agreed to bribe the driver to obtain water of better quality which 'cost' only a fraction of the price of the inferior quality truck water. High levels of perceptions reflect the serious impact of high water costs, and are correctly perceived as such by participants. The associated absence of responses highlights the complete lack of opportunities for addressing the issue.

Mixed pairings

A number of what I have termed 'mixed pairings' were observed in relation to aspects of water quantity (1 instance) and water quality (3 instances), although none in relation to perceptions of the security of access to water (cf. Appendix C). These 'mixed pairings' take two forms: (a) high perceptions of a constraint led to both very high and non-existing levels of responses by different participants; and (b) incomplete perceptions of a constraint lead to ill-matched responses.

The first form of mixed pairing is exemplified by perceptions of and responses to the lack of sufficient water for sanitation needs. The issue of sanitation was shown to be the single most consistently perceived constraint of the water-scarce environment across all participants (cf section 5.2.1: 'Lacking sufficient water for sanitation'). Most participants were highly aware of the dead-end that their private sanitation arrangements would eventually lead to and spoke at length of the dangers to health, excessive resource requirements of working around the constraint, and general desperation felt in relation to the lack of sanitation in the settlement. Yet this provoked two very different kinds of responses. Some reported the problem as being entirely out of their own hands, and despite many of these not expressing great faith in political efforts to resolve the situation and being aware that in the case of failure to provide such solutions, the ill effects would have to be borne entirely by them, these participants nevertheless stated that this was an issue to be resolved by others. The opposite view of being solely responsible for the resolution to the problem was expressed by others whose response involved, for example, the drastic measure of pursuing the illegal connection of a privately funded sewer to the municipal sewer in the main road of the settlement.

The most likely explanation for this discrepancy of responses to the same perception, apart from individual differences, lies in the different levels of neighbourhood representation. Those with effective and transparent representatives responded by not implementing any measures to reduce the load on their on-plot sanitation and delegation of the problem. Those who had experienced long-standing failure and corruption in their neighbourhood representatives and had seen the community split into warring factions had taken matters into their own hand and adopted high risk strategies. High levels of perception of a constraint engendering both very low and very high levels of responses amongst different participants arise here from inconsistent political

representation across the settlement, whereby long-standing experiences of good or poor neighbourhood representation lead to very different responses, neither of which is necessarily successful in addressing the constraint.

The other instances of a mixed pairing concern situations where a multi-faceted dimension of water scarcity, such as for example drinking water quality or 'free', good quality municipal water, was incompletely perceived, and where responses did not necessarily match the precise aspect of water scarcity that was perceived. For example, drinking water quality can be observed along physical, chemical and microbial indicators, but participants tended to associate poor water quality only with physical appearance and smell. As a result of this incomplete perception of the problem, participants treated poor quality water by a range of means, which were chosen according to inconsistently supplied information and individual economic means, but which did not necessarily address the aspect of water quality they were aware of. In a reverse example, the high-quality, 'free' water available weekly to some households was perceived as 'suspicious' by some due to being 'free' of cost, resulting in refusal to receive this water, with some residents preferring to use water of worse quality at a higher cost instead. Here, good quality, 'free' water had become mythicized to prevent its use. Table 6.1 illustrates.

Ill-matched responses to a partially perceived aspect of water scarcity				
Safe drinking water quality	**Drinking water quality in La Nueva Rinconada**	**Perceptions of water quality**	**Responses to poor water quality**	**Result**
'Does not represent any significant risk to health over a lifetime of consumption' **WHO, 2011:1**	'Compromised according to physical, chemical and microbial indicators' **Pebal La Inmaculada, 2010a**	Relate to physical and olfactory perceptions only. **Source: Residents' accounts**	Variable practices of chemical and heat treatment. **Source: Residents' accounts/ observation**	Ill-matched responses to a partially perceived problem fail to comprehensively address poor water quality and create further vulnerabilities through a false sense of security.

Table 6.1: Ill-matched responses to a partially perceived aspect of water scarcity

Incomplete perceptions of a multi-facted problem result in partial, and ill-matched responses which not only fail to address the problem's immediate or longer term effects, but create additional vulnerability as decisions taken and responses deployed use valuable resources and give a false sense of security which prevents further and necessary addressing of the problem.

Where partial perceptions of a constraint are met with ill-matching responses, haphazard and inconsistent education campaigns may be blamed in their failing to address participants' economic reality, or to fully educate about water quality; giving rise to negative consequences which are possibly only felt in the longer term.

The examination of how perceptions of water scarcity relate to subsequent responses has highlighted that across the different types of 'pairings' observed, both perceptions and responses are characterized by constraints on residents' deliberation, decision-making and action spaces. The analysis also highlights the non-substitutable and vital nature of water and the effects of normalization processes on both perceptions and responses. The mutual effects of multiple scarcities were seen to perpetuate chasms between perceptions of and responses to water scarcity. Lastly, issues of community organization and neighbourhood representation were seen to impact, as were processes of 'mythicization' surrounding the municipal 'free' water.

To better understand what constitutes residents' constraints on deliberation, decision-making and responses, how normalization to water scarcity unfolds, how

good quality water has become mythicized to prevent its use, and what role community organization and neighbourhood representation play in affecting perceptions of and responses to water scarcity, I now examine the role of social factors on perceptions in more detail, with a view to better understanding the processes that impact on the most precarious and arguably most dangerous interactions around water scarcity.

6.2 Social Factors affecting Perceptions

Two recurring observations during field work - varying levels of trust in neighbourhood representatives; and differing perceptions of the same aspects of water scarcity by different groups were confirmed in the previous section, suggesting that social processes play a role in the perception of, and in responses to the water scarce environment. In its aim to uncover how social factors affect perceptions, this section examines the notion of perceptive peer pressure (Tajfel, 1969) – an individual falling in line with the opinions of their wider social group – and how this impacts on perceptions of water scarcity in La Nueva Rinconada.

Data was examined both inductively and deductively, with deductive analysis guided by a model setting out relationships between perceptive peer pressure, a group's trustworthiness, cohesion, size and competence, as derived from literature and illustrated in figure 6.1. I examine the model from the bottom up, examining group cohesion, size and competence before showing how these impact on perceptions of trustworthiness of the group. Lastly, I show how different perceptions of trustworthiness impact on perceptions of the water situation.

A person's social group of course varies in scale, make-up and over time. For the purpose of analysis, I assumed that each participant is part of social groups at five distinct, yet dynamic and overlapping scales; (1) their own household; (2) their close social group of local friends and family; (3) the wider neighbourhood; (4) the settlement as a whole; and (5) their place of origin. Participants will of course be part of a number of other social groups, and the make-up and influence of each will vary over time, but these five are focused on here as the data showed them to influence perception of the water-related environment.

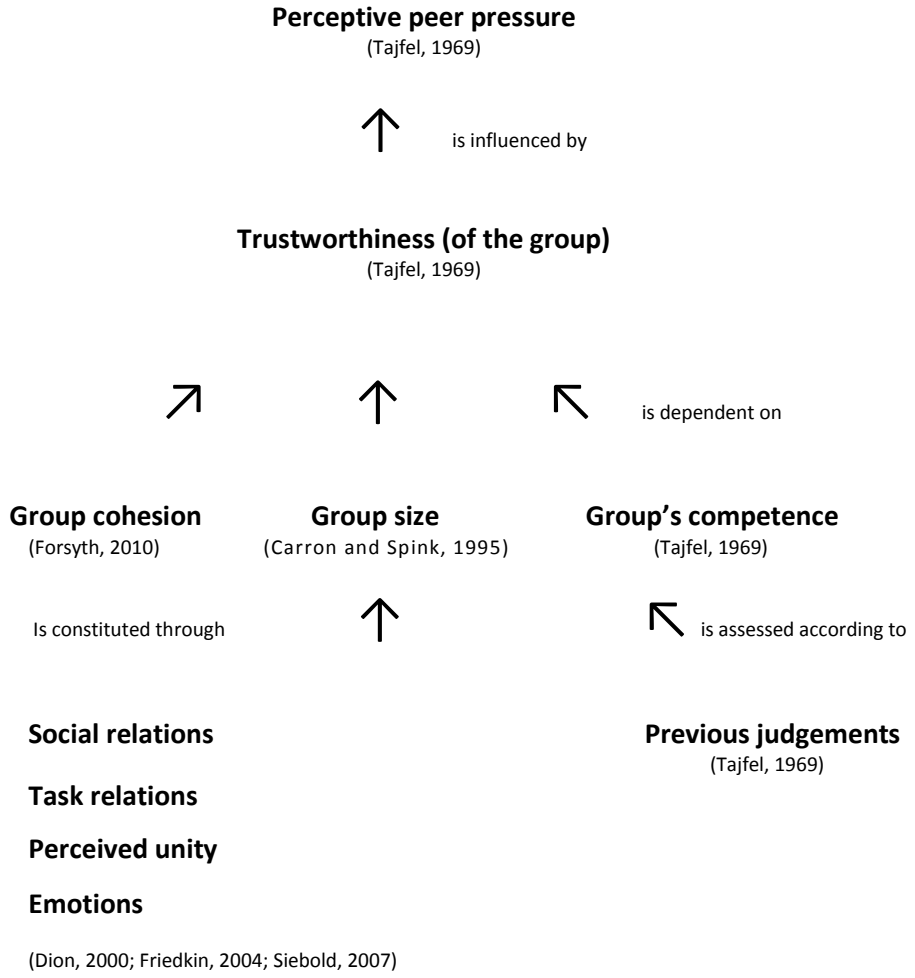


Figure 6.1: The effect of social relations on perceptions

This can be examined using the concept of perceptive peer pressure (Tajfel, 1969), which can lead a person to mis-perceive parts of their environment in order to fall in line with the (potentially erroneous) perceptions of the wider group. The extent to which this occurs is influenced by how trustworthy a person considers their group to be, which in turn is dependent on its cohesion, size and competence (*ibid*). Group cohesion (Forsyth, 2010) derives from a combination of social relations, task relations, perceived unity and emotions (Dion, 2000; Friedkin, 2004; Siebold, 2007). Competence is assessed depending on how correctly the group has judged situations in the past (Tajfel, 1969).

6.2.1 Group cohesion

A group is said to be cohesive when its members possess bonds linking them to one another and to the group as a whole. These links can take a variety of forms and serve multiple purposes, making cohesion a multi-factored process, with no 'typical trait' nor 'single theory' of a cohesive group having been defined (Forsyth, 2010:119). I focus here on four characteristics observed in the study population - social relations, task relations, perceived unity, and emotions – all of which have been shown to maintain cohesion in a group (Dion, 2000; Friedkin, 2004; Siebold, 2007).

Social relations

The importance of social relations for dealing with water scarcity has already been touched on in chapter 5 (cf. section 5.4.6). Three features of social relations stood out in La Nueva Rinconada and are here discussed in the context of their impact on group cohesion: heightened interdependence of individual households arising from economic and political precariousness; differing degrees of willingness to cooperate with the wider social group; and the distancing of individual opinions from group goals.

Whilst a certain degree of mutual dependence is typical of social relations anywhere, a heightened interweaving of lives and mutual interdependence arises out of shared hardship and the relative remoteness and isolation of the settlement, and can be seen to affect perceptions of water scarcity in La Nueva Rinconada. For example, houses are often constructed 'borrowing' a neighbour's wall, requiring extended negotiation and agreement and continuing good neighbourly relationships. Dependencies created along fundamental aspects of life, such as shelter, affect how participating parties view each other. As a result, the extent to which a household's livelihood is intertwined with that of its wider group affects how much weight is given to the group's opinion.

Figure 6.2: Mutual dependencies created along basic aspects of life, such as shelter, affect perceptions

A participant's home is constructed 'borrowing' the wall of a neighbour's dwelling. The process is contingent upon successful negotiation and agreement, as well as continued good relations, which influence how parties view each other and what weight they afford each other's opinion.

Within this context of mutual dependence, participants in Villa Sol showed limited willingness to cooperate. Cooperation was observed at the household and friends and family levels only, but described in negative terms or as non-existent at the larger scales of the neighbourhood and settlement, as the first quote below illustrates. In Absalón Alarcón, the influence of the household and local family and friends was described in stronger terms, and positive feelings at the neighbourhood level were also expressed. Yet qualifications and limitations to such support were voiced in private. For example, participants were largely supportive of the representative's efforts towards communal infrastructure provision and educational campaigns, but would differentiate detailed aspects of this in private, whilst at the same time emphasising their support for the neighbourhood community and its goals. This differentiation of opinions voiced in public and private, whilst also perhaps typical of human nature, also suggests that cooperation was not entirely voluntary, as the second quote illustrates.

'Nosotros cuando vinimos aquí a vivir ahí recién empezamos a organizarnos para hacer escaleras… Solamente los que vivimos aquí nada más, los demás no querían pues, decían "¡ay!, si yo no camino por ahí", así. Y ahora todos caminan por ahí. Los otros pasan pero a veces no quieren, dicen "¡no!, los que viven ahí que lo hagan". Y así no debería ser, ¿no?, todos deberían apoyar y… Esta escalerita la hizo mi esposo, la vecina del frente y una vecina, tres nada más.'

'When we first settled here, we began to get organized to construct stairs…only those of us who live here [in this block],the others didn't want to [participate], they said "Ah! But I don't walk along there!". And now they all walk along there. The others use the stairs, but sometimes they don't want to [help], they say "No! Those who live there should do it!". That's not how it should be, should it? Everyone should help and…This stair was built by my husband, the neighbour opposite and another neighbour, just three [of us].'

Villa Sol resident

'Éramos unidos. Hasta ahora son unidos. O sea, si querían tocar un asentamiento salían todito los… son ciento veinte asentamientos, si tocaban a un asentamiento salían todos obligatorios a apoyar. Si tenían problema algún asentamiento, venían a pedir apoyo. Y de acá teníamos que salir obligatorio, y si otro problema otro sector tenía, también teníamos que salir.'

'We were united. Even now [the neighbourhoods] are. Or rather, if they wanted to touch one neighbourhood, [we] all came out [to defend it] … there are 120 neighbourhoods, if they touched one, all the other ones were obliged to come out and help. If any neighbourhood had a problem, they came to ask for help. And ever since then, we've been obliged to come and help, if another area had a problem, we also had to help.'

Absalón Alarcón resident

Where social ties are based largely on individual relationships, such as in neighbourhood 1, this makes for a more fragile social group than contexts where willingness to cooperate extended across social scales and transcends individual personalities (Forsyth, 2010:119), as seen in Absalón Alarcón. The latter is said to produce more stable social groups, as individuals have an interest to remain in the group even when others leave (Mobley et al, 1979; Forsyth, 2004:119).

Task relations

Willingness to cooperate with the wider group, whilst making for more stable ties than individual relationships alone, does not necessarily make for a stable social network over time. More cohesive groups yet are achieved where people feel committed to specific shared tasks, and believe they have joint abilities as a group for achieving those (Bandura, 1997:476; Forsyth, 2010:120). Key to this is that beliefs must be shared by the majority of the group, and its members must possess a sense of interdependence of individuals' contributions and shared resources (Zaccaro et al, 1995; quoted in Forsyth, 2010:120).

A history of communal failure to progress the neighbourhood's aim of titling provision had resulted in a strong sense of resignation and disbelief in the ability of the wider group to achieve communal aims in Villa Sol. Resignation and disbelief were voiced in two distinct manners; either as quietly evasive resignation and withdrawal; or as outspoken anger and disbelief, with both groups of respondents readily admitting their own reluctance to participate towards communal tasks and displaying high levels of individualization in attempts to address the challenges of the water scarce environment.

In Absalón Alarcón, on the other hand, task relations were both reported and observed to contribute to the group's cohesiveness, albeit with several qualifications. Whilst participants would express and show their support for communal tasks by participating in events, attending compulsory weekly work sessions, or by lending personal belongings to group events, as highlighted by the first quote below; they expressed reservations and qualifications of their elected representatives in private, as highlighted by the second quote below. As participation in communal work sessions was enforced by the neighbourhood representative by threat of a costly fine, this suggests that beliefs in a joint ability to achieve goals did not arise solely from within the group, but were in part externally imposed. Residents also lacked a sense of interdependence of individual contributions and resources.

'Yo sí colaboro cuando hay cualquier cosita acá. Ahí tengo mi cámara, les presto también para que tomen foto. Yo tengo acá encargado el botiquín de la manzana. En mi manzana me encargan los botiquines de todos. Lo tengo organizado. Encargada. O sea, en cada manzana hay dos botiquines, uno lo tengo yo con extintor.'

'I always collaborate whenever they need something. I have my camera, which I lend them to take photos [of events]. I'm also in charge of the pharmacy for my block. And they put me in charge of everyone else's pharmacies. I have it all organized. I'm in charge. Or rather, every block has two pharmacies, and I am in charge of the one with the fire extinguisher.

Absalón Alarcón resident

'Es que depende del dirigente también que tiene que caminar. Parece que el dirigente no camina creo, creo, ah; no sé cuál será el motivo del que no llega agua. Porque acá el cerro[30] ya debe tener agüita, ¿sí o no?. Pero no. El dirigente tiene que caminar, hablar. No sé en qué trabajará. Nos viene, nos cuenta sus historias, nos trae una cosita otra cosita, hay personas que no creemos, hay personas que están creyendo. Realmente no sabemos en qué está caminando la señora.'

'It also depends on the representative, and to what extent they apply themselves. It seems that this one doesn't do that; whatever the reason may be why we still don't have water. Because here in the settlement we should already have water, should we or shouldn't we? But no. The representative needs to apply themselves, negotiate. Who knows what she is working on. She comes, tells her stories, brings us this thing and that, some of us don't believe [in her], others do. We really don't know what the representative is working for.'

Absalón Alarcón resident

[30] 'Cerro' literally translates as hill, but is exchangeably used to refer to informal settlements in Lima, as many are located on the city's hills.

Perceived unity

The previously examined features of group cohesion have focused inward. The notion of 'perceived unity' refers to how groups are perceived from within and without, with groups said to be more cohesive when they are perceived as highly unified by outsiders, as well as by members expressing a sense of belonging and commitment, loyalty and identification with the group. Such unity is often expressed through the use of communal pronouns and the refusal to differentiate between members of the group (Forsyth, 2010:120-1).

In both neighbourhoods, there was limited evidence of perceived unity of the group. Outsiders readily identified a general lack of unity in both neighbourhoods, but within this, also differences in unity between the two neighbourhoods, with Absalón Alarcón perceived to be more unified than Villa Sol. This was unanimously attributed to differences in neighbourhood representation, but the representative of Absalón Alarcón also offered historical reasons as a further explanation. She explained how a previous culture of fear and oppression, ultimately related to the lack of rights deriving from not owning the land, had socially fragmented the group. Both explanations signal that unity was thought of as externally enforced rather than as occurring from within, both in the past and to a considerable degree still in 2012. As the neighbourhood representative explains:

'Te comento. No haya habido unión, sino que todos eran sumisos, y la secretaria general decía "¡se va a hacer tal cosa!", o sea, era autoridad así … ¡tantas actividades, tantas tareas!, y todos lo que hacían con miedo, era temor, no era unión, era miedo. Mira, antes en las asambleas era una característica, aquel vecino que levantaba su mano para pedir la palabra y se le ocurría contradecir a la junta directiva, simple y llanamente a las dos semanas ese lote, esa casa estaba levantada. Así de sencillo. ¿Por qué? Porque como no tenían ningún documento que les ampare, es más, la misma comunidad, nada de que yo me parcializo, yo te apoyo, no, porque el siguiente que apoyaba era el que salía.'

'Let me tell you. [At the time], there wasn't any union, everyone was subservient, and the representative would say "This is what will be done!", or rather, that is what authority looked like…."So many activities, so many tasks!", and everyone carried them out in fear, it was dread, not union, it was fear. Look, at the time, the community assemblies were like this. Any neighbour who raised his hand to address the assembly, and it occurred to him to contradict the representatives, quite simply, two weeks later, this person's plot, their house, would be removed. Just like that. And why? Because they had no document to protect them, and worse, their own community, no one would take sides, or support them, no, because the next person to help would be the person to be driven out of the neighbourhood.'

Absalón Alarcón representative

Within participants' very limited perceptions of unity in Villa Sol, some degree of it was perceived among the neighbourhood's factions, with participants signalling association through the use of terms such as 'we', or 'this group of neighbours'. As this had arisen out of a strong negative necessity, such as being resident in a similarly problematic block of the neighbourhood; or being united in joint disapproval of another group of neighbours; shared disappointment with representatives; or joint refusal to engage in communal works due to lack of personal benefit, those expressions highlight differentiation between members of the neighbourhood and between different factions. It exemplifies that the use of communal pronouns can signal division, as well as unity.

In Absalón Alarcón, whilst some degree of internally perceived unity was reported at the scale of the neighbourhood, residents' relatively high levels of commitment to communal tasks was paired with limited identification with the group, as evidenced by frequent declarations of individual differentiation. Residents of Absalón Alarcón were highly aware of the need to *appear* united as a group, as this was perceived as positive by outsiders, especially those in power to resolve the all-important titling issues. When discussing the need to appear united the phrase that 'the powers that be have their eye on the settlement' was frequently used. In this neighbourhood, perceived unity appeared to arise largely out of an awareness of the need to appear united for the sake of external onlookers, and to a lesser degree from a sense of commitment, loyalty or belonging.

'La mirada del estado, cualquier gobierno que ha pasado vienen acá, focalizan acá bastante la ayuda.'

'The eye of the powers that be is on the settlement, and has been, with subsequent governments, they focus their help on this area.'

Absalón Alarcón resident

This analysis suggests that perceptions of unity at the neighbourhood level were impaired by high levels of individualization, even if they did manifest at the level of smaller factions. It also shows that unity arising from negative necessity appears to be neither successful in effecting change, nor is it likely to be very stable over time.

Positive emotions

Whilst social relations, commitment to communal tasks and perceived unity are important aspects of a cohesive group, shared positive emotions are vital for a group to persist over time and achieve its goals to its members' satisfaction. This aspect of group cohesion distinguishes itself from the others examined here by its focus on 'the emotional intensity of [the group's] members, [and] not to the skill of its leaders' (Forsyth, 2010:121). It is characterised by enthusiasm, rather than mere confidence and by the collective sharing of emotions (*ibid*). Positive emotions towards one's group have been shown to predict a number of positive behaviours which, when combined, engender group cohesion over time. Positive emotions can be observed through individuals helping other group members, protecting the group as a whole, making constructive suggestions, improved personal performance, spreading goodwill, [or] enhancing survival (Spoor and Kelly, 2004; Zhou and George, 2001).

Neither of the neighbourhoods displayed a large number of indicators of positive emotions. In Villa Sol, they were notable through their absence. The previously discussed unity arising from shared negative experiences was characterized entirely by negative emotions.

In Absalón Alarcón, all indicators of positive emotions were strongly expressed as desirable and practiced by the neighbourhood's representative herself at all times and in relation to all challenges facing the neighbourhood (as illustrated by the first quote, below), but only one indicator, the helping of others, was observed within the group. Instead, the representative had to resort to the threat of fines to ensure comprehensive participation towards communal goals (Figures 6.3 and 6.4). Residents found these measures unnecessary and heavy handed, but at the same time thought that the representative was too lenient compared to earlier leaders, who had been known to evict residents from the neighbourhood for non-compliance, as illustrated by the second quote below. This suggests that whilst enforcement was unpopular, there was also a widespread understanding that communal goals were more likely to be achieved through external enforcement than voluntary contribution, suggesting that positive outcomes may be associated with negative emotions.

'Lo que a mí me gusta, es que han venido solos, no porque les amenace ni por nada, voy y les hablo y quiero que hagan algo por convicción, no por temor, no por miedo, sino porque entiendan que es necesario para ellos; o sea, no es que yo voy porque le apoyo a la secretaria general, no, lo hago porque es necesario para mis hijos, para mí, para mi familia, para mi desarrollo, finalmente cuando yo hago algo por mí estoy haciendo algo por la comunidad. Eso es lo que se quiere lograr. Que ellos… usen su derecho para ellos mismos, para velar, para mejorar. Entonces como que ya tienen otra opción, un nivel… y eso les da también a ellos seguridad para mejorar su casa, para construir.'

'What I like is that they came by themselves,not because I threaten them, I go and talk to them and want them to do things because they believe in it, not driven by dread, nor by fear, but because they understand that it's necessary for them; or rather, I don't go to help the representative, no, I do this for my children, for me, for my family, my development, and in the end, if I do something for myself, I also support the community. This is what I want to achieve. That they…use their rights for themselves, to guard themselves, to improve their lot. So that gives people options, a level of….and then also the security to start improving their houses, to build.'

Absalón Alarcón representative

'La dirigente no se hace respetar también. [La dirigente] debe decir ya… eso era hace tiempo para desalojarlo, botarlos a esas personas que están haciendo desorden. Antes era así, al que hacía desorden ya, al toque le levantaban su choza y ya, se iba con todas sus cosas. Así era antes con otra directiva pues. [Esa] no tiene carácter, no es de pelear, no es de… '

'The representative doesn't command any respect. She should say "that's it…" Before, people who didn't comply were thrown out [of the neighbourhood], those who caused problems. Before it was like that, those who caused upheaval, straight away they tore up their hut, and that was that, off they went with all their things. This is what it was like before, with another representative. [This one] is spineless, she's not up for a fight, she's not…'

Absalón Alarcón resident

Figure 6.3 and 6.4: Positive outcomes are achieved through enforcement and associated with negative emotions.

In Absalón Alarcón, positive emotions were expressed and displayed by its representative in relation to all challenges and at all times, yet she had to resort to the threat of fines to ensure participation towards communal goals that would pave the way for water provision.

Figures 6.3, top and 6.4, bottom, show a board announcing which group's turn it is to attend the public roadworks on the following Sunday at 7am and a log of attendance used to calculate fines. Attendance was recorded in minutes, with residents told they owed, for example, 4 minutes for next time, if they left early. One missed work session equated to a payment of one bag of cement at the cost of PEN 20, the equivalent of 8 barrels of water.

6.2.2 Group size

Group size is the second factor taken into account when considering how trustworthy one considers their social group to be, with small groups said to elicit higher perceptions of social cohesion (Carron and Spink, 1995). In the study location, the opposite seemed to hold true. In Villa Sol, the various smaller factions formed within the neighbourhood displayed very limited levels of group cohesion as a result of shared negative experiences. In Absalón Alarcón, where residents identify more with the larger group at the neighbourhood level, cohesion was observed along several indicators, albeit with the qualifications described above.

6.2.3 Group competence

Confidence in a group's competence arises from individuals assessing its previous judgements and their consequences. The extent to which the group's perceptions are trusted varies accordingly. In neighbourhood no. 1, confidence in the larger group had been eroded by a long history of corruption and self-serving of its representatives and associated failures to achieve communal goals. Belief in the competence of the smaller sub-groups was limited due to their association being borne out of negative necessity. In Absalón Alarcón, a more positive picture presented itself, with individual differences widely reported, but relative confidence in the competence of the representative reported by most, although by no means all participants.

The analysis of social factors bearing on perceptions of water scarcity has provided further indication that the large number of water-related tasks, in conjunction with a history of negative experiences of community representation, combine to lead to considerable individualization in Villa Sol, evidenced by a lack of belonging, loyalty or cohesion within the neighbourhood. In Absalón Alarcón, more positive evidence was uncovered which supports the notion that social factors do impact on perceptions of water scarcity. The chasm between the two neighbourhoods' perceptions of water scarcity supports the starting point from the outset of this section that perceptions of the same aspect of water scarcity can vary widely between individuals and groups. The next section therefore examines in more detail the observed discrepancies between perceptions and subsequent responses with a view to informing how this affects resilience to water scarcity.

6.3 The classification of stressors into positive, negative and neutral

The observed discrepancies in perceptions of water scarcity call for a better understanding of how what is perceived is interpreted. Chapter 2 has outlined that perceptions are informed by features of the environment, a person's previous experiences, expectations of future outcomes and by temporal dimensions. Whilst water scarcity is commonly classed as an environmental stressor, in the psychological literature, 'stressors' are defined merely as occurrences that elicit a response. Only after they are assessed as positive, negative or neutral, are responses and coping strategies chosen (Cordon, 1997; Wheaton and Montazer, 2010).

The foregone analysis explored the existence or lack of perceptions and their relation to subsequent responses. I now extend this examination towards understanding the *quality* of responses to water scarcity by identifying (a) which aspects of the water scarce environment are assessed by residents as negative, neutral or positive; and (b) whether responses and coping strategies are chosen accordingly.

6.3.1 Stressors classed as negative

When considering life in a water scarce environment, one imagines that most aspects of this would be classed as negative by those experiencing its effects. However, only issues perceived as 'threatening, unpredictable or anxiety-producing' (Cordon, 1997:n.p.) or constituting a 'threat, demand or constraint' (Wheaton and Montazer, 2010:187) are said to entail negative classification, and have been shown to result in heightened mobilization of resources to address the stressor.

Stressors perceived as threatening were reported, among others, in relation to water quality, and responses were seen to be part-proportionate or highly constrained. For example, it was said that 'drinking untreated water is asking for sure death' and that residents were 'already scared' of water used for construction polluting nearby drinking water. In the first instance, the partially proportionate response of treating water before drinking attracted considerable downsides, as discussed. In the second instance, responses were confined to expressing fear and to warn those who drank untreated water of its ill-effects.

The experience of having fallen ill from untreated water and the expectation of this outcome repeating produce a response that partially addresses the stressor. Where no response other than noting fear was reported, the relatively rarer events of construction works had not shaped expectations and responses as much as more regular events had. Here, unpredictability of construction works polluting water did result in an appropriately negative assessment of the situation, but entailed a heavily constrained response.

'No se puede tomar agua… ¡Ay! Que algunos niños yo les veo que vienen, vamo', se zampan en el tacho y lo toman el agua, veo que de sus tachos viene, agarran con el tazón, cla, cla, cla, "¡ay!, ¡cómo vas a tomar el agua así –le digo-, mira cuántos bichos tiene!" le digo…"¡qué asco! -le digo-, ¡se hace hervir el agua!" Yo si no, no estoy acostumbrado. Tomo agua así será para que me manda matarme; yo tomo agua, i'ta que no puedo!'

'You can't drink [this] water….oh! I see some children, guzzling water from the barrel, bringing water from their barrels in their cup, clack, clack, clack, "oh, how can you drink this water, I tell them, "can't you see all the critters in there" I tell them…."how disgusting - I tell them - water has to be boiled [before drinking]". I, for one, am not used to it. If I took water like this it would be asking for sure death, me drinking water like this, I can't!

Absalón Alarcón resident

'El cemento también cuesta y entra bastante agua, ¡uy!, cuando construyen, cuando hacen piso más agua entra. Sí, a parte se compra para hacer esto y aparte de se compra para cocinar.
Porque ya tengo miedo ya…Puede caer cemento al agua y eso si consumes te puede chocar.'

'Cement is also expensive and needs a lot of water, wow! When they are building, building floors, more water is needed. And you have to buy water for construction and water for cooking.
I'm already scared….cement falling into the [cooking] water, and if you drink that, it can really do you harm.'

Absalón Alarcón resident

Many aspects of the water scarce environment were characterized by being unpredictable. The widest array of stressors was recounted in relation to not knowing if water will be available when needed. This entailed a large range of negative classifications of stressors arising from unpredictability, which were seen to largely be addressed by highly constrained responses. Multiple stresses arose from not knowing at what time of the day the truck would pass; not knowing how much water would be available if and when it did pass. Further stresses arose from the knowledge that such unpredictability would cause a large range of considerable disadvantages in water-unrelated aspects of life. The daily need to wait at home for unpredictable water deliveries prevented households from making use of local services and employment opportunities. Children had missed days at school because they had arrived after the school gates closed; families were unable to keep doctor's appointments, and women were unable to commit to local employment opportunities. Responses to this large array of constraints were confined to buying more water than needed to cover households against the possibility of not being able to purchase water for some days; incurring additional costs from water wasted as it was spoilt by heat and environmental pollutants before being consumed, and water storage taking up considerable amounts of living space.

Anxiety was frequently expressed in relation to most aspects of the water scarce environment; as a general feeling of suffering from the water situation, insecurity of supply, and being left without water altogether. It was also widely noted as children's anxiety over being singled out as 'dirty' at school for coming from the settlement.

Responses to such anxiety were severely constrained by experience and expectation of future outcomes. In response to anxiety over being left without water, participants' means of addressing this was often reduced to calling out 'water, water' in desperation to attract the water vendor's attention. In other instances, residents were reduced to stating their desperation, without any means of recourse, and were forced to borrow or buy water from a neighbour. Children were widely reported to be anxious about being singled out as coming from the settlement. Many had been called 'dirty like a pig' in reference to the area's pig-raising activities by teachers and peers. All children demanded daily baths to prevent such bullying, despite the discomfort of taking baths in small amounts of warm water in cold air.

These examples show that stressors which are classed as negative for producing feelings of threat, unpredictability and anxiety do not necessarily lead to the mobilisation of all necessary resources towards heightened responses and certainly do not appear to result in good coping with these situations. Such instances are further exemplars of constrained deliberation, decision-making and action spaces. Indeed, coping strategies were so heavily constrained that stating distress was the only recourse available.

6.3.2 Stressors classed as neutral

Cordon (1997) suggests that only those stressors classed as positive or negative would entail a subsequent response, with stressors classed as neutral assumed not to entail any response. I examine this proposition by contrasting aspects of water scarcity classed as 'neutral'; that is, perceived as neither negatively nor positively impacting, with subsequent responses. This exploration was guided by the frequent observation during fieldwork that many aspects of water scarcity which are considered part of the phenomenon in the literature, did not appear to register as particularly stressful or even noteworthy, yet a range of sometimes highly time and resource-intensive responses were deployed, such as for example in response to lack of drinking water or lack of water for personal hygiene. Section 6.1 cast further light on this phenomenon by showing that 'neutral' perceptions of water scarcity could precede both a lack of response (which would be in confirmation of the literature), but also instances of resource-intensive responses.

To understand this discrepancy, two distinct dimensions relating to the cumulative nature of environmental stressors are instructive. On the one hand, stressors accumulate over time, and on the other, in large numbers. Being forced to address a large number of stressors repeatedly and over a long time leads to normalisation which entails two distinct, yet overlapping, ill effects. On the one hand, the effects of stress itself erode capacities for deliberating appropriate responses and lead to favouring the use of habitual reactions (Schwab and Wohl, 2009), and on the other hand, the effects of normalization reduce awareness of a stressor, which in turn prevents participants from engaging with it towards longer-term, more structural resolutions. It would not seem unreasonable to conclude that the combined effects of lack of awareness and reduction of capacities for deliberation are likely to lead to worse outcomes than responses to

more extreme and sudden shock might, as these might prompt more drastic responses.

Returning to the initial model, a more nuanced constitution of the 'stimulus + perception = response' linearity appears to arise in the context of evidence from La Nueva Rinconada and in relation to 'neutral' assessments of water scarcity:

Persistent exposure to large no of stimuli

↓

reduces/ negates perception and deliberation abilities

=

diminished capacity to respond

Figure 6.5: Revised perception-response model.

Evidence from La Nueva Rinconada suggests that where aspects of water scarcity are perceived as neutral, they do not entail a lack of response. Instead, the effects of stress itself, normalization processes and constrained deliberation, action and decision-making spaces occupied by residents of the settlement, in combination with the essential role of water to daily survival result in a reduced capacity to address the stressors arising from water scarcity.

6.3.3 Stressors classed as positive

Not all aspects of the water scarce environment are perceived as negative. On the opposite end of the spectrum lie those stressors which are assessed as positive. These are said to enhance the quality of responses and entail positive effects in the form of potential for 'growth, mastery, or some form of gain' (Cordon, 1997, n.p.). This proposition is examined here to see if in a context of water scarcity in La Nueva Rinconada, positive classifications of aspects of the water scarce environment give rise to enhanced responses and potential for 'growth, mastery or gain' (*ibid*) for individuals, households or the wider group.

A number of participants had comparatively well working water access, acquisition, storage, use and discarding mechanisms in place, and perceived some aspects of the water scarce environment as positive. This included those who bought water from the grid; some of those whose house was located directly on a main water delivery route; some of those who were in receipt of 'free' water deliveries; those who had comparatively higher levels of education; those who displayed entrepreneurial spirit; those who were economically relatively well established; and those whose means and ingenuity had allowed the installation private water infrastructure.

Charting positive perceptions across these groups, it is striking that perceived positives fall entirely into the category of 'some form of gain' (cf Appendix D). No one reported positive aspects of the water situation as providing potential for personal or communal growth or mastery. Considering the time frames of the notions of gain, growth and mastery; gain constitutes the most immediate benefit, with growth taking a longer term association and mastery requiring the longest sustained commitment. I provide two readings of this observation.

On the one hand, as positives were never seen as unconditionally so, but were often qualified by constraints which partly or wholly negated their benefits, short term gains took precedence over longer term considerations. If a positive is immediately clouded by a large array of mostly insurmountable negatives, it is not surprising that these situations do not engender longer-term engagement, as figure 6.6 and the adjacent quote illustrate.

Figure 6.6.: A small number of positives are outweighed by numerous negatives.

Such was the case, for example, for a family of 6 who illegally bought water from the grid. Its superior quality was universally praised by participants, as was the relatively more secure access to water through this means of acquisition. However, these positives were negated through lengthy storage compromising water quality, and through less frequent supply requiring large amounts of storage space, which compromised living space. Equally, the fact that supply was still erratic, although not quite as erratic as that provided by the water trucks, and the threat of having to share the vendor's fine if caught contributed to tainting the positive perceptions of superior water quality and outweighed positives.

'De ahí cada uno ya buscó quien le quería vender agua. Algunos que quisieron, algunos no quisieron. Los que quieren vender agua nos están vendiendo pero como dicen que les viene multa algunos no quieren, solamente una señora está que nos da agua a todos.

De repente alguien le pasa la voz; la verdad no sé cómo… cómo ellos se enteran de que nos está dando. Pero así dice, le viene una multa de trescientos…Bastante dice. Por eso algunos no quieren dar. Porque así nos dijo, "cuando me viene multa me ayudarán a pagar", nos dijo.

A veces la persona que nos vende no tiene tiempo, tiene que esperar un día, dos días sin agua. Como es la única que nos da, antes nos cobraba dos soles cincuenta, ahora la señora nos cobra tres soles. Controla por la hora. Ella calcula ya con cuánto tiempo estás jalando, diez minutos, media hora, ya sabe cuánto has llenado.'

'Since then everyone has had to find someone to sell them water. Some wanted to [sell], others didn't. Those who want to sell us water do so, but as they say that they'll be fined, some don't want to [sell]; there is only one woman who sells to all of us.

Suddenly someone lets them know, I really don't know how they find out that she sells to us. But she says that she gets fined three hundred [soles]….quite a lot she says. That's why some don't want to sell. That's why she told us "If I get fined you'll help me pay".

Sometimes the person who sells us water doesn't have time, you have to wait a day, two days without water. As she's the only one who gives us water, before she charged two soles fifty, now the woman charges three soles. She charges by the hour. She Works out how much time you've been drawing [water], 10 minutes, half an hour, and knows how much you've drawn.'

Villa Sol resident

The large array of negative perceptions tainting positives is again symptomatic of the severely constrained deliberation, decision-making and action space residents occupy in relation to the water scarce environment. Meeting its multiple demands on a daily basis monopolises residents' efforts and resources on

immediate tasks, leaving little or no means for the consideration of longer term or structural measures.

6.4 Conclusions: Perceptions of water scarcity in La Nueva Rinconada: A necessary evil?

This chapter has aimed to expand the picture of urban water scarcity in La Nueva Rinconada by casting light on residents' perceptions, and understanding these in relation to subsequent responses.

Residents' overriding perception of 'suffering from water' revealed apparently contradictory nuances of helplessness, resignation and familiarization versus feelings of 'abnormality' regarding the water situation and strong feelings that it needed to be addressed. These contradictions appeared to arise from varied factors spanning different environments and scales, from the social to geographical, and from the experienced to the political. Simultaneously, the overriding importance of achieving titling provision consistently moderated the extent to which water scarcity was reported to be problematic, and prompted the question whether, despite the myriad of problems it presented, water scarcity was considered a 'necessary evil'.

Considerable discrepancies between perceptions of and subsequent responses to water scarcity appear to be indicative of constraints on residents' ability to consider the best action available, make decisions and take appropriate action in response to water scarcity. Such constraints were seen to arise out of a combination of having become habituated to the water scarce environment, and the interaction of multiple forms of scarcity.

Normalization to the water scarce environment was evidenced by discrepancies between low levels of perceptions coupled with high levels of responses, for example where drinking water scarcity was concerned. The co-existence and dynamic interaction of multiple scarcities was seen in relation to perceptions around security of water supply, and showed that water scarcity interacted with other forms of scarcity, such as for example lack of suitable local employment or health provision, to constrain residents' livelihoods.

The vital and non-substitutable nature of water was revealed through water management processes which required constant engagement and high resource expenditure in order to meet daily needs, whilst not being perceived as problematic, such as for example the lack of perceptions observed in relation to sufficient drinking water coupled with a large array of responses.

At the same time, constraints such as arising from the mythicization of good quality, cheap water supplied by the municipality prevented some residents making use of this to mitigate the effects of water scarcity.

The combination of these factors was seen to culminate in heightened vulnerability, especially in situations where responses inadequately dealt with the effects of water scarcity whilst residents felt satisfied that they had addressed these.

In examining the discrepancy between perceptions and responses, social factors pertaining to neighbourhood representation stood out as they attracted considerable variations in residents' perceptions. The effectiveness of neighbourhood representation, and its history of relative success or failure in advancing neighbourhood progress, was seen to play a considerable role in not only how people perceive water scarcity, but also how they respond to it. The extent to which people trusted their wider group played a role, with considerable differences observed between both neighbourhoods. Where lack of trust in the wider group failed to exert positive 'peer pressure' on residents' perceptions of the water scarce environment, efforts to resolve the situation satisfactorily appear less likely to succeed. Perceptive peer pressure, despite associated risks of 'mis-interpreting' information was here observed to be a vital mechanism in addressing the multitude of challenges arising from lack of a vital resource like water, with specific evidence underlining its importance in dealing with larger scale, structural issues affecting water scarcity, such as negotiations for titling provision.

Aiming to understand why responses did not necessarily follow perceptions of water scarcity, examining if classifications of water scarcity entailed the predicted response uncovered deviations and nuances to the linearity suggested by the literature. Further evidence of constrained deliberation, decision-making and action spaces was observed, for example where responses to poor water were confined to expressing fear. Whilst it may be argued that stress awareness and verbalisation might mitigate perceptions of stress, both of course fail to address not only the immediate effects, but also the underlying causes of such stress.

The sheer amount of stressors classed as negative observed by this analysis provides evidence not only of the extent of stress caused by water scarcity, but also of how its cumulative effects impact on the ability to respond appropriately. We saw that cumulative effects of water scarcity erode capacities for deliberation,

decision-making and action as they expose residents simultaneously to a large number of water-related stresses; and to changing stressors over extended periods of time.

Lastly, positive perceptions of some aspects of the water scarce environment were seen to be largely negated before positive effects could materialize. This provides further evidence of what I will call the disabling (as opposed to enabling) environment, which, instead of enhancing responses and positive effects on livelihoods, cancels out all but the most immediate forms of gain, and thus prevents opportunities for longer term growth and mastery to come to fruition.

Evidence from this chapter suggests that residents' capacity to respond to the myriad of stressors arising from water scarcity is largely reduced to daily coping, whilst simultaneously consuming a large array of differnt resources and eroding the ability to critically engage with water scarcity towards longer term solutions, which is likely to ultimately impact on resilience to water scarcity.

As the present analysis has pointed to factors of personal agency as well as to the effects of larger socio-political and natural systems on the ability to respond appropriately to water scarcity, the next chapter will examine the question of how much residents are in control of the water scarce environment in more detail.

Chapter 7:
Controlling Water Scarcity

7.1 Control: a multi-scalar concept

The concept of control affects water scarcity across the spectrum that spans individual experiences to its political construction. Broadly speaking, 'the political and economic control of resources is an obvious factor affecting [their availability and use]' (Huss-Ashmore and Thomas, 1997:309; cf. chapter 3). Perceptions of personal control, and particularly the feeling to be able to 'do something about it' (*ibid*) positively affect 'the ability to adjust and persist' (Mason et al, 1976:165; also Mason, 1968; quoted in Huss-Ashmore and Thomas, 1997:309). As a result, 'an individual's perception of control has much to do with how that person will encounter his life's stresses' (Lefcourt, 1982:110). Perceptions of control can override differences in personal temperament (*ibid:* 102), making perceptions a suitable indicator for examining the outcomes of attempts to control the water-scarce environment independent of individual personalities.

Methodologies for examining control are disparate. The 'locus of control' literature (Rotter, 1954, 1990; Borden and Hendrick, 1973; Basgall and Snyder, 1988) focuses on perceptions of control at the individual level, whilst the political ecology literature (e.g. Swyngedouw, 1997; Budds, 2004) tends to draw out processes at the macro scale. The concept of control is here examined as a composite with a focus on understanding personal perception and agency in exerting control over the water scarce environment in the context of the wider socio-political forces that shape this.

This chapter delineates the boundaries of participants' abilities to exert positive control over the water-scarce environment by progressively unraveling perceptions of control and relating them to the quality of outcomes. The chapter concludes by discussing how perceptions of control affect attempts to exert control over the water-scarce environment in La Nueva Rinconada, and reflects on the parameters that shape the boundaries of residents' ability to exert control in this context. These ultimately impact on the capacity for resilience to water scarcity.

7.2 Perceptions of control

Whilst the perpetual cycle of challenges and their resolution is a normal and necessary element of the process of building capacity to deal with life (Flach, 1988), it is perceptions of personal control; the feeling to be able to 'do something about it' that is instrumental in positively affecting outcomes of responses (Mason et al, 1976, 1968, quoted in Huss-Ashmore and Thomas, 1997:309). The concept of the 'locus of control' allows the exploration of 'individual differences in the extent to which […] [control] is viewed as a consequence of one's own behaviour or a consequence of [external] forces [such] as "chance", "fate", or "powerful others"' (Borden and Hendrick, 1973:32). People who feel that they are in control of the outcome of situations are said to have an internal locus of control, whilst those who tend to attribute outcomes to influences other than their own are said to have an external locus of control. Internal loci of control are associated with more successful outcomes, whilst external loci of control are associated with less successful outcomes (Lazarus and Folkman, 1984; Lefcourt, 1982).

Perceptions of control are usually assessed using a scale on which 'internal' and 'external' form opposite extremes. However, as I am concerned with uncovering yet unknown aspects of participants' environments that contribute to perceptions of internal or external control, and as the research environment did not lend itself to the administration of scales, a more open, interview and observation-based approach was adopted. To unravel the relationship between individual perceptions of control, the effects of attempts to exert control over the water scarce environment, and the environmental features that bear on this relationship, I explore perceptions of control first in relation to life in the settlement in general, and then specifically in relation to the water situation.

7.2.1 Internal and external loci of control

Shifting perceptions of control over life in the settlement

Participants displayed a striking mixture of internal and external loci of control in their perceptions of life in the settlement. On the one hand, participants sought the causes for many ills within their own person, motivation, and ability to effect change, which points to an internal locus of control. On the other hand, participants described profound and wide-reaching helplessness towards many aspects of their lives. This helplessness manifested as a combination of a perceived lack of ability to consider solutions to a range of problems, and placing the responsibility and authority to solve these problems with others. Both point towards an external locus of control.

One would expect anyone to display a mixture of internal and external loci of control in relation to their life as a whole as it is uncommon to feel either wholly in control, or entirely not in control of one's life. The co-existence of internal and external loci of control is here nevertheless striking and warrants further examination as it indicates a rather inexorable combination of perceptions: participants blamed themselves for many (if not all) problems affecting their life in the settlement, but perceived the power to address the majority of these issues to lie with others.

The combination of internal-external perceptions of control was most strongly expressed in the discourse on land titles, which were unanimously considered the single most important prerequisite for the provision of other services, including water and sanitation; and the single least likely problem to be resolved. Participants on the one hand recounted their lack of control over achieving titling status, giving examples of price rises as time passes making plots unaffordable; a series of corrupt and self-serving neighbourhood representatives embezzling funds and delaying the titling process; and their lack of knowledge over which plots are located on which type of land affecting the ability to move plot strategically to advance the titling issue. Participants' perception that the solutions to these problems lay outisde their own realm of action and influence points towards an external locus of control. Furthermore, in Villa Sol, all participants explicitly linked the lack of control over the provision of land titles to the lack of general progress in the neighbourhood.

This perceived lack of control was vocalized as all-encompassing by several participants, highlighting both the intensity and extent of the external locus of control felt in relation to titling problems, and extending this feeling to others:

'Ya por esa razon no hay nada, avance, no podemos hacer nada, ni para desagüe, ni para luz, nada. Pero qué se puede hacer, por la necesidad que tenemos estamos hasta el momento aguantando todo, ¿no?, qué se puede hacer, todos también, no sólo yo. Así pues, sufriendo.'

'And that's why there's nothing, no progress, we can't do anything, neither for sanitation, nor for electricity, nothing. But what can we do, out of sheer necessity are we putting up with all this, aren't we? What can we do, [it's] all of us, not only me. Well, this is what it is, suffering.'

Villa Sol resident

Because of the importance attached to the provision of land titles, and perhaps because of the persistent delay in advancing the issue, residents had elevated the receipt of land titles to an idealized status, which would resolve all other problems. A strong belief that land titles would pave the way towards resolution of all other problems prevailed, and many related perceptions of control over other aspects of life to the receipt of land titles, with some imagining a future when the receipt of land titles would solve all ills.

'Cuando tienes título ya pues, te dan todo ya. Sin título no puedes hacer nada. Porque con título ya pues puedes hacer cualquier préstamo para material, pa'cualquier cosa…'

'When you have your title [deed], they'll give you everything. Without title [deed] you can't do anything. When you have your title, you can ask for any [bank] loan for materials [to improve your house], for anything…..'

Villa Sol resident

This strong belief of the land title solving all other ills helpfully illustrates the interweaving of internal and external loci of control. An external event (the receipt of land titles) enables the exercise of personal control ('you can do anything'), whilst the withholding of this external event (not getting land titles) is believed to remove all agency for personal control ('you can't do anything').

I interpret this interweaving of internal and external loci of control as a result of the shifting degree of success that a strongly engrained internal locus of control had been achieving over the years since the settlement was founded. Participants' recent history of exerting control towards positive change saw residents' successes and failures in dealing with water to be

largely dependent upon their own efforts. As these efforts had yielded mostly short-term solutions (which more often than not entailed further challenges, cf. section 6.3), the community was undergoing a shift in perceptions about the ability to effect change when this study took place. This shift can be traced along 3 distinct phases of the settlement's existence.

A strong perception of being the master of one's fate yielded consistent results in the face of very adverse conditions at the beginning of life in the settlement. During the years when residents first invaded the land, fought violent battles with land owners, were repeatedly driven from the land and returned in ever-greater numbers to eventually establish their right over a bare area of rock, the belief that they alone could exert control to achieve their aims was proven effective.

'Había desalojos, nos tiraban piedras, todo; hemos sufrido duro. Pero si hemos luchado. Así hemos vivido acá.'

'There were evictions, they threw stones at us, everything, we have suffered badly. But we did fight. That's how we lived here.'

'Nosotros vivíamos con el corazón en la mano, decían "¡desalojo!". En la entrada de Villa Sol, ellos se encargaban de avisar, tiraban [avellanas], cuetes y avisaban que ya… o sino, cuando iba a venir policías, en la entrada hacían hueco, unas zanjas grandes para que no pase ni un cambión.'

'We lived with our hearts in our hands. They would cry "Eviction!". At the entrance to [the neighbourhood of] Villa Sol, they stood guard, threw [stones], rockets and would call when to throw… other times, when the police were on the way, they made a big hole at the entrance, big trenches so that not even a single [police] truck could get past'

Villa Sol resident

'Y a mi pareja le digo "invasión", "vamos". él me dice "no, están agarrando terrenos dice por allá" me dice así, él no quiso pues. Y yo ya me… "a ver voy a ir", no me trajo ese día, al día siguiente vengo y ¡uuu!, gente, llenecito todo era, gente, gente, ¡ah!, yo me quedé mirando, "¡uau!", dije así. Y me comencé a subir al cerro, arriba pues, en ahí había un pedacito, en ahí me agarré también.'

'I told my partner that there was an invasion, and we should go. He said "No, they are occupying land [far] up there", he didn't want to go. So I [said]…."ok, I will go", and that day he didn't take me [there], but by the second day I came. "Oh! People, completely full of people it was!" I was watching it all [in awe]. So I started climbing up the mountain, high up, and up there was a sliver [of land], and there I seized [a piece of land] too.'

Absalón Alarcón resident

In the second phase of the settlement, when the invaders' presence was accepted, but the land was still bare, households continued to see the positive effects of their ability to effect change. Living for many years between straw

mats that provided shelter, whilst levelling the rock face to flatten their plot, and slowly and at great personal, physical and economic costs carving roads for water truck access out of the bare rock, individuals and communities succeeded in progressing homes and communal infrastructure as and when economic means allowed the addition of more stable materials. Some aspects of this phase are still very much alive in parts of the settlement, where communities continue to extend road access, build retaining walls, whilst individual families improve the quality of their homes.

'Me vine a vivir de comienzo. Acá ya comencé a vivir con la esterita. Una esterita me compré, hemos doblado así, como tipo caracol, ahí dormíamos. Para eso yo tenía mi hijito mayor nomás, el que tiene trece años ahorita, con él nomás, él en su corralito, nosotros en piso, con alfombra dormíamos. Así hemos comenzado.

Acá pues trabajábamos… por cada domingo todos los comunidades subíamos a trabajar con pico, lampa, para hacer una carretera como para que entre el aguatero, el óvalo ya pues. Ya pues, hemos demorado…

Poco a poco. Ya pues, comenzamos a construir poco a poco, ya pues por cuatro lados ya la casita, ya pe' ya comenzamos a armar nuestras cositas poco a poco, ya teníamos cómo… ya teníamos una casita. Ya el agua también jalamos agua con manguera, ahora ya compré mi manguera, cosas así, ya nos acomodamos ya pe', ya ahora ya…'

'I came to live here in the beginning [of the invasion]. I started living here with the straw mat. I bought myself a straw mat, and we folded it like this, snail-shaped, that's where we slept. That's why I only had my older son at the time, who is thirteen now, [we lived here] with just him, in his pen, we on the floor, we slept on a carpet. That's how we started.

So here we worked…every Sunday all communities went up to work [on the road] with pick axes, shovels, to make a road for the water truck to come in, at the oval. Well, [the works have] dragged on…

Bit by bit. We started to build bit by bit, so now the house has four walls, and we're starting to equip it bit by bit, so we now have a home. And water, too, we drew it by hosepipe, now we've bought our own hosepipe, that sort of thing, so bit by bit we've adjusted ourselves, so now [we are ok]…'

Villa Sol resident

Figures 7.1 to 7.4: Transition from internal to external locus of control.

Figures 7.1 and 7.2: The images evidence the extent of success that perseverance and hard work in adverse living conditions initially yielded, and chart the transition from a positively felt and exercised internal locus of control at the beginning of the settlement's existence to perceptions of lack of control, disillusionment, desperation and helplessness.

This transformation is also seen in the private realm. The image on the top shows the pure rock face which bounded this participants' plot in 2000, and was manually chiseled away and transformed into a retaining wall towards the neighbouring plot. The image at the bottom shows the same wall in 2012, now finished in concrete and part of an elaborate concrete and steel construction that supports a two-storey property.

Photographs: Participant (top), researcher (bottom)

Figures 7.3 and 7.4: A strongly engrained Internal locus of control continues to effects change in the current phase of the settlement.

In 2012, when the settlement had on the whole reached phase 3 of its existence, a strong internal locus of control continues to make a positive impact in areas where persistence and manual labour are required, as evidenced here by early morning weekend communal works to advance road construction for water deliveries to reach more households in neighbourhood no.2. Top: residents at work. Bottom site of current work highlighted in road, with community-constructed retaining wall and stairs visible in front, and current communal water barrel location in the distance.

Photographs: Researcher

By 2012, in the third phase of the settlement, residents of the more established neighbourhoods had reached the limits of their ability to effect change through sheer persistence and hard manual labour. With many having been resident and having invested heavily since the inception of the settlement, in 2012 they had reached a stage where they sought their quality of life to be improved through secure land tenure and the provision of basic services. Many expressed concern over the effects that the delay in providing these would have on their own ability to survive in old age, and on the ability of their children to carve out a livelihood in Lima.

As tried and tested means of effecting change were starting to prove ineffective in obtaining the provision of basic services, and as residents realized that the limits of the ability to exert control towards progress were being reached, while the means for effecting the now desired change, or leaving for a place with better opportunities were beyond their reach, a heavily ingrained internal locus of control was being frustrated and transformed into perceptions of disillusion, helplessness and exasperation:

'Pero así estamos luchando acá qué se puede, porque yo no tengo dónde ir, tengo que vivir nomás acá.'	'That's why we keep fighting here for all we can, because I have nowhere else to go, I can't live anywhere but here.'

Absalón Alarcón resident

As residents experienced the limits to their ability to effect positive change, the municipality continued their rhetoric to enforce a strong internal locus of control through demands that a neighbourhood complete an ever-growing list of infrastructure elements and legal requirements before it becomes eligible for consideration for the provision of land titles and basic services (Ortiz Sánchez and Donayre Muñoz, 2011:20-21; COFOPRI, 2012). The completion of these items is on the one hand highly time and labour intensive (such as the manual building of access roads and retaining walls, cf. figures 7.3 and 7.4), as well as costly, resulting in extremely slow progress due to lack of funds for materials, machinery and technical expertise. On the other hand, they require neighbourhood representatives who display strong motivation, in-depth knowledge of the political and administrative systems and the ability to unite and motivate a diverse and economically fragile community. As such, the odds for completing these tasks are stacked against communities, providing the government with perpetual excuses for not progressing titling negotiations and subsequent service provision. At the

same time, the physical, economic and mental strain of these demands trap residents in a cycle of exhaustion and lack of resources which prevent them from considering other, perhaps more socially and politically disruptive means of lobbying for their rights.

'Las necesidades son una infinidad de cosas. Por ejemplo, nosotros estamos en proceso de solucionar el problema lo que es del saneamiento físico legal, todo lo que es… bueno, no hay ni un solo zona de La Nueva Rinconada que no tiene ese problema.

Pero para eso necesitamos primero sanear la infraestructura del lugar. Y todo eso requiere inversión. ¿Te das cuenta? Hay mucha gente que con las justas puede conseguir para comer y a veces hasta no. Entonces, si uno le pide un adicional para que inviertan en el sector… hay algunos que sí son pudientes, ¿no?, si pueden hacerlo, pero hay… la mayoría no lo pueden hacer. Eso es el problema.

Es por eso que estamos como locos queriendo construir la infraestructura, nos piden la infraestructura tiene que estar bien hecha…Pero cómo lo construimos. Conseguimos el recurso… actividades propias, hacemos actividades, fiestas, deporte… entonces vamos juntando economía. Y lo hacemos con recursos propios y con la mano de obra de la misma gente del pueblo.

Por ejemplo, esas pequeñas escaleras que existen, eso lo hemos hecho propio costo y como nuestra zona es propiedad privada dicen, nadies quiere invertir pues.'

'There are endless necessities. For example, we are in the process of resolving the problem of the physical-legal restructuring; there is not a neighbourhood in La Nueva Rinconada that doesn't have this problem.

But that requires us to first improve the infrastructure. And all that needs investment. Do you realize that? There are many people who just about have enough to eat, and sometimes not even that. So if I ask them to invest in the neighbourhood…a few residents are affluent, aren't they?, they can invest, but…the majority can't. That's the problem.

That's why we are working like crazy to build infrastructure, they [the government] require good quality infrastructure…But how do we build it? We need to get the means….our own activities, we arrange activities, [working] parties, [fundraising] sport events….so we amass some funds. And we build with our own means and with the labour of the people themselves.

For example, these little stairs there, we built them from our own funds, but as they are on privately owned land, no one [from the outside] wants to invest.'

Villa Sol representative

'Antes, caminabamos. Incluso hemos hecho marcha hacia el congreso a pie, desde el puente Atocongo, pidiendo agua. Ahora ya no. Se cansa.'

'We used to protest. We even marched to congress, by foot, from the Atocongo bridge, demanding water. Now we don't any more. It gets tiring.'

Absalón Alarcón resident

The forces operating at the political level and bearing on these relationships appear largely unknown to residents, trapping them in a situation where they perceive the limits to their ability to effect the required change, yet continue to have a deeply ingrained internal locus of control enforced. As a result, residents ultimately hold themselves responsible for the delay in the provision of infrastructure, and ultimately for the failure to be granted sanitation and water infrastructure. One participant, referring to both residents and neighbourhood representatives, noted why the vital elements for the provision of land titles and basic services don't advance:

'Sera porque no avanzamos por la gente misma, no podemos apoyar.'

'It is probably because of people themselves that we don't progress, we can't support [the necessary efforts].'

Villa Sol resident

Repeated failures of a strongly engrained internal locus of control to achieve desired outcomes saw the emphasis of advancing the interests of the neighbourhood shift towards prioritizing household needs, resulting in tendencies of individualization. Again this was most visibly exemplified in the titling discourse, where residents expressed a strong awareness of having reached the boundaries of their abilities to effect change communally. Instead, many spoke of households prioritizing their own needs over that of the neighbourhood, such as for example for control over titling negotiations to be taken by each and every household individually.

'Uno que tanto esfuerzo hacemos para poder avanzar, para poder solucionar nuestros problemas, pero no pues.'

'With all the efforts we make to progress, to be able to solve our problems, but, well, nothing.'

'Qué nos cambiará pues, de repente pues ya pues, unos cuantos que estamos apto ya pues, tratar de seguir al dueño ya pues de frente, ya no con dirigente sino que hablar. Eso estamos pensando unos cuantos, mejor de frente con dueño hay que hablar.'

'What will [ever] change for us, and now, some of us are ready, ready to get things moving forward with the [land] owner, not wait for the [neighbourhood] representative to speak to them. That's what some of us are thinking, we better advance things [on our own] directly with the [land] owner.'

Villa Sol residents

Other examples illustrate how an interweaving of internal and external loci of control traps residents in a state of limbo. With many residents having come from rented accommodation where they were subject to landlord's whims or under the social control of relatives, many expressed satisfaction of

being in control of their own house. Yet this was diminished through perceptions of lack of control as families cannot advance the construction and quality of their homes due to not owning the plot. With severe doubts over the likelihood of ever being being awarded title deeds, investment in the house is risky and leads to a stalling of development in individual plots, and in the settlement as a whole. As well as exemplifying a further instance of short-term gains at the cost of longer-term progress, this illustrates being trapped in limbo with the ability to progress livelihoods severely constrained.

'Sí, pero es más tranquilo, o sea, 'onde que es tu casa es más tranquilo, gastas pero qué puede ser, es más tranquilidad en lo que es tu casa, nadies te dice nada, si tú quieres puedes hacer una sopita, un segundo, lo que sea, estás con tus hijos, es más tranquilo.'

'Yes, but [here] it is quieter, or rather, when it's your house it is calmer, you spend [money] but what can it be, it's more peaceful as it's your house, no one tells you what to do, if you want you can prepare a soup, a main dish, whatever takes your fancy, you are with your children, [it is] more peaceful.'

'Realmente nos dicen que… es privado, a veces nos dicen remanente, porque el dueño, o sea, ha tenido unos problemas que… cuando nosotros hemos invadido, los papeles hasta (…), de ahí ya como ya ha pasado ya doce años, el señor ya todo ya ha abarcado ya así, (…), según, o sea lo que dicen.'

'In reality they told us….it's private land, then they tell us it is 'contested', because the owner, has had problems that…..when we invaded, the papers […]…..and now 12 years have passed, the owner has already enclosed everything…..according to, or rather, that's what they say.'

'Pero realmente, ahora con esto… que vamos a… de COFOPRI que viene, que vamos a hacer, este ingeniero, es ingeniero, ya, ahí vamos a saber la realidad cómo es. Porque nosotros como estamos viviendo… por decir, yo, mi casa, es provisional.'

'But really, with these things….what will we [do]…..[hoping] that COFOPRI come, what can we do, this engineer, […] and so we'll know for certain what the situation is. Because the way we live here, that's to say, my house is only provisional.'

Villa Sol residents

A comprehensive lack of control over the water-related environment

Participants' accounts rendered a complex picture of a strongly professed external locus of control in relation to the ultimate aim of municipal water and sanitation provision. This spanned the spectrum of forces operating at the political scales to domestic considerations.

Where the larger forces of water provision are concerned, residents recounted lacking control over the type of water source their household used. A lack of information about the variety of water sources in the settlement and lack of knowledge about the particulars of the many tanker routes when participants first settled in the area had resulted in plots being chosen without strategic consideration of the impact of the plot's location on water provision. For example, the positive event of a stand pipe being installed in one neighbourhood resulted in residents of the preceding neighbourhood suddenly being exposed to reduced frequencies in water delivery. Those living at the very end of the route were often not able to buy water at all as trucks had run out by the time they reached them, and few trucks were incentivized enough to make the long journey for the custom of few households (cf. chapter 5, map 5.29).

'Acá siempre están sufriendo de agua todos, la mayoría casi… ya pues, siquiera partes algunos partes por arriba, ¿no?, los que ya tienen ya su cómo se llama, su agua provisional, todavía no es estable sino provisional dice…el pilón. […] Pilón nomás jalan y tiene su agua, ya no están comprando nada ya, tiene su agua.'

'Here everyone is suffering from water, the majority almost…..well, apart from some parts up [hill], aren't they? Those who already have their, what's it called, provisional water, it's not from the grid yet, but provisional, they call it…..a standpipe. Now they draw their water from their standpipe and are [no longer] buying any [water from the trucks] anymore, they already have their water.'

Villa Sol resident

Other instances of strongly perceived external loci of control revolve around the complexities arising out of the protracted titling negotiations and difficult geography of the settlement. In particular, a range of techno-political factors, all of which are outside the control of individual households, affect the provision of water and sanitation infrastructure. The government requires the titling situation of an entire neighbourhood to be resolved before considering the provision of water infrastructure. Many neighbourhoods in the settlement comprise plots at the bottom of the valley (which are on privately owned land) and further up into the hills where the

land is owned by the state, with many comprising additional so-called 'contested' zones where ownership is unclear. With titling issues on privately owned land unlikely to be resolved due to the range of factors discussed earlier, the lower parts of many neighbourhoods remain legally contested zones. As a result, even if there was the political will to provide water infrastructure to state-owned plots, it is technically difficult and cost prohibitive to provide sanitation to the upper parts of a mountain without accessing its lower parts (cf. chapter 5, maps 5.28 and 5.35)

A strong perception of an external locus of control was displayed by all participants' discourse on control over water and sanitation in comparison to other utilities. All felt able to control life without electricity, but not without water and sanitation. Perceptions of a wide-reaching external locus of control extend to most participants' belief that the power to resolve the above issues lies with neighbourhood representatives. Many perceived a lack of control over the focus and extent of efforts representatives make on behalf of their neighbourhood. Participants perceived a lack of transparency, as well as a lack of recourse over democratically elected representatives who do not fulfil their roles.

Beyond these issues engendering an external locus of control at the larger scales, residents also perceived challenges relating to water acquisition, storage, treatment, use, reuse and discarding at the domestic scale to be mostly outside their own control.

Poor water quality was perceived to be largely outside of residents' control, yet attracted a large range of responses. Water recycling, although necessary for economic reasons, was not always practicable due to storage and pollution constraints. Many participants also perceived a lack of control over infectious disease emanating from living in an unhygienic environment, despite their own extensive efforts to control their environment, as others did not follow the same hygiene practices. It appears that control over water quality was only successfully exerted at the level of the household, and amounts to short term coping as other people's practices diminish the extent to which the detrimental effects of insecure access, and polluted environments could be controlled towards positive, long term outcomes.

Gaining access to water when needed was also characterized by an external locus of control. All participants recounted a complete lack of control over

the frequency of water deliveries, which vary greatly and unpredictably, even for the same household, making the planning of water purchases difficult. Lack of control over the distance to the water source highlighted additional areas of life where residents felt unable to control water-related issues. This affected the quality of water available, as more easily accessible water was of inferior quality and large distances needed to be bridged to get cleaner water.

This range of issues shows an extensive lack of perceived control in relation to water-related challenges operating at the political and domestic scales. Whilst a large array of actions to exert control over the water-scarce environment was observed, residents' perceptions of being in control were few and far between.

At the domestic scale of water use, strong differences between absent perceptions of control and effective practices to exert control were observed. They concerned accounts of actions taken to remedy problems, but these generally stopped short of being expressed as perceptions on control. For example, as previously discussed in chapter 6, residents expressed no perceptions of themselves or others being in control of the amount of water they consumed, despite displaying a large array of responses to address a relative lack of water (differential intra-household allocation, reducing drinking water, etc.). Equally, whilst a certain amount of control over the quantity of water being bought was observed (when water is available, there is a certain control over how much one buys. If a truck comes, and is still full, he will sell whatever a person asks for), participants did not perceive themselves to be in control of this.

Similarly, whilst all participants exerted control to improve poor water quality, no perceptions of *being in control* were recounted, and measures taken failed to comprehensively address the problem. Figure 7.5 illustrates an instance of a considerable discrepancy between a large array of actions taken to control the various challenges of the water-scarce environment and the notable lack of perceptions of being in control of the parameters that shape these actions.

In one instance affecting the ultimate aim of sanitation provision, a strong desire to resolve the issue was expressed, but again fell short of reaching perceptions of control. This concerned considerations of the private provision

of a clandestine sewer connection in conjunction with a small group of neighbours. This group of neighbours had reached the limits of their ability to deal with sanitation on their own plot, and believed that the neighbourhood representatives would not resolve the sanitation problem on their behalf. The participant expressed a strong desire to resolve the issue privately, but at the same time displayed an external locus of control when describing the limitations of the group's plans for this undertaking. These included a lack of knowledge for obtaining technical expertise, financial difficulties, fear of sabotage by others and threats of fines if caught. The following quote illustrates.

'[El agua y desagüe], es lo más esencial pues. No se puede… Justo nosotros estábamos pensando, como nosotros vivíamos aquí, está cerca de la pista, hay un desagüe que pasa por ahí, ¿ya?, entonces nosotros estamos pensando, ¿no?, así entre todos los vecinos así hacer una conexión clandestina para desagüe, para echar ahí, para no perjudicar a 'nadies' también, trabajar y hacerle.

Pero no sé pues, no sé cómo… no conseguimos todas las personas por ejemplo, que nos diga "ya, esto pueden hacer, necesitan tanto de tubo, esto lo pueden hacer así…"

Entonces, para hacer eso… no encontramos pues a la persona, ¿no?, que él diga "ya, yo les hago por tanto, les cobro pues", estaría bien porque todos quieren el desagüe, ¿no? Nosotros somos 26 vecinos, los 26 quieren.

Todos quieren. Sino que nosotros nomás nos pusimos de acuerdo. Lo que pasa es que de repente ahí, este, ¿no ves?, van a echar de repente todos basura, de repente se malogra así el tubo, todo va a ser inundación y ahí nos van a encontrar que estamos haciendo mal y nos va a venir multa a todos.'

'[Water and sanitation] is the most important. [Without it] we can't [live]…..We have been thinking, as we live here, we're close to the main road, and there's a sewer going through that road, you see? So we have been thinking, right? To construct, among all the neighbours, a clandestine connection to the sewer, so we can get rid of our waste water that way, so we don't harm anyone, [we] work and do it.

But I don't know how to….get someone who tells us, for example, 'yes, this you can do, you'll need this much pipeline, you can do it like this….'

So to do that….we haven't found anyone, right? Who tells us 'ok, I'll do it for that much, I'll charge you this much' that would be good, because everyone wants sanitation, don't they? We are 26 neighbours, all 26 want to take part.

Everyone wants it. We have only just reached an agreement. What happens is that suddenly, […] someone will throw their rubbish into [our sewer], the pipeline gets ruined, everything will flood and that's how they'll find out that we have been doing this illegaly and we'll all be fined.'

Villa Sol resident

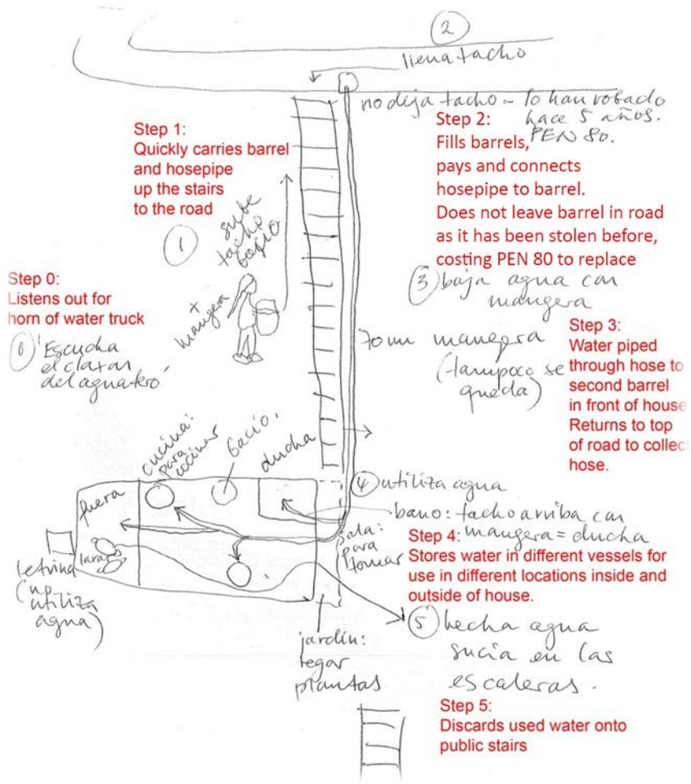


Figure 7.5: A resident's water acquisition map and account of how she obtains, transports, stores, uses, reuses and discards water illustrate the stark contrast between the large array of actions taken to control the various challenges of the water-scarce environment and the notable lack of perceptions of being in control of the parameters that shape these actions.

'Mi tacho está arriba, al óvalo. Llevo mi tacho, no dejo.

Acá está. Este mi tacho llevo y manguera lo estiro, lo bajo, todo lleno mi ducha, lleno acá mis tachitos, dos chiquitos, me bajo otra vuelta.

No dejo.Porque me ha perdido un tacho…Me lo robaron. Habían vaciado el agua y lo robaron mi tacho.
El tacho que me perdió ya pasó como cinco años. Desde ahí continúa mi tachito que ya me bajo. (…) tacho bueno yo como era más pequeño mis hijos ya como sea jalaba, lo dejaba mi tazón, "ah, otro día para comprar" diciendo, ya dejo con agüita pe', pero un día que subo, la sorpresa que no hay tacho, nadie han visto, nadie sabe. Ya, pues, tendré que comprarme otro tacho. Un tacho está como ochenta. Ochenta soles compré un tachito.

Eso fue para no desconfiarme ya, ya me traigo ahora mi tacho ya. Junto con mi tacho ya ando.

Subo el tacho, lleno el agua, bajo todo, lleno vuelta me bajo. Con manguera, sí. Setenta metros de manguera tengo.

Dos veces a la semana compro, sábado y lunes compro. Ahora, este… todos… me agua ahora ya acabó, tengo que comprar ahora mañana.

Acá mi ducha tengo acá un tachito. Ahí lo lleno y lo que sobra acá, y ahí sito. Con eso tiene para cocinar, para lavar mis servicios, y si agua me falta ya para lavar ropa pa' baño son de acá ducha que lo llena.

Otro tachito está acá atrás, ahí. Y un tacho pa'dentro, en mi sala. Y en la cocina. Si, vació ya queda, eso está vacío.

Ahora dejan acá óvalo vacío. Lo que vive la señora a su frente, ella nomás su tacho siempre está ahí porque vive cerquita, de ella nomás su tachito está perenne.
Lo resto bajamos. Acá mi vecina también tiene sus dos tachos sube y baja su agua.

Mientras que viene [el aguatero] de allá nosotros, en la otra esquinita que está, de ahí ya… ya para ese lado ya tienes que estar ahí subiendo por el tacho ya. Rápido. Y a veces se regresa rápido de allá nomás, cuando ya no tiene agua ya se regresa y por las puras subes con tacho, ya esperas o vuelves con el tacho. Así estamos. Esa es la… trajín que hacemos.

También bajo la manguera, lo enrollamos, bajamos, todo lo metemos acá.'

'My barrel is up the hill, at the oval [in the road]. I take it back down here, I don't leave it there.

Here it is. This barrel I take [up the hill] and roll out the hose, pull it down [the stairs], fill my shower, fill my barrels here, two small ones, and I'll [do another round to] come down again.

I don't leave it [up there]. Because I already lost one….they stole it. Emptied the water and stole my barrel. Five years ago that was. Since then I take my barrel back down with me. […] It was a good barrel, as my children were smaller and you had to draw water, I left my jug up there, [thinking] "ah, I'll buy [more water] another day", I'll leave some water in there, but one day I get up there, what a surprise – there's no barrel, no one has seen anything, no one knows anything. Well, so I had to buy another barrel. That was about PEN80. For PEN80 I bought a new small one.

I don't want to mistrust anyone, so now I bring my barrel down here. Now I walk [up and down the stairs] together with my barrel.

I take the barrel up the stairs, fill it with water, bring it all down, and the same again. With the hosepipe, yes. I have 70m of hosepipe.

I buy twice a week, Saturday and Monday. Now, this….everything….my water has now run out, tomorrow I'll be buying now.

Here for my shower I have another small barrel. I fill it and what's left and use it for this. This one serves to cook, to wash my dishes, and if I'm short of water for washing clothes or for the bathroom, I'll take some of the water from the shower.

Then behind [in the back yard] I have another barrel. And one in the living room. And one in the kitchen. That one's already empty now.

Now they leave the oval [up on the road] empty. Only the woman who lives right opposite keeps her barrel there because she lives so close by, only her barrel is there permanently. The rest of us bring ours down [the stairs]. My neighbour here also carries her two barrels up and down [the stairs].

As the water truck approaches from there, we, while he's at the other corner, over there…at that moment you already need to be going up the stairs with the barrel [to catch him]. Quickly. And sometimes he comes back quickly, too, when he's run out of water, he comes back and in the end for nothing you run up the stairs with your barrel; then either you wait or you take your barrel back down. That's what it's like. That's our….comings and goings.

I also take the hosepipe down, we roll it up, bring it down, and store it all here.'

7.3 Effects of control

The foregone analysis of perceptions of control uncovered a spectrum of actions taking place to control water-related challenges within a context of strong perceptions of lacking control over those challenges. In order to shed further light on the emerging discrepancy between perceptions of control and efforts to successfully exert control, and ultimately to understand if perceptions of control contribute to resilience to water-scarcity, I now examine the effects of attempts to exert control over the water scarce environment.

To establish if people's perception of control is related to their ability to exert control for a positive outcome, a definition of control beyond that of its perception is necessary. Four operationalizable concepts adapted from the literature on power[31] (Wrong, 1979) serve to delineate the boundaries of overt and social control: Intentions behind compared to outcomes of control; the effects of attempts to exert control; the extent to which the water-scarce environment can be controlled; and the boundaries within which such control can be exerted.

Intentions

For effects of control to be observable, an 'intended and effective influence' (Wrong, 1979:3ff) over another person, a group or a situation must be observable. Wrong distinguishes such an overt exercise of control from the social control that is employed as part of the natural process of socialization, whereby social norms and values are internalized and as such cannot be said to constitute explicit intentions to exert control. Wrong identifies such social control through being generally exercised by groups over individuals, whereas overt attempts at control can take the opposite form of an individual controlling others. The latter is examined here, as overt intentions to exercise control over others and situations are both observable from the data.

Chapter 3 had outlined how participants' abilities to exert control over the water scarce environment are ultimately shaped by the covert, yet wide-reaching control that national and local governments and wealthy elites

[31] Section 2.2.2 has discussed the differences and overlaps between the concepts of power and control.

exercise over the urban poor through the persistent failure to address inequitable access to water. Data was not specifically collected to examine the intention of such elites, but the literature scrutinizing this phenomenon suggests that the effects of this are seen in the persistent lack of access to water and sanitation by a large part of Lima's poor population (cf. chapter 3).

At the scale of the neighbourhoods, attempts to exert both positive and negative influence over others were observed. In Villa Sol, many residents recounted their lives being influenced by corrupt and ineffective representatives through their inadequate and unfair representation of residents' interests. This had the effect of not advancing issues related to water provision sufficiently fast or thoroughly, leading to severe delays, embezzlement of communal funds, and widespread disillusion.

'Cinco el metro cuadrado ha comprado. A nosotros también estaban diciendo hace tiempo "compra", sino que los dirigentes decían no, que… reversión al estado, dijeron que el área… iba haber… no había nada, nosotros hemos ingresado, y entonces va haber reversión al estado. Y nosotros reversión al estado, esperando, esperando reversión al estado han pasado los años y ahora está caro el terreno, ha subido. Si ese tiempo nomás nos hubiéramos puesto las pilas, hubiéramos juntado, hubiéramos hecho actividades, entre toda la población hubiéramos juntado, juntado, y así hubiéramos comprado a cinco dólares el metro cuadrado. Pero el dueño de acá siempre nos ha dicho así, treinta dólares, veinte dólares, treinta dólares…Ahora está cincuenta dólares, cada vez está subiendo más y más.'

'[They] bought [their land] at $5 per square meter. All this time ago, they also told us [to] "buy", except the representative said not to, that….the land would go back to the state, […]…..there was nothing, we came in, and so the land would return to the state. So we wait and wait for the land to return to the state, and years have passed and now the land is expensive, [the price] has gone up. If at the time we would have got our act together, united ourselves, organized some activities, got together with all the neighbourhood, together, then we would have bought at $5 per square meter. But now the owner here has been telling us $30, $20, $30…..now it's at $50, it just keeps going up and up.'

'Las dirigentes no ponen su parte. Estamos en nada ahorita. Por ejemplo el dirigente nos dijo para plano visado noventa soles nos tocaba por moradores, hemos pagado todo y no se sabe hasta ahora. Esos son razones para que la gente ya se rebelaron, o sea ya no quiere participar tampoco pues, ¿no? Y ahora nos dice "ah, no, la tesorera se ha ido llevando la plata", o sea no hay serio las cosas que respetan, ¿no? Uno que tanto esfuerzo hacemos para poder avanzar, para poder solucionar nuestros problemas, pero no pues.

Cambio de dirigente hemos hecho varias veces… Varias veces y nada, ninguna. Otro dirigente acá atrás también igual dijeron, acá la otro dirigente pero ahí también se ha quedado.'

'The representatives don't pull their weight. There is nothing new now. For example the representative told every resident to pay PEN90 to get the neighbourhood plan approved. We paid and until now we've not heard anything. That's why people have already rebelled, or rather don't want to participate any more, right? And now he tells us "ah, no, the treasurer has run off with the cash", or rather they're not serious and don't respect [people], right? All this effort to make progress, to resolve our problems, but nothing comes of it.

We've changed the representatives several times [already]…several times, but nothing, no one [is better]. They said this other one over here was the same, there the other one also hasn't changed.'

Villa Sol residents

In Absalón Alarcón, the representative displayed strong intentions to exert as much control as possible to secure all residents' contribution towards the communal goals of the neighbourhood, with a longer term view of water and sanitation provision. This intention was largely effective in that it forced, through strong financial incentives and intense peer pressure, widespread collaboration in communal efforts towards titling and service provision. In this case, it can be said that control indeed was exerted, with its effects clearly observable.

Lastly, residents deployed a range of responses to exert control over the multitude of daily manifestations of water scarcity, but, as previous sections have shown this not to be perceived as exercising control, it cannot be said that such actions were preceded by intentions to exercise control.

Lastly, contesting Wrong's assertion that socialization is entirely separate from the exercise of intended control, the data from La Nueva Rinconada shows that in a context of socially constructed and persistent water scarcity, the process of socialization is partly characterized by living in a water scarce environment, and is as such not clearly distinguishable from the overt exercise of control. Those growing up in water-scarce environments are, within and across generations, socialized to internalize parts of the water scarce environment as 'normal'. As a result, persistent water scarcity affects subsequent generations' perception of the water-related environment. Livelihoods and human potential are widely impacted by the persistent lack of water, and the control exercised over its availability and access. When normalization processes prevent dimensions of daily life from being identified as intended attempts to exercise control, people are denied the opportunity to realize the exercise of control as such and react and mobilize accordingly. It appears that in Lima, the exercise of political control over water permeates socialization processes and blurs the boundary between the two, with detrimental effects.

Effectiveness

Control can further be observed by studying its effects. Wrong (1979) argues that when no effects (positive or negative) are observed, it is unlikely that control was exerted. However, as this study is interested in the quality of outcomes, and as the analysis has uncovered severely constrained

deliberation, action and decision-making spaces as a recurring theme; this suggests that in a context of socio-politically constructed water scarcity, control may well be exerted, but without the desired effects being produced. This section therefore explores the relationship between intentions to exert control and the quality of responses aimed to control the water scarce environment. Three afore-discovered themes are given further nuances by this examination: normalization processes; constrained deliberation-, decision-making and action spaces and short-termism.

Processes of normalization were seen to eradicate perceptions of some aspects of the water scarce environment as problematic and requiring attention. As a result, whilst responses to those problems took place, they were characterized by a lack of specific and problem-focused intentions and mostly failed to address the full magnitude of a particular problem. This is further highlighted by revisiting the afore-discussed notion of constrained deliberation-, decision-making and action spaces with a particular focus on the timescale of controlling water-related problems. Within severely constrained deliberation, action and decision-making spaces, participants tended to solve water-related problems in the short term, with solutions likely to entail additional problems requiring further actions. In such instances, the exercise of control may achieve the intended outcome in the short term, but fail to resolve the issue in the long-term.

Extent and comprehensiveness

The 'extent' of control examines how widely control is exercised by looking at the ratio between people on either side of the controlling-controlled relationship (Wrong, 1979). Chapter 3 had discussed how in Lima, a minority controls water provision for the majority of urban poor, suggesting that control is extensively exercised over water by elite minorities over the majority of poor urban dwellers. Here, then, I move on to examining the notion of 'comprehensiveness', which aims to delineate the number of areas or different situations that those exercising control have influence in. Wrong (*ibid*) suggests that control can be exerted not only over others, but also independently of others over situations, or in relation to the self.

I here examine to what extent, within the context of having water access, availability, quality and pricing controlled by wealthy elites, residents of La Nueva Rinconada are able to exercise control over the water-related

environment. This examination was guided by the question to what extent participants control the water-related environment; compared with the extent to which constraints of the water-related environment control their lives.

The notion of 'water as a non-negotiable' is given further nuances here. We had previously seen that water, being a vital and non-substitutable aspect of many dimensions of daily life, is 'non-negotiable' in that participants were forced to respond to water-related challenges whether they recognized them as problematic or not. We had also seen that exercising control over other aspects which were reported to constrain quality of life, such as titling issues or electricity provision, whilst seen as equally or more challenging (titling provision) or more easily circumvented (electricity provision), did not affect daily lives in as comprehensive a manner as the lack of water and sanitation did, nor did these issues attract as extensive and frequent a range of responses.

Thus, the constraints of the water-scarce environment exert control over all areas of life and well-being. This was observed in relation to the established categories (quality, quantity and security of access) used to measure water scarcity, and in a range of areas beyond. These include, for example, the inability to make use of local services such as employment, healthcare or educational facilities due to the need to wait at home for unpredictable water deliveries. These examples show that the extent to which livelihoods are controlled by the water-scarce environment extends to dimensions far beyond those of immediate water use.

In summary, an imbalanced relationship of control prevails whereby people's lives are controlled by the water-scarce environment to a very large extent, whilst the areas in which they in turn can exercise effective control over the water-scarce environment are very limited.

The notion of control in relation to the self – one's actions, thoughts or perceptions in relation to a constraint – can under certain circumstances provide valuable means of addressing a challenge (Wrong, 1979). However, as the water and sanitation situation is so precarious, and demands a large array of non-negotiable daily responses to address its constraints, participants' accounts revealed a very limited scope for exercising control in relation to the self. A number of areas were reported where such control was exercised, such as differential intra-household allocation of water for personal hygiene; or

reduced consumption of drinking water to lessen the stress on sanitation facilities. Whilst these actions can theoretically be said to constitute effective attempts to control aspects of the water-scarce environment, they are again characterized by meeting a short-term goal with a high likelihood of attracting additional problems in the longer term.

Intensity: The boundaries of control

The notion of the 'intensity' of control delineates the boundaries within which control can be exercised without the context it relies on breaking down (Wrong, 1979). This implies that if those subject to control can cause the context under which they are being controlled to break down and remove the circumstances under which they are controlled.

The starting point for examining the boundaries of control over the water-scarce environment is a hypothetical one as water is vital to daily life. Water being a non-negotiable and non-substitutable resource of daily life, no instances of any context related to water breaking down were observed or reported. On the contrary, I showed how participants attempted at all times to exert control over their water-related environment, regardless of whether the challenges triggering these responses were actively perceived or not.

Nevertheless, imagining scenarios of the contexts of control over water breaking down can provide a useful additional dimension to our understanding of the notion of control over water. I do this in relation to the three tangible categories of water scarcity: quality, quantity and security of access, with a view to understanding the boundaries of control and roles of key stakeholders in the struggle to control water access, purchase, storage, treatment, use, reuse and discarding. For each of these, I first outline who controls a particular aspect, and then examine whether a scenario of this control breaking down is conceivable.

The ultimate break down of the context of control over water would be for end users to stop buying trucked water. This happens only in isolated instances, which in turn are rarely under the control of residents, but instead driven by chance events, such as a neighbourhood receiving a standpipe, or obtaining a plot at the edge of the settlement in proximity to neighbours who are willing to illegally sell water from the grid.

Water quality is influenced by the water source, its treatment and storage by suppliers, means of transport to the settlement, and storage by end users. In

chapter 5, we saw that residents of La Nueva Rinconada have no control over any of these factors, except that of end user storage, which was seen to be only partially addressed due to lack of awareness and restricted economic means. Residents therefore have no comprehensive means for controlling water quality, and, due to being dependent on trucked water for daily survival, no leverage for causing the established context of control over water quality to break down.

Historically, circumstances have once forced the temporary breakdown, and relative rearrangement, of control over water quality in Lima. During the 1991 cholera epidemic, considerable loss of life led to the beginning of water reforms and regulations, which are, however, far from fully implemented (Fernández-Maldonado, 2008). The context of control over water temporarily breaking down was at the time caused by the still persisting causes of inadequate public health infrastructure (Greenpeace, 1998; Tickner and Gouveia-Vigeant, 2005), so cannot said to have arisen out of individuals' efforts to exert control.

The quantities of water residents use is controlled by the number and frequency of trucks accessing different neighbourhoods, and by end users' ability to purchase and store water. Residents have only very limited control over the number and frequency of water trucks accessing their plot. Chapter 5 outlined that this is largely controlled by how close to a main road a plot is located, and by how many customers a truck expects to serve along a certain route. When customers are in desperate need of water, they try and exercise control over water deliveries by calling out to passing trucks to access their area. These calls are sometimes responded to, and other times they remain unheard.

When water is delivered, and assuming that a truck has plenty to sell, end users have some control over how much water they buy. This is, however, diminished by water being costly and easily perishable. Nevertheless, due to lack of control over secure access to water, those who are economically able to, exert control over water quantity by over-buying, which in turn entails storage challenges, which we have seen to negatively affect water quality and impact on living space. Other ways of exerting control over the amount of water used are reduced consumption, where we saw the drawbacks of negative impacts on health and self-image. Control is also exercised by those living on high-frequency routes by buying smaller quantities, thus minimizing the negative effects of over-spending and water perishing. In conclusion, the

context of the control over water quantity breaking down in unthinkable whilst the system is truck-based.

The context of insecure access to water is entirely controlled by an informal trucked supply network which operates roughly according to the laws of supply and demand, except that supply does not always meet demand in all circumstances, as described in chapter 5. With an almost complete lack of alternative water supply, except for those contexts described above, residents have no power to cause the context that controls water supply to break down. Residents' scope for exerting control over insecure water supply is therefore extremely limited. With plots highly contested and moves within a neighbourhood strictly controlled according to length of stay and resulting eligibility in annual lottery bids for any vacant plots, moving plot to strategically improve access to water is difficult. Residents' only control over this is to persevere by staying in the neighbourhood long enough to become eligible for the plot lottery, but with few plots becoming vacant, chances of winning the plot lottery are slim.

These three aspects of water provision show that the non-negotiable and non-substitutable nature of water, in combination with political ill will to redress the balance of inequitable water provision in Lima dictates that controlled-controlling relationships within informal settlements are maintained, without any recourse by residents to cause this context to break down, and to reclaim control in this way. As a result, residents are trapped in a context which reduces their ability to exert control to the daily and domestic scales. This was seen to result in residents controlling the water and sanitation environment to enable short-term water use, but without ever placing ultimate control over their water-related environment in their hands.

7.4 Conclusions : Controlling the water scarce environment in La Nueva Rinconada

Comparing participants' perceptions of control over life in general with those of the water-related environment, an inextricable interweaving of internal and external loci of control emerged in relation to the former, whilst the water-scarce environment engendered an almost complete lack of perceptions of control.

The unescapable combination of internal-external locus of control is a further indicator for the previously identified constrained deliberation-, decision-making and action spaces which residents of La Nueva Rinconada occupy. The examination of perceptions of control provides additional nuance to what shapes these.

Government rhetoric to enforce internal loci of control perpetuated residents' perceptions that they were largely to be held responsible for the delay in achieving the aim of water and sanitation provision whilst at the same time becoming increasingly aware that they had little or no control to advance these issues, as power to do so was held by others. Having become trapped in physical and mental exhaustion from the Sisyphean task of trying to achieve the conditions for change prevented them from mobilizing resources towards alternative, and potentially politically more disruptive means of achieving their aims. These findings give rise to the question whether, in the face of such an overwhelming array of tasks with relatively poor means of achieving these, it is easier to dedicate oneself to time-consuming tasks which require comparatively less mental effort than to the task of considering alternatives. Residents' constrained deliberation, decision-making and action spaces are thus characterized by an inescapable combination of internal-external loci of control.

This finding was further strengthened by the observation that processes of time bear on constrained deliberation-, decision-making and action space. We saw that residents achieved short term goals, such as being in control over their own home, but were unable to advance their longer term goals, such as securing land tenure and progressing the physical improvement of their homes. As a result, they found themselves trapped in a limbo characterized by the perpetual pursuit of short term gains at the cost of longer-term aims.

In contrast to this mixed internal-external locus of control in relation to life in general, we saw that the water-scarce environment produced a near-complete external locus of control, both in relation to the wider socio-political forces affecting water provision, and in relation to domestic water use. This arose out of a combination of features characterizing a context of unpredictability, rapid change and scarcity of resources. Ultimately, the strong external locus of control in relation to these issues arose out of a context of multiple scarcities, which occupied residents' time and resources, and made the delegation of some responsibilities to elected neighbourhood representatives necessary. This casts an interesting light on the boundary between internal and external loci of control. Those elected to represent others have a moral, as well as legal duty to serve their electorate, which, in theory, should compel them to extend perceptions of control into the realm of their duties. Residents should feel that although they are not personally in control of certain issues, those representing them will serve their interests, and act as an extension to individuals' locus of control. The evidence documenting a strongly perceived external locus of control in La Nueva Rinconada suggests that delegating tasks to representatives equates to relinquishing control.

The unanimous and far-reaching external locus of control further indicates that residents have internalized the experience that their efforts are not effective in addressing the problem of water scarcity. This has resulted in a clear loss of faith in their abilities to address the problem successfully at the socio-political and at the domestic scales. This is worth emphasizing, as it is indicative of the longer term effects that the repeated negative experience of failing to control the water-related challenges of their environment can have. Basgall and Snyder (1988) showed in experimental circumstances that those with an external locus of control, after receiving negative feedback, 'expressed less satisfaction with their performance' (*ibid:* 660), or, in other words, assessed their ability to meet challenges as less positive. This suggests that the repeated frustration of participants' initially successful internal locus of control might, over time, lead to a widespread external locus of control, which, as Basgall and Snyder (1988) show, is likely to further impair residents' ability to deal with the multiple challenges of the water-scarce environment. Among the study community, the locus of control principle may be at work in reverse of its original configuration, and subject to the negative feedback mechanisms outlined by Basgall and Snyder. The locus of control model predicts that when a person perceives themselves to be in

control of a challenge, they tend to have better outcomes. Here, as efforts to exert control are repeatedly frustrated, participants' perceptions of their ability to exert positive control towards longer term aims are adversely affected. The data from La Nueva Rinconada suggests that a negative spiral may form as a result; whereby repeated lack of 'success' in exerting long term control over the water-scarce environment results in a shift from an internal to external locus of control, which in turn adversely affects participants' ability to exert positive control in the longer term. Figures 7.6 and 7.7 illustrate:

Original Locus of Control Model

Perception of personal control (internal locus of control)

↓ *leads to*

Better Outcomes

(After Mason et al, 1976; Lefcourt, 1982; Borden and Hendrick, 1973; Lazarus and Folkman, 1984)

Figure 7.6: The original Locus of Control Model

Revised Locus of Control Model

Repeated failure to achieve positive outcomes

↓ *adversely affects*

Perceptions of personal control

↓ *result in*

Loss of faith in ability to exert control
(shift from internal to external locus of control)

↓ *adversely affects*

Ability to exert positive control

(After Basgall and Snyder (1988) and as evidenced by data from La Nueva Rinconada)

Figure 7.7:

The revised Locus of Control Model charts the effects of repeated negative feedback on perceptions of personal control

Examining the discrepancy between perceptions of control and efforts to exert control along a series of observable indicators uncovered several nuances to previously uncovered findings, as well as a number of additional aspects.

We saw that intentions by neighbourhood representatives to exert control resulted in desired outcomes of community participation, but this raises the question whether exerting control forcibly is justifiable for a positive aim and outcomes, and whether forcibly exerting control in such circumstances can usefully contribute to resilience to water scarcity.

The data from La Nueva Rinconada contests Wrong's (1979) assertion that social and overt control are separate entities, as normalization processes were seen to blur the boundaries between both. The interplay of time with normalization processes was found to be an important factor impacting on resilience to water scarcity. As normalization eroded perceptions of problematic aspects of water scarcity, subsequent responses were rendered inadequate and resulted in short-term solutions with associated longer-term problems.

We saw that the water-scarce environment exerted control over residents' lives to a disproportionately larger extent than residents were able to control this environment in return. In particular, livelihoods were constrained by the impacts of unpredictable water supply, which forced residents to forego a series of local services to attend to the need to obtain water.

Examining the notion of control in relation to the Self revealed a very limited scope for exercising control in this manner. Of the instances where self-control was observed highlighted that this took place in such constrained action-and decision-making spaces that it cannot reasonably be considered a desirable attempt to control water scarcity, as any such actions were seen to attract further, more severe problems than those they resolved. This observation lends support to the notion that control is neither desirable nor acceptable in relation to all aspects of life. Instead, some areas, including the provision of basic services, should be the responsibility of political institutions. The exerting of control in relation to the Self is humanely and morally unacceptable in the context of a vital and life-sustaining resource like water.

Lastly, the examination of the boundaries of control revealed that in a context of politically constructed water scarcity, and due to the vital nature of water to everyday life, residents of La Nueva Rinconada have no power to cause the water-

related context to break down. Within this all-encompassing lack of control over the situation, only once instance of exerting control over the security of access to water was observed. As the possibility of strategically moving plot to improve water provision requires several years of paying dues to the neighbourhood through continued residency and chances of 'winning' the lottery are slim, the costs of such an option are extremely high.

This chapter's findings point to considerable discrepancies between perceptions of control and subsequent actions to exert control on the one hand; and to a dynamic interplay between internal and external perceptions of control on the other, which is likely to impact the capacity for resilience to water scarcity. The following chapter therefore examines residents' responses to water scarcity in more detail with a view towards shedding further light on the parameters that affect resilience to water scarcity over time.

Chapter 8:
Responding flexibly to water scarcity

8.1 Responding flexibly to water scarcity

With its focus on action, the concept of flexibility serves well to complement the foregone examination of perceptions towards a holistic picture of the parameters that shape resilience to water scarcity. It has been suggested that responding flexibly to environmental challenges affords a good chance of long-term persistence in rapidly changing contexts. If responses to environmental changes happen fast enough and at a sufficient scale to meet a challenge, but at the same are minimal enough so as not to rule out responses in the opposite direction should contexts and challenges change in future (Thomas, 1997:197), the resulting flexibility affords a good chance of continued persistence in environments of rapid change and scarce resources.

This chapter sets out to understand the nature of flexibility in residents' responses to water scarcity in La Nueva Rinconada along the concpet's defining parameters (cf. section 2.2.3). The first part of the chapter describes manifestations of flexibility in response to water scarcity by examining four of its observable dimensions. These comprise (1) a temporal dimension; a fast-enough response (e.g. Thomas, 1997; Golden and Powell, 2000; Gustavsson, 1984); (2) a spatial or scale-related dimension; a response extensive enough to meet the challenge (e.g. Thomas, 1997; Gustavsson, 1984); (3) intention, which examines whether people take a proactive or reactive stance to change (e.g. Golden and Powell, 2000); and (4) focus, which considers the area where flexibility is created (Golden and Powell, 2000). The chapter's second part analyses the nature of flexibility as evidenced by these observables, and presents a series of vignettes to illustrate three considerable costs that arise from responding flexibly to water scarcity. The chapter concludes by discussing the implications of the nature of flexibility observed in La Nueva Rinconada for flexibility theory, and outlines limits to the concept's desirability.

8.2 Examining flexibility

8.2.1 Time

When a person's livelihood is challenged by a change in the environment, it is vital that responses occur fast enough to meet this challenge (Thomas, 1997; Golden and Powell, 2000; Gustavsson, 1984). In a context of water scarcity, this means that residents need to act fast enough to ensure they have sufficient good quality water available when they need it. Through the temporal dimension of flexibility I examined the timeliness of participants' responses to the various challenges of water scarcity. This is conceived of in two major ways, which examine the timeliness of (1) perceptions of, and (2) responses to water scarcity. For each challenge encountered, the 'critical' time span within which participants perceived a water-related challenge and responded to it was examined and an assessment made whether this was fast enough to meet the challenge encountered. Two complementary means of analysis establish (i) whether a challenge is perceived to be affecting short, medium, or long term aspects of life, and if each of these is perceived to require daily, occasional or infrequent responses; and (ii) whether responses take place to meet daily challenges, improve a situation through thinking ahead, or involve long term plans. Appendix E, table E1, summarizes.

The analysis of the timeliness of participants' perceptions of and responses to water scarcity shows these to be heavily characterized by short-termism. This takes two main forms, short-term successful responses without regard for longer term outcomes, and short-term successful responses which engender more substantial problems in the long term. These exist alongside several aspects of water scarcity that residents are entirely unable to respond to. Table 8.1 summarizes the observed categories.

OVERALL CATEGORY OF WATER SCARCITY	Individual Measure of Water Scarcity	Predominant Time Scale of Responses							
		1. Mostly Short term	2. Short and medium term	3. Short, medium and long term	4. Short and long term	5. No Response possible	6. Are actions taken within the critical time span?	7. Highest level of commitment required	8. Are costs associated with the response taken?
Water quantity	Drinking water	√					YES	Some effort & commitment	YES
	Food preparation	√					YES	Little effort & commitment	YES
	Sanitation			√			YES in the short term, NO in the long term	Considerable effort & irreversible changes	YES
	Personal hygiene		√				YES	Some effort & commitment	YES
Water Quality	Physical, chemical, microbial	√					YES in the short term, NO in the long term	Some effort & commitment	YES
	Provenance					√	NO	Exceeds participants' ability to commit/ respond	YES
	Length and location of storage			√			YES in the short term, NO in the long term	Considerable effort & irreversible changes	YES
Security of Access	Location of neighbourhood			√			NO	Considerable effort & irreversible changes	YES
	Location of dwelling			√			NO	Considerable effort & irreversible changes	YES
	Rainfall					√	NO	Exceeds participants' ability to commit/ respond	YES
	Storage capacity			√			YES	Some effort & commitment	YES
	Social relations			√			YES	Considerable effort & irreversible changes	YES

Table 8.1: Timeliness of responses to water scarcity, associated levels of commitment and resulting costs

Participants' responses to the various dimensions of water scarcity occur fast enough to meet the challenge encountered in 5 out of the 12 categories (green), whilst in 3 categories responses occur fast enough to address the challenge in the short term, but not in the long term (orange). In four areas, participants' are unable to respond in the critical timescale (red).

Levels of commitment and effort required are inconsistent with the quality of outcomes.

Regardless of whether responses occur in the critical time span or not, and regardless of the level of commitment associated with a response, costs of varying magnitudes arise from all observed responses.

In 5 of the 12 aspects of water scarcity (table 8.1, green highlights), participants perceived and responded to challenges at short notice, with immediate effect, and produced sufficiently swift responses to meet challenges within the critical time span. Lack of water for drinking, food preparation and personal hygiene were perceived to be common constraints on everyday life which occurred frequently. As they were relatively easily addressed, requiring minimal commitment or effort apart from time, participants did not perceive them as 'events of crisis'. As they constitute daily water needs crucial for survival, residents had developed well-established means of dealing with these aspects of water scarcity. The use of storage capacity and social relations to contribute to secure access of water, on the other hand, were perceived to affect residents' lives in the medium and longer term, and were seen to require larger efforts in the form of expenditure for water storage infrastructure, and larger sacrifices, for example in giving up valuable living space to store water. Other responses involved irreversible commitments, such as for example the decision to move to an inaccessible plot in an inconveniently located neighbourhood to be near family and friends, whose support would be crucial in times of water crisis.

In 3 aspects of water scarcity, (table 8.1, yellow highlights), residents perceived and responded to challenges in a timely manner to address them in the short term, but not in the long term. Indeed, the short term solutions to these aspects of water scarcity tended to engender larger problems in the longer term. Water use for sanitation purposes and manipulating the length and location of storage to improve water quality were perceived to affect livelihoods in the short, medium and long term. Participants were highly aware of the dilemma of needing to use water to hygienically use and maintain their pit latrines, whilst at the same time being forced to reduce water use so as to avoid the latrine filling up quickly. Whilst the short term dilemma was keenly felt and expressed, it was not translated into a widespread awareness of the longer term problems that are guaranteed to arise from the sanitation bottleneck. Equally, participants were aware of the need to store water for consumption in cleaner, better maintained containers. Lack of comprehensive knowledge of how to use such water, however, resulted in further contamination, for example by transferring water by hand, using jugs. As a result, participants' short-term solutions of using cleaner storage containers created further problems in the longer term due to inappropriate use. At the same time, both these aspects of water scarcity required considerable efforts (e.g. the digging of pit latrines, or giving up valuable

living space for water storage) and long-term commitments (such as large investments). Poor water quality arising from physical, chemical and microbial aspects was perceived and responded to in the short term only. As participants had been given conflicting and inconsistent information, and perhaps because of general low levels of awareness, only visible aspects of poor water quality were perceived and responded to through a range of inconsistently applied means, such as boiling or chemically treating water. This aspect of water scarcity required some effort, mostly in investing time, as well as financial commitments, from participants.

The 4 remaining aspects of water scarcity (table 8.1, red highlights) afforded no possibility for participants to respond in a timely manner. In these cases, the parameters for action were entirely outside residents' action and decision-making space. The provenance of poor quality water and the use of rainfall to contribute to water security afforded no possibility for residents to respond, and as a consequence, no effort or commitment was made. Changing plot or neighbourhood to improve secure access to water were considered difficult within crucial time spans. Nevertheless, residents went to considerable efforts to try and obtain a more conveniently located plot within their neighbourhood, or move into a more accessible neighbourhood. As both initiatives were difficult to arrange, required long waiting times, and depended on a number of factors largely outside of individuals' control, residents were mostly unable to employ these strategies to respond to water scarcity in a timely manner.

In summary, participants' responses to the various dimensions of water scarcity occurred fast enough to meet the challenge encountered in some areas, whilst in others responses occurred fast enough to address the challenge in the short term, but not in the long term. In some areas, participants' are unable to respond in the critical timescale. Levels of commitment and effort required were inconsistent with the quality of outcomes. Regardless of whether responses occurred in the critical time span or not, and regardless of the level of commitment associated with a response, costs of varying magnitudes arise from all types of responses. These will be discussed in section 8.3.2.

8.2.2 Scale

Flexibility in responding to water scarcity can further be observed by examining the 'scale' dimension of flexibility, which refers to the extent to which participants respond to foreseeable and unforeseeable challenges, and the range of options that are available in doing so. Foreseeable and unforeseeable challenges are seen as the opposite ends of a continuum (Golden and Powell, 2000:377). Foreseen challenges are examined by assessing whether responses are planned, and how risk is assessed in doing so. Unforeseen challenges are examined to understand how uncertainty is dealt with and whether new opportunities are made good use of. Appendix E, table E2, summarizes.

Perceptions of risk arising from foreseeable dimensions of water scarcity were seen to be inexistent, limited, or at best incomplete, in that mostly short-term implications of risk were perceived. While the full extent and longer term consequences of such risks revealed itself over time, the effects of this were diminished by participants' simultaneous normalization to these risks. For example, participants were aware of the risks of ill health, additional workload and loss of comfort associated with moving to a zone without water and sanitation provision. As the full extent and implications of this were only gradually revealed once residents had settled in the zone, this increased risk awareness was negated by a simultaneous normalization to these risks. This can be explained by the persistent exposure to these risks and the overwhelming number of risks to navigate on a daily basis. Additionally, every resident's hope of gaining land titles was seen to override or at least diminish perceptions of risk.

Such normalization prevented 'out of the ordinary' perceptions of risks paving the way for invention or previously untried responses. As most challenges of water scarcity occurred repeatedly, if not predictably, participants expected to be dealing with these as part of their daily routines. This affected the ability to respond in that it had led participants to develop a range of relatively efficient and to some extent 'tried and tested' responses which prevented spontaneous action or the development of new solutions to well-known aspects of water scarcity.

Thus, responses to foreseeable events, although planned in advance and not requiring irreversible commitments or large efforts, cannot be said to be creating flexibility in responding to water scarcity as they attract considerable costs whilst failing to address the full breadth of the challenge. Two examples drawn from participants' treatment of water for drinking purpose illustrate this. We saw that treating water for drinking purposes by boiling or through the addition of

chemicals is haphazard and inconsistently applied, addressing only some aspects of poor water quality. Whilst this response to an aspect of water scarcity is planned, does not involve excessive resources or irreversible commitments, it nevertheless fails to create flexibility in responding to water scarcity as it not only fails to fully address the breadth of poor water quality, but in addition attracts considerable costs, such as long-term risks to health, in the process. Another example concerns residents' choice to reduce drinking amounts if daily allowances of treated water have run out due to the time intensive nature of the process, resulting in under-consumption. This cannot be interpreted as a flexible response to a foreseeable challenge as it fails to satisfactorily address the challenge of lacking good quality drinking water and carries considerable long term health implications.

A number of aspects of water scarcity were considered unforeseeable by participants, despite a high awareness of associated short term risks. As a result, no responses were prepared, or responses were deployed to mitigate ill effects only after they had occurred. Such misestimations occurred across the three scarcity categories of quantity, quality and security of access, and included the perception that running out of latrine space was unforeseeable (despite awareness that increased water use led to rapid filling of pit latrines); and that gastrointestinal infections caused by poor quality water should be treated through medical attention rather than better treatment of water prior to consumption (despite a general knowledge that poor water quality adversely affects health).

Lastly, the almost all-encompassing lack of new opportunities arising from the various dimensions of water scarcity is striking. Several factors explain this. First and foremost, water's essential and non-substitutable role in sustaining daily life (Savenije, 2002) means that its lack is unlikely to give rise to positive opportunities. Secondly, the aforementioned processes of normalization prevent extraordinary perceptions of water scarcity giving rise to new opportunities in responding to it.

An isolated instance of an 'opportunity' arising from the wider context of water scarcity is seen to further perpetuate deeply engrained water scarcity rather than providing the opportunity to challenge it. Absalón Alarcón, thanks to its representative's good relations with the municipality, was in receipt of a weekly delivery of good quality water by the municipality. This water was reported to be

free of charge, but in reality each recipient paid the driver of the water truck PEN0.50 per delivery, as a 'tip for his fizzy drink'. Water was not delivered to those who did not tip. Residents saw the tip as an entirely acceptable exchange, as it represented ¼ to ⅕ of the price of a barrel of the poorer quality water they usually bought.

Whilst this example shows that the single opportunity arising from pervasive water scarcity allowed residents to make use of it by enjoying a weekly delivery of better quality, good value water, it is at the same time illustrative of inequality and corruption within the settlement. Only those neighbourhoods whose representatives maintain good relationships with the municipality receive this water. Corruption of the municipal employee presents additional limitations to residents' abilities to make good use of this 'opportunity'. As a result, these weekly water deliveries act to only momentarily relieve the effects of water scarcity, and simultaneously force residents into complicity with underlying processes of inequality and corruption at the local and municipal scales, rather than providing the opportunity for contesting and challenging these.

8.2.3 Intention

Whilst change in the environment is ubiquitous, in responding to this we have a range of options available. The dimension of intention refers to the degree with which households take an 'offensive or defensive stance towards flexibility' (Golden and Powell, 2000:377). To allow a more nuanced exploration of the concept, I extend offensive/ defensive to include proactive/ reactive. Differences in definition of these concepts were useful guides in capturing the nuances of participants' perceptions about, and the natures of responses to the various dimensions of water scarcity. The term 'offensive' bears connotations of aggression or attack (Oxford English Dictionary, 2015), whilst being 'proactive' more neutrally refers to 'creating or controlling a situation (rather than just responding to it after it has happened)' (*ibid*). The term 'defensive' again implies an act of aggression in its definition of 'for the purpose of resisting attack' or 'to defend and protect' (*ibid*), whilst 'reactive' neutrally refers to 'acting in response to a situation (rather than creating or controlling it)' (*ibid*). The impact of participants' 'intention' in creating flexibility is assessed through temporal means by observing if action is considered or taken before or after a challenge has occurred. Appendix E, table E3, summarizes.

Four distinct patterns were observed in participants' stances to the manifold challenges arising from water scarcity. These are: a uniformly proactive stance; localised proactive stances within a wider reactive context; variable stances dependent upon participants' external circumstances; and a wide chasm in responding to the structural and practical aspects of the same aspect of water scarcity. All stances were found to have costs associated with the flexibility created. These are discussed in section 8.3.2.

Residents' responses were entirely proactive in responding to lacking sufficient water for personal hygiene and in employing social relations to mitigate the effects of insecure access to water. In chapter 5, I had discussed the widespread differential intra-household allocation of water for personal hygiene. In addition to this, all households saved water from activities such as soaking clothes for multiple reuse in bathing and washing. A proactive stance was thus seen to be fully incorporated into participants' everyday lives by ensuring suitable water was carefully stored, and exact quantities were heated to precise levels of comfortable temperatures to avoid over-use of costly gas whilst making the bathing experience as pleasant as possible, as is exemplified by one participant's account:

'El agua que utilizo para lavar la ropa no lo boto, porque eso utilizo para que vayan al baño. […]Porque es agüita limpia o de jabón o de Ace, o también lavo ahí, por decir, la parte del baño, el plástico o el tacho de basura, ahí lo lavo, no lo boto hasta que esté sucio, sucio. […]También para… cuando le baña al bebe, este… como en la noche ya, como todos andamos y vienen con los pies sucios, con esa agua se lava. Ahora le va a ver cuando le baña ahí, le baña en tinita y esa agüita de jabón con eso nos lavamos los pies…'

'The water I use for clothes washing I don't throw out, because I use it to bathe them [the children]. […] Because it's clean water, or soap water, or with detergent, or I also wash there, that's to say, in the bathroom, the buckets or the lids of the rubbish bins, I wash them in that water, I don't throw any water out until it's dirty, dirty. […] Also to…..when I bathe the baby,…because at night, as we all walk and they come home with dirty feet, we wash with this water. Now you'll see when I bathe him [the baby], I bathe him in the bowl and with this soap water we then wash our feet.'

Villa Sol resident

Where social relations contributed to securing water supply, proactive stances were observed in residents' settling in areas where they had pre-existing social relations, and in cultivating these relations, in some cases expressively with the intention of mitigating the effects of insecure water supply. Such a proactive stance, however, was clearly shown to arise out of need, rather than choice, as examples where social relations had deteriorated, shows. In such cases, the effects on water security were keenly felt, and clearly expressed. One participant expressed severe criticism of a neighbour's character, whilst stating that she

ensured to nevertheless stay on good terms with this neighbour as she owned a shop and was thus, in contrast to the participant's own very precarious economic situation, always economically able to buy water and lend or sell it on in times of crisis. Other examples concerned a participant recounting the drastic reduction in their ability to access water delivery and discarding points since a severe falling out with a neighbour who lives near the water delivery point had led to physical and verbal abuse.

One example of water storage to address insecure supply shows that flexibility can be created within an umbrella context of reactiveness by carving out proactive stances. Participants' responses to lacking secure water supply is reactive, as evidenced by households' storage capacity. As water deliveries are so very unpredictable, participants have no choice but to react to whatever situation presents itself in their particular neighbourhood and near their particular plot at any given time. Nevertheless, participants create considerable individual flexibility through a wide range of means of storing water to mitigate the effects of insecure water supply. Even though action to arrange water storage is taken once residents have occupied a plot, great ingenuity and initiative are shown to address the constraints of insecure water supply on an individual basis and in response to changing circumstances. In the variety of solutions that were observed in response lacking secure water supply, despite generally being forced into reactiveness, participants displayed a range of proactive traits, which allowed individual solutions to address, circumvent and mitigate the many unknown parameters of water supply in each situation.

In other aspects of water scarcity, participants' response stance was largely informed by external circumstances outside their personal control, such as, for example, the geography of their plot, which appeared to impact on residents' stance towards on-plot sanitation. On steep plots space for latrines is scarce due to the geographic constraints of such plots. This led occupants to strategize carefully to accommodate accessible living quarters and on-plot sanitation. These residents displayed high levels of awareness of the constraints of their plot, and a proactive stance to sanitation challenges. Those occupying a flat plot, on the other hand, displayed a reactive stance, as latrines were randomly placed on the more easily accessible external area. In these cases, the possibility of space for on-plot sanitation one day running out was considered to a much lesser degree. Easy accessibility and a consequent maximising of living space led to remedial

action of on-plot sanitation provision being taken after the problem had occurred, which is indicative of a reactive stance. Figures 8.1 and 8.2 illustrate.

'Si pues, no hay dónde botar. Lo único que tendríamos que hacer un hueco, o sea silo, ahí echar agua, cada uno en su casa. Pero acá en el cerro no se puede. ¡Roca es! Puro roca es esto. Puro roca. Nosotros hemos pampeado, sacado piedra, piedra, hemos hecho botar abajo todo…. Puro roca es. No se puede hacer hueco. Pa' nuestro silo también un hueco hice, un pequeño nomás y con ladrillo ya. […] para el baño no, no vacío al baño, sino se llena también y dónde hago otro silo, no se puede. Una vez nomás lo hemos cambiado porque ahorita no, porque cómo se llama, echamos cal, el cal lo seca todo.'

'Well, there's nowhere to throw [our water out]. The only thing we could do is make a hole, a latrine, to discard our water, everyone in our own house. But here on the mountain that's not posible. It's rock! Pure rock….we've flattened the ground, taken off stone by stone, carrying it all downhill….this is pure rock. You can't just make a hole in it. For our latrine we also made a hole, just a small one and brick-lined. […] for the bath [water], no, I can't throw my water in the latrine, otherwise it fills up and where would I put another one, it's not possible. We've just changed the location once, and now we use, what is it called, limestone powder, it dries it all out.'

Absalón Alarcón resident on steep plot

Figure 8.1:
A home constructed on a steep plot bounded by vertical drops and rises on both sides (top left and right) has forced its occupants' engagement with the problem of on-plot sanitation. Minimal space is available for sanitation (bottom left and top right), and the difficulty of digging pit latrines in the solid rock, as well as the distance to water acquisition and discarding points (bottom right) has resulted in occupants taking a proactive stance to the problem of sanitation.

'El baño esta al costado del patio. Por eso queremos el agua, agua y desagüe. Porque eso se necesita acá. Porque por el silo hay veces se llena, hace un hueco en otro lado, el otro lado está olor ya. Prácticamente, en doce años que estoy viviendo acá ya habré hecho como tres huecos ya, entonces casi ya no hay sitio ya para el baño. Y así se llena el hueco. Pero qué voy a hacer. A ver hasta dónde aguantaré.'

'*The toilet is in the courtyard. That's why we need water, water and sanitation. That's what's needed here. Because the latrine fills up after a while, you dig a hole in another location, and it already smells. In the 12 years I have been living here I would have made as many as three new latrine holes, so there's almost no space left for a new one. And so the hole fills up. But what can I do. We'll see how long I can bear it.'*

Absalón Alarcón resident on flat plot

Figure 8.2:
Two homes constructed on a plot on near-flat ground (top left and right) and close to water delivery and discarding opportunities (top left and right) results in occupants taking a reactive stance to sanitation challenges, which has resulted in space for pit latrines running out. The current latrine occupies that last free space (bottom left and top right, dark yellow). A number of earlier and now full latrine holes (top right, light yellow) are covered in stones (bottom right).

In both scenarios, the constraint reaching a bottleneck is entirely a matter of time, as both plot types are ultimately constrained by the lack of municipal sanitation provision. Nevertheless, the challenges of the steep plots appeared to bring the problem of sanitation to the forefront of participants' awareness and maximised opportunities for engaging with the problem before it reaches a bottleneck.

The most striking observation in examining participants' stance towards the various aspects of water scarcity concerns a large gulf between participants' stances to the two distinct components –structural and practical – of each aspect of water scarcity. The reasons for this chasm are various, and include disillusionment resulting from proactive stances having repeatedly failed to address the structural aspects of water scarcity; and residents being left no choice but to remedy the resulting problems in a reactive manner by addressing the practical, everyday aspects of the particular constraint.

For example, participants' stance to poor water quality, and particularly to the provenance of water adversely affecting its quality, was entirely reactive. Whilst some expressed anger about the unknown provenance of water, all agreed that they could do nothing to address the issue. Most had attended water marches in the past, but noted in a disillusioned way that they had spent days losing earnings through attending these marches whilst no change ever resulted from these actions. As a result, in 2012 all action to address poor water quality was taken after the problems arising from unknown provenance of water had occurred.

Another example concerns the treatment of water for drinking purposes. Chapter 5 had outlined that due to structural failings at many levels, water quality is poor, and participants expressively stated how they tried to address these problems. Due to inconsistent and insufficient levels of awareness of the extent of the problem, however, this proactive stance failed to fully address the problem of poor water quality, and people fall ill from inadequately treated water. They are then left with no choice but to reactively treat the effects of this through medication.

8.2.4 Focus

The last observable dimension of flexibility , termed *focus* by Golden and Powell (2000), refers to the 'area in which flexibility is created' (ibid.:377). It is examined by observing if flexibility is created by making changes to the internal system (e.g. through a change in attitude or the way a household is internally organized), or through relationships with external agents or the environment (e.g. through different means of acquiring resources or households forming support networks). Appendix E, table E4, summarizes. The areas in which flexibility to water scarcity is created among the study population are characterized by 6 different patterns, with a clear emphasis on the internal system emerging. Table 8.2 summarizes.

In 4 aspects of water scarcity, flexibility was created largely through internal systems, but complemented through external relationships (table 8.2, blue highlights). For example, the impact of length and location of storage on water quality was mitigated through changes to internal systems, such as the use of multiple storage containers of different size, type, state of cleanliness and location to allow storage of different types of water for different lengths of time. Additional flexibility in mitigating storage impacts on water quality was created through external relationships, such as the use of a neighbour's infrastructure to swiftly transport water from the road to a holding tank near a participant's house.

3 aspects of water scarcity were mitigated by creating flexibility typically through internal systems, but through external relationships in times of crisis (table 8.2, yellow highlights). For example, the lack of water for drinking purposes was usually addressed through intra-household reduction in consumption, but in times of crisis, when no water was available for purchase, neighbours would lend, gift or sell water to alleviate this problem. Similarly, the lack of water for food preparation was usually addressed within households by foregoing food at midday to be able to cook at night. When water ran out or was not delivered, people created some flexibility in dealing with this through external relationships, such as by purchasing affordable food from street stalls.

No scope for creation of flexibility through either the internal system or external relationships was observed in relation to the provenance of water, which, as previously discussed, was beyond the control of individual households; and in relation to using rain water to contribute to security of water supply, which, due to pollution and very low rainfall, was not a feasible option (table 8.2, red highlights).

Creation of flexibility through internal systems only was observed in relation to the use of water for personal hygiene (table 8.2, orange highlights). The shortage of such water was addressed entirely through reuse of water and differential intra-household allocation of water. This may be due to the residents feeling ashamed if they had no water for this purpose, and as water for personal hygiene is not essential for survival, such feelings could be reduced by not involving external relationships in addressing this lack.

Creation of flexibility through external relationships only was observed, by definition, in the use of social relations to mitigate the insecure supply of water (table 8.2, dark green highlights).

Lastly, the creation of flexibility through internal systems, which depended on external relationships, was observed in relation to the treatment of water to improve its quality (table 8.2, light green highlights). Relative flexibility in mitigating poor water quality appeared to be created largely at the individual household level, through chemically treating and boiling water to address some of the worst aspects of its poor quality. As the widely fluctuating ways in which the same type of water was treated, and the widely varying understanding of what constitutes adequate treatment are considerably influenced by uncoordinated and contradictory education campaigns and haphazard and intermittent supply of chemicals across the settlement, this evidences that flexible responses to poor water quality, although achieved through the internal system of the household, extensively depend on external relationships. They fall short of creating satisfactory flexibility in addressing poor quality water.

Water Scarcity Dimension	Water Scarcity Measure	Area in which flexibility is mostly created	
		Internal system	External relationships
Quantity	Drinking	√	*(√)*
	Sanitation	√	(√)
	Personal Hygiene	√	×
	Food Preparation	√	(√)
Quality	Physical, chemical, microbial	√	(√)
	Provenance	×	×
	Length and location of storage	√	(√)
Security of Access	Location of neighbourhood in Settlement	√	(√)
	Location of dwelling in neighbourhood	√	(√)
	Rainfall	×	×
	Storage capacity	√	(√)
	Social relations	×	√

Table 8.2: Creating flexibility through the internal system or external relationships

Key :
√ ***= main area where flexibility is created.***
(√) ***= secondary area where flexibility is created.***
× ***= no creation of flexibility observed.***

2 measures of water scarcity do not present any opportunity for creating flexibility in responding to the constraint (red). In the remainder of the measures, flexibility in responding to the constraints is mostly created through changes to the internal system, with external relationships called upon only in times of crisis, or to complement the flexibility created primarily through the internal system of the household.

The colour coding shows that:

- **No scope for participants' responses creating any flexibility in dealing with the constraint.**
- **Flexibility is created exclusively through the internal system.**
- **Flexibility is usually created through internal systems, but through external relationships in times of crisis**
- **Flexibility is created largely through internal systems, but complemented through external relationships**
- **Flexibility is created through the internal system, but is dependent on external relationships**
- **Flexibility is created, by definition, exclusively through external relationships**

The analysis of these dimensions of flexibility suggests that flexibility in dealing with water scarcity in La Nueva Rinconada is certainly polymorphous and multi-dimensional. It further reveals characteristics of both plasticity and agency in participants' responses. It is, however, in considering the balances that residents of the zone strike between competing interests, and in examining the paradoxes, tensions and trade-offs that characterize their dealings with water scarcity, that we begin to appreciate the enormous costs that arise from responding flexibly to water scarcity. The next section first examines the nature of flexibility in La Nueva Rinconada as evidenced by the foregone analysis, and then outlines associated costs.

8.3 The nature of flexibility : costs and trade-offs

8.3.1 The nature of flexibility in La Nueva Rinconada

The foregone examination has documented the nature of flexibility in La Nueva Rinconada. The solution of water-related problems in the short-term, but with associated longer term challenges; considerable tendencies towards individualization; and inequality arising from constrained deliberation, decision-making and action spaces all affect how flexibly residents are able to deal with water. Revisiting the characteristics of flexibility presented in chapter 2 allows the nature of flexibility in dealing with water scarcity in La Nueva Rinconada to be delineated.

Polymorphous and multi-dimensional

Flexibility to water scarcity in La Nueva Rinconada took a number of forms and was observed in several dimensions, including those of time, the management of risk, and the engagement of social relations.

Flexible responses to water scarcity were characterized by considerable short-termism, as evidenced by plentiful examples where flexible solutions to water scarcity appeared to resolve a problem in the short term, but did not persist into the longer term, or indeed attracted additional, new, or more severe challenges than the problem they had initially sought to address. Residents' management of poor water quality is one such example. Such short-termism also affected perceptions of risk. Residents displayed a generic awareness of risks associated with several dimensions of water scarcity, but mostly lacked more comprehensive appraisals of longer-term risk associated with the same problem.

Different forms and dimensions of flexibility were characterized by inconsistency between levels of effort and commitment expended to address a challenge of water scarcity and the quality of outcomes. For example, the challenges of responding flexibly to changing circumstances that affect the availability of water for food preparation were relatively easily addressed within the critical time span, and with low levels of effort or commitment. By contrast, the challenges arising from an inconvenient plot location could not be addressed within critical time spans, yet residents went to considerable efforts, and committed to irreversible changes in trying to move to a better located plot.

A great variety of flexibility was observed in the different ways in which participants used a combination of making changes to their internal system and employing external relationships to respond flexibly to water scarcity; although an emphasis on the internal system clearly emerged.

Flexibility as plasticity & Flexibility as agency

In La Nueva Rinconada, the conceptualizations of flexibility as plasticity and flexibility as agency need to be understood in conjunction, as the former gives rise to, or acts as a prerequisite to, the latter. Flexibility manifested as plasticity, that is, as sensitivity to external conditions, only in some aspects of water scarcity, and only in limited ways in other aspects. Where residents met the challenges of water scarcity in a timely manner, such sensitivity was clearly evident, and formed the precondition for ensuing action, such as for example in the widespread awareness that water supply was insecure, and in residents addressing this through storing large quantities of water. Instances where responses addressed an aspect of water scarcity in the short term, but failed to do so in the long term, are indicative of a limited sensitivity to external conditions. This concerned especially a typical pattern whereby residents were aware of the daily manifestations of a problem (e.g. that using water to flush and clean the latrine fills it up quickly) but did not translate this into awareness of the longer term impacts of the same process (e.g. a lack of awareness that on-plot latrine space would eventually run out).

Some aspects of water scarcity were characterized by a highly unbalanced combination of plasticity and agency, in that participants might be highly aware of a constraint (such as lack of secure access to water), but without any recourse of creating flexibility in all its forms (e.g. unable to use rainwater to aid water

security). This provides further evidence of a highly constrained decision-making and action space.

In other instances, normalization processes diminished residents' sensitivity to external conditions. As a result of participants not perceiving certain aspects of water scarcity as 'special events', associated responses failed to fully address all its dimensions. Instead, sub-ideal and habitually deployed responses were repeated with limited success.

The example of residents developing a large range of individually tailored water storage solutions within a context that otherwise forced them to react to unpredictably changing water delivery contexts is illustrative of a considerable display of agency within contexts that otherwise constrained residents' ability to be proactive. The resulting problems suggest that individual agency alone cannot successfully mitigate the full spectrum of a disabling environment.

Elsewhere, individual agency appeared to be directly informed by external conditions, such as residents' plot geography. Residing on a flat or difficult and inclined plot gave rise to different levels of sensitivity to external conditions, and engendered different levels of agency which nevertheless fell short of mitigating the structural lack of water and sanitation provision.

The most severe limitations to personal agency in creating flexibility are perhaps seen by comparing situations that create flexibility in dealing with water scarcity within the household (which are largely successful), with those that require engagement with external relationships beyond the household (which largely fail to tailor the path of action to desired outcomes). The high costs of creating flexibility through external relationships (e.g. maintaining such relationships wholly for the purpose of addressing water scarcity) and the constraints imposed by external systems which fail to support efforts of individual agency (e.g. persistent frustration of attempts to address the political problems of water scarcity) force residents into individualistic dealing with water scarcity.

Paradoxes, tensions and trade-offs

The aim of trade-offs is to effect a compromise. The nature of trade-offs effected in relation to water scarcity in La Nueva Rinconada show severe limitations to the ability to make trade-offs, as no recourse for action is available to residents in relation to some aspects of water scarcity, such as for example in relation to the

provenance of water, or in the impossibility of using rainwater to contribute to a household's water security.

Where trade-offs and compromises are observed, these result mostly in short-term compromises, such as for example bribing the truck driver to receive good quality free water, but fail to address the more structural problems of such exchanges, such as underlying inequality and corruption. These show the limits of flexibility in dealing with water scarcity to be characterized by considerable short-termism. Additionally, a context of multiple scarcities, illustrated in this example by economic and political precariousness, forces residents into complicity with, and perpetuates the underlying systems of corruption and inequality that such trade-offs rely on, effectively trapping residents in a Sisyphean cycle in which they are only able to address the effects, but not the root causes of water scarcity.

8.3.2 The costs of flexibility

We saw that households in La Nueva Rinconada respond to water scarcity in in some very flexible ways, and in other areas less so, with both attracting a range of risks and costs. To consolidate and interpret the foregone analysis of flexible responses to water scarcity, the following section discusses three distinct costs of responding flexibly to water scarcity to illustrate the identified themes of (1) individualization; (2) inequality arising from constrained deliberation, decision-making and action spaces; and (3) short-termism, using a range of vignettes that cover the water use cycle from acquisition, via storage to use and re-use to the eventual discarding of water.

The impact of flexibility on social support mechanisms

Participants identified numerous areas in which the flexibility of their responses to water scarcity affected social support mechanisms, or were in turn affected by these. The prevalence of creating flexibility within the internal system of the household can be attributed to the tasks of acquiring, storing, using and discarding water being time and resource intensive; focusing activities in and around the home, which appears to limit the scope for social support mechanisms to produce flexibility. In instances where flexibility was created through external relationships, they carried with them considerable risks and costs, which limit the frequency with which social support mechanisms are employed to create flexible responses to water scarcity. The following examples illustrate these issues.

Rosario's[32] house is located down a steep hill, some 150m from the road where the water truck passes. She has gone to great lengths to buy a solid water storage tank, replace its broken lid and construct an enclosure to protect it against damage (Figure 8.3). She has connected a hosepipe to it, negotiated with neighbours to run this through their plots, and connected it to another holding tank above the roof of her house (Figure 8.4), from where a hosepipe takes water into her courtyard where she has built herself a sink and tap to use water as and when she needs it (Figure 8.5). Another hosepipe takes waste water across the courtyard and out of her property (Figure 8.6). Rosario reported how convenient this arrangement of a private water infrastructure is, but also described the effort it took to afford, construct and negotiate access with neighbours. These costs were entirely borne by the household. She related the positive changes, such as time savings and improved hygiene, this arrangement had brought, but contrasted this with the negative social effects that have arisen from it, which include the envy of neighbours, occasional purposeful damage inflicted to the infrastructure, and the need to maintain good social relations with those whose plots her hosepipe passes through. The flexibility she has created for herself through her private water infrastructure has also started to strain social relations. Her waste water is discarded away from her house onto the communally built and funded concrete stairs, which are slowly being eroded from Rosario's waste water, causing further conflict between her individual interests and those of the wider community (Figure 8.7).

[32] Names have been changed.

Figure 8.3

Figure 8.4

Figure 8.5

Figure 8.6

Figure 8.7

Figures 8.3 to 8.7: Household flexibility compromises social relations.

A household has created flexibility in dealing with the constraints of water scarcity entirely through the internal system by constructing personal water infrastructure. The top row shows the protected on-road water reception tank and intermediary holding barrel; the middle row shows the home-built sink, tap and splashback solution and the hosepipe taking waste water out of the courtyard. The bottom image shows the communally built stairs with a permanent wet patch where this household's drainage solution erodes communal infrastructure, which has started to strain social relations.

In a reverse situation, strained social relations were seen to hamper household flexibility in dealing with water scarcity. Betty's house is located some 80m up very steep stairs (fig. 8.8). Her water barrels are located at the bottom of the stairs, in the main road, which doubles as an open sewer (fig 8.9). Residents of this neighbourhood are forbidden by threat of fine to discard water onto the stairs to prevent damage. Betty carries all the water she needs to her house in buckets, each trip taking around 10 minutes for two 20l buckets. She uses and reuses water as best she can, and when the water reaches a level of pollution that prevents further use, she carries it back down to the main road to dispose of it. Betty has been locked in a dispute with a neighbour over a job she held, and lost, at the local health centre. Whenever she approaches the main road, arguments and physical violence erupt. To reduce these stressful encounters to a minimum, Betty uses the main road only to buy water, and takes an alternative route to access the rest of the area. The effects of the strained relations with her neighbour mean that she stores her waste water (and rubbish) in the courtyard (fig 8.10) - which is usually designated to wash laundry and for the children to play in - until it is night time, when she feels safe to discard her waste water under cover of darkness.

Figure 8.8

Figure 8.9

Figure 8.10

Figures 8.8 – 8.10: Strained social relations hamper household flexibility.

Social conflict forces the participant to store waste water in her courtyard (Figure 8.10) and only make the lengthy trip from her house down the stairs (Figure 8.8) to the main road where her barrels are located and which doubles as an acceptable open sewer (Figure 8.9) under cover of night, significantly restraining her flexibility in dealing with water scarcity.

Cristel is fortunate to live at the very edge of the settlement, and have neighbours whose houses are connected to the municipal water supply. She and her neighbours have communally bought a strong and very long hose pipe which they connect to a tap in their neighbour's house (Figure 8.11) to fill their barrels with water of better quality and at a cheaper price. This communal organisation works well for all involved, except that the practice is illegal. Seller and buyers have an informal agreement that if the seller is caught, all buyers share the fine. A flexible response to the challenge of acquiring good quality water is created through external relationships, but carries considerable risks, with potential costs borne by those least able to afford them.

Figure 8.11

Figure 8.12

Figure 8.13

Figures 8.11 – 8.13: Flexibility is created through external relationships but carries considerable risks.

Every fortnight, water is illegally sold from a neighbouring property connected to the municipal water grid (Figure 8.11). The hosepipe is strung across the road that separates the formal part of Pamplona Alta from the informal settlement of La Nueva Rinconada (Figure 8.12), causing considerable risk of detection to buyers and seller alike; although an informal arrangement stipulates that any fines are shared by all buyers. The hosepipe is extended up the stairs of the settlement to reach as many buyers' houses as its length allows (Figure 8.13).

Delia lives just beneath the road where the water trucks pass. Her family has improved their water storage capacity by constructing a brick holding tank which holds up to 5 blue barrels of water (fig. 8.14). Delia reported that she allows the 5 neighbours who live below her to use the tank for intermediate storage, which enables them to transfer water to their barrels by hosepipe, rather than carrying full barrels down the steep hill on a precarious path (fig 8.15). She does not take payment for this service and generously insisted that the tank was free for all to use. The neighbours who benefit from this service recounted the immense help this provides for them, but also qualify that the service only comprises the very short term holding of water, no longer than immediately after purchase, and that Delia does not take any responsibility for the amount stored, nor for paying the *aguatero* on her neighbours' behalf, as this has caused conflict in the past. They add that the service, although not paid for when it is used, is provided on the understanding that Delia receives a Christmas present of considerable value, such as a piglet, for her efforts, and that failure to provide this may well result in being excluded from the circle of beneficiaries. Here the challenge of acquiring water was met through flexibility created through external relationships, but involves considerable economic and social costs to the beneficiaries.

Figure 8.14

Figure 8.15

Figure 8.16

Figures 8.14 – 8.16: Flexibility is created through external relationships but carries costs

A participant's brick water holding tank (Figure 8.14) benefits the neighbours who live further down the hill and away from the water delivery route (Figure 8.15), albeit at considerable social and economic costs. One of the beneficiaries stores her water barrel and hosepipe until they are needed to draw water from the holding tank (Figure 8.16).

Rosario's, Betty's, Cristel's and Delia's cases exemplify the association between a household's individual flexibility and wider social support structures. Individualisation resulting from addressing the pressures of water scarcity primarily through modifications to the internal system of the household, and considerable risks and social costs associated with responses created through external relationships, are defining features of the tensions that arise from responding flexibly to water scarcity.

The effects of intra-community inequality on flexibility

Once a household has acquired its water, it needs to store it until it is needed for use. Two water storage scenarios illustrate some of the range of factors that create inequality within the community, which in turn restricts the areas in which a household can respond flexibly to water scarcity.

Cristel considers herself fortunate to be able to buy water of superior quality at cheaper rates from her neighbour connected to the grid, despite the legal and financial risks this carries. To minimise the risk of being caught and liable for a prohibitive fine, Cristel buys water only fortnightly. As a result, large amounts of space inside and outside her home are taken up with water storage, severely compromising the amount and quality of living space that is shared by 7 people of three generations (figures 8.17-8.18). The need to store water for extended periods between purchases negatively affects water quality as it gradually becomes polluted in inadequately covered containers and from the heat (fig. 8.19). Cross contamination between clean and polluted water occurs as life unfolds in a living space constrained by water storage containers.

Compare this case to that of to Violeta, who was one of the first settlers to arrive in the year 2000. At the time she settled higher up in her neighbourhood, as the more desirable plots along the main road were already taken. As the family paid their dues to the neighbourhood (through the concept of *hacer la vivencia:* extensive residency), they earned land occupation rights through continuous occupation of their plot and became eligible for intra-neighbourhood lotteries for coveted plots. Violeta's family now lives at a convenient location at the corner of two water delivery routes, and can buy water several times per day from the various *aguateros* who pass the house. The family uses only 2 water barrels to meet their daily needs, which are located outside their front door, with one designated for consumption and the second for other water uses (fig. 8.20). As a result, the space taken up for water storage within the house and courtyard is minimal, and confined to two distinct water use stations, one for dish washing (fig 8.21) and the other for washing clothes (fig 8.22). These stations include storage of used water for reuse. All other water is fetched from the barrels outside the home as and when it is needed. Violeta reported how moving to this plot had transformed their lives. With the space needed to store water minimised by the convenient location, her husband was able to relocate his workshop to the courtyard of the house (fig 8.22), thus enabling him to work from home and save

valuable time and funds that were previously spent travelling and renting workshop space.

Figure 8.17

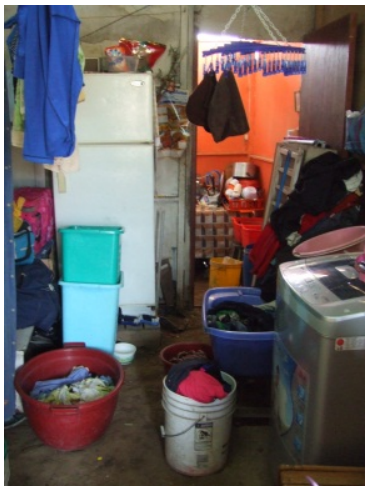


Figure 8.18

Figure 8.19

Figure 8.17 – 8.19: Factors outside of residents control cause inequality and affect flexibility (1).
Inequality resulting from neighbourhood and plot location affects the range of flexibility in relation to water storage. Here, large amounts of outdoor space (Figure 8.17) and living space (Figure 8.18) are taken up with storage space and water is contaminated and cross-contaminated due to inadequate storage (Figure 8.19).

Figure 8.20

Figure 8.21

Figure 8.22

Figure 8.20 – 8.22: Factors outside of residents control cause inequality and affect flexibility (2).
Length of residency positively affects flexibility in water storage. In this case, water storage is confined to two barrels outside the house (Figure 8.20) and distinct water use stations inside the house (Figure 8.21), which allow valuable space to be used for business (Figure 8.22).

Cristel and Violeta's cases epitomise the extent to which inequality within the community is caused by factors largely outside a household's control, such as residency in different neighbourhoods, differential lengths of stay and disparity in the location of plots within a neighbourhood. Such inequality in turn impacts on the extent to which which a household is able to respond flexibly to water scarcity, and the extent to which it is exposed to water-related risks and has to bear costs arising from flexible dealing with water scarcity.

The effects of trade-offs between long-term and short-term flexibility

Once water has been acquired, stored, used and reused, its disposal poses perhaps the greatest challenge to residents of La Nueva Rinconada, whose responses to this aspect of the water use cycle display the least flexibility. The lack of sanitation constitutes one of the most acute pressures on households, as depending on the location and geography of the individual plot, the household is either forced to use up valuable living space for consecutive pit latrines (on flat plots, cf. figure 8.2), or have their latrine located outside the house on the difficult to access steeper parts (on steep plots, cf. figure 8.1). The ease with which water is disposed of is further contingent on a household's proximity to a main or secondary road, as only these are considered acceptable open sewers. Discarding water along stairs or unmade paths can cause damage to the community-made infrastructure and strain social relationships and attract fines (cf. figures 8.3-8.7). In both scenarios, the lack of sanitation presents a severe dead end, and demarcates the limits of residents' ability to create flexibly. To illustrate the substantial impacts of these limits on a household's ability to remain flexible in dealing with the lack of sanitation in the longer term, consider the water disposal situations of Guadalupe and Alejandra.

Guadalupe occupies a coveted flat plot on a main road in Absalón Alarcón. Her house covers some 90% of the plot, with half sub-let to subsidise her income as she is an elderly single person responsible for her own maintenance. 10% of the plot is occupied by an open courtyard, where clothes are washed and the shared latrine is located. Guadalupe cannot afford lime stone powder to dry latrine contents without filling them up quickly. In the 12 years she has occupied her plot, the courtyard space has been filled with latrine pit after latrine pit (cf. figure 8.2), with the current location the last spot that has not been filled with concrete to seal off a full latrine pit. Guadalupe discards her used water into the open sewer in the main road, but the waste water needed for flushing and cleaning the latrine has nowhere to go but the pit, which she estimated would be full within the next 6-9 months. Guadalupe seemed surprised when asked what she would do when the last space for latrines was used up, and expressed faith that by that time, the settlement would be provided with a sanitation system, as the neighbourhood representative was very effective and surely would be taking care of this dilemma when the time came. She also noted that these kinds of problems were not for her to worry about, but for 'those in the know' to resolve.

Alejandra and her neighbour, on the other hand, occupy two steep plots in Villa Sol close to the entrance of the settlement (Figure 8.23). They are unable to dispose waste water outside their houses as the adjacent stairs have been frequently damaged, and are forced to carry it down the stairs to the nearest road in buckets. They face similar sanitation pressures to Guadalupe, but their households of 4 have in 7 years of occupancy filled only one latrine pit, with the second currently in use. Alejandra and her neighbour reported on the complex pressures faced and strategies employed to dispose of faecal matter and delay the point of latrine space running out: The children are allowed to use the latrine to defecate, but the parents chose to bag faeces and add them to the household waste, which is discarded in an open rubbish dump by the side of the main road. Rubbish collection is haphazard. The families invests in lime powder despite its high cost to dry the pit contents and avoid it filling up with water. To further reduce the strain on the latrine, the families avoid drinking too much unless the weather is very hot. Alejandra and her neighbour expressed no faith in the neighbourhood council to resolve the sanitation issue at any time, as it had frequently proven itself to be corrupt and ineffective. Instead they detailed the plans of a group of neighbours to illegally connect to the nearby sewer in the main road of the settlement, for which an engineer was being sought despite residents lacking the necessary social or professional connections to find someone trustworthy, and the technical expertise to appraise any proposal.

Figure 8.23: Plot location and ineffective neighbourhood representation diminish flexibility

Two participants' houses are located in a context that exemplifies the limits of coping with the lack of sanitation, characterized by a lack of space for consecutive latrine pits on the steep plots requiring repeated lengthy trips to discard water in the distant main road (seen in left image in the distance). In this instance it has led to radical - and illegal - considerations of a clandestine connection to the municipal sewer. The main road in which a sewer runs can be seen in the distance at the bottom of the valley.

Guadalupe and Alejandra's cases typify the relationship between perceived short-term coping and longer term engagement with the lack of sanitation in the settlement. It seems that those who felt they coped well with a dimension of water scarcity (even if only in the short term only) were, not surprisingly, less inclined to contemplate longer term solutions to the problem. Those who were reaching the limits of their ability to respond well to an aspect of water scarcity were unsurprisingly more inclined to consider longer term solutions that involved more radical changes with perhaps less irreversible consequences.

Equally, an effective neighbourhood representative or council appeared to reduce the extent to which individual households felt responsible for the resolution of challenges arising from water scarcity. Despite recounting severe limitations in their coping with various dimensions of water scarcity, the extent to which responsibility for resolving the problem was perceived to lie within the individual household appears to be proportionally related to the trustworthiness and effectiveness of the neighbourhood representation.

8.4 Conclusions : The costs of flexibility

This chapter has examined how flexibly residents of La Nueva Rinconada are in responding to water scarcity. Responses were observed to be flexible in some ways, lacking flexibility in others, and most notably were characterized by attracting considerable longer-term problems. The analysis also unearthed inconsistencies between levels of commitment and effort with the quality of outcomes, both of which highlighted further nuances to the previously observed constrained deliberation, decision-making and action spaces which La Nueva Rinconada's residents occupy. These were here evidenced by a combination of normalization processes; short-termism; inequality and individualization.

Plentiful examples where flexible solutions to water scarcity appeared to resolve a problem in the short term, but did not persist into the longer term, or indeed attracted additional and more severe challenges were indicative of considerable short-termism affecting residents' dealings with water scarcity. This appeared to arise from a combination of normalization processes and the overwhelming number of daily water-related tasks consuming residents' resources, including those of time and mental capacity, to consider the longer-term implications of their responses to water scarcity.

Normalization processes were seen to have affected residents' assessment of risks arising from water scarcity, and had impacted negatively on their ability to foresee and flexibly respond to such risks. Perceptions of risk were further skewed by the overriding aim of one day being awarded land titles. Extraordinary perceptions can give rise to new opportunities to respond to a problem, but in La Nueva Rinconada, normalization processes in conjunction with the overwhelming number of water-related tasks to be addressed on a daily basis prevented its more extreme manifestations from being perceived as extraordinary.

Other circumstances were seen to counter normalization tendencies, such as difficult plot geography ensuring that the pressures arising from lack of sanitation were kept at the forefront of residents' minds, providing a higher likelihood of mitigating its effects as external circumstances forced engagement with the problem. It is vital to note, however, that such engagement was forced by circumstances largely outside the personal control of individual households, and can therefore not be taken as a positive example of flexible dealing with the constraint of lacking sanitation.

Inequality within the settlement, and wider socio-political inequality of water provision, as evidenced by inconsistent municipal water deliveries, was seen to negatively affect not only residents' ability to make use of good quality water, but also to force residents into complicity with underlying processes of corruption, rather than enabling them to contest these.

Individualization was observed as a key characteristic of residents' constrained deliberation, decision-making and action space in their dealings with water scarcity. In examining the areas where residents created flexibility, a clear emphasis on the internal system emerged, with external relationships employed to aid flexible dealing with water scarcity only in a complementary role or in times of crisis. Nevertheless, this examination highlighted the considerable impact that external relationships have on households' ability to deal flexibly with water scarcity, such as where households' flexibility was considerably constrained by wider systems' failures to comply with their role in providing good quality water.

Revisiting flexibility theory, it becomes apparent that while flexibility certainly is polymorphous and manifests in a range of forms, arising through different time scales, levels of effort and commitment and in different stages of the water use cycle; when dealing with paradoxes or negotiating trade-offs between competing interests, the combination of constraining factors prevented participants from forming comprehensive strategies for responding flexibly to water scarcity. Conceiving of flexibility as plasticity and as agency in conjunction showed that in La Nueva Rinconada, sensitivity to external conditions did not necessarily give rise to successful agency in tailoring the path of action to a satisfactory outcome, providing further evidence of constrained deliberation, decision-making and action spaces.

The large array of ever-changing responses that a single aspect of water scarcity requires participants to deploy on a daily basis highlights that flexibility should not be seen as desirable in any situation and at any cost. It is neither reasonable nor morally or humanely acceptable to expect residents to be completely flexible to the myriad of challenges of water scarcity, as they require excessive resources including mental capacities. In the context of a vital, non-substitutable and life-supporting resource such as water, some inflexibility, or rather, consistency and predictability in the environment are essential to free people's mental and resource capacities from having to be alert to sudden, unpredictable and potentially life-threatening changes.

Chapter 09: Discussion

‘To be bent without breaking…’: Resilience in environments of rapid change and scarce resources

9.1 Resilience in environments of rapid change and scarce resources

In this chapter, I discuss the study's findings and their implications for theory, and to a lesser extent, practice. This first section revisits the research focus and methods and describes the findings. In the second section, I discuss the findings' implications for our understanding of scarcity, water scarcity, rapid change and resilience.

Research focus and methods

Water scarcity is nowadays widely acknowledged as a socio-political construct rather than merely a result of physical shortages. The experience of water scarcity has been the subject of a small number of recent studies. Empirical evidence linking the experienced dimensions of water scarcity to its wider socio-political construction, however, has been limited. This study has been based on the premise that understanding how water scarcity is experienced is a necessary prerequisite not only for a holistic understanding of the phenomenon, but in influencing how socio-political power can be usefully exercised in addressing and mitigating its causes and effects. The study provides some empirical evidence for the proposition that ways of experiencing an environment are inextricably linked to ways of acting within it (after Ingold, 2000), and identifies a range of features that characterize the link between the experienced and socio-politically constructed aspects of water scarcity.

This study was based on the premise that our age-old means of adjusting our livelihoods to changing environments are becoming inadequate in contemporary environments of rapid change and scarce resources (cf. chapter 1). Resilience was employed as the umbrella concept for exploring the likelihood of long-term persistence in environments of rapid change and scarce resources. Adopting a holistic definition of resilience with a focus on positive long-term outcomes, I examined resilience to water scarcity using the proximate indicators of perceptions, control and flexibility.

Lack of water, one of life's most vital resources, served as a testing ground for exploring the parameters that affect resilience in environments of rapid change and scarce resources. Due to the under-explored nature of the experience of water scarcity, I adopted a methodology aimed at uncovering depth, rather than breadth, of the parameters that shape resilience to water scarcity. 23 households in two neighbourhoods of La Nueva Rinconada, a recently established informal

settlement in Lima, collaborated in the production of data for 5 months in 2012. I carried out participant observation in the settlement as a whole, in participating neighbourhoods, and extensive observation in participating households. Participants measured their water use over the course of one week, and I verified this measure with two additional estimates. I spent days, and in some cases weeks, accompanying household heads in their daily life to observe their water acquisition, storage, use, re-use and discarding practices. I interviewed participants and produced water maps for each household, and recorded visual data of water-related activities in the settlement, neighbourhoods and households. Eight key stakeholder interviews provided an external perspective on the wider forces and causes that shape the key observations that emerged from residents' accounts.

Acknowledging that resilience is informed both by individuals and the wider socio-political and ecological systems that support them, the methodology adopted features of the extended case method (after Van Velsen, 1978; Burawoy, 1998; and Mitchell; 1983). By understanding the specifics of each case by investigating the societal forces that shape it (Small, 2009), limited claims of theoretical generalization have been made, based on the identification of two 'key explanatory factors' (*ibid:* 196): the limits to personal agency and the role of institutional support. These are discussed in section 9.2.3. Aiming to understand whether residents of La Nueva Rinconada were resilient to water scarcity, I was guided by the following questions:

1. Does water scarcity exist in the study location? If so, how do its extent and quality manifest, and how resilient are residents to it? (Chapters 5, 9)
2. How do perceptions of water scarcity relate to responses to the constraint? (Chapter 6)
3. How do perceptions of control relate to attempts to exert control over the water scarce environment? (Chapter 7)
4. How flexible are residents in dealing with water scarcity? (Chapter 8)
5. How do perceptions, control and flexibility delineate resilience to water scarcity? (Chapter 9)

Summary of findings

Through its examination of the presence, extent and quality of water scarcity in La Nueva Rinconada, and by analysing resilience to water scarcity through the three proxy indicators of perceptions, control and flexibility, the study found water scarcity to manifest along all three of its indicators of quantity, quality and security of access. The onus of addressing its effects was seen to lie almost entirely on end users, whilst their ability and means for doing so were heavily constrained by individual capacities for adjustment and by features of a disabling environment.

Participants' constraints on considering the best action available, making informed decisions and deploying appropriate responses to water scarcity arose from a combination of having become normalized to the water scarce environment; the effects of the interaction of multiple forms of scarcity; the overwhelming number of water-related tasks consuming resources including time and mental capacity; and from the effects of inequality operating at different scales. Consequently, residents' constrained ability to respond appropriately to water scarcity resulted in processes of short-termism, loss of trust in their ability to effect change and individualization, all of which further limited residents' resilience to water scarcity.

9.2 Implications of findings for theory and practice

This section discusses the relevance of the study's findings to theory and practice in the areas of scarcity (and water scarcity in particular), resilience and rapid change. It reflects on the factors that were found to bear on resilience to water scarcity in La Nueva Rinconada, and discusses the relevance of constrained deliberation-, decision-making and action spaces and disabling environments to resilience; their roots in the effects of normalization, multiple scarcities, overwhelming water tasks, and inequality; and the problems that arise from subsequent developments of short-termism and processes of individualization. I discuss two key explanatory factors for these findings, and reflect on their implications.

According to the methodological approach described in chapter 4, the aim of this discussion is not to draw generalizations about resilience in contexts of water scarcity or rapid change, but to infer conceptual generalizations that may be

helpful in advancing theoretical perspectives of (water) scarcity, resilience and environments of rapid change.

9.2.1 Resilience to scarce resources

Water: A 'special' type of scarcity

Water displays a range of 'special' characteristics (Savenije, 2002). This study provides some evidence that of these characteristics, its fugitive and difficult to store, and non-substitutable nature and vital role to daily survival give rise to two distinct issues that shed light on our understanding of scarcity and resilience. The 'special' nature of water makes it ill-suited for drawing generalizations to other forms of scarcity. The findings from this study therefore impart very specific insights for our understanding of water scarcity, which require careful delineation in their applicability to other forms of scarcity.

The effects of multiple water-related scarcities caused, through a combination of their prolonged persistence, large number, time-consuming nature and non-negotiable urgency, what has been termed a 'mind set of scarcity' (Mullainathan and Shafir, 2013), whereby scarcity adversely affects the ability to deal with the effects of scarcity itself. In La Nueva Rinconada, this was particularly evidenced by participants' resources of time and mental energy being consumed by extensive daily water tasks to the extent that few resource were available to consider alternative, longer-term solutions beyond daily coping. Similar effects have been observed in experimental and field studies (Mani *et al,* 2013) where poverty was seen to reduce cognitive function, or, as the authors term it: '[…] poverty-related concerns consume mental resources, leaving less for other tasks.' (*ibid:* 976).

Mullainathan and Shafir (2013) highlight that whilst all forms of scarcity can evoke a common mind set of scarcity that lacks capacity to deal with scarcity itself, different forms of scarcity can have very different outcomes. The difference lies in whether people have a choice of evading the scarcity they are subjected to. Similarly to the authors' example of poverty (*ibid:* 149), this study has shown constant and time consuming engagement with the problems of water scarcity to be unavoidable; participants had no choice not to address its challenges. The lessons arising from water's special nature for our understanding of scarcity are thus not new, but confirm that, similarly to 'poverty [equating] scarcity in the very commodity that underpins all other aspects of life' (*ibid:* 150), the 'magnitude and

gravity' (to use Shafir and Mullainathan's terminology) of lacking the vital and life-sustaining resource of water adversely affects many other aspects of life. Water scarcity can thus be said to be not only all-consuming, but also extremely broad in its reach and effect on other aspects of life.

The grounding of this finding in this study's data make this finding, whilst not new, relevant to the discussion of the most appropriate approach to managing Lima's scarce water. It underpins previous studies' assertions that the privatization of water, due to its associated high costs for end users, does not provide a viable way of managing Lima's scarce water, and especially not for the city's poor populations, who would simply not be able to afford high water costs.

Secondly, water's vital nature to daily survival shows that in a context of vital resource scarcity, it is inappropriate to employ resilience as an aim; instead, its use as an indicator, aimed at assessing appropriate areas of targeted support and interventions that enable individuals, households and communities to act resiliently, would be more fitting. This is exemplified by considering that resilience can be observed in the ease or difficulty with which environmental challenges are adapted to or resisted (Walker *et al,* 2004; cf. chapter 2, resilience indicator no. 2). The vital nature of water to daily survival meant that residents had little scope for resisting frequent changes; and were forced to adjust to whatever situation presented itself; and to expend whatever resources of time, economic and mental means necessary to meet the multitude of ever-changing water-related challenges. Taken at face value, this could be interpreted as resilience and the ability to adapt to change, but, as those actions are entirely borne from lack of choice, this finding highlights that this particular dimension of resilience cannot, in a context of water scarcity, be employed to assess household resilience, as such a reading would not only be erroneous, but inhumane. Therefore, in a context of vital resource scarcity, this particular dimension of resilience appears suitable as an indicator only, not as an ultimate aim.

The dynamic, nested interaction of multiple scarcities

As 'all systems exist and function at multiple scales of space, time and social organization, […] the interactions across scales are fundamentally important in determining resilience at any particular focal scale.[…]' (Resilience Alliance, 2015). Walker *et al* (2004) discuss that many of resilience's other attributes are influenced by the dynamics of '(sub)systems at scales above and below the scale of interest' (*ibid:* n.p.), and note the importance of focusing on '[…] rationaliz[ing]

the interplay between change and persistence, between the predictable and unpredictable' (*ibid)* through the notion of hierarchies of influences between embedded scales.

This research found effects operating at different, nested scales (from socio-political and geographic structures to mental capacity) to diminish resilience to water scarcity. At the structural scale and within a wider context of poverty and inconsistent and unplanned provision of services in the settlement, the lack of secure water supply highlighted the constraints arising from a severely disabling environment of multiple scarcities. This had various detrimental effects, not only on resilience to water scarcity, but also on residents' ability to make use of other basic services, such as education, health and employment provision within the settlement. The widespread and persistent unpredictability and unreliability of water deliveries, predictable only in the sense of being largely unpredictable, in conjunction with water's vital role to daily survival required residents to prioritize its acquisition over the provision of other vital and locally available services. Whilst children were enrolled in school, they were often excluded for the day if the school gates were closed when they arrived late after having to wait for a water delivery. Similarly, whilst most residents were registered with one of four health centres in the settlement, under-provision, restricted opening times and limited availability of medical staff resulted in residents not being able to see a doctor if the daily opening times coincided with them having to wait for water. Similarly, participants reported having lost local employment as the need to prioritize water acquisition interfered with their ability to attend reliably.

Participants were able to 'accommodate considerable disturbance' (cf. section 2.1, resilience indicator no.1) caused by unpredictable water deliveries, poor water quality and lack of water; but were forced to reorganize their daily lives such that they could not simultaneously or consistently benefit from other basic services of health, education and employment provision. As such, they displayed the ability to accommodate a considerable amount of change to their daily routines, but as the services they had to forego to obtain water constitute vital and basic provisions, they did so with considerable difficulty, and with significant risks and costs to their livelihoods. One such cost arose from processes of individualization. Participants' ability to reorganize their daily lives to accommodate the myriad water-related challenges led to considerable individualization as households largely did so by making changes to their internal

system, instead of drawing on external relationships. The role of informal social support in contexts of lacking formal security networks is well documented (e.g Bloch *et al,* 2008; Dercon, 2005), and highlights that despite residents superficially displaying signs of resilience in their ability to absorb disturbance and reorganize (Walker, 2004) to adjust to the challenges of water scarcity, this carried considerable long-term costs. This highlights, more than any other example, the truism that resilience indicators can only reliably work in conjunction, never in isolation.

In addition, the interaction of water scarcity with other forms of scarcity provides evidence of scarcities at the structural level affecting the experience of scarcity at the personal level. For example, the above-discussed inability to sustain local employment was seen to trap women into the role of 'least deserving' household member where water use for personal hygiene was concerned.

Scarcity of livelihood security, evidenced by a comprehensive lack of land titles, was seen to diminish perceptions of other scarcities, evidencing not only a clear hierarchy in residents' perceptions about the importance of issues affecting their lives, but also highlighting a further limitation on resilience to water scarcity. As the lack of tenure security and associated threat to future livelihoods skewed, overrode, or even negated perceptions of water scarcity and associated risks and dangers, this further diminished residents' ability to appropriately assess and respond to its causes and effects.

9.2.2 Resilience in environments of rapid change

Resilience can be observed along several temporal indicators. The proximity to thresholds of fundamental change (Gunderson and Holling, 2002; Walker *et al,* 2004; Carpenter *et al,* 2001) can be assessed in temporal terms, as can of course the time it takes to return to equilibrium following a disturbance (Pimm, 1984; Tilman and downing, 1994). The effects taking place at nested scales can also be understood in terms of time scales; and the capacity for resilience to be learned (Allan and Bryant, 2014; Luthans *et al,* 2006; Nelson *et al, 2007;* Reid, *2012)* comprises temporal means to consider if learning takes place in time to prevent the crossing of thresholds of no return.

I have defined rapid change as occurring at a rate that does not allow sufficient time for the consideration of appropriate human responses (Thomas, 1997). Acknowledging that change is inherent in any system, and that degrees of human adjustment to the environment vary with changing contexts (Nelson *et al,* 2007), this study has focused on understanding the nuances associated with the pressures arising from reduced time for decision-making in a context of scarce resources, and in the face of uncertainty and unpredictability deriving from some impacts' delayed appearance (IPEC, 2003).

This study has highlighted three distinct dynamic interactions of temporal processes that impact on resilience to water scarcity. Residents' responses to water scarcity were characterized by considerable short-termism. Many of the responses deployed to address a water-related problem in the short term attracted more severe, longer-term challenges. Secondly, in the absence of title deeds providing a secure future and paving the way for the provision of basic services, livelihoods were to some extent indefinitely suspended within an environment of rapid change. Lastly, the previous section has highlighted the difficulties residents of La Nueva Rinconada face in consistently or simultaneously benefitting from basic services of water, health, education and employment provision. I briefly reflect here on the temporal dimensions of this and its significance for resilience.

Short-termism and the disabling environment

Evidence from this study shows that residents' ability to appropriately respond to the myriad of stressors arising from water scarcity was largely reduced to daily or very short-term coping with its challenges, whilst simultaneously consuming economic resources, mental capacity and taking up large amounts of time. This was seen to not only fail to comprehensively address the problems arising from water scarcity, but also to erode the ability to engage with its challenges towards longer term-solutions. This suggests that temporal effects at different, nested scales, impact on the capacity for resilience to water scarcity in La Nueva Rinconada; and specifically, that managing water-related challenges in the short-term compromised long-term prospects (cf. chapter 2, resilience indicator no. 6).

The observation of widespread short-termism in dealing with water scarcity also serves as a useful example to highlight the roots of participants' constrained deliberation, decision-making and action spaces in what I have called a 'disabling' environment. This allows wider conclusions to be drawn between resilience of individuals and households, and the role of their supporting socio-political and natural environments in facilitating or hindering this. Short-termism was seen to arise directly from a combination of residents having become normalized to water scarcity; being overwhelmed by numerous water-related tasks and unable to address the effects of multiple scarcities simultaneously; and from the effects of wider inequality. All these effects arose from factors largely outside of households' control, which places their roots within the wider socio-political and natural environments, rather than within households' capacity for resilience. It can tentatively be concluded that resilience to water scarcity, despite considerable individual agency and ingenuity in addressing its short-term challenges and effects, is significantly hampered by the constraints of a disabling environment, and specifically by the combination of shortcomings of the various systems which undermine households' capacity for resilience.

Lastly, the dimension of resilience that considers the time it takes to return to equilibrium following a disturbance (cf. chapter 2, resilience indicator no.4) provides, in the study context of water scarcity, another example to highlight the dangers of assessing resilience at face value. Residents were seen to return to their previous status quo within relatively short time spans following a range of water-related disturbances, which could be interpreted as resilience along this particular dimension. However, as the status quo did not meet the basic human right to sufficient, safe and secure water, this provides further evidence that

resilience may be better employed as an indicator, rather than an ultimate aim, and for the need to provide two readings of this study's findings. I revisit both points in the next section, 9.2.3.

Livelihoods suspended in rapid change

The study found that, similarly to many rapidly evolving urban areas, both the wider and water-related environments of La Nueva Rinconada were subject not only to rapid change, but also to considerable uncertainty and unpredictability. Two issues relate to the interplay between disparate time scales and their effect on resilience to water scarcity in La Nueva Rinconada. Both revolve around residents' overriding aim and original reason for settling in the area; the hope of one day being awarded title deeds.

I have discussed that the absence of title deeds caused residents' livelihoods to be suspended in time, as it prevented them from investing in the construction of their homes and in the wider community. This was evidenced by the idealization of titling deeds (cf. section 7.1) and by significant tendencies towards individualisation in dealing with water scarcity (cf. section 8.2: 'Focus'). At the same time, the study unearthed evidence that the rapidly changing environment hampered the identification of feasible pathways towards the longer term goals of titling, water and sanitation provision. This allows the tentative conclusion that the effects of rapid change in a context of water scarcity did not so much result in insufficient time for decision-making (Thomas, 1997)[33], but rather perpetuated an environment of uncertainty and unpredictability, with the described detrimental effects on residents' ability to plan a feasible path towards their ultimate goals; and which hindered the construction of individual livelihoods and communities.

The idealization of title deeds can further be interpreted as a notional proximity to 'thresholds of fundamental change' (cf. chapter 2, resilience indicator no. 3), as the receipt of title deeds embodied the idea to which residents attached their hopes and dreams; imagining how the provision of land titles would solve many other ills (cf. section 7.1: 'Shifting Perceptions of Control over Life in the Settlement'). It does not seem unreasonable to conclude that this idealized view of approaching a 'threshold of future resilience' mitigated many other aspects which pointed towards an absence of resilience to water scarcity. Envisioning the proximity of fundamental change brought on by the provision of title deeds

[33] As the non-negotiable nature of water forced the prioritized engagement with the issue, and the investment of considerable time to devise solutions, albeit with less than ideal outcomes.

helped residents to bear the many water-related ills year after year. This suggests that the proximity to a notional, positive threshold can have negative effects on resilience, which, to the best of my knowledge, has not been documented elsewhere.

Competition between equally pressing rights and needs

I have discussed above that residents, whilst able to accommodate considerable disturbance caused by unpredictable water deliveries, poor water quality and lack of water; were unable to simultaneously or consistently benefit from other basic services of health, education and employment provision. This observation holds some insights into the factors that affect resilience in environments of rapid change, and some associated policy relevance.

Rapid and informal growth in the context of a reluctant, or at best, accepting, but not proactive or supportive state is inevitably characterized by haphazard and uncoordinated provision of services. Whilst many grassroots, local government and non-governmental institutions were working to provide a range of basic services in La Nueva Rinconada in 2012, the lack of coordination between these resulted in incomplete coverage of local needs. In this context of haphazard, incomplete and uncoordinated provision, residents displayed considerable agency and ingenuity to address the numerous water-related challenges. However, in the absence of settlement-wide enforcement and coordination mechanisms, the patchy provision of services considerably restricted residents' ability to build livelihoods and maintain health and wellbeing.

This provides tentative evidence that individuals or households can display only very limited resilience where the wider socio-political systems fail to provide an enabling environment. It also suggests that, similarly to the process described for the safeguarding of water quality (cf. section 5.3), the compliance of responsibilities ought to be linear. Where the state and its institutions fail to comply with the prior provision of basic services, individuals', households' and communities' subsequent scope for displaying resilience is severely constrained. Without wanting to over-stretch the comparison, similarly to the safeguarding of water quality, individual, household and community resilience can only be fully enabled by prior institutional compliance which creates enabling environments that facilitate the capacity for resilience.

9.2.3 Resilience: Multi-scalar indicator, not ultimate aim

The limits to individual agency in contexts of institutional limitations

The findings discussed in the previous section give rise to two 'key explanatory factors' (Mason, 2002:196), which, as well as illuminating the connection between experienced dimensions of scarcity and rapid change and its wider, socio-political construction, allow some degree of generalization that may advance theoretical perspectives that may be instructive in studying different cases of scarce resources and rapid change elsewhere (cf. section 4.1). They concern the limits to individual agency in contexts of institutional limitations. It is useful to revisit both definitions of resilience at this point.

I had at the outset described Vaillant's (1993) definition of resilience as compelling for its dual focus on the individual and its supporting systems; recognizing both the impact of external forces and acknowledging individual plasticity and agency in reacting and responding to these (cf. section 2.1). My interpretation of this study's findings suggest a clear relationship between processes of individual and household plasticity and agency in bringing about resilience to water scarcity, and the role that socio-political systems play in enabling or hindering the same. The study shows, through its documentation of participants' severely constrained deliberation, decision-making and action-spaces; their causes in processes of normalization, multiple scarcities, overwhelming number of water-related tasks and wider inequality; and the detrimental effects of resulting short-termism and individualization, that individual agency and plasticity in responding to water scarcity cannot in isolation engender resilience. Instead, individuals' and households' efforts are only likely to be successful in contexts of prior compliance of institutional provision of, in this case, the basic services of water and sanitation. This gives rise to two separate readings of the data.

Resilience to water scarcity in a context of rapid change: Two readings

This study has presented a number of findings which, taken at face value, might be construed as constituting resilience to water scarcity. Revisiting the concept's composite definition presented in chapter 2, it could be argued that participants of this study displayed some signs of resilience along its first four defining indicators (cf. section 2.1).

Residents of La Nueva Rinconada, in responding to water scarcity, accommodated considerable amounts of disturbance without crossing thresholds that make recovery difficult or impossible. In addition, they underwent change, not with particular ease, but due to the vital nature of water forcing this to take place. How close this brings people to a 'threshold of no return' in La Nueva Rinconada is impossible to say as this was not observed to have been reached in 2012; but local health, education and economic indicators (Andina, 2014[34]; Pebal La Inmaculada, 2016[35]; INEI, 2014) suggest that being forced to prioritize daily acquisition of water at the cost of other basic services is likely, through the dynamic and nested interaction of multiple scarcities and their delayed effects on health and livelihood construction, to maintain subsequent generations close to such a threshold at best, or push them beyond it at worst; although the vital nature of water suggests that residents will continue to expend all necessary resources to prevent the crossing of such thresholds, at considerable costs and risks. The study identified the notion of an imagined proximity to a positive threshold of fundamental change arising from the receipt of title deeds, but this was seen to adversely affect perceptions and subsequent resilience to water scarcity. Lastly, the study unearthed plentiful evidence of residents' ability to return to equilibrium following a disturbance (Pimm, 1984; Tilman and Downing, 1994), but I have argued that as a status quo of lacking water and sanitation cannot be humanely or morally acceptable, this cannot be interpreted as constituting evidence of resilience.

This gives rise to the second and better grounded reading of this study's findings. Taking into account the effects operating at nested scales and their impact on resilience, this study found that the constraints arising from a severely disabling environment significantly hampered the development of individual and household resilience. More strongly, the data showed, through its documentation of short-termism in dealing with water scarcity, that residents of La Nueva Rinconada were not able to manage change without compromising long-term prospects.

Revisiting Vaillant (1993), I therefore conclude that in the Peruvian autumn of 2012, participants of this study displayed 'The capacity to be bent without breaking' (*ibid*:284), but that their 'capacity, once bent, to bounce forward' was by no means given.

[34] Apart from the under-provision of medical services for the population, the combination of lack of sanitation and water provision and proximity to pig rearing frequently causes the declaration of health emergencies in the zone.

[35] Continuing struggles with comprehensive education provision are evidenced by widespread programmes of 'alternative education'.

This leaves the consideration of the last of resilience's indicators, the capacity to be learned. Several areas of the data point to restrictions on participants' capacity to 'learn' resilience. For example, the neighbourhood representative's enforcement of participation in public works, whilst no doubt benefiting the community's longer term aims, raises doubt whether in a context of forced attendance, residents can 'learn' of the benefits of public participation, especially as attendance is provided in a context of significant exhaustion of resources of time, money and mental energy. Such depletion of resources itself leaves very little space for learning to take place. Most importantly, however, the data provides strong evidence for the assertion that in contexts of vulnerability and poverty and lack of basic services, the learning of resilience should not be included in its definition, as it cannot be morally acceptable to expect people to 'learn' to cope with such environments.

Resilience as indicator, not aim

This observation can be expanded to the entirety of the concept of resilience itself. The discussion presented in this chapter provides some support for the notion that resilience can act as a valuable indicator to disentangle the nuances of how people navigate environments of rapid change and scarce resources. If used as an indicator, resilience can usefully serve to identify areas of potential, collaboration or the most fertile ground for intervention. Employing resilience as an aim or outcome in contexts of vulnerability and poverty and in relation to basic, life-supporting resources, however, places the onus of 'compliance' on those least able to be resilient. The evidence presented in this study suggests that it cannot be morally acceptable to employ resilience as an aim or outcome, and especially not in isolation when referring to the qualities of individuals, households or even communities. Instead, any discussion on resilience must entail a comprehensive acknowledgement and definition of the role of wider systems in achieving this aim. This is further supported by the fact that its proximate indicators of control and flexibility also revealed instances where control, or flexibility, whilst achievable, cannot be considered desirable or morally just in relation to a vital and life-supporting resource like water.

Resilience critiques revisited

In chapter 2, I have discussed the value and application of the resilience concept by engaging with three prominent critiques of the concept, which I now reflect on in light of this study. The first related to concerns arising from an undifferentiated conceptual transfer from ecological to social systems (Adger, 2000; Reid, 2012). The findings from this study support the notion of differences between social and ecological systems and, from its focus on social processes, show that the 'capacity to cope with surprises and large scale changes' (Adger, 2000: 361) alone does not engender resilience. The study further provides ample evidence of the need to be explicit about agency and power (Béné *et al,* 2012) of both individuals and the wider systems that support them. Lastly, the study provides some evidence that incremental adjustments (Sudmeier-Rieux, 2014) are unlikely to engender resilience, whilst the capacity for transformative action (*ibid*) was severely hampered in a context of lacking institutional support and in relation to a vital and life-sustaining resource like water. In summary, the evidence from this study suggests that balanced attention to actors and their supporting systems; careful examination of the nature of responses (incremental or transformative); and appropriate acknowledgement of notions of individual agency and power can all begin to address the valid critiques of undifferentiated transfer of the resilience concept from ecology to social systems.

The second prevalent critique concerns the mis-use of the resilience concept within the neoliberal doctrine (Reid, 2012). Reid's contention that the concept of resilience can be 'elemental in producing vulnerable societies and individuals accepting of, rather than challenging the resulting status quo' (*ibid:*74) was certainly supported by this study, which found residents resource-depleted and subsequently unable to mobilize resources. Were this equated with resilience, the concept would certainly be employed in a harmful manner. My suggestion to employ resilience as indicator, rather than aim, goes some way towards addressing this concern, as does Reid's argument that the use of the term makes 'the poor' subjects by emphasizing their 'adaptability' over their security, and by defining the role of the vulnerable as characterized by the need to 'permanently struggle to accommodate [themselves] to the world, [as opposed to being] political subjects which can conceive of changing the world' (*ibid:*74).

I have in chapter 2 suggested that, in mitigation of Reid's comprehensive rejection of the concept, the resilience model may be usefully employed by recognising the

assets of vulnerable populations and emphasizing these as the vital foundations to build on instead of replacing them; essentially shifting decision-making from external to internal actors by giving affected populations the right of choice as to which assets to emphasize in efforts to help build resilience. The data from this study, however, shows that this may not be a straightforward undertaking. On the one hand, unless the underlying causes for lacking basic resources and associated lack of time and mental energy is addressed, it will be difficult, even in a context of political will, to motivate people to take on these time-consuming tasks. Such a shift would also culturally not be easy, as it requires the development of critical capacities and associated confidence for decision-making and taking action that have historically often been eroded. This was exemplified, for example, by the neighbourhood representative's account of how her work was much easier when she first took charge of her area several years ago, when its residents were largely illiterate and used to following orders of perceived superiors. The representative commented that her efforts to simultaneously advance education and democratization in the neighbourhood's decision-making processes had considerably slowed progress in advancing communal works.

In summary of my response to Reid's critiques of the resilience concept, I would therefore maintain that providing concrete evidence from empirical applications in contexts of poverty and vulnerability can be helpful to substantiate or nuance, or indeed refute these criticisms. The need to engage with resilience in contexts of vulnerability and inequality is most strongly supported by the inseparable nature of the experienced and political dimensions of scarcity, which this study has documented. To inform a substantial critique of the political processes that perpetuate livelihoods endangered by scarcity, concrete evidence of the lived experience can contribute to nuancing such critiques, and to evolving the concept of resilience towards addressing these very issues.

The final critique of resilience concerned widespread assertions that resilience reduces, mitigates or even counters vulnerability or risk (Sudmeier-Rieux, 2014). This study provides evidence to support Sudmeier-Rieux's (2014) findings that people in marginalised communities are often highly resilient (if resilience is not defined as encompassing positive long-term outcomes); but that this arises from 'dangerous living conditions and high vulnerability that created risk – as well as resilience – in the first place' (Sudmeier-Rieux; 2014; Reghezza-Zitt *et al*, 2012). This study therefore supports Sudmeier-Rieux's assertion that resilience should

not erroneously be equated with people's ability to reduce their own vulnerability or risk, and provides nuances to this assertion through showing that resilience in this case only refers to short-term resilience, and that for longer-term positive outcomes to be secured, the status quo that produced any such resilience requires questioning to uproot underlying inequalities. Similarly, the study supports Levine *et al*'s *(*2012) observation that resilience can also be observed alongside corruption and inequality.

Chapter 10: Conclusions

10.1 Resilience in environments of rapid change and scarce resources

In this final chapter, I summarize contributions to knowledge, answer the research question, offer reflections on methodology, discuss the study's limitations and finally outline directions for future research.

10.1.1 Summary of findings

In attempting to understand how resilient residents of La Nueva Rinconada are to water scarcity, the study found that:

- Water scarcity manifested along all three of its indicators of quantity, quality and security of access. The onus of addressing its effects lay almost entirely on end users, whilst their ability and means for doing so were heavily constrained by both individual capacities for adjustment and by features of a disabling environment.

- Participants' constraints on considering the best action available, making informed decisions and deploying appropriate responses to water scarcity arose from a combination of:
    - having become normalized to the water scarce environment;
    - the effects of the interaction of multiple forms of scarcity;
    - the overwhelming number of water-related tasks consuming resources including time and mental capacity; and
    - the effects of inequality operating at different scales.

- Consequently, residents' constrained ability to respond appropriately to water scarcity resulted in:
    - processes of short-termism;
    - loss of faith and individualization; both of which further limited residents' capacity for resilience to water scarcity.

10.1.2 Contributions to knowledge

The study found that in responding to water scarcity, residents of La Nueva Rinconada were able 'to be bent without breaking' Vaillant (1993:284), but that their capacity 'once bent, to bounce forward' (after Vaillant, 1993) was by no means given. Specifically, the study makes the following contributions to the literatures on (water) scarcity, rapid change and resilience.

(Water) scarcity

Water, due to its vital role to daily survival, is a special type of resource that does not make it amenable to generalization to other, non-vital types of scarcity. The interaction of water scarcity with other types of scarcity operating at different scales was found to diminish resilience. The study further supports the notion of the interaction of multiple, nested scales of water scarcity and the difficulty of assessing their effects through its finding of residents' difficulties to consistently or simultaneously benefit from basic water, health, education and employment provision.

Rapid change

This study has provided evidence for the need to define resilience as comprising long-term, positive outcomes as it found short-term responses to water scarcity to attract more severe, longer-term challenges. Further, residents' livelihoods were suspended in a context of rapid change, providing additional evidence of the need for a focus on longer term positive outcomes.

Resilience

The study's findings suggest that the concept of resilience, in contexts of vital resource scarcity, cannot reasonably be employed as an aim, but can usefully serve as an indicator for identifying the most appropriate areas of intervention or support. This was supported by evidence highlighting that individual agency and plasticity in responding to water scarcity are only likely to engender resilience in contexts of prior compliance of institutional provision of enabling environments.

This provides an interesting starting point to revisit Ingold (2000) and Swyngedouw *et al* (2002). The study provides some evidence of Ingold's (2000) assertion that ways of seeing the environment are inextricably linked to ways of acting in the environment. In doing so, it highlights the importance of the experience of urban water scarcity to a holistic conceptualization of the concept. It also suggests that studies focusing on the experienced dimensions of socio-environmental processes can usefully contribute to a more nuanced understanding of how exactly the effects of 'power geometries […] shape the

particular social and cultural configurations and the environments in which we live' (Swyngedouw *et al,* 2002:4).

Moreover, the findings of this study go beyond suggesting a non-directional association between experiences of and actions within the environment. The finding that resilience requires chronological compliance or prior provision of enabling conditions before individual or household resilience can emerge suggests that the relationship, whilst not necessarily causal, is at least linear. That is to say that, based on the evidence of this study, resilience of individuals and households cannot unfold to its full potential unless the socio-political systems which support them *first* provide enabling environments that allow this to happen.

10.2 Reflections on methodology and research limitations

Some of the limitations of this study in relation to generalizability and external validity have been discussed in chapter 4. I discuss here a small number of limitations arising from the chosen approach.

The study is not the first to present reproducible steps for measuring urban water scarcity, indeed it has heavily drawn on previous studies for this task, none more so than Wutich's (2006). It does present empirical evidence of how such quantitative measures, when analysed in light of participants' accounts and wider environmental observations, can serve to link the experience of water scarcity to the wider socio-political forces that shape these.

There are different means of examining human experiences which could have been pursued. Many of these, such as the Experience Sampling Method (e.g. Hektner *et al,* 2007) provide more comprehensive means of examining experience than those adopted here. However, as this study was concerned with uncovering depth of experience, I chose to be guided by the recurring themes which emerged from the data early on, and selected the proxies for estimating resilience accordingly. Narrowing the analysis process to the three proxies meant accepting that certain areas of the experience of water scarcity remain untouched in this study.

Similarly, there are a range of frameworks available for assessing resilience (cf. section 2.1.1) which are more comprehensive in their approach than the methodology developed here. Again, as this study focused on household experiences, it was preferable to tailor the methodology to focus on those, and let

the explanatory factors pertaining to the systems that support them arise from participants' accounts. Choosing not to adopt a methodology that put equal weight on investigating the role of the physical, ecological and political systems that support people is therefore consistent with the focus of this study.

Notwithstanding these limitations, the indicators of perception, control and flexibility, whilst not exhaustive in their coverage of resilience, proved to be useful proxy indicators for the concept. This arose in part from having operationalized them to pay attention to both individuals and their supporting systems, but also rather serendipitously from considerable overlaps in their findings with the larger findings pertaining to resilience. For example, the analysis uncovered significant areas of overlap where the data showed neither control, nor flexibility, nor resilience to be desirable or morally acceptable in a context of water scarcity.

The biggest limitation of this study arises from constraints of time and funds which prevented me from returning to La Nueva Rinconada to verify the study's findings. Whilst the emerging themes were discussed with some participants and key stakeholders during data collection, the connections between those findings presented in chapter 9 could not be verified due to these constraints. Returning to La Nueva Rinconada to verify these findings might possibly have resulted in a shift in the findings' weighing and priority, and potentially also in my interpretation of the findings presented here. I accept that my account is therefore only one of several possible accounts, and that it presents the interpretation of a snapshot of a situation in a specific place and at a specific time. As the post-script shows, the situation in La Nueva Rinconada has changed since the data for this study was collected. Nevertheless, I believe that the process described and the general findings are likely to be transferrable through time and space.

10.3 Directions for future research and concluding remarks

10.3.1 Directions for future research

There are three distinct areas of potential to extend this research in future. They concern (i) the application of the developed methodology in similar settings to provide additional nuance and hierarchy to findings; (ii) closer focus on the effects of disparate time processes through a longitudinal study; and (iii) the application of the developed methodology to other contexts of non-vital resource scarcities.

This study has aimed at depth, rather than breadth of understanding of the relatively understudied link between the experience and socio-political construction of scarcity. Applying the methodology developed here in different settings of water scarcity in rapidly changing Peruvian informal settlements could widen the range of impacting factors with a view to substantiating and further refining the findings presented in this study. Applications of this methodology across other, similar contexts have the potential to improve our understanding of the findings' hierarchy by uncovering additional, confirmatory or refuting evidence from settings that are similar in cultural, historical, environmental and political context.

As the interaction of disparate time frames was found to impact on resilience to water scarcity in environments of rapid change, a longitudinal study could contribute valuable insights. Specifically, a detailed investigation of the interaction of rapid environmental change whilst residents' ability to advance livelihoods is 'suspended' in time would present a worthwhile area of focus, with potentially interesting insights into the effects of rapid urbanization and policy relevance for most effective areas of intervention to support the construction of livelihoods in such contexts.

Lastly, applying the methodology of this study to contexts of other types of scarcity, and particularly those that don't constitute a vital, life-supporting resource as water does; could usefully test the validity of the developed methodology to understanding the experience of scarcity in environments of rapid change. Two areas appear particularly attractive for future focus. It would be interesting to observe if the interplay between the limits to personal agency and the effects of relative absence of institutions in providing services presents as similarly significant in other contexts of scarce resources and rapid change. Secondly, focusing a similar, qualitative study on scarcity of time and mental capacity (which were resources found by this study to be exhausted in a context of multiple scarcities) holds the potential for providing a qualitative, real-life dimension to similar quantitative studies in experimental contexts (e.g. Mani *et al*, 2013).

10.3.2 Concluding remarks

The data provided empirical evidence of La Nueva Rinconada's residents being overwhelmed by the daily tasks associated with managing water scarcity to the point where their facilities for deliberation, decision-making and responding were

severely compromised. I have shown these observations to be consistent with quantitative experimental studies and field observations that have documented the reductionist effects of poverty on cognitive function (Mani *et al,* 2013). The authors' recommendations for policy implications of their findings provide an interesting point of consideration for the Peruvian context. Mani *et al* (2013) propose that to alleviate the detrimental effects of poverty on cognitive function, the imposition of what they term 'cognitive taxes' on the poor should be avoided, as any task requiring the processing of complex new information consumes cognitive resources. Instead, they recommend the provision of simple 'interventions, help, prompts, reminders' (*ibid:* 980), and the coordination of such efforts to coincide with periods of improved cognitive capacity, which arise from periods of relative easing of poverty (*ibid:* 980). This suggests that timing is crucial in efforts to help alleviate the effects of the scarcity mind set. The authors suggest that such measures could not only have the effect of 'contributing to economic stability' (*ibid:* 980), but would 'actually enable greater cognitive resources' (*ibid:* 980).

Such measures constitute a very different approach to the more common technocratic solutions to addressing water scarcity. More interesting, however, is the question whether such recommendations would be welcome in the Peruvian context by the country's and capital city's economic and governing elites. Some support for this doubt arises from this data itself, which showed that the government's constantly changing requirements for ever-more complex infrastructure provision at the cost of an economically, time and expertise-poor community delays the onset of titling negotiations. Whilst there is no 'hard' evidence for this proposition, abundant popular rhetoric around 'how to stop people invading' suggests that, whilst the days of slum evacuations are over in Lima, the governing elite's strategy may well to some extent covertly be aimed at maintaining the large population in the capital's informal settlements in a state of mental and physical exhaustion, and thus delay the provision of land titles and associated basic services.

This turns deliberations full circle to the limits to individual agency and the role of institutions in providing basic services in contexts of poverty, vulnerability and inequality discussed above and in the previous chapter. Concluding from the evidence presented in this study that the underlying problem concerns the failure of the Peruvian state to provide the basic services of water and sanitation would

be simplistic and perhaps overly biased by my own background of having grown up in a welfare state of the global North. This view might also be contentious among the majority of Peruvian society, as those not living in conditions of multi-dimensional poverty do not have basic services supplied either, but are, for example, often responsible for drilling their own wells, albeit at considerable costs. The difference lies, of course, in some sections of society being able to afford to do this, whilst the large number of urban poor are not.

Notwithstanding, universal human rights provide a useful starting point for global equity and sustainability, and this study has hopefully shown that of these, water is as important as any other. Even if one believed that the Peruvian state's failure to comprehensively provide basic water infrastructure arises, not out of ill will, but from lacking the institutional capacities for doing so, this does not negate the issue of engrained and historic socio-economic inequality within the country. Whilst it would not be reasonable or desirable to call for the provision of free housing or free basic water and sanitation provision for Lima's urban poor, this study's findings do show that the onus should be on the Peruvian state and and its institutions to create conditions of equal opportunity which enable all sections of Peruvian society to create sustainable livelihoods and meet their basic human rights, including that to water.

Post Script

This account has hopefully given an impression of the perpetual, unpredictable, multi-scalar and rapid change that affects residents of La Nueva Rinconada and their dealings with water and sanitation. In May 2016, as this account was being finalized, drastic changes were reported which resulted in serious set-backs for Absalón Alarcón and the wider settlement.

The owner of the land occupied by the health centre in Absalón Alarcón had lodged a complaint that the state was offering services from illegally occupied land. The owner offered to sell the land on the condition that the neighbourhood representative withdrew from her duties and had no further involvement in the public life of the settlement. The neighbourhood community refused to accept this condition. As a result, the upper parts of the neighbourhood, which are located on state land, split from the lower parts of the neighbourhood that are located on privately owned or contested land. The newly created neighbourhood at the bottom of the valley elected its own representative, who was unable to prevent the closure of the health centre despite meeting the land owner's demands, reducing the overall number of health centres serving the settlement to just three. The upper part of the neighbourhood has since been able to finalize the paperwork for the provision of municipal electricity, and in May 2016 received electricity from the grid.

Biographical sketch

Originally from Germany, Julia trained as an architect at the Bartlett School of Architecture, University College London, and worked for 9 years on architectural projects with an environmental, education and international development focus. Driven by a desire to understand the problematic interface of social and environmental aspects of architectural projects, she undertook the MA International Architectural Regeneration and Development (IARD) at Oxford Brookes University, where she developed her interest in human-environment relations towards the subject of this thesis. She has been working as an associate lecturer on the MA IARD since 2011.

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Appendices

Appendix A: Typical water use record sheet

USO DIARIO DEL AGUA

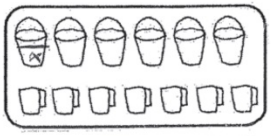
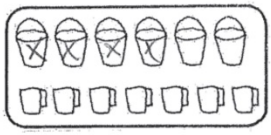
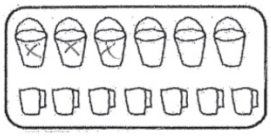
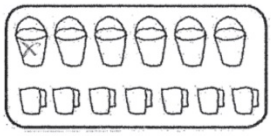
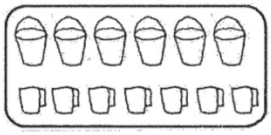
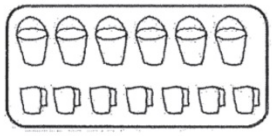
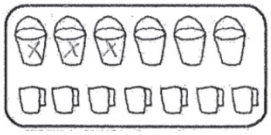
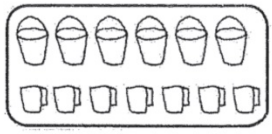
DIA/ FECHA 22-5-12 NOMBRE Maira Robles La Rosa A.H. Abzelo Mairá MZ __ LT __

¿HA COMPRADO USTED AGUA HOY? SI [X] NO [ ] ¿CUANTA? 1 tacho

¿CUANTO HA PAGADO POR EL AGUA HOY? PEN 2.00

POR FAVOR, INDIQUE LA CANTIDAD DE AGUA USADA PARA CADA ACTIVIDAD MARCANDO EL NUMERO ADECUADO DE BALDES Y/O JARRAS.
TAMBIEN, POR FAVOR, INDIQUE DE DONDE VENIA EL AGUA USADA PONIENDO UNA CRUZ DONDE APLIQUE. MUCHAS GRACIAS.

¿HA UTILIZADO AGUA HOY PARA...	¿CUANTOS BALDES Y/O JARRAS HA UTILIZADO HOY PARA ESTA ACTIVIDAD?	¿ERA ESA AGUA LIMPIA O REUSADA?	¿DE DONDE VENIA EL AGUA?
LAVADO DE MANOS		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO
LAVADO DE CABELLO		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO
CEPILLADO DE DIENTES		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO
ASEO PERSONAL		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO
PREPARAR EL DESAYUNO		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO
PREPARAR EL ALMUERZO		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO
PREPARAR LA CENA		LIMPIA / REUSADA	PAGADO / DONADO / OTRO / PRESTADO

¿HA UTILIZADO AGUA HOY PARA...	¿CUANTOS BALDES Y/O JARRAS HA UTILIZADO HOY PARA ESTA ACTIVIDAD?	¿ERA ESA AGUA LIMPIA O REUSADA?	¿DE DONDE VENIA EL AGUA?
PREPARAR BEBIDAS		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
LAVADO DE PLATOS		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
AGUA PARA LA LETRINA		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
ASEO DEL BANO		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
LAVADO DE ROPA		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
TRAPEO DE PISOS		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
RIEGO DE PLANTAS		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO
BANAR MASCOTE		LIMPIA REUSADA	PAGADO DONADO OTRO PRESTADO

¿TIENE USTED ALGUN OTRO COMMENTARIO SOBRE SU USO DE AGUA EL DIA DE HOY?

Hoy no use agua para lavado de Ropa

Appendix B: Common perceptions of water scarcity

Suffering from water

Juntamos en todo, en baldecito, en tacho, en todo lo que podamos recoger el agua. Y… es lo único que sufrimos del agua… y el desagüe que tenemos silo, no tenemos baño.

'We collect [water] in everthing, in buckets, in barrels, in anything we can. And….that's the only way we suffer from water….and [for] sanitation we have a latrine, we don't have a toilet.'

'Más antes sufríamos, cuando hemos empezado a vivir cuánto hemos sufrido de agua, traíamos de abajo, del mercado así, hasta ahí nomás cerca, de ahí…'

'Before, we suffered, when we first started living here, my, how we suffered from water, we brought it from down there, from the market, to there, nearby, from over there….'

'Y los de allá se quedan sin agua. …sin agua. […]. En tiempo de calor ahí si sufren un poco los de allá, porque se acaba el agua y…'

And those over there end up without water. … without water. […]. When it's hot, those over there do suffer a bit, because water runs out and….'

Villa Sol residents

'No pasa por acá. A veces se van de frente o a veces se van por acá doblando y no viene a veces por acá, padezco, ¡ay!, tengo que ir hasta al esquina y llamar "¡agua, agua!". Se sufre.'

'[The water truck] doesn't pass by here. Sometimes he just drives by or he takes a different turn and doesn't come; oh, how I suffer! I have to go to the corner and call "water, water!" What suffering.'

'Pero tanto sufrimiento hemos pasado en estos años, hemos sufrido tanto, no había escaleras, hasta ahorita mi hijo sigue sufriendo, sube agua arriba. Es que no hay carretera por ahí…'

'How we've suffered over the years, we have suffered so much, there were no stairs, my son is still suffering now, carrying water up [to his house]. There's no road over there [near his house]…'

'Porque son doce años que estamos sufriendo y ahora que creo que ya tiene más derecho de tener siquiera agua y luz, agua y desagüe; el alcalde ya debería pensar, poner un desagüe siquiera por el costado y ponernos agua, pero…'

'Because we've been suffering for 12 years now, I think we should have a right to have at least water and electricity, water and drainage; the mayor should be thinking about putting in drainage , at least on the side [of the road] here, and provide water, but…'

'Por eso yo digo, no me quejo. Lo único nomás sufrimos… lo único sufrimos nomás a veces por botar el agua a la calle…'

'That's why I am saying, I'm not complaining. The only thing we suffer from….the only thing we sometimes suffer from is having to discard our [used] water into the street…'

‘Mi mamá dice “estoy sufriendo otra vez” dice. Porque mi mamá en Canto Grande también se las vio feas, porque no había agua, no había luz, yo era chiquita cuando he llegado allá, entonces está retrocediendo a lo mismo.’

‘Solamente vienen a chamullar nomás, siempre el alcalde vienen a hablar, hablar. Ellos cuando… antes que entran de alcalde te prometen muchas cosas, pero cuando llegan a ser alcalde ya no avanzan mucho, eso es lo malo que hay los alcaldes, tanto el presidente como los alcaldes son las mismas. ¿Sí o no?’

‘My mum says “I’m suffering again”, she says. Because my mum, in Canto Grande, she also had it bad, because there was no water, there was no electricity, I was small when I arrived there, so she [my mother] is back to square one.’

‘They just jabber on, the mayor always comes to talk, talk. When they…..before they are elected they promise you the earth, but when they’re in office they don’t progress much on anything, that’s the problem with mayors, the president [of the republic] and the mayor, they’re the same. Am I right or wrong?’

Absalón Alarcón residents

Appendix C: Pairings and discrepancies of perceptions of and responses to water scarcity

	(a) Balanced pairings		(b) Discrepancies		(c) Mixed pairings
	HIGH levels of perception followed by **HIGH** levels of responses	**LOW** levels of perception followed by **LOW** levels of responses	**LOW** levels of perception followed by **HIGH** levels of responses	**HIGH** levels of perception followed by **LOW** levels of responses	(c.1) **CONSISTENTLY HIGH** perceptions lead to both **HIGH** and **NON-EXISTENT** responses in different participants (c.2) **VARIED** perceptions followed by **MIS-MATCHED** responses to some aspects of perceptions
Water quantity	Lack of water for 'other' uses	Lack of water for food preparation	Lack of drinking water	Cost of water	Lack of water for sanitation (c.1)
			Lack of water for personal hygiene		
TOTAL	**2**		**3**		**1**
Water quality		Physical, microbial, chemical indicators of water quality			Unsafe drinking water (c.2)
		End user storage			Clean drinking water (c.2)
		Role of educational efforts in implementing measures			Inadequate distribution of water (c.2)
TOTAL	**3**		**0**		**3**
Security of access	Rainwater harvesting	Location of Neighbourhood in settlement			
	Storage capacity	Location of household within settlement			
	Social relations				
TOTAL	**5**		**0**		**0**
TOTAL	**10**		**3**		**4**

Distribution of different types of perception-response pairings across the three categories of water scarcity shows all types of perception-response pairings (balanced, discrepancy and mixed) in relation to quantitative dimensions of water scarcity top light blue row), whereas issues of water quality engender only balanced and mixed pairings (middle dark blue row). Dimensions of water scarcity related to security of access, most notably, were seen to only provoke responses in line with perceptions (bottom light blue row).

Appendix D:
Positive perceptions of the water scarce environment and associated forms of gain

The table below illustrates some examples which highlight that positive perceptions of the water scarce environment only result in short-lived, immediate forms of gains due to the large range of associated problems preventing opportunities for 'growth' or 'mastery'.

Positive Perception of an aspect of the water-scarce environment	**Reason**	**Form of gain**	**Associated problems and negative perceptions**
Water is cleaner	Due to being bought from neighbours connected to the grid.	**Immediate gain**: Better quality water at better cost than from trucked supply.	Intermittent supply to reduce risk of being caught in illegal transaction. Resulting need to store large quantities over long periods means living space is compromised. Water quality deteriorates. Supply still erratic if seller not available; no alternative source. Costly water is over-stocked to bridge potential periods of seller unavailability, and wasted if spoilt before needed for consumption.
Neighbouring plot is empty	Allows resident to discard water locally instead of carrying it a long distance to main road.	**Immediate gain:** Saves valuable time.	Corrodes fragile public stairs and verges. Can change any time if plot is re-occupied.
Free water is delivered weekly	Effective neighbourhood representative is politically well connected	**Immediate gain:** Water smells different and looks cleaner, is assumed to be of better quality.	Limited benefit as delivery days and times vary unpredictably, are sometimes missed if resident not at home. If received, needs to bribe driver to ensure he returns next time.

Appendix E: Observable Dimensions of Flexibility

Table E1: The 'temporal' dimension of flexible responses: Summary of analysis parameters

		Associated perceptions and response types		
PERCEPTIONS	Time frame affected	Operational	Competitive	Strategic
	Type of challenge	Short term	Medium term	Long term
RESPONSE TYPES	Timeframe of responses	Day-to-day or within a day	Occasionally	Infrequently
	Commitment required	Day-to-day	Some effort or commitment	Irreversible, long-term changes and/or considerable commitment
			Thinking ahead to make improvements	Long term plans

Table 8.1: Analysing the time dimension of flexible responses.

Two complementary means of analysis establish (1) whether a challenge is perceived to be affecting short, medium, or long term aspects of life, and if each of these is perceived to require daily, occasional or infrequent responses; and (2) whether responses take place to meet daily challenges, improve a situation through thinking ahead, or involve long term plans.

The analysis parameters are developed after Thomas, 1997; Golden and Powell, 2000; Gustavsson, 1984.

Table E2: The 'scale' dimension of flexible responses: Summary of analysis parameters.

The Scale Dimension of Flexibility		
Environmental challenge occurs		
TYPE OF CHALLENGE		
Foreseen	←---------- CONTINUUM ----------→	**Unforeseen**
Risk	**RELATED CONCEPTS**	**Uncertainty**
Planning for foreseeable events	RESPONSE OPTIONS	Making use of new opportunities Rapidly responding to the unforeseen

Table 8.2: Analyzing the scale of flexibility.

Foreseeable and unforeseeable challenges are seen as two ends of the continuum for this dimension of flexibility (Golden and Powell, 2000:377). Foreseeable challenges are related 'to the concept of risk and involve planning responses for foreseeable events' (Carlsson, xx), whilst unforeseeable challenges relate to 'uncertainty and how to make good use of new […] opportunities and to rapidly respond to […] unforeseen changes […]' (Golden and Powell, 2000:377). Unforeseen events can provide potential opportunities, as well as challenges.

Table E3: The 'intention' dimension of flexible responses: Summary of analysis parameters.

The Intention Dimension of Flexibility		
Environmental challenge occurs		
Offensive **Proactive**	RESPONSE OPTIONS	Defensive Reactive
Action is considered or taken *before* a challenge occurs.	EMPIRICAL MEASURE	Action is considered or taken *after* a challenge occurs.

Table 8.3: Analysing participants' stance, or intention, in creating flexible responses, by examining if action is considered or taken before a challenge arising from water scarcity occurs, or afterwards.

Table E4: The 'focus' dimension of flexible responses: Summary of analysis parameters.

The Focus of Flexibility		
Environmental challenge occurs		
Internal System	AREA WHERE FLEXIBILITY IS CREATED	External Relationships
e.g. **attitude change;** **change to internal organization of a household** **…**	OBSERVABLES	e.g. different means of acquiring resources; forming support networks with other housheolds …

Table 8.4: Analyzing the area where flexible responses are created.